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CONTENTS.

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Science and Philosophy.

THE suggestion made by Prof. F. G. Donnan in a letter which appears in our correspondence columns this week, that workers in natural science and philosophy should somehow be brought together in order to elucidate and discuss those fundamental problems with which both are concerned, will, we believe, be given careful consideration over a wide field of thought. During the past twenty-five years mathematicians and natural philosophers have been led to deal with problems of an essentially philosophical character; while purely philosophic workers from their side have been tending more and more to concentrate attention upon those same problems and to attempt to prepare the way for a more adequate solution of them. Most of the really fruitful work in philosophy during the present century has been devoted not to elaborating great speculative systems, but to careful detailed research upon such specific problems as the nature of sense-data and their relation to physical entities, the character of space and time in their relation to one another, the basis of scientific induction, the interpretation of life, the relation of mind to Nature, and so on. This has been the case not in Great Britain alone, but also on the continent of Europe, as, for example, in the extremely valuable work that has emanated from Husserl and his pupils, one of the most original of philosophic thinkers in Germany at the present time.

It is obvious that one of the chief difficulties in all such investigation is that it is impossible nowadays for any one individual to be an expert in more than one or two of the various departments of knowledge upon which the problems referred to touch. Few things would be more helpful to the advance of philosophic thought at the present juncture than a combined effort on the part of men of science and workers in philosophy to face the issues which from both sides are being forced upon human reflection. The old hard-and-fast distinction between science and philosophy can no longer be sustained; and the time has come when it should be explicitly recognised that philosophy is, in truth, a branch of science.

It is being more and more widely recognised that on one hand the predominantly classical tradition in itself is seriously inadequate to modern tendencies, while, on the other, the difficulties arising from the steadily increasing scientific specialisation are patent. Science is being compelled, merely by its own incessant expansion, to investigate its ultimate basis. This is pre-eminently a philosophical problem of the most intricate order, while the indispensable specialisation practically excludes

the requisite acquaintance with the governing philosophic principles and methods. The conclusion seems obvious that research must be complementary, and also systematically directed so far as this is possible without interfering with individual initiative. It is well to remember that Aristotle was both a great scientific pioneer and a great metaphysician.

The progress of physical research in the early years of the twentieth century had a profound effect on the minds of both scientific workers and philosophers. The implication of the theories of relativity and quanta, particularly in relation to notions of space and time, brought the physicist and the mathematician into the realms of philosophy. The excursion was not popular. Many scientific workers felt alarm and discouragement at the tendency of physical science towards metaphysics ; they feared that the doubt and obscurity which have characterised much of the metaphysics of past centuries would invade their science.

Among the philosophers there was a movement to grapple with the new problems presented by experimental philosophy. Thus we find Prof. H. Wildon Carr publishing a work entitled " The Scientific Approach to Philosophy " (1924), in which he sets forth his views on the relation of science to philosophy, adopting the view that the fundamental distinction is that, whereas philosophy seeks to see reality as a whole, science is more concerned with particulars, proceeding to laws rather than to a systematic whole. Mr. Bertrand Russell, on the other hand, believes that the subject matters of science and philosophy are identical and both start from the same point but proceed in opposite directions. Prof. A. N. Whitehead, who is also mathematician and philosopher, has formulated a philosophy of Nature through the study of the history of science. Only within the last few days a work in which physical science and philosophy are combined, by another pioneer investigator and thinker, has reached us. We refer to Sir Oliver Lodge's " Beyond Physics ", which aims at the beginning of a philosophical outlook which shall include a basis for life and mind of a physical, though non-material, character.

This work may be taken as an example of the change which has come over positive science during the past quarter of a century or so, referred to by a reviewer in a notice of Prof. Dotterer's " Philosophy by Way of the Sciences " in NATURE of April 5. " Not less striking ", he remarked, after indicating the changes in the pursuit and teaching of philosophy, " is the changed attitude of men of science, their modified faith in mechanistic explanations of life, and especially of the life of man, their consciousness that every line of scientific inquiry leads to problems which (using the word physics in its older and more general sense) are beyond-physics, that is, are metaphysical. Hence the present position, that some of our leading men of science are also among our leading philosophers."

Conditions thus seem to be favourable for a closer *rapprochement* between science and philosophy, with the double purpose of working out a real philosophy of Nature and of undertaking a critical overhaul of scientific concepts, perhaps more especially in the biological field. Whether at the moment much would be gained by an international meeting devoted exclusively to questions of the relations between science and philosophy is, however, doubted by representative workers in both fields. There is a feeling that the common basis of the two groups would be found to be disappointingly small, and that in the absence of sufficient mutual understanding the outcome would be more disruptive than unifying. Long-range discussion in separate scientific and philosophical journals, and interchange of views between men of science and philosophers at their respective congresses, are helpful in presenting the different points of view, and their extension would be welcomed. When the different workers find themselves in the same field they will naturally desire to join in periodical meetings or conferences to consider promising lines of development.

At the meeting of the British Association in South Africa last year, General Smuts and other philosophers spoke on questions of interest to both men of science and philosophers ; and one of the subjects to be discussed at the International Congress of Philosophy, to be held in Oxford next September, is the question of the metaphysical importance of recent advances in physics. As General Smuts is to be the president of the British Association at the centenary meeting in London next year, we suggest that a small joint committee might be appointed representing the British Association, the British Institute of Philosophical Studies, and the Aristotelian Society, to draft a programme of appropriate papers for discussion during the meeting. There is at present no Section of the British Association devoted to what may be called scientific philosophy, but philosophic minds are to be found in all the Sections ; and it should be possible to arrange a special meeting for the discussion of the basis of all knowledge. Perhaps someone will bring the matter forward at the International Congress of Philosophy with the view of getting a joint committee appointed to effect the co-operation desired, whether through a periodical international assembly or otherwise.

Is Humanism Dead?

Publii Ovidii Nasonis Fastorum Libri Sex: The "Fasti" of Ovid. Edited with a Translation and Commentary by Sir James George Frazer. Vol. 1: *Text and Translation.* Pp. xxxi + 357. Vol. 2: *Commentary on Books I. and II.* Pp. v + 512. Vol. 3: *Commentary on Books III. and IV.* Pp. v + 421. Vol. 4: *Commentary on Books V. and VI.* Pp. v + 353. Vol. 5: *Indices, Illustrations, Plans.* Pp. xiii + 212 + 95. (London: Macmillan and Co., Ltd., 1929.) 5 vols., 126*s*. net.

AMONG other fashionable revolts of to-day, our reaction against the classics is perhaps a minor, but a vexatious and disruptive crisis, which, while it affects primarily education, also enters deeply into our whole cultural outlook. The radical spirits of the day are definitely anti-classic. The conservative tendency, on the other hand, still leads many thinking people to affirm that no man of science or sociologist has ever rivalled Aristotle, no thinker reached the heights of Plato, and that no philosopher is more worth studying than Democritus, Thales or Anaximander. People also still speak of the absolute necessity of memorising Latin cases or of conjugating Greek verbs in order to understand the working of human speech or to acquire the faculty of logical thought. This of course is an untenable line of defence of a cause not altogether lost.

The grip of dead tongues on the study of language is and has always been pernicious. The habit of framing all our linguistic conceptions and grammatical categories on a language which we never can use in its principal function—of living speech between living people and in a living culture—has made philology lose touch with real life and become a barren discipline. Again, it is but an affectation to treat the scientific and philosophical work of classical writers as anything but wonderful documents of a past culture. As direct contributions to modern scientific knowledge they are obviously worthless.

Yet all sane people have an uneasy feeling that it is impossible to dispose thus lightly of humanism. We cannot sweep away the influence of classical antiquity on our own culture. Nor can we banish philological methods from our schools, our philosophies, our social sciences—any more than we can drop the influence of Greek or Latin on our vocabulary and grammar. Classical antiquity has become an essential part of our civilisation—a living myth upon which our culture is built. For every culture has to rely upon a retrospective vision, a grand illusion of a Golden Age, lawgiving and inspiring, supplying the present with a life drawn from the past.

The historical myths of our own civilisation are the belief in the divine inspiration of the Jews; in the Olympic beauty and wisdom of the Greeks; in the political majesty of Rome as the fountain-head of law and statecraft. The fact that some of us have come critically to doubt whether Greek sculpture is more perfect than Japanese decorative art, or to suggest that the Indian epics might equal Homer, or that the social and political systems of China are as worthy of study as those of Rome, will never change the fact that emotionally we find our 'promised land' around the eastern basin of the Mediterranean, that somehow Athens, Rome and Jerusalem have acquired a dominance over our emotions as well as over our thought.

The anthropologist above all must believe in the continuity of tradition, and whatever defects our classical tradition has, it cannot be jettisoned. Classical interests must and will receive ever-widening scope and an increasingly greater depth through constructive criticism. Our knowledge of Greece and Rome must be placed within the context of other cultures. In this sense, humanism, as living mythology and inspiring science, is not dead and never will be.

If we define, then, an anthropologist as one who passionately loves the continuity of tradition and works for its preservation and development; who also brings to this task a profound knowledge of our own mythology as well as of the superstitions of other savages—Sir James Frazer is the greatest anthropologist of our age. He is also one in the long line of succession of great humanists. For, constantly reshaped by criticism from within and without, humanism has, in fact, grown from a narrow and rigid discipline to that all-embracing vision of humanity as a whole which, in Great Britain and this generation, has given us the works of Jane Harrison, Gilbert Murray and James Frazer. The five volumes of the "Fasti" which mark Frazer's return to applied anthropology and to first-hand classical research and reinterpretation, naturally provoke these reflections.

The earliest humanists who awoke to the reality of Greek and Latin civilisation from the dead grip of medieval scholasticism and Church tradition, regarded ancient writing and ancient art as a revelation unto itself. When, through the discoveries of comparative Indo-European linguistics, the scope was widened, we were shown that,

through the sacred books of the East, and through the comparative study of Sanskrit and Zend, Celtic and Slavonic, a new meaning could be given to the religious conceptions of Greek polytheism, to the institution of the Mediterranean patriarchal household, and to the legal norms and historical vicissitudes of the Hellenic and Italic peoples. But it was only by placing Latin and Greek culture in the widest comparative survey that the full humanistic meaning could be given to all that is beautiful, and all that is crude and barbarous, in customs and beliefs revealed to us by Virgil and Ovid, Homer and Sophocles.

In this work of revealing to us the full human meaning of Greek and Latin culture, Frazer started with his classical interests. The six volumes of his "Pausanias" give us a vision of ancient Greece as it was in the times of Imperial Rome. In his "Golden Bough", starting from one of the most inexplicable and barbarous customs recorded from Latium, Frazer gives us the theory of primitive culture and of the rational savagery of human faith, a theory which will for ever remain a masterpiece of comparative anthropology. Then the great Cambridge scholar, casting himself for a time completely adrift from his Mediterranean moorings, explored the remote continents of Africa, Australia and the New World, discovering the real nature of totemism and exogamy; interpreting, in the "Worship of Nature", the relations between primitive man and his environment; giving, in the "Belief in Immortality and the Worship of the Dead", a new insight into the desire for survival; and, mindful of another 'promised land', he analysed folk-lore in the Old Testament, with an insight into Semitic spirit and culture only rivalled by his Greek and Latin scholarship.

Now, again, in the "Fasti" of Ovid, he returns to his original interest, and in the running commentary to the poetic version of the Roman calendar, shows once more the kinship between ancient classical belief and that of humanity at large. In the first volume we are given the Latin text and the translation, characterised by Frazer's accuracy and learning, as well as by his sense of beauty both in English and Latin. But as we read it, there arise at every step those queries and enigmas which not even the best translator can overcome in a direct rendering. Indeed, Frazer needs three bulky volumes of comments to his short half-volume of translation. But these volumes are not merely a commentary on Ovid and his Roman calendar, but on the whole life of the Roman nation. For a pious and practical people like the Romans marked down in their programme of the year, besides historical and legendary landmarks, also dates of religious or magical importance, days of economic or political significance, festivities which affected the family, the city, and the State. Thus a great deal of Roman civilisation, projected along the weeks, months and seasons, unrolls before the reader in its yearly sequence.

Right from the beginning we are brought to the heart of the real interests which led man to systematise his times and occupations and wed them to the regular courses of sun, moon, and seasons. Frazer comments on the 28th line of the poem, in which Ovid accepts the traditional version attributing to Romulus the institution of a ten-months year. So absurd did this legend appear to some scholars that no lesser a man that Joseph Scaliger and his much younger confrère G. F. Unger rejected it as a mere fallacy of crude folk-lore. Anthropology, however, not only endorses Ovid in his fabulous sources, but also can give us a full explanation of the apparent irregularity. Frazer is able to show that an incomplete year, based as a rule on lunar divisions, is found all over the world, in defiance not merely of theoretics of the ten-months year, but also of the innumerable theories given in explanation of this anomaly. This shortened year is due simply to the fact that the real interest of an agricultural people is directed towards what happens on the surface of the earth and not on the vault of the heavens. The calendar is determined by the cultivation of fields and the growth of crops, and not by the abstract rotation of stars and constellations. Even in the counting of time humanity crawls on its belly, scarcely aware of what passes above and around.

Line after line we follow the vagaries of Roman time-reckoning, and of Ovid's explanations. We learn about the widow's mourning, and about the unlucky periods of intercalary days and months. We are led into an analysis of primitive licence, and of the annual mock-kings. This last subject leads us near to the theme of "The Golden Bough", to which the present book contains, incidentally, a great many riders and additions. Especially interesting is the long commentary (vol. 3, p. 72) to the lines:

"The strong of hand and fleet of foot do there reign kings, and each is slain thereafter even as himself had slain."

It would be quite impossible to give point for

point the gist of the many illuminating comments —some brief and pithy, others leading us far afield over the surface of the earth and into the ramifications of a belief or custom, but all pertinent and illuminating, all characterised by that solid grip on fact, by that reluctance to vague theorising, which are the greatest qualities of Frazer's work.

We acquire a great deal of comparative knowledge about the Latin divinities, Janus and Jupiter, Vesta and Juno ; about the Lares and other family gods ; about Roman family law and its Latin sources and the constitution of the household ; about the Sacred Fire, beliefs concerning cross-roads, werwolfs and vestal virgins.

The fifth volume illuminates the learned body of the work with diagrams and illustrations, in the choice of which the author reveals himself again as a scholar and an artist. It also contains an excellent index.

Frazer, who, since the recent publication of this book, has given the world two more volumes on such widely different subjects as the logic and thought of Plato and the myths of the origin of fire, has demonstrated once more the vigour and fertility of the new science and of its master. Perhaps the highest praise that can be given the work under review is that it forms an indispensable compendium to "The Golden Bough", to which it constantly refers, and of which it is a worthy illustration and amplification.

B. MALINOWSKI.

Space and its Properties.

The Size of the Universe : Attempts at a Determination of the Curvature Radius of Spacetime. By Dr. Ludwik Silberstein. Pp. viii + 215. (London: Oxford University Press, 1930.) 10*s*. net.

DR. SILBERSTEIN'S monograph is concerned with the hypothesis, now widely favoured, that space is not infinite, but is a closed domain analogous to the surface of a sphere. Besides giving a general account of this theory, it includes an exposition of certain views which have led him to an estimate of the 'radius of space' much smaller than the estimates of other writers. Whatever reservations we may wish to make with regard to this controversial part of the work, the book as a whole can be cordially welcomed. It is written lucidly, vividly, and with keen flashes of insight. It can scarcely be read by a non-mathematical reader ; but the mathematician is not delayed with details, and is guided quickly and racily to the interesting results. The style of expression brings to mind vividly its enthusiastic and impetuous author. The reader may not always agree, but he will enjoy disagreeing with so ingenious an advocate.

Silberstein rejects the spherical world of Einstein and adopts that of de Sitter. This is in accordance with general current opinion ; and in any case de Sitter's is the better working hypothesis, since it is the one which has interesting astronomical consequences. Whilst agreeing with his choice, we cannot agree with the reason on which he lays most stress. He seems to regard it as a blemish of Einstein's world that its equations do not admit of the insertion of a particle of matter (a mass-centre), whereas de Sitter's admit it. But, when examined, this superiority of de Sitter's world is found to arise from the fact that it is entirely empty ; the insertion of a gravitating particle does not upset its equilibrium because there is nothing to upset. When de Sitter's idealised conception is modified into a practical astronomical universe, this supposed advantage is the first property to be discarded.

It is a feature of de Sitter's world that every particle appears to be repelled from the observer with an acceleration proportional to the distance, so long as the distance is small compared with the radius of space. (The law of acceleration at large distances depends on the definition of distance adopted.) In consequence of this, the symptom of world curvature that has been looked for by most authorities and used as the basis for estimating the size of the universe is a velocity of recession of distant objects increasing with the distance. This effect is shown markedly by the spiral nebulæ, which are the most distant objects known. Silberstein differs from everyone else in taking the symptom to be an increase of average speed with distance, irrespective of whether the motion is receding or approaching ; he uses for his material star clusters and even stars, which have no marked preponderance of receding velocities. In considering this divergence, it must be borne in mind that we know only the present velocities of celestial objects, and it is, of course, impossible to say that a particular instantaneous distribution of velocities is irreconcilable with any assumed field of force. The most we can do is to connect the field of force and the velocity distribution by some plausible theory of the origin and development of the present state of affairs. We have not space to describe Silberstein's claim to plausibility ; it is ingenious but we do not find it convincing.

Some months ago Dr. Silberstein caused a mild sensation by announcing a radius of the universe so small that it left the astronomer scarcely room 'to swing a cat in'. This calculation is given by him in an appendix; it gives a mere 2,000,000 parsecs for the radius of space. (The nearest spiral nebula is distant about 300,000 parsecs.) The result depends on stellar motions only. We naturally object that inasmuch as world curvature obviously does not explain the main features of stellar motions, it is unreasonable to suppose that it is the only effect to be considered in interpreting their minor correlations. In fact, the phenomenon attributed by Silberstein to space-time curvature appears to be one which is more usually ascribed to galactic rotation. His older value used in the main part of the book was eighteen times greater; and it demands considerable mental agility on the part of the reader who wishes to review the arguments in accordance with the reduced scale.

Three years ago a very substantial advance in this subject was made by Abbé G. Lemaître (*Annales de la Société Scientifique de Bruxelles*, April 25, 1927). Until recently, this paper seems to have been almost unknown, and we can scarcely blame Dr. Silberstein for being unaware of it; but it is unfortunate that the new point of view does not appear in his book. In particular it renders obsolete the contest between Einstein's and de Sitter's cosmogonies. We can now prove that Einstein's universe is unstable. The equilibrium having been disturbed, the universe will progress through a continuous series of intermediate states towards the limit represented by de Sitter's universe. By Lemaître's analysis the history of this progress can be studied; and the intermediate stages (one of which must represent the present state of the world) can be treated in detail.

A. S. EDDINGTON.

Classification of the Octopoda.

A Monograph of the Recent Cephalopoda: based on the Collections in the British Museum (Natural History). Part 1: *Octopodinæ*. By G. C. Robson. Pp. xi + 236 + 7 plates. (London: British Museum (Natural History), 1929.)

IN the present volume, the first instalment of a systematic account of the recent Cephalopoda, Mr. G. C. Robson has attacked the most difficult part of the work—the classification of the sub-family Octopodinæ, the largest division of the order Octopoda. The difficulty of classification is enhanced by post-mortem changes which modify or efface the sculpture of the skin and distort the shape of the body and head, by the amount of material available for the study of a single species being generally limited, and hence the amount of variation of the species unknown, and by the defective descriptions of earlier workers, which are often based on more or less valueless characters. The author directs attention to the need for intensive studies on the variation of a single species carried out on living examples, and gives the results of an examination of a number of characters in twenty-one specimens of *Octopus vulgaris*.

A brief description of the structure of the genus *Octopus* deals especially with the features which are important in classification and is followed by a short account of the habits and a note on the characteristics of young forms.

In his remarks on phylogeny and classification, the author states that the sub-family seems to be broken up into a large number of disconnected and often monotypic groups rather than along well-defined lines of evolutionary significance. He has, however, reviewed the evidence with the object of obtaining indications as to the characters of the primitive Octopodine, and concludes that these were—rather short, equal arms, a low equal web, probably a W-shaped funnel organ, numerous gill filaments, a small undifferentiated hectocotylus, simple rhachidian teeth on the radula, a superficially placed ink-sac, and a widely open mantle aperture.

The Octopodine species which have been adequately described fall into the genus *Octopus* (with five sub-genera) and eight other genera. For these species tables of measurements and other details—in most cases of thirteen characters—are given. This is followed by the systematic account in which each genus is defined, the type species designated, and remarks added on matters of historical import. For each species the synonymy is given, the locality of the type specimen is stated where this has been traced, a note of the specimens examined, a statement of the known distribution, a description and remarks are added. A list of sixty-seven insufficiently diagnosed species of *Octopus* is appended, and a brief account added of three species of uncertain generic position. A bibliography and an index—both adequate—complete the text.

The author is to be congratulated on his method of handling a very difficult subject, which has involved much detailed work and careful analysis and consideration.

Our Bookshelf.

Recollections of My Youth. By Ernest Renan. Translated by C. B. Pitman. Pp. xlvi + 360 + 2 plates. (London: George Routledge and Sons, Ltd., 1929.) 7*s.* 6*d.* net.

THIS new edition of Renan's second most famous book has the great additional advantage of an introduction by Dr. Coulton. It may well be, as Dr. Coulton suggests, that these autobiographical reminiscences will survive the long and solid works in which Renan condensed the learning of his time. If so, it will be due more, one may think, to the charming picture he has left us of the Breton life and country and friends of his youth than to the account of the long-drawn struggle which took him at last from his early faith and intended profession.

Most people who have a sense for such things have read the "Souveneur de Jeunesse" long ago, but they would do well to renew their acquaintance in Mr. Pitman's quite competent and readable translation, and with the aid of Dr. Coulton's useful signposts. It must suffice here to note two passages of special interest to scientific readers, one of which is quoted by Dr. Coulton in his introduction. Renan, writing after these "Souvenirs" in 1891 just before his own death in 1892, uttered one of the most remarkable judgments on public affairs on record: "My dear children of the new generation, how many things you will know forty or fifty years hence which I shall never know! How will the inmost soul of the Kaiser William II. develop? What will be the end of the conflict of European nationalities? What turn will the social question take? What will be the coming fate of the Papacy?"

The other passage occurs towards the end of the "Souvenirs" themselves. There was a moment before Renan left St. Sulpice when he might have taken up the study of natural science, and he says that he much regrets that he did not do so. "It is by chemistry at one end and by astronomy at the other, and especially by general physiology, that we really grasp the secret of existence of this world and of God, whichever it may be called." Possibly, if he had done so, mankind might have gained from a mind so industrious, synthetic, and humane, a view of scientific evolution as a historic whole which we have still to build. He would scarcely have been a great discoverer; he might have been one of the greatest historians of science. F. S. MARVIN.

Steam and Gas Engineering: a Text covering Power Generating Apparatus utilising Energy released by the Combustion of Fuels. By Prof. Thomas E. Butterfield. Pp. xv + 481. (London: Macmillan and Co., Ltd., 1929.) 18*s.* net.

PROF. BUTTERFIELD holds the chair of heat power engineering at Lehigh University, and his text-book has been written to fill what he felt to be a real lack in material for teaching the subject. He is therefore concerned more with elementary principles and general descriptions of plant than with the work of the designer and the operating engineer, and the student who wishes to master any branch of heat power engineering will have to supplement his reading by consulting the books and articles mentioned in the bibliographies appended to each chapter. Most of the books referred to are either British or American.

The book may be divided roughly into four sections, the first treating of fuels, combustion, boiler furnaces, grates, the boilers themselves and their auxiliaries; the second deals with the various types of reciprocating steam engines; the third with steam turbines; and the last with internal combustion engines. Though owing to the extensive use of the motor-car the aggregate horse-power of internal combustion engines exceeds the total horse-power of steam plant, yet the place occupied by the latter in central power stations gives it the greatest engineering interest, and more space is thus given to steam than to gas and oil.

All the usual features found in steam plant are dealt with, including mechanical stokers and condensing plant, and there are chapters on heat and work, the properties of steam, the laws of gases, gas and steam cycles, and the nozzle and blade calculations for steam turbines, and the student thereby gets a broad foundation on which to base his further studies. A few historical notes are given regarding gas and oil engines, and similar notes might well have been given on steam engines and steam turbines. It is somewhat strange to read descriptions of steam turbines without meeting with the name of Parsons.

Kristallzeichnen. Von Dr. Robert L. Parker. Pp. vi + 112 + 50 Zeichenblättern. (Berlin: Gebrüder Borntraeger, 1929.) 20 gold marks.

THIS is one of the few books which deal exclusively with the drawing of crystals. It consists of a threefold division into text, tables, and drawing sheets. The text forms a practical introduction to crystal drawing, and theory is well blended with practical application.

The first few chapters are devoted to general questions such as the choice of a projection, and to the older methods of drawing as on the projection of the crystal axis, and with the aid of the stereographic and gnomonic projections. The position of the projected axes is given by co-ordinates (Weber's method), and a chapter is devoted to the method of determining the co-ordinates for the orthographic and clinographic projections in the case of each crystal system. Each method of drawing is illustrated with worked examples.

In the second half of the book is explained the author's new "Bildkantenazimute" method. This, without loss of accuracy or applicability, offers a great saving in time and labour over the older methods, and has the great advantage that it does away with confusing constructional lines. The slope of the edges is given by an angle measured in azimuth from a fixed point. The angles are derived by a simple calculation from the co-ordinates of the axial cross and the indices of the edges together with the axial ratio. Once calculated, the values are then available for all subsequent drawings of the same species. Prepared drawing sheets allow of rapid plotting of the edges.

The method may be adapted to any projection, but in the tables are given the angular values for the orthographic and basal projection for twenty minerals in addition to all the cubic values. It is the obvious method to use in drawing cubic crystals. The text is well illustrated.

The Journal of the Institute of Metals. Vol. 42. Edited by G. Shaw Scott. Pp. xii + 846 + 48 plates. (London: The Institute of Metals, 1929.) 31*s.* 6*d.* net.

THE original papers contained in this volume were presented at the meeting of the Institute in Düsseldorf last autumn, and include several contributions from Continental metallurgists. They fall into three main groups. The first includes a general discussion on metallographic methods, as well as separate papers on dilatometry. Here will be found a useful survey of modern methods of investigation, including some of very recent development. A second group is concerned with recent progress in melting and casting non-ferrous metals, special attention being given to electric heating. The extent to which electric heating has replaced the use of direct fuel in the German copper and brass industry is very striking, and the laboratory metallurgist, accustomed to the difficulties of vacuum operations, may be surprised to find that charges of as much as four tons of metal have been successfully cast *in vacuo*, an induction furnace being used for the purpose.

The subjects of corrosion and chemical attack are represented by several papers, one of which deals interestingly with the formation of patina on copper, and another with the wastage of locomotive firebox stays. The influence of the Non-ferrous Metals Research Association in encouraging and supporting work of scientific as well as of practical interest is conspicuous. The abstracts and bibliography occupy no less than 360 pages, and this section of the volume is, as usual, very thorough in character, and indispensable to the metallurgist.

Applied Inorganic Analysis: with Special Reference to the Analysis of Metals, Minerals, and Rocks. By Dr. W. F. Hillebrand and Dr. G. E. F. Lundell. Pp. xix + 929. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 42*s.* 6*d.* net.

THIS important work is the result of prolonged experience on the part of both authors, whose publications on analytical subjects are well known. Although attention is more especially directed to metal, mineral, and rock analysis, the book is really a general treatise on quantitative analysis, and as such will appeal to a wide circle of readers. The treatment is essentially practical, and the details necessary for successful procedure are carefully described.

References to the literature are given very fully, and a great number of critical observations and comparisons of methods add considerably to the value of the book. The treatment is not exhaustive, and the reviewer has failed to find more than one method which he has himself used with success, but the authoritative treatment of the methods selected is entitled to the high praise which the book as a whole fully deserves. Although the price is somewhat high, the saving of time which the possession of the book will realise makes it worth the cost. Every chemical laboratory will find the book of great value.

Anthropology of the Syrian Christians. By Rao Bahadur L. K. Ananta Krishna Ayyar. Pp. xvii + 338 + 48 plates. (Ernakulam: Cochin Government Press, 1926.)

THE Syrian Christians of Malabar are, in their way, one of the most interesting communities in India. Originally a single community, they afterwards divided themselves into various sects in circumstances over which they had no control, each with its divergent set of social customs and religious differences. Yet all of them claim equally to be descended from, and themselves to be, true followers of the Apostle Thomas. They have on many occasions attained prominence from their numerous and interminable disputes about the possession and administration of church property, a character, however, in which they are not peculiar either in India or elsewhere.

Mr. Krishna Ayyar's investigations into the manners and customs of the Syrian Christians of Malabar, Cochin, and Travancore were originally made so long ago as 1910, and the results embodied in vol. 2 of "Cochin Tribes and Castes". Later opportunities for intensive study have enlarged the material, and the Cochin Government has now sanctioned its publication in a separate volume. Four chapters are given to the history of the Syrian Church, and the remaining thirteen are devoted to the description of manners and customs. It is interesting to note that not only are there many survivals of Hindu customs among these Christians, but also they show the same tendency to frequent fission into sects which is to be observed in the formation of castes and sub-castes by division among the Hindus.

The Statesman's Year Book: Statistical and Historical Annual of the States of the World for the Year 1930. Edited by Dr. M. Epstein. Sixty-seventh Annual Publication: Revised after Official Returns. Pp. xxxi + 1458. (London: Macmillan and Co., Ltd., 1930.) 20*s.* net.

THE changes in the new issue of this familiar work of reference are in matters of detail. The political world has been relatively quiet and there are few changes of frontiers or adjustments of territory to be recorded except the acquisition by Norway of a few polar islands. Yugoslavia now appears under that official name in place of the old Serb, Croat, and Slovene State. As usual, the revision of detail has been thorough, and an immense mass of useful statistical and descriptive matter appears within a small bulk. The copious bibliographies of official reports and non-official publications have been again revised. There are two coloured maps, one showing Northern China with Manchuria and Mongolia, and the other Lithuania with the territory claimed by both that State and Poland. The usual introductory tables give world output of various commodities.

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.*]

Complete Spectral Diagrams of Crystals.

IN NATURE of Dec. 21, 1929 (vol. 124, p. 946), W. Linnik describes a complete spectral diagram [1] of quartz produced by a conical X-ray pencil, which pencil is obtained by the movement in two directions of a narrow pencil about a point. The rays reflected

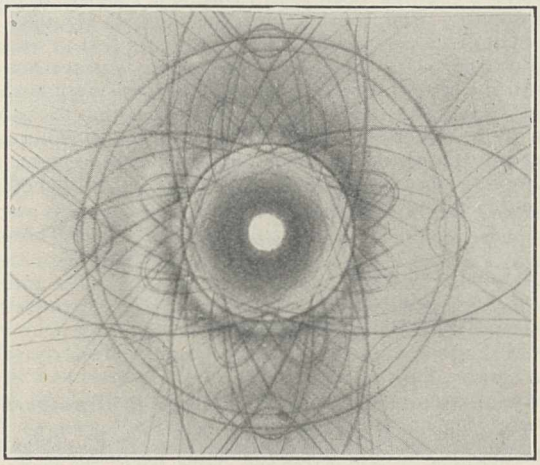

FIG. 1.

from inside the crystal come out on the side of the crystal opposite the source of rays and fall on a photographic plate. A screen is moved with the ray and prevents the direct unreflected pencil from falling on the plate.

This method permits the production only of a very

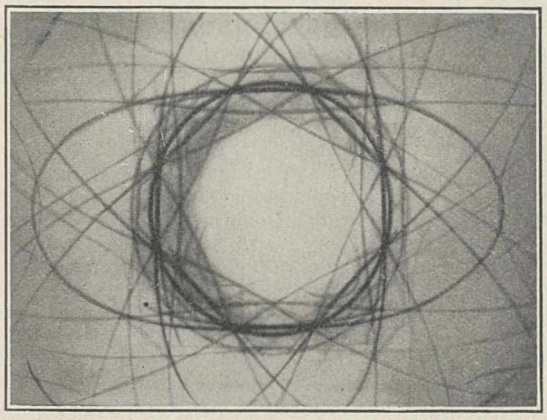

FIG. 2.

limited part of the complete spectral diagram. Far more complete diagrams, as shown in Figs. 1, 2, and 3, are obtained by reflection at the surface of a rock-salt crystal backwards by using a very broad conical pencil. Fig. 6 of Seemann [2] shows the arrangement of apparatus to produce such diagrams, provided that the photographic plate is placed parallel to the surface of the crystal and not perpendicular.

The chief difference from Linnik's diagrams consists in the presence of closed circles and ellipses. The short hyperbolic segments of Linnik are only present in Fig. 2 within the two circles. In Fig. 2 the focus was in the plane of the photographic plate—in Figs. 1 and 3 it was not in this plane. In addition to this, the

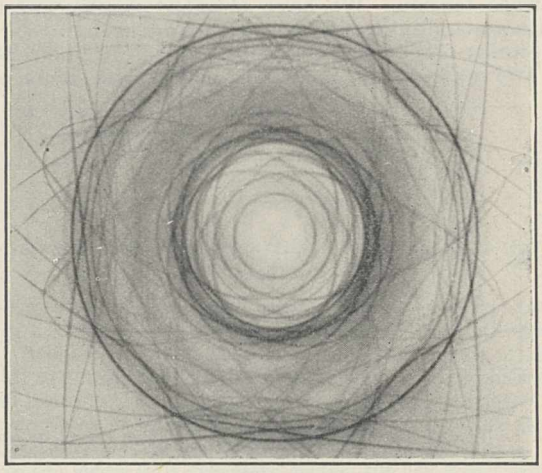

FIG. 3.

distances between the crystal and the point focus of the X-ray tube, and between the former and the photographic plate, were different in the three diagrams. A screen or diaphragm is not used in this method, and all parts of the apparatus are kept fixed during the exposure.

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K. F. SCHOTZKY.

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Freiburg i. Br., May 7.

[1] H. Seemann, *Physik. Zeitschr.*, **20**, 169-175; 1919.
[2] H. Seemann, *Ann. Physik*, **53**, 461-491; 1917.

Adsorption from Solutions containing Two Solutes.

ACCORDING to Gibbs's theory of capillarity, since the surface energy of a solution is at the minimum compatible with the other conditions of equilibrium, a substance which lowers the surface tension will be present at the interface in greater amount than in the bulk of the solution. If two solutes are present, both of which lower the surface tension, it might be expected that that which causes the greatest surface tension lowering will be adsorbed to a relatively greater extent than the other. If the difference is considerable, we may get the almost exclusive adsorption of the more active substance.

We have determined, by means of the capillary electrometer, the surface tension lowerings produced at polarised mercury surfaces by solutions containing two surface-active substances, and have found cases in which the lowering caused by the mixture is identical with that produced by the more active substance, when present alone. For example, $M/20$ sodium *o*-toluate by itself causes smaller surface tension lowerings than $M/20$ sodium cinnamate at all potential differences (Fig. 1), and the electro-capillary curve of the mixture is identical with that of $M/20$ sodium cinnamate. When the sodium cinnamate concentration is reduced, while that of the toluate remains constant, the curve of the mixture remains identical with that of the cinnamate to below $M/50$. With $M/60$ sodium cinnamate, the effect of $M/20$ sodium toluate first becomes observable.

The surface tension lowerings of $M/50$ sodium cinnamate and $M/20$ sodium toluate separately at $V = -0{\cdot}3$ volt, are equivalent to 3·4 and 2·1 cm. of mercury in our apparatus, so that a difference in the lowerings caused by the two substances of about 30 per cent is sufficient to prevent the adsorption of sufficient toluate to cause a measurable change of surface tension. We have obtained similar effects with seven mixtures of salts of organic acids.

Similar observations have been made with mixtures of two neutral substances. In many cases, owing to

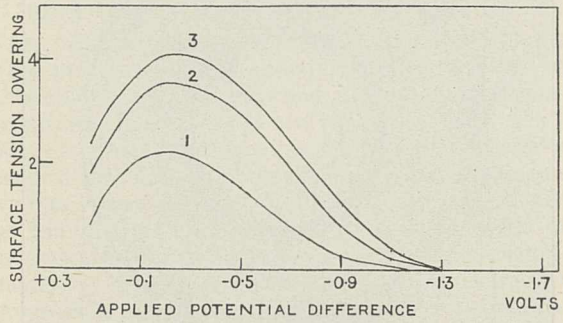

FIG. 1.—1, $M/20$ sodium *o*-toluate; 2, $M/50$ sodium cinnamate, and $M/50$ sodium cinnamate + $M/20$ sodium *o*-toluate; 3, $M/20$ sodium cinnamate, and $M/20$ sodium cinnamate + $M/20$ sodium *o*-toluate.

the maximum surface tension lowerings occurring at different potentials, the curves of the two substances intersect and one substance causes the greater lowering on one side of the point of intersection, the other substance on the other side. In such cases we have found that the curve of the mixture approaches the higher curve on each side of the point of intersection (Fig. 2). Near the point of intersection the lowering is greater than that produced by either substance separately, but much less than the sum of the two. This type of behaviour is exhibited by the systems,

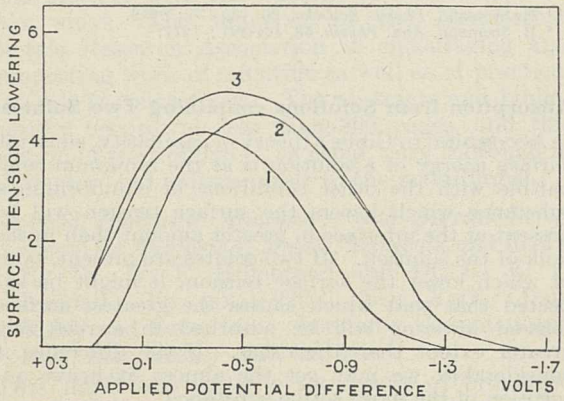

FIG. 2.—1, $M/20$ phenol; 2, $M/100$ caffein; 3, $M/20$ phenol + $M/100$ caffein.

caffeine-phenol, phenol-lactose, caffeine-lactose, and salicin-saccharose, all of which have been measured in $M/2$ sodium sulphate solution.

According to Langmuir's theory of adsorption as applied to the surfaces of solutions, the relation between the number of molecules of a solute adsorbed (Γ) and its concentration (c) in the solution is:

$$c(1 - A\Gamma) = k\Gamma,$$

where A is the surface area occupied by each adsorbed molecule, and k a constant. It can be shown that this relation leads to Szyszkowski's equation, $\Delta\rho = \frac{RT}{A} \log \left(\frac{c}{a} + 1\right)$, where $\Delta\rho$ is the surface tension lowering and $a = k/A$. Now $1 - A\Gamma$ is the fraction of the area of the interface which is unoccupied by any solute molecules, and if a similar relation applies when two solutes are present, the amounts adsorbed are determined by the equations:

$$c_1(1 - A_1\Gamma_1 - A_2\Gamma_2) = k_1\Gamma_1,$$
$$c_2(1 - A\Gamma_1 - A_2\Gamma_2) = k_2\Gamma_2.$$

It can be shown that these equations lead to the relation:

$$\log_e \frac{(\Delta\rho_1)_{c_2}}{(\Delta\rho_1)_0} = -(\Delta\rho_2)_0 \cdot \frac{A_2}{RT},$$

where $(\Delta\rho_1)_{c_2}$ is the lowering produced by the first substance in a solution containing the second substance at a concentration c_2, and $(\Delta\rho_1)_0$ and $(\Delta\rho_2)_0$ the lowerings produced by the two solutes separately at the concentrations at which they are present in the mixture. It has been found that this relation applies reasonably well to the data for neutral solutes, A_2 varying to a certain extent with the applied potential difference. In mixtures containing surface-active ions, the effect of the less active substance is somewhat less than that predicted by the equation, probably owing to the electric field of the adsorbed ions hindering the adsorption of more ions of the same sign. A complete account of this work is to be published in the *Journal of Physical Chemistry*.

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Synapsis and Chromosome Rings in *Œnothera*.

IN a letter in NATURE of May 17, p. 743, Dr. Darlington, having observed what he believes to be parasynapsis or side by side pairing of threads during meiosis in certain plants, mostly allied to the Liliaceæ, where such conditions have been described before, assumes that meiosis in all other organisms must fit in with his particular scheme of events. Since 1911[1] I have been inclined to the view that some organisms conform more nearly to the parasynaptic story, while others agree essentially with the telosynaptic account. Certainly nothing that Dr. Darlington has observed has given me any reason to alter that view.

Œnothera is by no means the only genus in which the observations lead naturally to a telosynaptic conclusion. In *Lathyrus*, Dr. Latter[2] has shown that the evidence of telosynapsis is very clear, and no fair treatment of her observations can twist them into a parasynaptic interpretation. The spireme is shown from a remarkably early stage in the heterotypic prophase to be a continuous single thread, which gradually shortens and thickens and becomes arranged in a characteristic way, with seven loops radiating from the centre. Each loop clearly represents a pair of chromosomes attached end to end. A parasynaptic interpretation is not only contrary to all her observations, but also would involve as well the disruption of the individuality of every chromosome at this period.

This is not the place to discuss cytological details, but Darlington has referred to the work of two of my pupils, and a word is necessary on this subject. Anyone who reads the papers of Dr. Sheffield,[3] only one of which was referred to by Darlington, and examines her drawings, will recognise the very high quality of her technique, and the cogency of the evidence for telosynapsis in the forms she has studied. Her results need no defence from me. For example, in the segmented spireme stage the connexions between the chromosomes are sometimes short and sometimes very long, yet they are invariably single; but on Darling-

ton's hypothesis they should be double, as he finds them to be in *Tradescantia* and other forms.

Catcheside's very interesting case [4] of a triploid *Œnothera* with its 21 chromosomes all arranged end-to-end in the spireme to form a closed ring is, if correct, a fatal blow to Darlington's theories as applied to *Œnothera*, as he has admitted. Having admitted so much, he now denies the facts, but Mr. Catcheside's preparations have been examined by other cytologists besides myself, and we were agreed that his interpretation is correct, although the evidence is not, perhaps, so copious as one would like. Moreover, the usual distribution of the chromosomes as 10 + 11 in the reduction division, which I first showed in 1909,[5] and Catcheside has recently confirmed, is the result which would be expected from a ring of 21 linked chromosomes with successive members oriented towards opposite poles. The early conclusion of mine [5] which Darlington quotes, "that there is usually no metaphase, strictly speaking", in *Œnothera*, has been abundantly confirmed by the work of many subsequent investigators, the zigzag arrangement of the chromosomes at this time being in marked contrast to their usual alinement.

Cleland (who has also described telosynapsis in many *Œnothera* forms) and Blakeslee [6] have recently shown that the rings of chromosomes in many *Œnothera* species have a possible explanation on the basis of segmental interchange according to Blakeslee and Belling's hypothesis for *Datura*. While such comparisons are to be welcomed as representing a possible advance, there are, nevertheless, important differences between the two genera, and in any case in recent years there has been evidence to suggest (in such papers as that of Latter on *Lathyrus*) that segmental interchange can also take place in connexion with telosynapsis and not merely as the result of lateral pairing of threads. Blakeslee and Belling's hypothesis of segmental interchange is therefore quite independent of parasynapsis, and there is no reason why its occurrence in *Œnothera* should be regarded as an indication of lateral pairing.

Whether my work on *Œnothera* during the last twenty years and more has been "sterile" can safely be left to others to judge. Those who wish to form an unbiased opinion should read Lehmann's "Die Theorien der Œnotheraforschung" (Fischer, 1922), which deals with the whole subject up to 1922. They will then be able to realise the important part which the cytological investigations of *Œnothera* have played in the history of genetics. A more recent monograph (Gates, 1928 [7]) deals also with some of the later work. My first critical paper on the subject [8] showed a telosynaptic course of events, contrary to my anticipations at that time, and of the scores of papers on the subject published since, every critical one has repeated the same story in all essentials, though with varying details and additional facts. Especially has the constancy of chromosome linkages been brought out in recent years. Various parasynaptists have endeavoured to make the facts fit into their ideas, but without conspicuous success. Notably the Gregoire school have investigated *Œnothera*,[9] but failed completely to find evidence of parasynapsis. They could only repeat in its essentials the telosynaptic account. Recently Weier [10] has made another attempt. But anyone who examines his figures, for example, Figs. 18-22 and 36-39, will see that the special method of fixation which he recommends has been anything but a success, with the result that the chromatin has flowed together to form what he calls the "central coagulum", which is obviously not a natural condition.

The idea that all organisms must conform to one scheme of pairing has seriously retarded progress in this field. There are signs that some of the younger cytologists are developing less stereotyped ideas on this subject.

R. RUGGLES GATES.

King's College,
London, May 19.

[1] Gates, *Bot. Gaz.*, **51**, 321.
[2] *Annals of Botany*, **40**, 277.
[3] *Ibid.*, **41**, 799; *Proc. Roy. Soc.*, **105**, 207; also Gates and Sheffield, *Proc. Roy. Soc.*, **105**, 499.
[4] *Trans. Roy. Soc. Edin.*, **56**, 467.
[5] *Bot. Gaz.*, **48**, 179; 1909.
[6] *Proc. Nat. Acad. Sci.*, **16**, 1930.
[7] *Bibliographia Genetica*, **4**, 401-492.
[8] *Bot. Gaz.*, **46**, 1; 1908.
[9] See Vancanover, *La Cellule*, **37**, 203-225; 1927.
[10] *La Cellule*, **39**, 271; 1930.

Interpretation of Infra-Red Frequencies of the Diamond.

NATURE of May 10 contains two interesting communications—one by Robertson and Fox and another by Ramaswamy—on the infra-red frequencies of the diamond, as determined directly and as inferred from the Raman effect. With the view of interpreting these lines, it appears to me to be of interest that attention be directed to the following facts:

Some time ago (*Sitzungsberichte der Preuss. Akad. der Wiss.*, **33**, 447; 1926), from an analysis of the change of the specific heat with temperature, I had concluded that the atoms of a number of crystallised substances are capable of assuming two states differing in energy to so small an extent that the higher quantum state is excited thermally at comparatively low temperatures. The diamond is one of these substances. Formerly, the attempt was made to interpret its specific heat with the help of a Debye function of $\theta = 1860$; but now a much better agreement with the experimental results is found by means of a Debye function of $\theta = 2340$ and the supposition that the C-atoms can assume two states differing in energy by 2120 calories per mol.

If we therefore desire to compare the infra-red lines with the thermal data, we must consider not only the altered frequency but also the possibility that the higher quantum state can be excited by light. From the above-mentioned energy difference a wave-length of 13·4 μ can be calculated (experimental error about 10 per cent). Reinkober has, in fact, found an absorption band at 14 μ. Now Ramaswamy believes he has discovered a diffuse band which can be calculated to correspond to a wave-length of about 15-16 μ. Taking the experimental error into account, which may be considerable in these Raman measurements, it is quite possible that this diffuse band is due to the transition to the higher quantum state brought about by the action of light. Whether this is actually the case could be determined first by a more accurate determination and discussion of the infra-red bands, and in the second place by determining the variation of the intensity of the lines with temperature, for which a perfectly definite course would be prescribed by the above-mentioned interpretation.

I may mention that the existence of an X-ray reflection from the 222 plane of the diamond may be connected with these two energy states of the C-atom, and moreover that, in the case of silicon and grey tin, both having the same crystal structure as the diamond, the specific heats point very definitely to the same phenomenon.

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May 24.

Scattering of X-Rays by Bound Electrons.

THOUGH Bergen Davis and his collaborators (*Phys. Rev.*, **23**) have reported the detection by means of an ionisation chamber of the modified lines (over and above the Compton effect) produced by the scattering of a monochromatic beam of X-rays by carbon in a direction at right angles to the direction of propagation, Coster (NATURE, Aug. 10, 1929), Ehrenberg (*Zeit. f. Phys.*, **53**), and Kast (*Zeit. f. Phys.*, **58**) have failed to observe the same on the photographic plate. In a previous note to NATURE, it has been pointed out by me that a portion of copper $K\alpha$ radiation in passing through carbon decreases its frequency by an amount equal to that of the $K\alpha$ radiation of carbon. The accompanying photograph (Fig. 1) shows the effect of copper $K\alpha$ radiation in passing through carbon, nitrogen, and oxygen. The known lines are marked as usual, while the new ones are shown by numbers. The white mark on the copper $K\alpha$ line is due to the fact that a piece of aluminium was placed just in front of the photographic plate to decrease the blackness of the plate in this region.

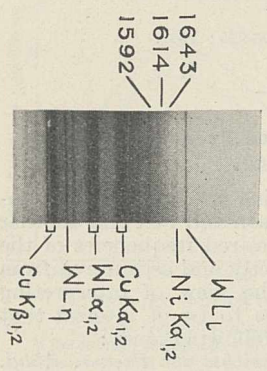

FIG. 1.

The lines are diffuse and very broad, and as such they could only be measured with a glass scale. Longer exposure does not improve the relative intensity of these lines, as the general radiation tends to blacken the whole plate. The three lines 1592 X.U., 1614 X.U., and 1643 X.U. are interpreted as due to the scattering of copper $K\alpha$ radiation by carbon, nitrogen, and oxygen. The frequency differences (ν/R) between the copper $K\alpha$ radiation and these lines are 20·1, 27·6, and 37·7 respectively, whereas the frequencies (ν/R) of the $K\alpha$ radiations of carbon, nitrogen, and oxygen are 20·4, 28·7, and 38·3 respectively.

Similarly, a portion of the nickel $K\alpha$ radiation in passing through carbon and nitrogen shows new lines the wave-lengths of which are 1719 X.U. and 1746 X.U., and the frequency differences between the nickel $K\alpha$ radiation and these lines are 20·0 and 28·1 respectively.

The absence of any modified lines by scattering (Coster, Ehrenberg, and Kast) in any other direction than that of propagation suggests that in all probability *in an interaction between a quantum and a bound electron*, the former on its passage through the medium loses a part of its energy and an equivalent amount of momentum in raising the electron from one orbit to the other, and is propagated in the original direction as a modified wave of lower frequency.

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Fluorescence of Mercury Vapour in the Far Ultra-Violet.

SOME years ago one of us (Terenin : *Zeits. f. Physik*, **31**, p. 40 ; 1925) observed a strong re-emission of the aluminium line at 1854 A. in the fluorescent spectrum of dense mercury vapour excited by an aluminium spark. A great deal of work has been done since on mercury band fluorescence, but this re-emission has not been recorded again. This can be explained by the strong absorption of the radiation in ordinary spectrographs with thick quartz and a long light-path in air ; a very small home-made fluorite spectrograph was used in the experiment mentioned. Last year this subject was re-examined by us in more detail. The part played by absorption was shown clearly by the fact that an exposure of five hours was needed to record the emission with an ordinary small quartz spectrograph, whereas five minutes sufficed with the fluorite one. In spite of the short focal length of the lenses (5 cm.) the dispersion of the fluorite prism was sufficient to show the aluminium lines at 1854 A. and 1862 A. clearly resolved.

Re-emission of the 1854 A. line begins to be noticeable at a much smaller vapour density than is required for mercury band fluorescence in the nearer ultra-violet and the visible. At a vapour pressure of about 10 mm., the re-emission is quite conspicuous. On raising the pressure of the vapour, the aluminium lines at 1862 A., 1935 A., and 1990 A. appear in succession, following the development of the well-known continuous absorption band to the long wave-length side of 1850 A. There is in addition in the fluorescent spectrum a continuous background, which spreads with increase in vapour density from 1854 A. to 2345 A., where it ceases abruptly. A similar emission, likewise localised in the neighbourhood of the resonance line $1^1S_0 - 2^1P_1$ of the atom, has been observed in the case of cadmium by Kapuscinski (*Zeits. f. Physik*, **41**, p. 214 ; 1927). The remarkable re-emission of exciting lines is no doubt of molecular origin, but its exact mechanism is still not clear.

On heating the vapour to 800° C. at constant pressure, the spectrum described above is quenched as a whole, which suggests a common origin for the re-emitted lines and the continuous background.

The presence of small traces of gases does not have the strong quenching effect which occurs with the near ultra-violet and visible fluorescence. This is consistent with the view that the state to which the molecule Hg_2 is raised by the absorption of the aluminium lines has a much shorter life than those responsible for the fluorescence in the near ultra-violet and visible ; the duration of the latter has been shown to be of the order of 10^{-3} sec. (Rayleigh, *Proc. Roy. Soc.*, **114**, 620 ; 1927. Pringsheim and Terenin, *Zeits. f. Physik*, **47**, p. 330 ; 1928). It is of interest that the band at 2345 A. (probably corresponding to the 2^3P_2 state of mercury) is strongly quenched by traces of gases, and so does not seem to be connected with the far ultra-violet fluorescence studied here.

A quantitative investigation of the subject is in progress.

M. ELIASHEVICH.
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The Acquired Characters of *Alytes*.

IN NATURE of April 12, p. 562, Dr. Charles Walker draws a parallel between the well-known experiments on plants transferred to other climate or soil and Kammerer's endeavours to prove the inheritance of acquired characteristics, especially in *Alytes obstetricans*. Without again entering into the whole matter, I would only like to point out that Kammerer (*Roux' Archiv*, **45**, 324 ; 1919) states distinctly that the *Alytes* returned to their habitual temperature retained the *habit* acquired at the high temperature artificially employed of copulating in the water (p. 328), and that the fourth generation of *Alytes* which were returned to normal conditions developed the nuptial pad in a male of the F_6-generation. It is the *habit* which was

induced and retained after return to normal climate. The deprivation of water proposed by Walker would not have been equivalent to a return to former conditions, but induction in the opposite direction. Furthermore, Kammerer himself did not think the nuptial pad of *Alytes* an example of a newly acquired characteristic, but suggested that the character had been inherited from the frog ancestors, which normally have these pads (p. 326). In his English account entitled "The Inheritance of Acquired Characteristics" (New York, Boni and Liveright, 1924), Kammerer writes (p. 6) on the pads of *Alytes*: "admittedly an atavism and not a new acquisition". He would not have opposed Walker's statement that *Alytes* had both potencies, either to develop or not to develop the nuptial pad, one or the other turning up under certain external conditions. Valentin Haecker has termed this "pluripotency" ("Pluripotenzerscheinungen, synthetische Beiträge zur Vererbungs- und Abstammungslehre", Jena, Fischer, 1925).

Lastly, I must mention the great difference of method in the old experiments on plants and Kammerer's experiments on the transmission of acquired characteristics in those other cases, in which not only a habit, but also a morphological or colour character was immediately affected. Whereas the plants were put back under the former conditions, Kammerer placed the progenies of animals modified by diverging external factors into an intermediate surrounding, thus avoiding the instantaneous counteraction of one modification by the opposite one. The difference of these progenies in the same surroundings was taken as proof of the transmission of the induced modifications. Returning to the case of *Alytes*, we have in the same surroundings the progeny of parents which have always been kept at normal low temperatures and breeding on land, and the progeny of those exposed for several generations to high temperature in water. As in Kammerer's other experiments on the transmission of modifications, we have *different* characters in the *same* surroundings, whereas in the experiments on plants referred to by Dr. Walker, there were *different* characters in *different* surroundings, and only a small divergence in time of growth marked the origin of two lots side by side in the old conditions. A comparison of the two lines of experiment can, I think, only be made in so far that both have furnished cases of 'pluripotency'. HANS PRZIBRAM.

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May 2.

Evolution of the Hive-bee.

IT has been recently suggested, or maintained, that the case of the worker-bee can be explained on the principles of genetics and mutation, but not on the Lamarckian hypothesis. The queen bee or fully developed female shows no maternal or industrial instincts, but she transmits such instincts to her daughters, the worker bees, which are sexually undeveloped females.

The question then is whether the absence of the above instincts in the queen bee is due to mutation, or to disuse. It can scarcely be disputed that the hive-bee is descended from a form like the humble bee or wasp in which a solitary fertilised female begins the summer by laying eggs, collecting food, making cells, and nursing the larvæ, and ends by resigning all these tasks to her sexually imperfect daughters. The fact that the worker-bee possesses and exhibits the industrial and maternal instincts is proof that it has inherited the genes of these instincts from its mother, the queen bee. But if the absence of the same instincts in the queen bee was due to mutation, she must have lost the genes of those instincts, and the worker-bee could not inherit them. Even if we suppose that the mutation was only a modification of the genes which prevented them becoming active, this modification would be passed on by heredity to the worker.

On the other hand, on the hypothesis that the loss of the instincts in the queen bee is due to many generations of disuse, it is easy to explain their presence and activity in the worker. For the suppression of the instincts will be impressed on the genes in association with the hormones present when it took place, namely, the hormones of the fully developed female reproductive organs. The workers will inherit the genes with the same modification, and as in them the reproductive system is never fully developed or active, the modification will never show itself, and the instincts will be in full activity.

The difference between the queen and the worker-bee is thus of the same kind as that between a male with secondary sexual characters and a female in which they are suppressed by the absence of the testis hormone, and I have not yet heard any explanation of the origin of the influence of sexual hormones on the development of secondary sexual characters on the theory of mutations. J. T. CUNNINGHAM.

Chiswick, April 29.

Science and Philosophy: A Proposed International Conference.

THAT great and epoch-making work of Eddington, "The Nature of the Physical World," must have raised afresh in many minds the ever-recurring question of the nature and meaning of science and its relation to philosophy and to our ordinary concepts of the familiar world. Many eminent men of science and philosophy have dealt with this age-long question in relatively recent times. One might, for example, cite Comte, Clifford, Huxley, Spencer, Balfour, Stallo, Mach, Ostwald, Pearson, Poincaré, Alexander, and Bergson. The rapidly advancing tide of scientific research during the last twenty-five years has made the question still more urgent, although it has been frequently discussed and illuminated by many acute minds of the highest quality. To mention again only a few examples, the names of Russell, Whitehead, Eddington, Jeans, Perrin, Rignano, Smuts, Einstein, Minkowski, Weyl, Heisenberg, de Sitter, Henderson, Morgan, Campbell, Lewis, Bridgman, and Ritter will occur to everyone.

My proposal is that poets, philosophers, psychologists, biologists, mathematicians, physicists, and chemists should be brought together to discuss this matter and, if possible, to elucidate it. There is urgent need to bring such men together and to do something towards a synthesis of thought and the advancement of a true *philosophie scientifique*. Perhaps the meeting of the British Association in 1931 might offer a possible occasion. Another possibility would be a meeting in Italy in celebration of the memory of Prof. Eugenio Rignano, who by his own writings and his editorship of *Scientia* did so much in the cause of scientific synthesis.

The ideal would perhaps be a special international meeting held, say, every five years. I believe very firmly that if the intellectual leaders of the world could meet at regular intervals and explain to each other, to their immediate audience, and to the world at large, their doubts and hopes concerning what the human mind has created from the data of sense, the cause of civilisation would be materially aided.

F. G. DONNAN.

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London, W.C.1.

Do Cockroaches eat Bed Bugs?

HOWLETT, writing on bed bugs in Lefroy's book on "Indian Insect Life", states: "In America cockroaches and small red ants are mentioned by Marlatt (*U.S. Ent. Circular*, No. 47) as being fond of eating bugs, the ants in particular being effective checks." In the account of cockroaches, however, Lefroy himself writes, "these insects are 'scavengers', and *none is known to feed on living plant tissue or to attack living insects*". In view of the contradictory nature of the two statements, my experience with these insects at Bombay is perhaps worth recording.

(1) It was observed that cockroaches generally frequented bug-infested bedsteads at night, although they were sometimes seen under the mattresses in the daytime also.

(2) The presence of cockroaches in very large numbers on a bug-infested cot was once noted to be associated with the complete disappearance of bugs, in a fortnight, after the cot was discarded from use.

In order to exclude alternative explanations for the presence of cockroaches and disappearance of bed bugs in the second case, direct experimental evidence was sought to discover if the cockroaches were really capable of eating bed bugs. Cockroaches were kept singly with one or more living bed bugs, in glass jars, each guarded at the mouth by a fine piece of muslin, tightly tied by means of a string. It was found that at least *Periplaneta americana* ate bed bugs, but preferably those young ones which had soft blood-gorged abdomens. Adult bugs with comparatively harder exoskeleton were sometimes rejected. The maximum number of bed bugs eaten by a cockroach was three out of twelve supplied to it in forty-eight hours, after which, during the following twenty-four hours, the cockroach preferred to starve. The repetition of the above experiments confirmed Marlatt's observation that cockroaches of this species will eat bed bugs.

A. N. GULATI.

4 Sobhan Bhuvan, Parsee Colony,
Dader, Bombay No. 14,
April 18.

Band Spectrum of Sulphur.

THE absorption spectrum of S_2 vapour has been investigated by Henri and his pupils (NATURE, **114**, 894; 1924; *C. R.*, **179**, 1156; 1924; *Jour. de phys.*, **8**, 289; 1927) and by Rosen (*Zeit. f. Phys.*, **43**, 69; 1927; **48**, 545; 1928). They found a band system leading from the vibrational levels of the normal electronic state of the molecule to the vibrational levels of an excited electronic state. They also found that those bands for which the upper states lie above a certain energy value are diffuse, a fact which can be explained if one assumes that in these states the molecule has the possibility of dissociating spontaneously into separate atoms, a phenomenon called predissociation by Henri (see, for example, Kronig, *Zeit. f. Phys.*, **50**; 347, 1928).

At the suggestion of Dr. Kronig, I investigated the spectra obtained by passing a high voltage discharge through hydrogen sulphide at a pressure of a few millimetres. It showed that the same band system obtained by the observers mentioned above in absorption appeared here in emission, with the one difference that the bands which in their investigations were diffuse are here entirely absent. After the current had been passed through the discharge tube for some time, a deposit of sulphur appeared on the walls.

These facts can be understood if it be remembered that the S_2-molecules produced by the discharge and raised to the levels in question have a very short lifetime. They will hence dissociate before they have a chance to fall back to the normal state under emission of radiation, so that the emission bands starting from them are very faint or entirely absent.

Besides the band system just discussed, the photographic plates showed another band system with its maximum intensity in the region of 2570 A. To judge from its appearance, it is also due to S_2. It is hoped to investigate in greater detail the structure of these bands, particularly with regard to a possible intensity alternation.

H. H. VAN IDDEKINGE.

Natuurkundig Laboratorium der
Rijks-Universiteit, Groningen,
May 9.

Water-meadows and River-flow.

I AM glad to see from Dr. Vaughan Cornish's review on pp. 737-8 of NATURE for May 17 that the Council for the Preservation of Rural England is directing attention to the unsuitability of water meadows for dwellings and to the fact that they serve as safety overflows for inhabited districts lower down the river in times of heavy flooding. The æsthetic advantage of these flats is also accentuated.

A point which does not seem to have been made is that water-meadows are essential for the existence of the river itself. If recent proposals for measures to ensure the rapid passage seaward of winter rainfall are adopted, the summer flow of such rivers as the Thames is likely to become negligible. In winter as much as 10,000 million gallons may pass over Teddington Weir in twenty-four hours; in summer as little as 100 million gallons. If the water now stored in the land around the upper reaches during winter floods is not allowed to collect in the future, then it is difficult to see how the summer flow can be maintained even at its present level or how flooding near London can be prevented in winter. The question affects navigation, sewage treatment, and water supply not only in the Thames but also in all such rivers. Lord Desborough has directed attention to the doubtful future of the water supply of many districts.

J. H. COSTE.

Teddington, May 23.

Flint Implements of Lower Palæolithic Age from the Mammaliferous Gravels of Yorkshire.

ON Feb. 15 last there appeared in NATURE the announcement of my discovery in Yorkshire of Upper Palæolithic implements, *in situ*, at the base of a glacial deposit of Pleistocene age.

Messrs. Dewey and Bromehead, of H.M. Geological Survey, have just completed an official examination of the sites under consideration, and, from the sections north of Bridlington, they have removed, with their own hands, numerous implements from the base of what they, also, consider to be a deposit of late Pleistocene age. A detailed report of these investigations will be issued in due course.

On Saturday, May 17, whilst examining, in their company, the mammaliferous gravels at Burstwick, in Holderness, I recovered therefrom a Levallois-flake, which, from its stratigraphical position, cannot be later in date than the Early Mousterian period. Last year, I found in this same deposit a small hand-axe, flaked on one face only; both these specimens will be described and figured at a later date.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2, May 19.

The Metallography of some Ancient Egyptian Implements.*

By Sir HAROLD CARPENTER, F.R.S., and Dr. J. M. ROBERTSON.

IRON in ancient Egypt has been the subject of many publications, and, concerning such aspects as the approximate date of the beginning of the Iron Age, the use of meteoritic iron, and the source of the Egyptians' knowledge of iron making, many different opinions have been expressed. With regard to some of these questions the position is such that evidence may be adduced in support of a variety of views each of which is at variance with certain portions of the total available evidence. Concerning the approximate date of the beginning of the Iron Age there are, for example, two main categories of evidence, the direct and the indirect, and generally speaking, the conclusion arrived at depends on which type is regarded as the more reliable. The evidence provided by the discoveries of iron articles, iron-smelting furnaces, or references to iron in writings or paintings constitutes the direct evidence, whereas the existence of hard stone carvings which would appear to have required the use of iron tools in their execution constitutes the indirect evidence.

Only six iron specimens which can be definitely shown to belong to the period 1300 B.C. have been found, whereas iron articles belonging to later periods are fairly plentiful. On the basis of this evidence, Petrie has suggested that iron did not come into general use in Egypt until 1300–1200 B.C., although it was apparently used sporadically for a period of from 2000 to 3000 years before this.

A further indication of the late beginning of the use of iron is provided by the evidence quoted by Rickard,[1] that mural pictures surviving from the period prior to 2000 B.C. show weapons coloured yellow or red, representing copper or bronze, but none of iron, which was usually coloured blue in paintings subsequent to 1500 B.C. In the long lists of tribute collected in the days of the Eighteenth Dynasty (1580–1350 B.C.) iron is not mentioned, and Rameses II. (1292–1225 B.C.) wrote to the King of the Hittites asking for a dagger. In the innermost sarcophagus of Tut-ankh-amen, who died about 1360 B.C., three iron articles were found—a dagger blade, part of an amuletic bracelet, and a miniature head-rest. Rickard infers from the position of these articles, which lay on the wrappings of the mummy, that they were the most precious things belonging to the dead Pharaoh, and that the iron was more rare and highly prized than the gold of which the sarcophagus was made. Among the funerary chattels found in the annexe of Tut-ankh-amen's tomb were some miniature iron implements, and Howard Carter [2] suggests that these might have been " gifts to the young King to record the arrival or discovery of iron in Egypt."

All the foregoing evidence goes to show that iron, although not unknown in Egypt before 1200 B.C., was very rare, and was probably not manufactured in that country. The majority of archæologists accept this evidence as conclusive.

If no appreciable quantity of iron existed in Egypt before 1200 B.C., copper and bronze tools must have been the only ones available, and yet from the Fourth Dynasty (2900 B.C.) the Egyptians were accustomed to sculpture hard stones, such as granite and diorite. According to Garland and Bannister,[3] " Many of the antique Egyptian statues are perfect examples of the sculpture's art ; the hardest stones were carved and shaped with unfailing accuracy, faultless symmetry and definition : sharp corners with perfect angles and knife-like edges, gracefully curved and plumb straight lines, grooves and serrations : deep and shallow depressions and reliefs, with delicate, undulating contours, or rigidly plane surfaces ".

Sculpture work of this kind is known to have been done for a thousand years before the introduction of bronze, when copper tools only were available—but even with bronze tools it is difficult to understand how this work was accomplished. The hypothesis that the Egyptians possessed some secret method of hardening copper has now been discarded, and two alternative explanations of their method of carving hard stone remain. One, due to Petrie, is that the work was done by means of emery-fed copper or bronze tools ; the other, that steel tools were used. Hadfield [4] goes so far as to suggest that " the ancient Egyptians were not only able to make steel for tools of all kinds, but also to cement and harden it, or, if not themselves steel-workers, they obtained the necessary material and help from the workmen of another nation ".

The existence of the hard stone carvings is difficult to reconcile with the evidence of the specimens found by excavators. The scarcity of iron relics of the period prior to 1200 B.C. may perhaps be explained by corrosion, by the existence of a superstitious objection to the inclusion of iron among funerary objects, or by arguing that the total number of metal specimens found is at best only a small proportion of those that must have been used. These arguments may, however, be met by appealing to the permanency of iron rust, and to the fact that many iron objects belonging to the period subsequent to 1200 B.C. have been found in tombs and elsewhere.

We incline to the view that iron was rare in Egypt until about 1300 B.C., for the evidence of this scarcity implied in the request of Rameses II. to the King of the Hittites, and in the nature and position of the iron objects buried with Tut-ankh-amen, is certainly strong.

The existence of a number of iron specimens definitely known to belong to the period 2900–1450 B.C. shows, however, that the Egyptians were acquainted with this metal for about fifteen hundred years before its use became general. During this, what may be termed, sporadic Iron Age, it was

* Based upon a paper read on May 1 at the annual meeting of the Iron and Steel Institute.

obtained in limited quantities either by home manufacture or by trade, and it has been argued that an intelligent people like the Egyptians would not have been content with a limited supply of this valuable commodity, but would have applied themselves to extending its production and manufacture. The validity of this argument rests, however, on the assumption that the iron was found to be superior, at any rate in certain respects, to copper and bronze, in the working of which the Egyptians had already acquired remarkable skill. On consideration it is quite clear, however, that the first efforts at iron-making would be most unlikely to produce a metal which would commend itself to the Egyptians or any other ancient people previously acquainted with the use of bronze.

We are liable to forget that the position of iron in modern civilisation is due to the abundance of its ores, the scale on which it can be manufactured, and the variety of alloys it forms with carbon. None of these considerations would influence its position when it first appeared in Egypt. The spongy mass of iron and slag obtained from the direct furnace required much heating and hammering to get rid of the slag and produce a coherent metallic lump. From this material the desired articles would have to be laboriously cut and forged with frequent reheatings, and the final product—if free from carbon, as most direct iron was—would be softer than bronze, devoid of ornamental attributes, and liable to rust. The manufacture of iron articles was therefore much more troublesome than that of similar articles in bronze, and when finished, the product would not display any properties superior to those of this alloy. It is probable, therefore, that iron when first discovered was developed with most avidity among people not previously acquainted with other metals or not highly skilled in their use. In Egypt conditions were far otherwise, and iron would probably be regarded as a curiosity, or something with possibilities, but not as an alternative to, or an improvement on, existing metals.

The position of iron in ancient Egypt clearly did not depend entirely on acquaintance with the metal, the ores from which it could be extracted, and the means by which this could be accomplished. Numerous other considerations have to be taken into account, and these may be summarised by stating that direct iron when compared with bronze did not possess sufficient advantages to compensate for the greater difficulty experienced in manufacturing useful articles.

The usefulness of iron for tools, weapons, and implements of all kinds would be greatly enhanced when means were discovered for converting it into *steel* by the introduction of carbon and a further extension of the utility of this metal would follow the discovery of quenching. With the development of these processes of carburising and quenching, iron, because of the *increased* hardness that could then be conferred on it, would assume a new significance, and it was probably from this time that it began to be taken seriously and the sporadic gave place to the real Iron Age.

Although there is in existence a large collection of ancient specimens of iron, comparatively few of them have been examined by metallurgical methods, and this is largely due to the reluctance of archæologists to submit specimens for examination when they anticipate that this will involve their partial destruction. It is certainly true that examination by chemical methods requires drillings to be taken, but microscopic examination can be carried out simply by polishing a part of the surface, and by this method a considerable amount of information can be obtained from the examination of ancient metal specimens without injuring them.

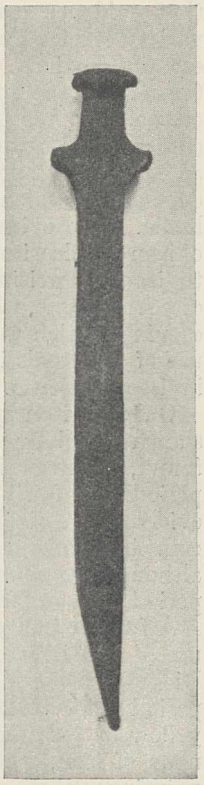

FIG. 1.—Specimen No. 6, a chisel.

Through the kindness of Sir Flinders Petrie, we have been able to examine nine representative specimens selected with his assistance from his Egyptian Collection at University College, London. The specimens examined were as follows :—

No. 1. A portion of a sickle. This specimen had been very badly corroded, and consisted mainly of iron oxide held together by a thin sheet of metal. The sickle consisted of two parts, a back and a blade. Sir Flinders Petrie considers that this specimen belonged to the Roman period, and was probably made in the second or third century A.D.

No. 2. A small knife in good condition. It is considered that this belonged to an early period in the Iron Age, and was probably made about 1200 B.C.

No. 3. A knife with a bronze handle. This specimen was in fairly good condition, although it showed marked surface corrosion and pitting. It is regarded as belonging to the period about 1200 B.C.

No. 4. A small knife in good condition. It is not an Egyptian shape, and is believed to have been imported from Europe about 300 B.C.

No. 5. This specimen is a very primitive piece of work, and it is difficult to say what it is. Sir Flinders Petrie was unable to assign it to any period.

No. 6. A chisel in good condition (Fig. 1). It is supposed to date from about 700 B.C.

No. 7. A hoe in good condition. This specimen is supposed to date from about 800 B.C.

No. 8. An axe head, corroded. It is believed to date from about 900 B.C.

No. 9. An axe head in very good condition (Fig. 2). This specimen is believed to belong to the same period as No. 8, namely, about 900 B.C.

The examination of these specimens was carried out in such a way that practically no damage was done to them. In each specimen a representative

area was polished and examined microscopically, micrographs being taken of typical structures. The hardness of these typical structures was then determined by means of a Brinell hardness tester with a 1 mm. diameter ball. In all the specimens extensive variations in microstructure were observed. Some of these were clearly the result of carburising and heat treatment, but others were due to variations in the composition of the original metal, which when produced in primitive smelting furnaces consists of particles that have been welded and not melted together.

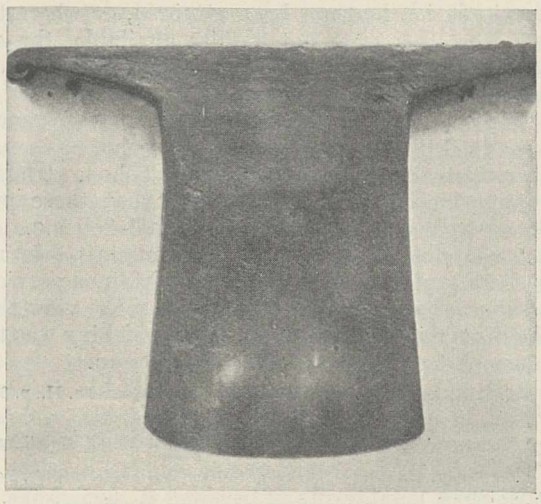

FIG. 2.—Specimen No. 9, an axe head.

The principal results that were obtained from examination of the specimens were, briefly, as follow :—

No. 1. This sickle consisted of two portions, a back and a blade. Microscopic examination showed that the back consisted mainly of ferrite with a little carbide, indicating that it had been made from iron containing a very small proportion of carbon. The blade, however, had been carburised so as to bring the carbon content up to about 0·35 per cent. It had then been quenched in water and tempered at about 600° C. (Fig. 3).

No. 2. This specimen, presumably made in the first place from almost pure iron, had been carburised so that the carbon content was raised to about 0·7 per cent at the edge. From the edge towards the back the carbon content decreased progressively, and the microstructure and hardness varied accordingly. After carburising, this knife had been heated to about 750° C. and air cooled—thus producing a hardness of 269 Brinell at the edge.

No. 3. This specimen had been given a similar treatment to No. 2, and the variations in microstructure were almost identical.

No. 4. This specimen had not been carburised or subjected to any other special heat treatment. It was a double-edged knife or dagger, and, whereas the middle of the blade was small grained and contained a fair amount of carbon, the edges were large grained and consisted of soft ferrite. The hardness of the middle of the knife varied between 137 and 143 Brinell ; that of the edges varied between 95 and 107 Brinell.

No. 5. This specimen contained a small amount of carbon and had been water quenched, thus producing a hardness which varied between 160 and 197 Brinell.

No. 6. This chisel had been carburised so as to produce a carbon gradient which varied from about 0·6 to 0·8 per cent at the edge to about 0·15 per cent $1\frac{1}{2}$ in. from the edge. It had then been heated at the edge and quenched by immersing the edge only.

No. 7. This hoe had been forged from direct iron and had received no further treatment.

No. 8. This axe head was badly corroded. It had been carburised, but the treatment had not produced the highest carbon content at the edge. It had then been quenched, but the original hard edge had evidently been removed by sharpening. The highest hardness number obtained was 229 Brinell in an area of high carbon at some distance from the edge ; the hardness at the edge was 207 Brinell.

No. 9. This axe head appeared never to have been used and was still protected by a blue film of oxide formed during the last heat treatment. For this reason it had not been corroded and the edge was sharp and regular. The carburising treatment had produced a carbon content of about 0·9 per cent at the edge, decreasing to a very small amount at 1 in. from the edge. Quenching the edge had resulted in the production of a hardness of 444 Brinell at the edge, and a progressive decrease in hardness to 62 Brinell at 1 in. from the edge.

It is evident from the examination of these nine specimens that although the Egyptian process of extracting iron from its ores was very primitive and resulted in the production of almost pure iron containing some slag, yet the metal workers of the period were able to produce in small articles a great variety of properties by means of carburising and heat treatment. All the articles examined do not show the same degree of skill in their manufacture

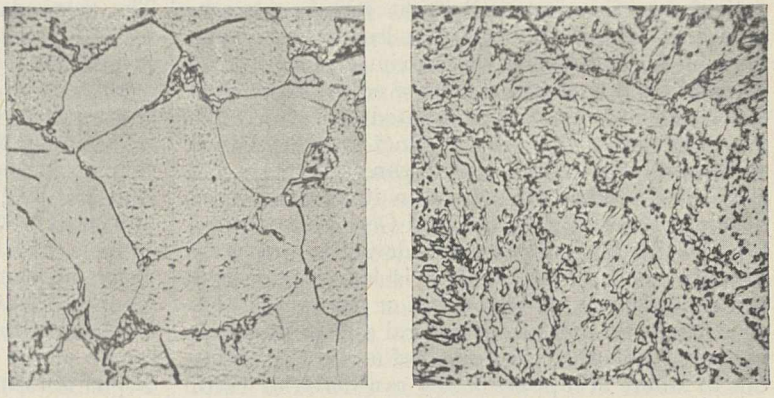

FIG. 3.—Specimen No. 1 ; (*a*) back ; (*b*) blade. ×820.

and heat treatment, even when they are considered according to their age. But even at the present time there are notable differences in the extent to which the metallurgical knowledge and skill of the community is exhibited by different products, and the same would certainly hold in ancient Egypt when the facilities for the spread of knowledge were, by comparison, very meagre.

So far as we know, the facts disclosed by the present work constitute the first definite evidence that carburising, quenching, and the advantages of heat treatment generally, were known and understood many centuries before the Christian era. Hitherto, the earliest direct evidence of hardening has been that provided by Hanemann,[5] who observed a hardened structure at the edge of a specimen found during the excavations on the site of Steinsburg at Römhild in Thüringen. This specimen belonged to a period about the beginning of the Christian era. Indirect evidence of quenching at a much earlier date is provided by a reference in Homer.

As already stated, the introduction of carburising and quenching would entirely alter the position of iron in comparison with bronze, and in our opinion it is probable that the Iron Age in Egypt did not properly begin until these processes were understood. In other words, it was not until iron had been converted into steel that the Egyptians obtained a range of alloys which were superior in properties to bronze and capable of more varied applications. In countries, however, where bronze was practically unknown, where notable skill in its manipulation had not been attained, or where the requisite ores were not readily available, the extensive manufacture of iron would follow more closely on its first discovery.

There is no reason to suppose that the specimens examined in the present work represent the earliest specimens to be carburised and quenched. The investigation has shown, however, that these processes were in use in the period 1200–800 B.C. As it was about this time that iron came into common use in Egypt, the information now obtained provides a substantial argument in support of the view that the discovery of carburising and quenching was the cause of the extensive utilisation of iron.

[1] T. A. Rickard: *Journal of Iron and Steel Institute*, No. II., p. 323; 1929.
[2] Howard Carter: *Illustrated London News*, July 2, 1928.
[3] H. Garland and C. O. Bannister: "Ancient Egypt Metallurgy" (London, 1927).
[4] Sir Robert Hadfield: *Journal of the Iron and Steel Institute*, No. I. p. 134; 1912.
[5] H. Hanemann: *International Journal of Metallography*, vol. 4, p. 248; 1913.

Chinese and Malayan Medicine.

IN his presidential address to the Chemical Section of the British Association last year, Prof. G. Barger pointed out that "the use of vegetable drugs led pharmacists to examine the constituents of plants and thus the foundations of descriptive biochemistry were laid". He suggested later on that "whilst organic chemists are often eager to investigate the constitution of animal and vegetable substances, they are less ready to undertake the preliminaries of purification and isolation and are therefore less apt to discover new ones".

So far as Germany and Great Britain are concerned, it is probably true that less work is being done on the isolation of the proximate constituents of plants and that in France the additions to such knowledge are of a strictly limited character. On the other hand, there is a distinct growth of such work in India, China, and Japan, and there are signs of a revival of interest in it in the United States. The earlier British and German investigations of this kind were usually devoted to severely practical ends, such as the isolation of active principles from vegetable drugs or the preparation of colouring-matters from natural dyestuffs, and it is just possible that the decline of interest is largely due to failure in supplies of new raw material worth examination. Directors of laboratories associated with the application of chemistry to medicine are apt to be afflicted by enthusiastic and credulous collectors of native drugs, who bring home an ounce or two of mouldy roots and a romantic story of marvellous cures of diabetes, tuberculosis, or cancer, and expect the chemist to examine the one and believe the other.

Much valuable work has been wasted in examining material of this kind. Though there is still much to be done, we already have much information linking up the groups of the systematic botanist with particular types of chemical compounds, and there are already clear indications that in the future, work on the constituents of plants is likely to proceed on systematic lines to be settled by co-operation between the botanist and the chemist. In this connexion it is satisfactory to find Dr. Hooper employing his well-earned leisure in identifying and recording the botanical sources of the drugs to be found in Chinese pharmacies in Malaya.[1] The particular specimens identified were collected by Mr. I. H. Burkill when Director of Gardens, Straits Settlements. The number of specimens dealt with is 456, and they are mostly of plant origin. The Chinese name of each drug is given, followed by the Romanised Mandarin transliteration. The botanical source is then stated, wherever possible, and a note as to the composition, uses, etc., of the drug is added.

Some of these substances were once familiar drugs in Europe, but have long been obsolete. Many of them are still in common use in European medicine; for example, *Datura Metel*, the usual source of the valuable alkaloid hyoscine; *Hydnocarpus anthelmintica*, the seed oil of which is one of the raw materials used in preparing the derivatives of chaulmoogric and hydnocarpic acids used in the modern treatment of leprosy; rhubarb root, for supplies of which European druggists are still dependent upon Chinese collectors; and a considerable number of aromatic drugs and spices such as mint, anise, dill and ginger.

The most interesting materials, however, are those which have not acquired fame in Europe, of which *Achyranthes bidentata* Blume is an example.

Judging from Dr. Hooper's note, the roots of this plant must be in fairly common use in China and Japan, where it is regarded as a cure for rheumatism, fever, and cutaneous diseases. In Perak it is given for extreme anæmia, whilst in India and Ceylon the roots of the allied species, *A. aspera*, have a reputation as a diuretic and astringent. These two species belong to the natural order Amarantaceæ. According to Wehmer (" Die Pflanzenstoffe ") the chief economic distinction of the plants of this order appears to be that of furnishing a number of harmless and useful vegetables, whilst their most striking constituent is potassium nitrate.

On the whole, therefore, it appears likely that the value of *A. bidentata* in the various diseases referred to above rests on a somewhat slender foundation.

A more plausible case can be made out for *Quisqualis indica*, the seeds of which enjoy a widespread reputation as an anthelmintic, in which respect they resemble two other plants of the same natural order, Combretaceæ, namely, *Combretum quadrangulare* and *C. pilosum*, neither of which occurs in Dr. Hooper's list, though the first is used in Siam and the second in India. Another species, *C. sundaicum*, is believed to afford relief to the confirmed opium-smoker suddenly deprived of his favourite drug. All these plants have been examined at various times, and from none of them has anything likely to account for their alleged anthelmintic action been isolated, the most interesting constituents so far as the *Combretum* spp. are concerned being usually tannin or its degradation products or related substances. Now that better methods of testing anthelmintics are being gradually worked out, it would be interesting to have some of these products tried by pharmacologists, as chemical methods of examination seem so far to have failed to justify native belief in their efficacy, unless, indeed, certain kinds of tannin prove to have hitherto unsuspected value as anthelmintics.

We also owe to Mr. Burkill's enthusiasm as a collector a monograph on the native medicines of Malaya.[2] He and his colleague toured through the Peninsula interviewing the native physicians and midwives and inducing them to provide specimens of the drugs they used. These, duly registered and numbered, have been placed in the herbarium of the Singapore Botanic Gardens. The botanical identifications of these specimens, their Malay names, localities, and medicinal uses, are recorded in the monograph, which also includes an index to the vernacular names, with explanatory comments by the senior author.

With regard to the medicinal uses it is explained that the Malays are apt to consider all sicknesses following childbirth as due to evil spirits and to place these in a special group called *sakit meroyan*. To ward off such attacks they administer during the first three days after childbirth—the period during which evil spirits are most powerful—preparations called *ubat meroyan*, and the word *meroyan* is introduced into the names of plants so used, often in highly fanciful expressions. As the authors put it, an *ubat meroyan* may not be intended to have any immediate effect, and many of the plants in the class possess the medicinal value of sympathy, but none chemico-physiologically.

The number of drugs so used appears from the list to be very large. These Malayan drugs include comparatively few that have found acceptance in European medicine, but many of them are well known as having a considerable reputation among natives in various parts of the world as specifics for certain tropical diseases. Among these are *Quisqualis* and *Combretum* spp., the alleged anthelmintic properties of which have been referred to already. Three *Alstonia* species are mentioned, including *A. scholaris*, which is included in the British Pharmacopeia of 1914, apparently on account of its supposed anti-malarial action, but there is no allusion to this use in this monograph except possibly in the case of *A. augustiloba* Miq., which is described as a cure for ' remittent fever ', used by smearing the leaves with coconut oil, heating and applying hot over the spleen. One of the Rubiaceæ, *Mitragyne speciosa*, is used for treating wounds, curing a craving for opium, eliminating worms in children, and reducing enlarged spleens, a truly beneficent plant, about which the authors unkindly remark that as a cure for opium-craving the remedy is apparently worse than the disease. This interesting plant has already been examined in Prof. Barger's laboratory and it appears to merit further attention from the chemist and the pharmacologist.

Many such examples of the value of botanical identifications as a guide to the chemist could be picked out of these useful publications, and from this point of view alone, Dr. Hooper and Mr. Burkill have rendered no small service in carrying out what must have been a difficult and sometimes tedious task.

It is to Prof. Bernard Read and his pupils in Peiping (Pekin) that we owe the introduction, or if the reader prefers it, the reintroduction, of the alkaloid ephedrine into European medicine for the treatment of asthma, a piece of work which has made ephedrine in a short time one of the more important alkaloids of commerce and has led to numerous researches on the botany and chemistry of the genus.[3] It is a curious fact that much of this scientific work and the resulting commercial organisation necessary for the collection of the *Ephedra* species for export to Europe and America for the manufacture of the alkaloid, have been accomplished while China has been undergoing violent political and military convulsions. After much discussion it has apparently been clearly established that the two species chiefly collected in China as sources of ephedrine are *E. sinica* Stapf and *E. Equisetina* Bunge, and that to both of these, and possibly others, the vernacular name *Mahuang* is applied. Both these species are fully described and illustrated by Prof. Read, and the complicated story of their botanical identification is clearly related.

There is still some doubt as to whether any of the commercial Chinese supplies are derived from *E. distachya*, as Prof. Read thinks there is good reason to believe this species occurs between the

Huang Ho and Yangtse Kiang Rivers, and Mr. E. M. Holmes has had commercial material apparently derived from this source.

It is a curious and disconcerting fact that when many plants of a genus have been examined, they quite frequently show remarkable differences in the character of their secondary constituents, such as alkaloids. It is not surprising that five of the Chinese species, namely, *sinica*, *Equisetina*, *gerardiana*, *distachya*, and *intermedia* should contain both ephedrine and its isomeride pseudoephedrine, the former predominating in all but *intermedia*, or perhaps that E. monosperma should contain a third alkaloid "Ephedrine, Spehr", and that these alkaloids should also occur in these species from India and Europe so far west as the Canaries, so far as they have been found there and examined. It is, however, remarkable that of the Ephedras found in the two newer continents, America and Australia, none has so far been found to contain alkaloids. Prof. Read's monograph is a useful and timely summary of the present position of the botany of Ephedra, and particularly of those species which have acquired commercial importance. Readers of NATURE do not need to be reminded of the valuable services which Kew renders to science and to industry, but it should be pointed out that, thanks to the work of Dr. Stapf on Ephedras, Kew has been able to render very considerable assistance in solving the problems arising out of the introduction of this drug into commerce.

T. A. H.

[1] "On Chinese Medicine: Drugs of Chinese Pharmacies in Malaya." By Dr. David Hooper, *The Gardens Bulletin*, Straits Settlements, vol. 6, part 1, December 1929. Price 2.50 dollars.

[2] "Malay Village Medicine: Prescriptions collected by I. H. Burkill and Mohamed Haniff." *Ibid.* Vol. 6, part 2. April 1930. Price 2.50 dollars.

[3] "Ephedra." By Prof. Bernard E. Read, professor of pharmacology, Peiping Union Medical College, Peiping, China. *Flora Sinensis*, Series B, vol. 24, part 1. 1930.

News and Views.

THE King's birthday honours list contains the following names of scientific workers and others associated with scientific activities: *Baron:* The Right Hon. Noel Edward Buxton, Minister of Agriculture and Fisheries. *Baronets:* Mr. Basil Mott, past president of the Institution of Civil Engineers, and Mr. F. H. Royce, founder, director, and chief engineer of Rolls Royce, Limited. *Order of Merit:* Prof. S. Alexander, in recognition of his eminent position as a British philosopher and for his services as a writer and teacher. *Knights:* Dr. E. Brown, secretary of the National Poultry Council of England and Wales; Major T. H. Crozier, Chief Inspector of Explosives, Home Office; Prof. A. S. Eddington, Plumian professor of astronomy in the University of Cambridge; Prof. Leonard E. Hill, director of the Department of Applied Physiology, National Institute of Medical Research; Dr. G. A. K. Marshall, director of the Imperial Bureau of Entomology; Prof. J. Arthur Thomson, Regius professor of natural history in the University of Aberdeen; Mr. H. W. A. Watson, lately Chief Conservator of Forests, Burma; Mr. H. Wright, chairman of the Executive Committee of the Governing Body, Imperial College of Science and Technology, South Kensington. *K.B.E.:* Sir Philip Hartog, chairman of the Education Committee, Indian Statutory Commission. *C.B.E.:* Dr. E. W. Smith, honorary technical adviser to the Area Gas Supply Committee, Board of Trade. *O.B.E.:* Mr. T. P. W. Barty, lecturer in civil engineering, Gordon College, Khartoum, and Municipal Engineer, Khartoum; Mr. J. A. B. Horsley, Electrical Inspector of Mines, Mines Department, Board of Trade; Prof. W. M. Roberts, professor of mathematics, Royal Military Academy, Woolwich; Dr. F. B. Young, Principal Scientific Officer, Admiralty Research Laboratory. *M.B.E.:* Mr. J. Haworth, general manager of the Sewage Disposal Department and Chief Chemist and Water Examiner, Sheffield Corporation; Mr. H. W. Jack, economic botanist, Agricultural Department, Straits Settlements and Federated Malay States; Mr. H. G. D. Rooke, lately Chief Locust Officer, Ministry of Irrigation and Agriculture, Iraq; Dr. A. Winstanley, Junior Inspector of Mines, Mines Department, Board of Trade. *C.I.E.:* Mr. F. F. R. Channer, lately Chief Conservator of Forests, United Provinces; Lieut.-Col. H. R. Dutton, lately Principal, Prince of Wales' Medical College, Patna, and Superintendent of the Patna Medical College Hospital, Bihar and Orissa; Mr. L. Mason, lately Chief Forest Officer, Andamans; Mr. R. R. Simpson, Chief Inspector of Mines in India. *C.V.O.:* Mr. Evelyn C. Shaw, secretary since 1910 to the Royal Commissioners of the Exhibition of 1851. *I.S.O.:* Mr. D. Keiller, head laboratory assistant, Imperial Institute of Veterinary Research, Muktesar, United Provinces.

THE President and Council of the Royal Society have recommended Mr. Ramsay Macdonald and General J. C. Smuts for election into the Society under the special statute which permits the election of "persons who in their opinion either have rendered conspicuous service to the cause of Science, or are such that their election would be of signal benefit to the Society". It should here be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage. In the Society's original statutes of 1663, it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title or place, and every one of His Majesty's Privy Council, might be elected. In process of time, such persons formed a panel or privileged class. However, in 1873, there was much discussion on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the Society from exceptionally personal or official advantages of position". Arising therefrom, the privileged class was limited to princes of the blood royal and members of the Privy Council. Statutes enacted in 1902 abolished the clause relating to privy councillors, and the basis of qualification remains now as quoted above. Its implications seem clear enough. The

opportunities of the chief officer of state in the scientific arena are always at hand; they have nothing to do with political complexities.

IN connexion with Mr. Macdonald's nomination for election, it is interesting to recall that within the past sixty years four precedents can be recorded for the election of a Prime Minister whilst holding the seals of office. The instances are: Mr. Disraeli, elected on Feb. 10, 1876; Mr. Gladstone, elected on Jan. 13, 1881; Mr. Asquith, elected Nov. 5, 1908; Mr. Baldwin, elected Nov. 3, 1927. The first-named signed the charter book, and was formally admitted by Dr. J. D. Hooker, the president, on June 1, 1876—fifty-four years ago—that also being the day fixed for the election of the fifteen ordinary fellows. Amongst these (and happily still with us) was Prof. H. E. Armstrong. Mr. Gladstone was admitted on May 19, 1881 (Mr. Spottiswoode was president), on which occasion William Crookes read a paper, "On Discontinuous Phosphorescent Spectra in High Vacua". It fell to Mr. Asquith, in 1912, as Prime Minister, to propose "The Royal Society" at the Guildhall banquet held in connexion with the two hundred and fiftieth anniversary of the Royal Society. Mr. Baldwin was formally admitted by Sir Ernest Rutherford, and a similar act when extended to Mr. Macdonald (following election) will provide the circumstance (we think without precedent) of the admission of two Prime Ministers during one presidency. The only Prime Ministers for more than half a century who have not been fellows of the Royal Society by special election or otherwise are Sir Henry Campbell-Bannerman, Mr. Lloyd George, and Mr. Bonar Law.

PROF. A. S. EVE's recently delivered presidential address to the Royal Society of Canada, entitled "The Universe as a Whole", essays to unite in a single view recent discoveries and theories in the physical and biological sciences and gives point to the suggestions made in our leading article this week. It is pointed out that, in spite of modern specialism, "many of the great advances to-day are made by those who are fortunate and able enough to be expert in two subjects, for example, in physics and in physiology, or in mathematics and physics, or in physics and chemistry, or in physics and philosophy. Borderlands are prolific." This seems to prove that the wider view is not always the more superficial; hence the value of such an inclusive conspectus as the one before us. Prof. Eve, in dealing with recent physical theories, observes that the new quantum mechanics constitute a "far greater *bouleversement*" than the principle of relativity, though the latter has attracted more public attention. Another observation of interest is that the search for ultimate nature of *substance* is probably futile and may be safely abandoned. Attention is now concentrated "on the *structure*, on the form, arrangement, and resulting habits or behaviour of things". "The appeal to models is passing away, and the trust in mathematical symbols, equations, and deductions is growing stronger."

PERHAPS the most interesting passage in Prof. Eve's address is the following, which occurs under the heading *Time*: "It is a remarkable fact that in physics, energy has an intimate relation with time, and also with frequency; so that it is a particular fad of the author to endeavour to ascertain to what extent we can substitute the frequency of waves for the perhaps less tangible, but more familiar concept of energy. This is scarcely the place to enlarge on this idea; and it must suffice to point out that, as Einstein explained gravitation on a geometrical basis, so it may be possible to consider energy more fully as an aspect of frequency, possibly arriving at a comprehensive wave theory of the Universe." Prof. Eve makes the observation that "It is somewhat strange to think that if the whole human species were submerged in Lake Ontario the water would rise but a few inches, and doubtless the Universe as a whole would go forward but slightly affected, and dynamically and materially unimpaired". This reflection leads to the thought of the eventual extinction of humanity upon this planet, and to the ultimate degradation of energy in the universe. But Prof. Eve is unwilling to believe that there can be no other alternative, and quotes the remark of Prof. A. N. Whitehead that though the universe is physically descending, yet it may be spiritually ascending. At any rate, upon a question which is far more obscure than it has been represented to be, one is entitled to suspect dogmatic statements.

THE annual report of the British Science Guild recently issued records a year of considerable activity. The Guild was invited to give the first evidence to be heard by the Board of Trade Patents Committee, 1929, which had been appointed as a result of its activities. The evidence was presented by Dr. W. H. Eccles, Major the Hon. H. Fletcher Moulton, and Mr. A. F. Ravenshear. A memorandum of evidence, supplementary to the report previously issued by the Guild, is to be found in the annual report. A committee of the Guild is now discussing the position of the technical expert in the public service and industry, and in this connexion it may be noted that the Guild protested vigorously at the entire absence of scientific and technical men from the present Royal Commission on the Civil Service. Further, it proposes to offer evidence before this Commission, its spokesmen being Lieut.-Col. W. H. D. Clark, late Deputy-Controller of the Patent Office, Sir Arthur Newsholme, late Principal Medical Officer to the Local Government Board, and Lieut.-Col. W. A. J. O'Meara, late Engineer-in-Chief to the Post Office. The Commission will therefore have an excellent opportunity of ascertaining some facts with regard to the loss of efficiency which arises from the subordination of those who have to those who lack expert knowledge of the work of technical Departments of State.

DURING the past year the Guild instituted an annual lecture to be given in honour of a benefactor, the late Sir Alexander Pedler, in a provincial town. The first of these lectures was delivered at Manchester by

Dr. G. C. Simpson, director of the Meteorological Office (see NATURE, Dec. 28, 1929, p. 988). The next lecture will be given at Liverpool on Oct. 22 by Sir David Prain, on the subject of "Science Discipline". The third edition of the Guild's "Catalogue of Scientific and Technical Books" is announced as in the Press. It has been entirely revised and enlarged, and its publication will be welcomed by the many readers of scientific literature who have found the previous editions valuable. Most scientific men welcome the work which the Guild is doing, but comparatively few seem to be willing to bear a small share of the burden by becoming members. On the other hand, Sir Samuel Hoare, who succeeds Lord Melchett as president, may be counted upon to bring with him new and invigorating ideas for the Guild's sphere of usefulness. The new honorary treasurer is Lady Lockyer, widow of Sir Norman Lockyer, founder of the Guild and of NATURE.

WHILE the Government of Great Britain is still only at the point of considering whether the creation of one or more national parks is desirable and feasible, the announcement is made (by Science Service, Washington, D.C.) that Poland is the latest nation to have developed a national park system. The largest of the Polish parks is in the Tatra range, a part of the Carpathians on the Czechoslovakian boundary, and joining with reserved areas across the borders it contributes to form a great international park covering 240 square miles. The wild creatures include bear, chamois, lynx, deer, and eagles. To the Polish parks has also been added the former royal Russian hunting preserves in Bialowicza, a forest some 11,500 acres in extent which formerly sheltered one of the last herds of European bison. The total land reserved in Poland at the present day, for recreational and educational purposes, includes six national parks, 48 forest reservations, 35 steppe reservations, 13 peat-bog reservations, 5 lakes, and 5 interesting rock formations. The national parks of Poland differ from most others in that the peasants living in them when they were established have been left there undisturbed.

WE turn from those spacious parks of Poland and wonder at the seeming lack of appreciation of such places in Great Britain. A Romney Marsh bird sanctuary is a possibility—a typical marsh area, frequented by rare migrant birds in winter and inhabited by a great variety of water-fowl in summer. In 1928 the Royal Society for the Protection of Birds purchased here an 18-acre meadow as the beginning of a larger scheme, and now the farmer-owner, himself a keen bird-watcher and protector, is willing to sell additional land sufficient to complete a compact reserve of 180 acres. Probably no more ideal bird sanctuary, with its open water, stretches of mud, rush and reed beds, and pasture land, is to be found in any of the marshes of south-east England. In many another country the State would step in to form a Government sanctuary (Canada has eighty such reserves), but we have scarcely yet reached that degree of development, and private enterprise is the only alternative. The amount required for the purchase of this desirable spot is £4000, of which £500 has already been subscribed, and the Royal Society for the Protection of Birds (82 Victoria Street, London, S.W.1) appeals for contributions from a bird-loving public to complete the purchase.

IN a short article in the *Empire Review* for May, Lord Onslow reviews the steps which have been taken in various parts of the British Empire for the preservation of the native fauna. If many wild creatures are to survive they must be guarded, but it need not be supposed that the enthusiasts for protection, such as the Society for the Protection of the Fauna of the Empire, seek to preserve animals in a manner likely to cause danger to life or property. They do hold, however, that experience shows that the protection of the wild fauna need not interfere with development, and that preservation is in itself an asset to any country. Lord Onslow rightly emphasises that if protection is to keep in touch with development its creation of sanctuaries must not be too rigid, but must permit of temporary or permanent adjustments to the needs of the animals within and the human beings outside the reserved area. How rapid are the changes which may occur is illustrated by two items in Lord Onslow's article. He hopes that the British Government will proclaim as a gorilla sanctuary the British territory adjoining the Belgian Park in the Belgian Congo, but such a proclamation was actually made several months ago. Again, he refers to the success of the introduction of deer to New Zealand, but the success has turned to nuisance, and, as a note in these columns last week indicated, there is now a widespread desire for the reduction in numbers and even the extermination of the superabundant deer.

ON May 30 the Halley Lecture was delivered at Oxford by Prof. A. S. Eddington, Plumian professor of astronomy at Cambridge, before a large and attentive audience, who thoroughly appreciated the lucidity of his exposition, and the touches of humour with which it was illuminated. Before embarking on the proper subject of his discourse, namely, the rotation of the galaxy, Prof. Eddington remarked that in the nineteenth century attention was principally concentrated on solar motion, which had to be allowed for in estimating the value and amount of stellar motions generally. The aspects which are now engaging attention are star-streaming, correlation between velocity and physical characteristics, between velocity and approach towards or recession from our system, and finally the rotation of the galaxy itself. The galaxy is a flattened, almost disc-like system, which presents a rough resemblance to the system of Saturn's rings. The solidity of the latter system was shown by Clerk Maxwell to be impossible dynamically. That the rings consist of comparatively small particles rotating about a centre, the outer particles moving at a slower rate than the inner, has been confirmed by spectroscopic observation.

CONTINUING, Prof. Eddington said that as the stars have individual as well as rotational motion, it is necessary in investigating the motion of a system such as the galaxy, to subject a large number of stars

to observation. An attempt has been made, by using the asteroids on the analogy of Saturn's rings, to find the centre of the galactic system; an obstacle to this endeavour is the fact that the proper motions of stars in the southern hemisphere are not sufficiently well known,—"it is like flying with one wing". Prof. Eddington concluded by touching upon the many dynamical problems involved in the modern conception of the stellar universe, and the unifying influence of the hypothesis of a 'cosmic cloud' pervading space, with its attribute of viscosity. A hearty vote of thanks was accorded to Prof. Eddington on the motion of Prof. E. A. Milne, seconded by Prof. H. H. Turner, the latter of whom took occasion to refer to the need pointed out by Prof. Eddington for additional centres of observation in the southern hemisphere, in connexion with the question of the future destiny of the Radcliffe bequest.

THE National Broadcasting Company of the United States charges no licence fee for listening in to its programmes. According to an interview with Mr. James, the promotion manager of the Company, which appeared in the *Daily News* for May 28, the necessary revenue is obtained by allowing commercial companies to 'sponsor' programmes. The big business houses buy broadcasting time at the rate of £2000 an hour. Of this time not more than five minutes must be taken in telling listeners about the firm and its activities. No charge is made to universities if they desire to send out educational broadcasts, but apparently they do not take advantage of this offer. Talks are strictly limited to fifteen minutes and the silent periods must not exceed half a minute. When listeners dislike a particular type of programme they write to the company making complaints. The N.B.C. serves a great chain of seventy-six broadcasting stations stretching from the Atlantic Ocean to the Pacific. Advertisers can buy up the broadcasting time of all the stations in a particular area of the United States. It is interesting to notice that gramophone records are banned. Mr. James states that the total business turnover is about five million pounds a year. The advertising companies take up about 60 per cent of the total broadcasting time. They find that it pays to give excellent programmes. A cereal company, for example, gives children's programmes at breakfast time, and some of the largest companies give excellent classical programmes. No charge is made for broadcasting church services. In Great Britain, owing to the terms of the charter for the B.B.C., there is no advertising by radio.

THE financial difficulties by which the Australian Government is beset are acutely affecting the position of the Council for Scientific and Industrial Research. It appears inevitable that the erection of the proposed forest products laboratory in Sydney must be postponed and also that of a joint administrative block (including museum, lecture hall, and offices) for the entomology and plant industry divisions at Canberra. The contract for the main plant industry laboratories was, however, let before the present situation developed and the work will now go to completion. Plans for the McMaster Laboratory for animal health in the grounds of the University of Sydney have been adopted and building will shortly begin. The Darling Laboratory for soil science, placed in juxtaposition to the Melrose Laboratory at the Waite Institute, Adelaide, will soon be ready for occupation. While, therefore, it is apparent that the next two years will be exceedingly difficult for the Council, with little or no prospect of any extension of activity, there is reason to hope that the main lines of work initiated during the past four years will not suffer a serious set-back. A very encouraging fact is a decision just announced by the directors of the Commonwealth Bank to present a sum of £13,000 from the Rural Credits Fund to the Council to enable it to carry out certain projects which otherwise would have been abandoned, or at least seriously curtailed; £10,000 will be used in the erection of a plant house at Canberra, and £3000 will provide for insectaries for the study of blowfly and buffalo fly (*Lyperosia exigua*) problems.

IN his Friday evening discourse, delivered at the Royal Institution on May 30, Sir Harold Carpenter discussed the metal crystal. When prepared by one of the usual methods, metals and alloys consist of an aggregate of small allotriomorphic crystals and contain from about one hundred thousand to several millions of crystals per cubic inch. Their properties accordingly are the properties of aggregates and are therefore composite. In all metals, however, the individual crystal is the unit of which the aggregate is built. It is therefore the simplest form of metal. From a scientific point of view, the study of individual metal crystals should precede that of aggregates. This enables any particular property of the metal crystal itself to be studied: the only variable being its orientation. It is the realisation of this fact which has given rise in recent years to definite attempts to prepare single metal crystals. Success has been achieved in three different ways: (1) By the production of the crystal from the vapour phase; (2) by its production from the liquid phase; (3) by conversion of the solid metal in the ordinary polycrystalline aggregate into a single crystal. Each of these is an example of *controlled* crystallisation. The mechanical and physical properties of the single metal crystal are, in the majority of cases, directional. This fact is more strikingly illustrated in the mechanical tests, because the single crystal test-pieces undergo distortion and assume new and striking forms. In both categories, however, the properties of the single crystal differ from those of the crystal aggregate, depending upon its particular orientation. Single crystal alloys have been investigated to a less extent but, in so far as evidence is available, it indicates that the same holds for them. Future research will involve the controlled production of single crystals in particular orientations. Such knowledge will form the basis of the scientific manufacture of metals and alloys possessing properties which can be specified with accuracy and certainty.

WE are glad to see in the report of the Board of the Institute of Physics, adopted at the annual meeting of the Institute on May 27, that the *Journal of*

Scientific Instruments continues to make progress. The *Journal* publishes many valuable articles and is of decided service in the laboratory and the instrument-shop. There is a special section devoted to laboratory and workshop notes, and an appeal is made for increased contributions to this section from workers in laboratories, workshops, and drawing-offices, etc. The *Journal* is distributed to fellows at the cost of the Institute and to associates and registered students at the reduced price of 10*s*. 6*d*. per annum.

DR. W. H. ECCLES, in the course of his presidential address, pointed out that the Institute of Physics was incorporated in 1920 in order to form into a professional body all physicists interested in industrial applications. Trained physicists had provided so many ingenious and useful weapons of attack and defence during the War that there was every anticipation of their future importance in British industry during peace. Until nearly the end of the War physicists who were occasionally called upon to enter the service of the State were officially classed as 'chemists', as the word 'physicist' had not appeared in the official vocabulary; and those who had entered industry did so in the guise of 'engineers'. The need for a professional Institute of Physics was evident. The stability which the Institute has attained after a life of ten years shows that the founders were justified in their belief that the time had come to secure for physicists a position comparable with that of professional workers in other departments of applied science and that an organisation was required to represent them. Dr. Eccles was re-elected president and other officers appointed were as follows, in addition to a number of members of the Board not subject to election: *Vice-President*, Dr. R. S. Clay; *Hon. Treasurer*, Major C. E. S. Phillips; *Hon. Secretary*, Prof. A. O. Rankine; *Non-Official Members of the Board*, Prof. J. A. Crowther and Sir Richard Gregory.

THE appointment announced last week of Prof. H. R. Robinson to the chair of physics at East London College, will strengthen the distinguished body of physicists already associated with the University of London, and East London College may be congratulated on obtaining so distinguished a successor to Prof. C. H. Lees, who is retiring shortly. Prof. Robinson was born on Nov. 26, 1889 and studied at the University of Manchester, where he obtained the D.Sc. degree in 1917, and at the University of Cambridge, where he obtained the Ph.D. degree in 1924. He has been lecturer (1912–14) and assistant director (1919–21) of the Physical Laboratories in the University of Manchester, Moseley Research Student of the Royal Society (1921–23), reader and Carnegie Teaching Fellow in the University of Edinburgh (1923–26) and since October 1926 professor of physics at University College, Cardiff. He was elected a fellow of the Royal Society in 1929, and has published numerous papers on radio-activity, X-rays and atomic structure, and similar topics in the *Proceedings* of the Royal Society and the *Philosophical Magazine*.

IN recent years various heavy metals either as salts or in colloidal solution have been recommended for therapeutic purposes especially in the treatment of tuberculosis and of cancer. The rationale of this treatment is the assumption that the pathological cells or tissues have a special affinity for a certain heavy metal, which thus exercises a direct toxic action on the abnormal cells in which it accumulates. Thus the lead treatment for cancer introduced by Blair Bell was based on the assumption that cancer cells have a special affinity for lead. It is therefore of importance to have accurate data concerning the distribution of various heavy metals after injection into an animal. This problem is dealt with in a recent paper by G. Hevesy and O. H. Wagner in which mice bearing a transplanted tumour received injections of small amounts of thorium, of lead, and of bismuth (*Arch. f. exp. Pathologica und Pharmakologie*, vol. 149, p. 336; 1930).

BY the ingenious device of injecting a heavy metal together with its radioactive isotope and making electroscopic measurements with the ash of the various tissues, Prof. Hevesy and Mr. Wagner have overcome the difficulty of determining accurately the extremely minute quantities of the various metals which may be present in the tissues. The method is of an astonishing delicacy since the amounts of tissue analysed were almost always less than 1 gm. and the amount of metal found is given in units of 1/1000 of a milligram to the fourth decimal point. The analyses show that neither thorium nor lead accumulates in the tumour cells. If, therefore, lead has any therapeutic effect in cancer it must be an indirect one. Bismuth, on the other hand, shows a striking selective accumulation in tumour cells. These may contain from five to fifty times as much bismuth as the surrounding normal tissues. This confirms the observations of H. Kahn (*Klin. Wchnschr.*, vol. 6, p. 2335; 1927), who has used bismuth preparations in the treatment of cancer with, as he claims, encouraging results.

LESS than four years ago, the Japanese Earthquake Investigation Committee, after more than thirty years of useful work, was transformed into the Earthquake Research Institute, the sole object of which is the promotion of scientific inquiries (NATURE, vol. 119, p. 576). The first volume of the *Bulletin* of the new Institute was published in 1926, and in each succeeding year two volumes have appeared, the last part of the seventh volume having lately reached us. Some idea of the value of the new journal may be gathered from the fact that the seven volumes contain 106 papers, 1704 pages, and 198 plates. In the first volume, all the papers were written in Japanese, but were provided with summaries in English or French. Since then, fortunately for European readers, the number of papers in their languages has greatly increased, until in 1929 two out of every three papers were printed in English, French, or German. A welcome and very remarkable feature is the extraordinary increase in the number of authors. Up to 1923, the year of the great earthquake, 96 per cent of the papers in the *Bulletin* of the Earthquake Investigation Committee appeared under the name of Prof. Omori. In the new *Bulletin* there are papers

by 41 authors, twelve of whom are frequent contributors. While many writers continue to deal with the Kwanto earthquake of 1923 and the Tango earthquake of 1927, almost the whole field of seismology is covered. Among the more important contributions may be mentioned the mathematical investigations on wave-motion by K. Sezawa, the time-curves of various earthquakes by T. Matuzawa, the studies on the after-shocks of the Tango earthquake by N. Nasu, and the observations on the tilting of the ground before earthquakes by M. Ishimoto.

THE Second International Conference of Benzole Producers met in London on May 30 and 31. Delegates were present from Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Poland, and Spain, and they were received by the president, Sir David Milne-Watson, president of the National Benzole Association. The Conference was opened by a speech of welcome by M. H. Laurain, president of the International Conference of Benzole Producers. Sir David Milne-Watson in his address outlined the remarkable progress which has been made in the production of benzole during recent years, principally in Great Britain and Germany. Five papers were read at the Conference dealing with motor fuels for high compression engines, resin formation in motor spirits, estimation of gum in motor benzoles, the European benzole market position, and sales organisation, respectively. These were followed by a kinematograph film showing what has been done to exploit British-produced benzole in Great Britain. The Conference concluded with a visit to the distribution depots, research stations, and various transport workshops of the National Benzole Company, Limited.

MR. C. C. PATERSON, director of the Research Laboratories of the General Electric Company, Ltd., Wembley, has been nominated for election as president of the Institution of Electrical Engineers in succession to Sir Thomas Purves, whose term of office ends on Sept. 30 next.

AT a recent session of the Council of the League of Nations, the Health Committee of the League was reconstituted for a further three years. Sir George Buchanan, senior medical officer, Ministry of Health, has been reappointed a member, and Dame Janet M. Campbell, also of the Ministry of Health, is a new member.

WE are informed that the Secretary of State for Scotland has appointed Sir William E. Whyte to be chairman of the Scottish Advisory Committee on Rivers Pollution Prevention in succession to the late Sir John R. Findlay, Bart., of Aberlour. Sir William has been a member of the Advisory Committee since its inception. The Secretary of State has also appointed Mr. David N. MacKay, of Messrs. MacKay, Paterson, and Chalk, solicitors, Glasgow, to fill the vacancy on the Committee caused by the death of Sir John Findlay.

THE Council of the Institution of Civil Engineers has recently made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1929–30: Telford Gold Medals to Messrs. David Anderson (London) and B. B. Haskew (Weston-super-Mare); a Watt Gold Medal to Mr. A. E. L. Chorlton (London); Telford Premiums to Mr. W. T. Everall (Lahore); Prof. E. G. Coker (London); Messrs. G. L. Groves (Croydon); R. C. Bristow (Cochin); E. T. Ward (Sulina, Roumania); Gerald Lacey (Bombay); R. W. S. Thompson (Sheffield); and R. F. Hindmarsh (Newcastle-on-Tyne).

THE second Daniel Guggenheim gold medal for notable achievements in aeronautics has been awarded to Dr. Ludwig Prandtl, of the University of Göttingen, "for pioneer and creative work in the theory of aerodynamics". The first award of the Guggenheim Medal was made to Orville Wright a year ago, and the medal was presented to him in Washington on April 8 in connexion with the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers. The medal is awarded by a corporation consisting of representatives of the American Society of Mechanical Engineers and the Society of Automotive Engineers, with five representatives of foreign engineering bodies, one each in England, France, Germany, Italy, and Japan.

A CLEARANCE list (No. 177) of books on entomology, geology, mineralogy, and general zoology, including mammalia, invertebrates, and ornithology, has just been issued by Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1. Nearly 700 items are listed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two veterinary surgeons under the South West Africa Administration—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 11). A teacher of mining and allied subjects at the Doncaster Technical College—The Secretary, Education Offices, Doncaster (June 14). An agricultural economist in the Department of Agriculture, Kenya—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (June 16). A junior officer in the wood technology section of the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 16). A lecturer in the Department of Mechanical Engineering of the Borough Polytechnic—The Principal, Borough Polytechnic, S.E.1 (June 16). An assistant organiser for dairy husbandry under the Wilts County Council—The Clerk of the County Council, County Offices, Trowbridge (June 18). A physicist in the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 19). A part-time lecturer in philosophy and logic at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (June 20). A full-time teacher of science—principally chemistry and botany—at the Shrewsbury Technical College—The Clerk to the Committee of Management of the College, Guildhall, Shrewsbury (June 21). An advisory officer in glasshouse work and market gardening under the Kent

Education Committee—The Agricultural Organiser, Springfield, Maidstone (June 21). An assistant for bulb research at the Agricultural Institute and Experimental Station, Kirton, Lincs.—The Principal, Agricultural Institute, Kirton, near Boston, Lincs. (June 21). An instructor in building for the Government Technical Schools, Uganda—C.A. (T), The Secretary, Board of Education, Whitehall, S.W.1; Scottish candidates, (C.A.), The Secretary, Scottish Education Department, Whitehall, S.W.1 (June 23). A pathologist to the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (June 23). An assistant in the botany and pharmacy department of the Dundee Technical College—The Secretary, Technical College, Bell Street, Dundee (June 23). An engineering workshop instructor at the Technical College, Port Elizabeth—G. H. Penney and Co., 23 Lime Street, E.C.3 (June 24). A full-time secretary of the Universities Bureau of the British Empire—The Secretary, Universities Bureau, 50 Russell Square, W.C.1 (June 25). Two senior timber assistants in the Forest Utilisation Circle, Burma—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (June 30). Two assistants on the higher technical staff of the Science Museum, one in the industrial engineering and manufactures department and one in the mechanical engineering, land transport and construction department—The Director and Secretary, Science Museum, South Kensington, S.W.7 (July 4). Probationary assistant engineers in the engineering department of the Post Office—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (July 10). A lecturer in charge of the Department of Zoology of the Natal University College—The Registrar, Natal University College, Pietermaritzburg, South Africa (Sept. 24). A lecturer in mathematics in the University of Reading—The Registrar, University, Reading. A teacher of electrical engineering at the Watford Technical School—The Principal, Technical School, Watford. A secretary of the Institution of Engineers and Shipbuilders in Scotland—The Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2. A chief engineer for the Manchester Steam Users' Association—The President of the Manchester Steam Users' Association, 20 Quay Street, Manchester. A chemical laboratory assistant in the Experimental Department of the Fine Cotton Spinners' and Doublers' Association, Ltd.—The Chief of the Department, Rock Bank, Bollington, nr. Macclesfield. A woman lecturer in botany and chemistry at the Studley Agricultural College—The Principal, Studley Agricultural College, Warwickshire

Our Astronomical Column.

Comets.—Comet 1930 *d* (Schwassmann-Wachmann), discovered at Bergedorf on May 2, is interesting for the near approach that it makes to the earth early this month. It is evidently a periodic comet, and Prof. Yamamoto asks that a lookout should be kept for possible meteors from it. He gives June 9 for the middle of the shower, and χ Herculis as the radiant point. No accurate orbit is yet to hand, but the following by Dr. A. C. D. Crommelin, from observations on May 2, 12, 22, suffices to give some idea of it:

T	1930 June 14·050 U.T.	
ω	192° 4′ 7″	1930·0
Ω	76 59 19	
i	17 36 32	
ϕ	43 47 17	
log a	0·51661	
log q	0·00517	
Period	5·9555 y.	

The elements do not appear to resemble those of any comet previously observed.

Another comet, 1930 *e*, was discovered by Mr. Forbes at Cape Town on the morning of May 31; it was of the ninth magnitude; its position was R.A. 23h 45m, South Decl. 33° 38′; daily motion 4′ west, 24′ north. It is too far south to be observed in England. It is Mr. Forbes' third discovery; in November 1928 he found a comet that had already been observed in 1818 and 1873, and in 1929 he found a periodic comet not previously observed.

The Large Fireball of May 16.—A considerable number of observations have been received of this object, but they are nearly all by casual spectators of such phenomena and therefore imperfect and in some cases erroneous. There is no doubt, however, as to the splendour of the object, though it appeared in the evening twilight when very few stars were perceptible. Descriptions have come from Lancashire, Yorkshire, and other counties, and many interesting notes have been sent from South Wales. The fireball had a long flight from east to west over the central region of England onwards to the Irish Sea, and it apparently vanished when it reached the Irish coast. Pursuing a course of more than 200 miles, its height declined from 65 miles to 43 miles at a velocity of about 25 miles per second. Several observers thought it was comparable in size with the moon, but this would make the object about a mile in diameter, whereas if the effects of glare and flame are eliminated, the actual size would be probably about 1 or 2 feet. The radiant point was in Scorpio or Ophiuchus, and it is quite remarkable that this region supplies many fireballs at various periods of the year and particularly in the spring months of May and June. The great meteor of Dec. 3, 1929, apparently emanated from the same region of sky, but the data were not absolutely trustworthy.

The Oldest Known Star Catalogue.—Most text-books state that Hipparchus was the first to draw up a catalogue of stars, but it appears that in this, as in many other respects, the East anticipated the West. The *Memoirs of the College of Science of Kyoto University*, vol. 13, No. 1, contain a paper by Joe Meta on the Chinese catalogue of Shih Shên, which he dates at about 360 B.C., or two centuries before Hipparchus. It is in 120 volumes, which contain a large admixture of astrology; this appears to have been one of the main motives of early celestial observations; but it had the good effect of causing careful records of phenomena to be preserved. The zodiac is divided into the 28 lunar mansions, 62 northern asterisms, and 38 southern ones. The identification of the stars gave much trouble, which was increased by numerous copyists' errors in the MSS. The paper describes the method of dating the catalogue, which was mainly done from the recorded declinations of the stars, and closes with the list of asterisms, which gives the Chinese names and their meanings, also the extent of each. The measures are in Chinese degrees, of which there are 365¼ to the circumference.

Research Items.

Atmospheric Pollution.—The Report recently published for the year ending March 1928 of the Atmospheric Pollution Research Committee of the Department of Scientific and Industrial Research is a quarto pamphlet of 68 pages, 40 of which are occupied by tables. The majority of the records are obtained by means of a glazed earthenware or glass funnel on the sides of which solid particles from the air deposit themselves and are washed by rain into a bottle placed below. Each month the contents of the bottle are analysed and the tons of deposit per square mile calculated. Rochdale has 13 of these gauges, London 11, and Glasgow 9. At Rochdale one gauge is placed at the centre of the town and the others within a mile of the centre. The average deposit per month is 33 tons per square mile, of which 15 tons are soluble. London has one station at which the deposit is about as heavy as that at the worst of the Rochdale stations, but stations at Kew and Victoria Park reduce its average to about 70 per cent of the Rochdale average. Glasgow has no station at which the deposit reaches 70 per cent of the worst London and Rochdale stations and its average is about 72 per cent of the Rochdale average. Rothamsted, Southport, and Kingston-upon-Thames get about a third of the average Rochdale deposit.

Chinese Mammals.—Since no attempt has yet been made to compile a list of all the mammals found in China, N. Gist Gee has made a praiseworthy and useful effort to gather together, without detailed specific revision, the records which so far have been made (*Peking Soc. Nat. Hist. Bull.*, vol. 4, p. 49, 1930). In the circumstances, the list cannot be regarded as perfect, but its value is obvious as a groundwork upon which future investigations of the mammalian fauna can be based. The list, which includes sub-species, gives one or two references to literature in each case and states the provenance. It covers 42 pages and comprises round about 700 species and sub-species.

External Parasites of British Birds.—A short but useful paper by R. S. Bagnall and W. Hall, written in 1912 and only now published (apparently without further editing) gives a list of mallophaga identified from some British birds (*Vasculum*, May 1930). Fifteen species of birds are dealt with here and the need for the examination of their lice is apparent in the nineteen species which are recorded for the first time as British, while species from the fulmar petrel and the little auk are new to the fauna of Europe. It is a remarkable and significant fact that the lice from these two British birds belong to species which have hitherto been found only on related species on the Californian coast.

Researches on Earthworms.—*Pheretima* is a genus of earthworms much used for experimental study in Japan. In the *Science Reports of the Tôhoku Imperial University* (Fourth Series (Biology) Sendai, Japan, vol. 4, No. 4, December 1929) there are two papers on this subject, the first by Hideomi Tuge, "On the Number of Ganglion Cells in the Suprapharyngeal Ganglion and in the XXX Ventral Ganglion of the earthworm *Pheretima megascolidioides* (Goto and Hatai)"; the second by Teruhei Hino, on "Carbon Dioxide Production in relation to the Growth of Body of earthworm *Pheretima communissima* Goto et Hatai". *Pheretima megascolidioides* measures 1½ feet when fully extended and is well adapted for experimental study. It was found that the number of ganglion cells in segment XXX was considerably larger than in the corresponding segment of smaller species previously used. In the suprapharyngeal ganglion one pair of nerves is associated with more than twice as many cells than the pair of nerves in the ventral ganglion. Mr. Teruhei Hino, who reared his worms from eggs, states that the gaseous metabolism in *Pheretima communissima* bears a direct relation to the body surface, and the carbon dioxide production per sq. cm. per hour is constant during the greater part of the growing period. When the sexual organs begin to develop the rate rapidly increases, to fall again after the breeding period.

Myriopoda of the Swiss National Park.—Dr. W. Bigler in an elaborate memoir has described the Myriopoda Diplopoda in the region of the Swiss National Park ("Die Diplopodanfauna des Schweizerischen Nationalparks". Ergebnisse der wissenschaftlichen Untersuchung des schweizer. Nationalparks, herausgegeben von der Kommissionen der S. N. G. zur wissenschaftliche Erforschung des Nationalparkes, December 1928 (1929)). This is specially a study in distribution, and in the region, which embraces various habitats including much high land, we find a large number of Myriopods belonging to the groups recorded. Besides the actual National Park reservations, neighbouring localities were also studied for comparison. Each genus and species is carefully described with details which affect their systematic position, especially the auxiliary copulatory apparatus of the male, which is of considerable importance in classification. Many species are found so far up as 2800 metres, those from the greatest heights belonging to the Julidæ and Ascospermophora. Between 1300 metres and 2800 metres the maximum occurs at about 2100 metres, the woodland limit being at 2200 metres. The largest numbers belong to the Glomeridæ, which range from 1450 metres to 2700 metres, and the Julidæ (having the widest range), from 1300 metres to 2800 metres. The work is of much interest and greatly extends our knowledge of distribution and habitat of the Diplopoda.

Australian Fisheries.—A map of the fisheries of Australia, prepared by the Development and Migration Commission for the information of the members of the Australian Fisheries Conference, has recently been issued by the Australian Government. Several attempts have been made to discover suitable trawling grounds around the coast especially in the south, and the positions of these explorations have been indicated by coloured signs. The most important work of the kind was that done by the Federal Investigation Ship *Endeavour* between 1909 and 1913, but it was not continued after the unfortunate loss of that ship. A series of notes is printed on the map containing information on the present position of the fishing industry in Australia, and these notes, used in conjunction with the map itself, give a clear indication of what has already been done and of the developments which are immediately called for. The map, which in addition to fishery information, gives isotherms showing air temperatures over the land, as well as sea temperatures, has been well reproduced by the Hydrographic Branch of the Navy Office at Melbourne.

Standardisation of a Plate Method of Counting Soil Actinomyces.—The study of the Actinomyces group of micro-organisms is as yet in its infancy, but enough is already known to indicate that these fungi play a very significant rôle in Nature—either as injurious

parasites to animals and plants, or as beneficial saprophytes which help to break down complex organic matter to humus in the soil. It is in the latter rôle that a special interest now attaches to them. One of the greatest difficulties in estimating the activities of the Actinomyces in the soil has been that of counting their numbers, since no two of the culture media in general use yield results which are at all comparable. Messrs. M. Ganesha Rao and V. Subrahmanyan (*Jour. Ind. Inst. Sci.*, vol. 12A, part 18, pp. 253-273) have done mycology a great service in comparing the variable counts obtained by the use of a considerable number of standard media, and in evolving a new synthetic media which gives maximum and consistent results. This is the type of problem which by reason of its laborious and unimaginative character is usually avoided by research workers. Its results, though simple, are often of more fundamental service to science than those of more spectacular problems, and we congratulate the authors on having carried the present one to a successful conclusion.

Cotton Yield and the Flowering Curve.—Mr. N. W. Barritt has an interesting discussion of the possible correlation between the production of flowers by the cotton plant and its subsequent production of cotton in the *Empire Cotton Growing Review*, vol. 7, April 1930. He points out that Egyptian workers on cotton have a general impression that the ideal plant should have a steep and narrow flowering curve, so as to ensure an early crop capable of being picked almost in one operation. "This belief appears to be based chiefly on the fear of the pink boll worm, notwithstanding the fact that Williams in 1926 showed conclusively that the increase in the boll worm always kept pace with the growth of the crop." Barritt examines some yields given by C. H. Brown for two new strains of cotton grown side by side in four different localities in Upper Egypt. Both strains give identical flowering curves which are very different in the different localities, and in both strains the broad flat flowering curve is definitely superior to the short steep curve. Barritt suggests very reasonably that this is because, with the steep flowering curve, most flowers open on the same day, and if these bolls afterwards ripen, such bolls are competing more intensely for the available carbohydrates, with, as a result, some starvation of the developing lint.

Cultivation of the Castor Oil Plant.—Castor oil, with its capacity for remaining liquid at low temperatures whilst it retains its high viscosity at high temperatures, has proved of great value as a lubricant in internal combustion engines, and especially in aeroplane engines. It is also used in the dye industry, in the manufacture of Turkey red, whilst the pure cold-drawn oil, which is free from the poisonous ricin contained in the seeds, is of course employed in medicine as a purgative. Its usefulness as a lubricant, particularly, points to an extension of its employment, and though the plant is scheduled in parts of New South Wales and Queensland as a 'noxious weed', there is probably good reason, in many tropical and sub-tropical regions, to consider carefully the possibilities of *Ricinus communis* as a crop. The plant is singularly variable in cultivation, yielding profusely in some places, whilst in apparently similar situations nearby, it may be very disappointing. The suitability of the plant for unused pieces of land, on the borders of cultivation, in refuse heaps and other waste spots, together with the ease with which the seed can be collected, make it almost an ideal crop for the small cultivator, or as a catch crop in permanent cultivation, provided that local conditions provide a good market for comparatively small quantities of seed. The habit of growth and method of cultivation of the plant, together with methods of oil extraction, etc., are dealt with fully in an article in the *Bulletin of the Imperial Institute*, vol. 28, No. 1, 1930. At present, India is the chief source of the world's commercial supply of castor oil, but instead of the primitive method of expressing the oil used in India, the seeds are tending more and more to be exported, especially to England and America. Brazil is also exporting both castor seed and oil.

Japanese Tectonics.—In the *Jap. Jour. Geol. and Geog. Trans.*, 7, No. 1, 1929, S. Yehara publishes the results of nine years' study of the geology and tectonics of Shikoku together with a beautifully printed geological map of the island and a map of the Japanese Islands illustrating tectonic movements during the Cainozoic. The dominant fracture belt is the 'Median tectonic line' which came into existence in south-west Japan about the close of the Triassic. All the pre-Tertiary rocks have been affected by movements exerted from the north (Lower Triassic and post-Jurassic). The north-east–south-west trend lines of the Cainozoic are referred to the 'peri-Setouchi' movement. The trend lines of Kyushu and the Riu-kiu festoon are similarly referred to the 'peri-Tunghai' movement. The two arcs cross in the extreme south-west of Japan and in the straits between Kyushu and Korea. To the west and north the trend lines are very different. In addition to the volcanic line of the Bonin Islands, there are the mountain ranges of Abukuma, and Kitakami (in the north of the main island) and of Hidaka (in Hokkaido). All these extend north-north-west to south-south-east. The horizontal pressure responsible for the movements is regarded as having come from the east, that is, from the Pacific, and is referred to the 'peri-Tuscarora' movement.

Investigation of Electrolytic Dissociation by the Raman Effect.—A paper by Dr. I. R. Rao in the May number of the *Proceedings of the Royal Society* gives further details of his work on the Raman spectra of nitric acid. A modified form of Prof. R. W. Wood's apparatus was employed, and both the origin of the ten sets of Raman lines established, and the relative intensities of a number of the satellites measured by means of a microphotometer, to obtain quantitative information about the numbers of NO_3 ions and undissociated HNO_3 molecules responsible for the scattering. The change in the degree of dissociation with progressive dilution could then be followed on the assumption that the intensity of the scattered light at 4567 A. was proportional to the number of free ions present. Extension of this work should permit of a decision between the alternative theories of complete dissociation at all dilutions and progressive dissociation with increasing dilution, at least in the case of this particular strong electrolyte.

Liberation of Electrons by Positive Ions.—A form of apparatus for investigating the liberation of electrons from metal surfaces by positive ions is described by M. L. E. Oliphant in the May number of the *Proceedings of the Royal Society*. The problem is complicated by the fact that the most convenient source of ions, an electric arc in gas at rather low pressure, must be in direct connexion with the chamber in which the ions are made use of, and the latter must be kept at very low pressure, so that differential pumping must be employed. In Dr.

Oliphant's work the ions were drawn from a helium arc through a positive ion sheath on to an auxiliary electrode, which collected most of them, but allowed a few to pass through a small hole to a second chamber. There they were sorted out from metastable atoms, given the desired speed, and allowed to impinge on a target. The electrons set free from the latter were analysed by a retarding field, or magnetically, the system of electrodes used in the second method being particularly ingenious and delicately mounted. Dr. Oliphant has obtained a considerable volume of valuable data, and has been able to show, in a second communication in conjunction with Mr. P. B. Moon, that all essential features of his results agree well with current ideas of the electrical structure of metallic surfaces.

Electrometric Hydrogen Ion Measurements.—Measurements of the hydrogen ion concentration of solutions are being recognised as of increasing importance not only in many fields of research but also in nearly every industry. To those who have not yet installed an electrometric apparatus for this purpose the Cambridge Instrument Company's new list (No. 108) of instruments will be welcome as a guide to the selection of a suitable equipment. The general designs are along well-tried lines and the following comments refer only to the more novel features. The potentiometer recommended for the highest accuracy has a selector switch so that measurements on three different solutions can be carried out in rapid succession. For more general and industrial work there are two self-contained portable potentiometers embodying Unipivot galvanometers with standardisation from either the galvanometer itself or, in Mr. S. W. Cole's pattern, from a Weston standard cell built into the instrument. The second pattern may be used with either a dry battery or an accumulator and has additional scales giving temperature corrections and direct readings of *p*H values. Dr. P. T. Kerridge's glass electrode outfit with a Lindemann electrometer has advantages where only small amounts of solution are available or where the hydrogen and quinhydrone electrodes are disturbed by oxidation or reduction. A recording potentiometer in conjunction with double quinhydrone electrodes is used to record *p*H values automatically and to give audible warnings when critical values are reached. The list includes a brief discussion and bibliography of typical industrial and research applications.

Formation of Iron Pentacarbonyl.—By the examination of the contents of a steel cylinder containing compressed coal gas which has been standing since 1899, Friend and Vallance found that considerable amounts of iron pentacarbonyl, $Fe(CO)_5$, had been produced. The pressure of the gas was probably between 50 atm. and 80 atm. The observations are recorded in the April number of the *Journal of the Chemical Society*; other recent researches noticed in NATURE also show that small quantities of iron carbonyl may be formed from carbon monoxide under pressure in steel cylinders during a period of a few weeks.

Chlorides of Sulphur.—Attention has been directed in previous notes to the investigations of Lowry and his collaborators on the chlorides of sulphur, the compounds S_2Cl_2, SCl_2, SCl_4, and S_3Cl_4 having been described. The researches have been extended by Lowry and Jessop, in the April number of the *Journal of the Chemical Society*, in which measurements of the dielectric constants of sulphur chloride mixtures over a range of composition from monochloride to chlorine and from room temperature down to the freezing-points are described. The isothermals for the liquids confirm the existence of sulphur dichloride but do not show any inflection corresponding with the tetrachloride, even at $-50°$. The dielectric constants of the solids, however, show a pronounced maximum at the composition of the tetrachloride, indicating, in agreement with previous work, that this compound exists in the solid state.

Structure of Strychnine and Brucine.—In the Bakerian Lecture delivered before the Royal Society on May 29, Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford, discussed the experimental evidence which is available for the development of structural formulæ for the highly complex molecules of the alkaloids strychnine and its dimethoxy derivative, brucine. From a study of the products of electrolytic and catalytic reduction, of nitration and oxidation, and so on, it has been possible to draw numerous conclusions which go far to establish the orientation of the various groupings in the two molecules. Thus strychnine, which possesses the molecular formula $C_{21}H_{22}O_2N_2$, appears to be a polycyclic compound, which contains (*a*) an ethylene linkage, (*b*) an etheric oxygen atom, which is almost certainly a member of a heterocyclic ring, (*c*) a tertiary basic nitrogen atom, (*d*) a cyclic amide group $>N\cdot CO\cdot CH_2$—, in which the nitrogen atom forms part of another heterocyclic ring, and (*e*) a benzenoid ring, to which this second nitrogen atom is directly attached. It is this aromatic nucleus which carries the two methoxyl groups in the molecule of brucine. A structural formula expressing the ascertained facts with a high degree of probability is given in Prof. Robinson's paper.

Inductive Interference in Telephone Circuits.—The troubles that arise owing to the inductive interference of power transmission lines with telephone circuits were discussed by Colonel Sir T. F. Purves, the engineer to the Post Office, in an interesting speech at Sheffield on Feb. 19 to the local section of the Institution of Electrical Engineers. He mentioned that the Comité Consultatif International des Communications Téléphoniques à Grande Distance (C.C.I.) has for some time been studying how to protect communication circuits both from inductive interference and from electrolytic action due to neighbouring power lines. The C.C.I. has issued a set of guiding rules to minimise inductive interference and to fix limits for the maximum disturbance permissible. There were, however, several outstanding problems which were being investigated by another international body, the Commission Mixte Internationale (C.M.I.). The most important problem at the present time is the dangerous inductive effects which occur in communication circuits when a fault arises on a high tension transmission line. 'Acoustic shock' is generally caused when a voltage sufficiently high to operate the lightning protectors (about 350 volts) is induced in the two wires of the telephone circuit. The lightning protectors which are on each side of the circuit do not act simultaneously. The charge consequently passes through the operator's set and the diaphragm of the telephone receiver is brought into violent contact with the pole pieces. The ear of the listener can be permanently damaged in this way. Even if it is not, frequent disturbance of this kind affects the nerves of listeners. In the case of operators, the loss of morale is often so serious that continued work becomes impossible. Sir Thomas Purves stated that in Germany and America the trouble due to this cause is very serious. The British Post Office has adopted 300 volts as the maximum permissible induced longitudinal voltage possible in a circuit, but it is very difficult to predict by computation.

The Physical Society's Discussion on Magnetism.

THE discussion on magnetism organised by the Physical Society and held on May 23, at the Imperial College of Science and Technology, admirably illustrates the thesis that with advancing knowledge our concepts of a particular region of Nature, even though they may serve to correlate a wider range of phenomena, become less clear cut and more diffuse and difficult to follow.

When Sir Alfred Ewing formulated his magnetic models, our knowledge (in great measure due to his own happily conceived experiments) was confined mainly to the properties of the ferro-magnetic elements, and that knowledge could be subsumed under certain relatively simple concepts. Sir Alfred, in his opening address, reminded us that his own model, though not to be regarded as anything more than a piece of symbolism, could still assist in clearing our views concerning certain ferro-magnetic properties. He illustrated this position by instancing a criticism of the model made by Swinburne, who pointed out that its behaviour indicated the unlikely condition of a zero hysteresis loss in a revolving field strong enough to produce saturation. Though the fact has almost escaped notice, experiments by Baily on the hysteresis loss in a revolving field have shown that the loss increases with increasing field strength to a maximum and then does fall almost to zero when the field is strong enough to produce saturation.

About the beginning of this century, Curie's investigations, developing the fundamental observations of Faraday, had resulted in the well-known generalisations that the mass-susceptibility of a diamagnetic was independent of the temperature, and of a paramagnetic varied inversely as the absolute temperature. The concept of the magneton was shadowed forth so far back as the eighteen-seventies by Weber, in a model identical with that of simple electron theory, save that the rôles of the electricities are reversed. Weiss gave the name to a fundamental unit of magnetic moment obtained from a study of the mass-susceptibility per gram-atom, and a knowledge of Avogadro's number, the number of atoms in the gram-atom. Such atomic magnetic moments were always found to be integral multiples of a fundamental quantity, the Weiss magneton, $18{\cdot}54 \times 10^{-22}$.

It is easy to calculate, by the classical laws, the magnetic moment of the magnet competent to produce the field due to an electron revolving in a circular orbit about a central nucleus. Writing down the angular momentum of the circulating electron, taking the ratio of the magnetic moment to the angular momentum, and in terms of the quantum theory assuming the angular momentum to be an integral multiple of $h/2\pi$, we easily find in the simplest case that the magnetic moment of the Bohr magneton is $he/4\pi m$, which, by substitution of known values, gives the magnetic moment of the Bohr magneton as almost exactly five times that of the Weiss magneton. The properties of a 'ring' electron, in which the revolving charge, instead of being concentrated at a point, is uniformly distributed over a thin anchor ring, have from time to time been discussed, and it is interesting to note that some of Schrödinger's recent results are strictly analogous to those obtained for this ring type of magneton.

Langevin's classical paper of 1905 gave a basis for Curie's experimental generalisations concerning the behaviour with temperature of dia- and paramagnetic bodies. Again an appeal is made to classical methods. The electron orbit behaves as a magnet and possesses a magnetic moment. It is possible that, for a given molecule, these orbital moments give no resultant magnetic moment. The application of a field which rises from zero to some final value, H, will cause a change in the magnetic moment which can be calculated on the assumption that an electromotive force is induced in the orbit, measured by the rate of change of the flux through it. It is not difficult to show that this change is negative. In a paramagnetic gas we have to deal with molecules which have a resultant magnetic moment, and, assuming an initial random distribution of the axes of these magnets, it may be shown that the application of a magnetic field results in the development of a magnetic moment giving a mass-susceptibility varying inversely as the absolute temperature.

So far the effect of any mutual molecular interaction has been neglected, but if, following Weiss, we assume the existence of a molecular field proportional always to the intensity of magnetisation, I, so that the total field is $(H + NI)$, we then obtain for the mass-susceptibility the modified Curie law, which makes the susceptibility inversely proportional, not to T, but to $(T - \theta)$. But considerations of the Zeeman effect show that Langevin's original treatment of paramagnetism requires serious modification, inasmuch as we find that only certain discrete values can be assumed by the resolutes, in the field-direction, of the atomic magnetic moments, and in order to resolve the difficulties of the situation it is necessary to endow the electron with an intrinsic spin and a magnetic moment.

These elementary considerations and many more points of importance in modern theory are developed in the contributions made to the discussion by Dr. E. C. Stoner and by Prof. H. S. Allen.

Prof. C. G. Darwin discussed the polarisation of the electron. The quantisation of the electronic orbit leaves unexplained certain finer phenomena which are covered by giving the electron itself an intrinsic spin, and now with the development of wave mechanics comes the notion that the electron can be considered as a polarised wave. Prof. Darwin considered in some detail the possibility of observing directly the magnetic moment of a *free* electron, as distinguished from the indirect verification observed by loading the electron with the core of a silver atom and subjecting the stream of atoms to the action of a non-uniform magnetic field as in the experiments of Gerlach and Stern.

Bohr has suggested that any experiment of this type carried out on streams of free electrons would necessarily give negative results, as the electrons would have uncertainties of position and speed which would blot out any systematic effect which we might hope to obtain. Prof. Darwin disagrees with this conclusion, based as it is on the assumption that the behaviour of the polarised electrons is observed by *one* magnetometer, whereas a survey of the magnetic field by several magnetometers may enable us to overcome the uncertainty.

Mr. W. Sucksmith discussed some difficult experiments on the measurement, for ferro- and paramagnetics, of the gyromagnetic ratio—the ratio of the magnetic moment of the magneton to its angular momentum—a knowledge of which leads to an estimate of the Landé splitting factor g. For the Dy^{+++} ion in Dy_2O_3 he finds for g the value $1{\cdot}28 \pm 7$ per cent, the theoretical value being 4/3.

Prof. W. Peddie's contribution dealt with the interrelations of magnetisation and temperature in crystals from the point of view of kinetic theory. He showed that a good general account of the phenomena can be given by a reduced equation of state of the second degree. Dr. W. L. Webster gave an account of magnetostriction and change of resistance in single crystals of iron and nickel, showing that there are two

stages in the process of magnetisation which involve different distortions of the crystal.

Dr. L. F. Bates described some experiments on the temperature-variation of the specific heat of manganese arsenide, which has a critical temperature in the neighbourhood of 45° C. The hypothesis of an internal field, put forward by Weiss, leads to a definite shape for the specific heat-temperature curve, and Dr. Bates finds that while the general form of the curve is similar to that given by the Weiss theory, the variation of specific heat with temperature is more nearly proportional to dI_θ/dT than to dI_0^2/dT.

Mr. F. C. Powell dealt with the change in size of a ferro-magnetic at the Curie point. A rough estimate of its magnitude has already been made for iron on Heisenberg's theory, but the experimental values had been misquoted. The present paper corrects this and also revises the theoretical estimate in the light of Heisenberg's modified theory. The numerical values for iron and nickel are calculated and are found to be of the order demanded by the theory.

Prof. Weiss and M. Forrel gave the results of an experimental study of the saturation data for a number of ferro-cobalts and nickel-cobalts and deduced therefrom the atomic moments of iron, nickel, and cobalt.

The paper by Prof. W. Gerlach is an experimental study of the relation between certain electrical and ferro-magnetic properties. Nickel is the substance under investigation and its change of resistance with temperature has been studied over a range which includes the Curie point. The curves showing the variation with temperature of the *temperature-coefficient* of the resistance are in very close agreement with the curves obtained by Weiss for the variation of specific heat with temperature. Prof. Gerlach further discusses the resistance-change of nickel in a longitudinal field and describes a new thermo-magnetic effect. If a ferro-magnetic body is placed in a homogeneous magnetic field, and a temperature difference is established between its ends, the lines of force of the field coinciding in direction with the line of temperature fall, an e.m.f. appears between the ends of the body. Prof. Gerlach describes preliminary experiments on the variation of this e.m.f. with variation of the temperature at the ends of the specimen.

It need scarcely be said that Dr. P. Kapitza's account of his remarkable experiments in strong fields was full of interest, and it is not too much to assert that a technique which has placed in the hands of experimenters a method for developing fields of 300 kilo-gauss in a volume of 3 cubic centimetres, even though the duration of the field be a hundredth of a second, represents one of the most important advances in experimental work that the last few years has afforded. The magnification of the ordinary effects observed reaches such large values that the short space of time in which the effects are observable introduces no unsurmountable difficulties. Thus the splitting of the lines in the Zeeman effect is so large that it may be observed by means of the ordinary prism spectrograph, and changes of electrical resistance which in ordinary fields require very special methods for their estimation are, in these large fields, increases of 20 or 30 per cent.

The whole discussion was thoroughly enjoyable. If it tended to show that modern magnetics, in some of its aspects, is still in a pre-Newtonian stage, where it is dominated by

> "Cycle on epicycle, orb on orb,
> With centric and eccentric scribbled o'er,"

it has cleared up some difficulties, focused attention on others, and has certainly helped to systematise the ideas of many of those who were present.

ALLAN FERGUSON.

Utilisation of Potatoes.

A PRACTICAL account showing how potatoes can be used most profitably at present prices is given in the *Scottish Journal of Agriculture*, vol. 13, p. 30. Both potatoes and oats have a high feeding value, and on farms carrying stock it is being found more economical to use them for food than to sell them. The quantities that can be safely used, their relative food values and costs, are compared with those of other commonly used food stuffs, data from actual feeding experiments being quoted in support of the recommendations.

Cattle can utilise potatoes raw, but for pigs they are better cooked; green or sprouted tubers should be avoided as they are liable to be harmful. Since the protein and mineral content of potatoes is low, a supplementary ration such as separated milk and a mineral mixture is necessary for young animals or dairy cows. On a ration containing a large proportion of oats and boiled potatoes so supplemented, young pigs gave as good gains, at lower cost, as when raised on other commonly used food stuffs.

The question as to the best use to make of surplus potatoes is also discussed. One of the chief difficulties lies in the fact that the surplus is a casual one, depending on seasonal conditions, although importation of foreign potatoes and overplanting contribute to the problem. The possible uses, other than human consumption, to which potatoes can be put are various. Feeding to stock, either whole or as silage, is probably the simplest way of dealing with the surplus, but silage-making needs further investigation and development in England. Alcohol, starch, acetic acid, or dried potatoes are successfully produced from potatoes on the continent, but so far little has been done in this direction in Great Britain. The fluctuating supplies of raw material present a special difficulty in establishing such industries.

Increasing the demand by selection for cooking quality rather than yield, increased export of seed, improved grading and better marketing, especially in early summer when imports are greatest, are further means by which the surplus may be reduced. In fact, better organisation, together with a diversion of the surplus into channels other than for human consumption, is necessary to make potato-growing in Great Britain remunerative and a trustworthy source of profit.

New Short-Circuit Testing Plant.

WE are glad to notice that the number of commercial testing laboratories in Great Britain is rapidly increasing. As a rule these laboratories are not co-operative but are set up by individual companies. In the *Electrical Review* for May 30 there is an interesting account of a short-circuit testing plant which has been erected by Messrs. A. Reyrolle and Co., of Hebburn-on-Tyne.

The plant has the short-circuit capacity of 1,500,000 kilovolt amperes and is the largest plant of this kind in Great Britain. It is situated at Reyrolles' New Town Works between Newcastle and South Shields. As large devices have to be tested, in some cases until they break down and are destroyed, and as huge amounts of electric energy are suddenly converted into heat, great precautions have to be taken to prevent fire. Cylinders filled with carbon dioxide are stored in the transformer room. The gas can be released by a switch in the control house or locally by hand and the machine and terminal pit are at once flooded with the gas.

In one of the tests an oil tank containing a hundred gallons of switch oil was heated to 140° C. It was ignited by means of wood and waste soaked in eighteen gallons of petrol and paraffin. The tank was then upset, and after sufficient time had been allowed to elapse to ensure that the oil was well ablaze the test bay door was closed and the carbon dioxide was released by operating the switch at the control house. The time that elapsed between the decision to close the door and the complete extinction of the fire was fifteen seconds. After about five minutes the door was opened again and the smoke and gas were allowed to dissipate. The damage done was negligible and consisted only in a slight blackening of the lamp shades, control switches, and other apparatus in the test bay.

We congratulate Messrs. Reyrolle and Co. on having constructed what is practically an electric power supply station capable of giving for testing purposes an infinite variety of electric loads reproducing the equivalent of the momentary outputs of our largest power stations.

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Geography has reappointed Mr. J. A. Steers, of St. Catharine's College, to be University lecturer in the Faculty.

J. S. L. Gilmour, of Clare College, has been appointed curator of the Herbarium and Botanical Museum.

The Council of the Senate has appointed Mr. H. M'Combie, of King's College, a member of the Consultative Council of University and School Science Teachers.

D. J. Watson, of Downing College, has been reappointed to the Frank Smart University studentship in botany.

A course of instruction in the technique of tissue culture will be given at the Strangeways Research Laboratory on July 1–29. Only a limited number of applicants can be received. Notification from those wishing to take the course should be sent to Dr. H. B. Fell, Strangeways Research Laboratory, Cambridge.

EDINBURGH.—Sir James Barrie has been elected Chancellor of the University, in succession to the late Lord Balfour.

LEEDS.—The foundation stone of the new library of the University will be laid on June 24 at 3 P.M. by the Lord Brotherton of Wakefield, donor of the library building; the Chancellor, His Grace the Duke of Devonshire, will preside.

OXFORD.—The report presented to Congregation by the curators of the Parks mentions the progress that has been made in labelling the trees; a most welcome and desirable addition to the opportunities afforded by the University for botanical study and observation.

NINE scholarships, each of the annual value of £25, have been founded at the Constantine Technical College, Middlesbrough, by the Imperial Chemical Industries, Ltd. Forms of application for the scholarships, returnable by at latest June 16, may be obtained from The Director of Education, Education Offices, Middlesbrough.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships for 1930, the recommending body being given in brackets: Dr. J. Farquharson (University College, London), for research in physical chemistry; Dr. M. Ritchie (Edinburgh), for research in chemistry; Dr. L. Rosenhead (Leeds), for research in aerodynamics and geophysics; Mr. C. P. Snow (Cambridge), for research in physical chemistry.

TWO or three years ago Mr. G. H. Bosch gave £222,000 to the University of Sydney for the establishment of chairs in the Medical School and for building and equipment of laboratories. Announcement is now made by a Reuter telegram from Sydney that the Rockefeller Foundation, no doubt following its usual practice of supporting local benefactions, has agreed to contribute £100,000 to provide laboratory facilities at the University for the departments of surgery, pathology, bacteriology, and allied subjects.

THE twenty-first Annual Conference of the Association of Teachers in Technical Institutions is being held at Brighton on June 6–10, under the presidency of Mr. H. A. Norman, head master, Junior Technical School, Bury. An exhibition of apparatus and books will be held in the Royal Pavilion, Brighton, on June 9 and 10. Among the topics for discussion are liaison between Government departments concerned with education schemes, interchange of teachers, Yorkshire Council for Further Education, National Certificates in building, university service and superannuation, Royal Society of Teachers, and junior technical schools.

VACATION courses for teachers and students in England and Wales have been arranged by the Board of Education, local education authorities, university bodies, and associations of teachers and others, to be held this year, chiefly in July and August, in London (19), Oxford (11), Cambridge (6), Bournemouth, Brighton, Seaford, Folkestone, Herne Bay, Saltburn-by-Sea, Scarborough, Bangor, Aberystwyth, Barry, Malvern, and other places. Particulars of these and of courses for teachers at Dundee, Glasgow, Aberdeen, and Edinburgh are contained in the Board of Education's recently issued pamphlet on the subject (H.M. Stationery Office, 6*d*.). The sciences, especially biology and psychology, figure prominently in this prospectus. The Brighton Education Committee, one of the six education authorities offering vacation courses, has concentrated on biology to the exclusion of other subjects. The course, on Aug. 1–15, will be conducted by Dr. W. D. Henderson, head of the department of zoology in the University of Bristol, and will include practical work and collecting in the field, with demonstrations on the material collected. It is intended for teachers of biology who prepare pupils for the first and higher school certificate examinations. Twelve university tutorial classes committees offer courses organised in connexion with the work of the Workers' Educational Association. All except one include psychology in their programmes. The Association of Women Science Teachers is holding a course in botany at Leeds and in chemistry at Bedford College, London. Courses for foreign students are provided by the Universities of Oxford, Cambridge, and London (2), by University College, Exeter, the College of Preceptors, and the Regent Street Polytechnic, London. For particulars of the arrangements by which British and foreign students attending recognised vacation courses in Great Britain can obtain reductions in railway fares on the British railways, application can be made to the National Union of Students, 3 Endsleigh Street, London, W.C.1.

Historic Natural Events.

June 8, 1918. Nova Aquilæ.—On this date Nova Aquilæ III was discovered independently by a number of observers when it had suddenly become a conspicuous star. On June 9 its brightness nearly equalled that of Sirius; it then began to fade, and eight days after its maximum it had decreased to one-fiftieth of its maximum brightness, while eight months later it was invisible to the unaided eye. It was found that, during the thirty years prior to 1918, a faint star had been photographed many times in the place occupied by the Nova—a star which afterwards increased in apparent brightness about 30,000-fold within four days. Telescopically the Nova remains as a variable star enveloped by an expanding shell of nebulosity which, apparently originating at the time of the sudden brightening, spread outwards radially with great velocity and was first visible in large telescopes six months later. The early recognition of this Nova enabled a unique spectroscopic study to be made of it in the early phases of its outburst which, appearing to us in 1918, actually occurred about the eighth century.

June 9, 1888. Waterspout.—A peculiar funnel-shaped cloud approached the village of Langtoft, Yorkshire, from the eastward, and burst over the hills to the westward. An enormous volume of water flowed down the hill, forming three parallel fissures in the chalk, in the deepest of which were four holes seven feet deep. The water then flowed into the village in a stream 40 feet wide and three or four feet deep, entering the houses and doing great damage, though no life was lost.

June 9, 1905. Luminous Cloud.—About three-quarters of an hour after sunset a luminous cloud was observed over the greater part of New Zealand, probably the trail of a meteor. At first it appeared as a long streak, gradually becoming *Z*-shaped. For more than twenty minutes it was brighter than the moon, then its glow became diffused and fainter, but it retained a glow equal to that of the zodiacal light for ten minutes longer.

June 9, 1910. Thunderstorms.—A series of violent thunderstorms occurred over England on June 7 and 9, 1910. On June 7 they occurred between 6.30 and 11.30 P.M., along a belt of country from Surrey to central Wales. On June 9 they occurred over the southern half of England and were accompanied by torrential rain and destructive hail, which did enormous damage between Wheatley and Waterstock, about six miles east of Oxford. This storm began with a hurricane about 1 P.M.; then about 1.15 P.M. hail fell in the form of large lumps of clear ice round a dull centre. It lay to a depth of about three inches on level ground, but was piled by the wind in heaps of two or three feet. The worst of the storm was over by 3 P.M., the depth of rain and melted hail being more than four inches.

June 10, 1886. Eruption of Tarawera (New Zealand).—Though for seven months there had been signs of activity, it was not until early on June 10 that the volcano broke into eruption, and a great cloud of smoke and vapour rose to a height of more than 8 miles and then drifted to the west. This was followed by a downpour of mud, water, and heavy stones that buried the country to a great distance from the volcano and destroyed the well-known and uncommon natural feature of the district, the Pink and White Terraces.

June 11, 1928. Waterspouts.—On June 11, about 10.30 A.M. no fewer than five waterspouts were seen between the eastern point of the Isle of Wight and the coast of Hayling Island. They formed near the Nab, and drifted south-south-west until opposite Bembridge Ledge, where they dissipated.

June 12, 1731. Drought.—The journal of Etienne Azambourg, a farmer of Enfournet, Dept. du Cher, records in June that "There has been so great a drought this year that I do not believe I have seen a similar one; nevertheless the soil was easily worked because the frost had broken the ground, for there had been a long and severe winter which thawed without rain, . . . but as it does not rain the corn will soon be lost. There is in France much bringing out of relics and prayers to Saints to obtain from God by their intercession tempests, and among others that of St. Jacques was brought here from Aubigny the 12th of this month. . . ." On June 26 he added: "On the 24th it has rained thanks to God as was necessary; this will soon make a harvest."

June 12, 1897. Great Indian Earthquake.—The Assam earthquake was felt over an area of about $1\frac{3}{4}$ million square miles, or half the size of Europe. Buildings were damaged over an area more than twice as large as Great Britain, while, within one almost equal in extent to Yorkshire, scarcely a house escaped ruin. The latter area showed many distortions such as fault-scarps (one of which was 12 miles long with a maximum throw of 35 feet), rock-fractures, and warping. This earthquake is noteworthy as being the first in which the two series of preliminary waves, primary and secondary, were distinguished on seismograms. For the first time, too, the long waves were observed to pass several stations a second time, having travelled to them through the antipodes of the epicentre.

June 13–15, 1903. Continuous Rain.—There was absolutely unbroken rain in London from 1 P.M. on June 13 to 11.30 P.M. on June 15, a period of $58\frac{1}{2}$ hours. This is the longest period of continuous rainfall on record in the British Isles. The rain was not especially heavy, the total amount being 3·44 in., but there was some minor flooding.

June 14, 1914. Thunderstorm.—A violent thunderstorm broke over south-west London during the afternoon, accompanied by violent rain and hail. On Wandsworth Common seven persons were killed by lightning while sheltering under trees. In Richmond Park 3·70 in. of rain fell in $2\frac{3}{4}$ hours, and the neighbourhood of Kingston Station was flooded to a depth of four feet. At Wimbledon, the District Railway was submerged by the bursting of a sewer, and at Tooting Junction station the water was a foot deep on the platform. At Catford much damage was done by lightning and hail.

Societies and Academies.

LONDON.

Geological Society, May 14.—Charles Barrington Brown: The geology of north-eastern British Somaliland. Geological results of four months' field work with the Anglo-Italian Boundary Commission in Somaliland. The area discussed is a belt of country along the 49th meridian east, from the coast to about 80 miles inland. There are three structural units: (1) The sunken block or belt of the Aden Gulf, bordered on the south by an important fault of 6000 feet throw, from the next unit, (2), the faulted upraised mass of the Al Hills, which continue as a bordering scarp along the south of the Gulf as the Aroru and Afaf Hills; on the south succeeds (3), the inland plateau-region at 2000 to 3500 feet elevation. This plateau is entirely unfaulted, but has been subjected to folding of a peculiar kind, resulting in gently undulating areas, unaffected areas, and numbers of small synclinal basins the origin of which is obscure. The Jurassic and Cretaceous

rocks crop out on the face of the Al scarp fronting seawards. The Lower Eocene forms all the surface of the Al Hills, a splintered block tilted to the south. The Middle Eocene covers all the inland plateau. There is a group of faults in échelon in the mountainous country, each with a throw of nil to 2000 feet in a short distance. The Aden Rift Fault was traced for a distance of 48 miles.

EDINBURGH.

Royal Society: May 5.—R. Crookall: Some curious fossils from the Downtonian and Lower Old Red Sandstone of Scotland. These fossil types occur in association with remains of fishes, *Birkenia*, *Thelodus*, and *Lanarkia* (the first of which occurs in England). They have not so far been recorded from rocks of corresponding age in England. Three types are recorded, the first, here named *Taitia catena*, being fairly common, while the remaining two are very rare. It is not possible definitely to determine their systematic position. Two of the types are probably algal in origin; the affinities of the third are quite uncertain. —A. C. Stephen: Studies on the Scottish marine fauna: additional observations on the fauna of the sandy and muddy areas of the tidal zone. The intertidal areas, the head of certain sea lochs on the west coast, and the sandy shores of some of the western isles have been examined. The dominant species were the same as on the other parts of the coast. Species showed the usual zoning, and these zones occurred in the usual relative order. Unless sheltered, the sands on the western isles contain few animals.—E. A. T. Nicol: The feeding mechanism, formation of the tube and physiology of digestion in *Sabella pavonina*. The elaborate ciliary mechanism connected with the branchial crown whereby food is procured, consists of catching, sorting, receptive and rejecting tracts. Some of the particles pass to the mouth, some are stored in the ventral sacs of the lateral lips to be used in adding to the tube, and the rest rejected via the palps. The separation into three groups is dependent entirely upon size. The anterior ventral glandular shields and the collar folds are concerned with building the tube. An amylase, protease, and lipase have been detected in the digestive fluid and conditions governing their optimum activities determined. — R. A. Fisher: The distribution of gene ratios for rare mutations. Correction and extension of the author's discussion in 1922 of the maintenance of genetic variability in species under the opposing influences of mutations tending to increase the variability and of selection tending to limit it. The principal corrections are (i) that the time of relaxation for the decay of the variance in the absence of both mutations and selection is now shown to be $2n$ generations, where n is the number of the species breeding in each generation; (ii) the distribution of gene ratios for the variance maintained by mutations without selective advantage or disadvantage is modified to a form closely similar to that established under the action of selection. The former method of differential equations is supplemented by a method using functional equations. Exceedingly minute values for the selective advantage or disadvantage are shown to make a great difference both to the chance of success of a mutation and to the contribution of such mutations to the specific variance.—Miss F. E. Allan: The general form of the orthogonal polynomials for simple series with proofs of their elementary properties. ξ_r is the polynomial of degree r in x, defined by the equations $\xi_0 = 1$, $S(\xi_p\ \xi_r) = 0$ where summation extends over n given equidistant values of the variable x and p has in turn all integral values from 0 to $r-1$. The numerical method of curve fitting by orthogonal polynomials which has been developed by R. A. Fisher is based on a knowledge of the value of the terminal differences and is given in this paper, and from it have been deduced $S(\xi_r^2)$, the residual variance at any stage, and Tchebitchef's difference formula connecting three successive polynomials of the system. By converting the terminal differences to central differences, and building up from these, a general form has been found for the polynomial of degree r of the orthogonal system, from which can be determined the explicit expressions for the polynomials. These are given as far as ξ_{10}.

PARIS.

Academy of Sciences, April 23.—Ernest Esclangon: The position of the celestial body supposed to be a trans-Neptunian planet. Four additional negatives were taken on April 15, 17, 19, and 20: the results of the calculations are given and compared with those worked out by Stoyko from observations on Mar. 17, 31, and April 17.—C. Sauvageau and G. Denigès: The sugar of the algæ (Florideæ). Criticism of a paper on the same subject by Colin and Guéguen.—Arnaud Denjoy: A class of analytical functions.—G. Maneff: The principle of least action and gravitation.—P. Swings: The variations of the relative intensities of the components of the doublets of rotation in the resonance spectrum of sulphur.—C. Marie and C. Haenny: The study of the ammonia-oxygen battery. The formation of nitrates and nitrites in the presence of alkalis.—Louis Glangeaud: The structure of the coastal regions of Algeria between Ténès and Philippeville.—Loeper, A. Mougeot, R. Degos, and S. de Seze: The glycogen of the heart and cardiac medicines. As regards glycogen, the drugs examined fall into two groups: one class, such as acetylcholine and quinidine, conserve the glycogen, the other, such as adrenaline, tend to make it disappear.—Henri Coupin: The conditions of formation of the conidia and perithecium in *Eurotium repens*.—Raymond-Hamet: The action of hordenine in an animal which has received an intravenous injection of yohimbine chlorhydrate.—Alb. J. J. Vande Velde and A. Verbelen: Biochemical researches on earth. Description of a new method for counting the micro-organisms in soil.—A. Policard and J. Devuns: Histochemical researches on the mineral particles contained in the lungs of miners. From the histochemical point of view the results obtained from the examination of seven lungs, four showing clinically no pulmonary troubles, confirm the results of MacCrae and of Watkins Pitchford and J. Moir on the lungs of Rand miners. The authors conclude that under the conditions of work in most coal mines, the distinction between anthracosis and silicosis is purely theoretical.

ROME.

Royal National Academy of the Lincei, Feb. 16.—Gino Fani: Spacial sections of the Grassmannian variety of straight lines of five-dimensional space.—U. Cisotti: Dynamic actions of translo-circulatory currents round an arched strip.—A. Russo: Nuclear dualism and sexuality in *Chryptochilum echini* Maupas. The individuals of the two categories of this organism exhibit distinct sexuality, determined by the different quantities of nuclear substance, by the different dividing processes of the nuclei, by their different physiological powers, and by their different destinations. The male sexuality, attributed to the B-gamete, may be an elementary and primitive form of the gametic differentiation of living beings in general, since the micronucleus, having lost all germinative capacity, does not take part in the formation of the micronuclei of the two classes formed after conjugation.—A. Tonolo: Intrinsic form of the equations of the equilibrium of elastic media (2).—Guido Ascoli:

Further regarding the linear representation of continuous functions.—**R. Caccioppoli**: Laplace's series. A group of theorems on the convergence of the series developments of Laplace's functions Yn, in particular, two extensions to the spherical functions of Jordan's classical theorem on Fourier's series, are developed.—**F. Sbrana**: The infinitesimal operation in the group of derivations.—**G. D. Mattioli**: The determination of the Riemannian varieties assumed by simply transitive groups of movements.—**M. Brelot**: The equation, (1) $\Delta u = c(x, y)u(x, y) c \geq o$.—**A. Gelfond**: The development of entire functions of finite order in Newton's interpolation series.—**N. Théodoresco**: Steps in a theory of the functions of a complex variable in the general sense (2).—**G. Vranceanu**: The conditions of rigidity of a Vm in an Sn.—**E. Pistolesi**: A rapid method for the calculation of the dynamic effect of a translatory current on a cylinder in the neighbourhood of an indefinite plane-wall. A rapid method is given for arriving at the result obtained by Raimondi in his recent treatment of this problem.—**G. Supino**: Further considerations on the choice between elastic solutions with equal resultants. In a recent note, the conception of fundamental solution was fixed: given an elastic solid bounded by the contour σ, this is divided into two zones σ_1 and σ_2, the distribution of forces (or of the displacements) on σ_2 and the resultant and the resultant moment of the forces on σ_1 being supposed given. These data do not determine completely the elastic solution, so that the fundamental solution is taken to be that which, while satisfying the data, renders minimum the work of deformation. The properties of such fundamental solutions are considered.—**B. Finzi**: Power relative to a translatory circulatory current in which an arched lamina is immersed.—**B. Caldonazzo**: Plane irrotational motions of perfect liquids in the presence of movable obstacles.—**U. Barbieri**: Astronomico-geodetic station of Eremo di Cherasco (2).—**A. Quilico** and **M. Freri**: A new method of formation of pyrrole blacks (2).—**M. Airoldi**: The age of the andesitic eruptives of the island of Capraia. The author's investigations indicate that these rocks belong to the lower Pliocene.—**G. Lincio**: The artinite of Monte Ramazzo (Liguria).—**Giulio Cotronei** and **Aldo Spirito**: Zoological constitution and grafting: experiments with *Anura* and *Urodelis*.—**G. Mezzadroli** and **E. Vareton**: Action exerted by ultra-short electromagnetic waves on the catalasic power of seeds. Waves of 2-3 metres length emitted by a radio oscillator exercise a favourable action on the germination of barley and bean seeds, which exhibit increased catalase activity during the first few days of germination.—**B. Monterosso**: Structure and function of the middle intestine of *Peroderma cylindricum*. Morphological (and, perhaps, functional) duplicity, which has long been debated, is definitely established in the case of this organism, owing especially to the very marked differential characters which distinguish the forms of one cellular type from those of the other, and also to the clearness with which the initial cell—the common source of both cycles—is presented.

Official Publications Received.

BRITISH.

N.Z. Department of Scientific and Industrial Research. Bulletin No. 15: Peach Culture; Spraying and Manurial Experiments in the Nelson District. By K. M. Curtis and T. Rigg. Pp. 22+4 plates. Bulletin No. 16: Cold Storage of Fruit; Investigations conducted with Apples during 1927 and 1928. By L. W. Tiller. Pp. 23+4 plates. (Wellington, N.Z.: W. A. G. Skinner.)

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1929. Pp. iv+336+120+12 plates. (London: H.M. Stationery Office.) 12*s.* 6*d.* net.

Records of the Indian Museum (a Journal of Indian Zoology). Vol. 32, Part 1, March. Pp. 64. (Calcutta.) 2.12 rupees; 5*s.*

British Engineering Standards Association. British Standard Dimensions for Components of Optical Projection Apparatus. (No. 379-1930.) Pp. 11. (London.) 2*s.* net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1203 (Ae. 364): Pressure Distribution over a Yawed Aerofoil. By D. H. Williams; with an Appendix on Rolling Moments on a Yawed Aerofoil, by A. S. Batson. (T. 2645.) Pp. 23+19 plates. 2*s.* 6*d.* net. No. 1274 (Ae. 420): Stresses and Strains in Airscrews with particular reference to Twist. By R. McKinnon Wood and W. G. A. Perring. (T. 2770 and a.) Pp. 14+4 plates. 9*d.* net. No. 1286 (Ae. 436): Records of the Lateral Motions of a Stalled Bristol Fighter Aeroplane with Slots upon the Upper and Wing Tips. Experiments made in the Cambridge University Air Squadron. By Prof. B. Melvill Jones, Flight-Lieut. C. E. Maitland and R. P. Alston. (T. 2813.) Pp. 8+23 plates. 9*d.* net. No. 1237 (Ae. 392): The Flutter of Aeroplane Tails. By R. A. Frazer and W. J. Duncan. (T. 2764: T. 2791.) Pp. 27+1 plate. 1*s.* 6*d.* net. No. 1292 (Ae. 441): Stalled Flight Tests of a Moth fitted with Auto Control Slots and Interceptors. By E. T. Jones, Flight-Lieut. C. E. Maitland and Flight-Lieut. W. E. Purdin. (T. 2885.) Pp. 3+2 plates. 4*d.* net. (London: H.M. Stationery Office.)

Seale-Hayne Agricultural College, Newton Abbot, Devon. Pamphlet No. 31: Sixth Annual Report of the Department of Plant Pathology for the Year ending September 30th, 1929. Pp. 28. Pamphlet No. 32: The Manufacture of Butter. By W. B. V. Tresidder. Pp. 21. (Newton Abbot.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1928. (Fourteenth Report.) Pp. xi+67. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

The Journal of the Royal Agricultural Society of England. Vol. 90. Pp. 8+372+clxx+xii+20. (London: John Murray.) 15*s.*

Education (Scotland). Report for the Year 1929 by the Director on the Royal Scottish Museum, Edinburgh. Pp. 12. (Edinburgh.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 11: On Changes of Rock Temperatures and Irregularities of the Earth's Rotation. By R. W. Wrigley. Pp. 153-165. 1*s.* Vol. 50, Part 2, No. 12: On a New Method of Measurement of Minute Alternating Currents. By Dr. D. F. Martyn. Pp. 166-174. 9*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. 68, No. 401, May. Pp. 525-656+xxxii. (London: E. F. and N. Spon, Ltd.) 10*s.* 6*d.*

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1929; with Report of the Director of Water Pollution Research. Pp. iv+23+4 plates. (London: H.M. Stationery Office). 9*d.* net.

Ceylon Journal of Science. Section C: Fisheries. Bulletins of the Ceylon Fisheries. Edited by Dr. Joseph Pearson. Vol. 4: Preliminary Account of the Results of Drift Bottle Experiments in the Gulf of Mannar. By A. H. Malpas. Pp. 95+21 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Transactions of the Ceramic Society. Vol. 29, No. 5, May. (Wedgwood Bicentenary Commemoration Volume, Part 1.) Pp. 400+xxxviii. (Stoke-on-Trent.) Parts 1 and 2, 30*s.*

The National Physical Laboratory. Report for the Year 1929. Pp. vi+298+15 plates. (London: H.M. Stationery Office.) 11*s.* net.

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 16: Upper Carboniferous Fossils from Tibet. By Dr. F. R. Cowper Reed. Pp. iv+37+4 plates. (Calcutta: Government of India Central Publication Branch.) 3.6 rupees; 5*s.* 9*d.*

Survey of India. Geodetic Report, Vol. 4, from 1st October 1927 to 30th September 1928. Pp. xii+146+17 plates. (Dehra Dun.) 3 rupees; 5*s.* 3*d.*

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 2: Fossiele Perde van Cornelia, O.V.S. Deur Dr. Ir. E. C. N. Van Hoepen. Pp. 11-24. (Bloemfontein.)

FOREIGN.

United States Department of the Interior: Geological Survey. Bulletin 811-C: Indiana Oolitic Limestone; Relation of its Natural Features to its Commercial Grading. By G. F. Loughlin. (Contributions to Economic Geology, 1929, Part 1.) Pp. vi+113-202+plates 27-45. 30 cents. Bulletin 811-D: The Rawlins, Shirley and Seminoe Iron-Ore Deposits, Carbon County, Wyoming. By T. S. Lovering. (Contributions to Economic Geology, 1929, Part 1.) Pp. iv+203-235+plates 46-50. 10 cents. Bulletin 811-E: Tertiary Volcanic Tuffs and Sandstones used as Building Stones in the Upper Salmon River Valley, Idaho. By Charles H. Behre, Jr. (Contributions to Economic Geology, 1929, Part 1.) Pp. ii+237-248+plates 51-53. 10 cents. Bulletin 822-B: The Granby Anticline, Grand County, Colorado. By T. S. Lovering. (Contributions to Economic Geology, 1930, Part 2.) Pp. ii+71-76+plate 6. 5 cents. (Washington, D.C.: Government Printing Office.)

United States Department of the Interior: Geological Survey. Water-Supply Paper 601: Surface Water Supply of the United States, 1925. Part 1: North Atlantic Slope Drainage Basins. Pp. vi+269. 30 cents. Water-Supply Paper 605: Surface Water Supply of the United States, 1925. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+179. 25 cents. Water-Supply Paper 617: Upper Colorado River and its Utilization. By Robert Follansbee. Pp. xv+394+13 plates. 65 cents. Water-Supply Paper 636-C: The New England Flood of November 1927. By H. B. Kinnison. (Contributions to the Hydrology of the United States, 1929.) Pp. iv+45-100+plates 2-14. Water-Supply Paper 636-D: Surface Water Supply of the San Joaquin River Basin, California, 1895-1927. By H. D. McGlashan. (Contributions to the Hydrology of the United States, 1929.) Pp. vi+101-168. 10 cents. Water-Supply Paper 636-E: Surface Water Supply of the Pacific Slope Basins in Southern California, 1894-1927. By H. D. McGlashan. (Contributions to the Hydrology of the United States, 1929.) Pp. vi+169-219. 10 cents. (Washington, D.C.: Government Printing Office.)

Contributions to the Genetics of *Drosophila simulans* and *Drosophila melanogaster*. By A. H. Sturtevant, C. B. Bridges, T. H. Morgan, L. V. Morgan and Ju Chi Li. (Publication No. 399.) Pp. v+296. (Washington, D.C.: Carnegie Institution.) 4 dollars.

A new Method of estimating Stream-Flow: based upon a new Evaporation Formula. By J. A. Folse. (Publication No. 400.) Pp. xi+237+22 plates. (Washington, D.C.: Carnegie Institution.) 5 dollars.

Flora of the Hermit Shale, Grand Canyon, Arizona. By David White. (Publication No. 405.) Pp. v+221 (55 plates). (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Carnegie Institution of Washington. Year Book No. 28, July 1, 1928, to June 30, 1929; with Administrative Reports through December 13, 1929. Pp. xix+105+439+2 plates. (Washington, D.C.: Carnegie Institution.) 1 dollar.

Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 6, No. 4. Pp. iii+319-362+9-24. (Tokyo: National Research Council of Japan.)

Methods and Problems of Medical Education. (Sixteenth Series.) Pp. v+251. (New York: The Rockefeller Foundation.)

Proceedings of the United States National Museum. Vol. 76, Art. 13: The Bryozoan Fauna of the Galapagos Islands. By Ferdinand Canu and Ray S. Bassler. (No. 2810.) Pp. 78+14 plates. Vol. 77, Art. 10: A nearly complete Shell of the Extinct Turtle, *Trachemys sculpta*. By Charles W. Gilmore. (No. 2833.) Pp. 8+3 plates. (Washington, D.C.: Government Printing Office.)

International Hydrographic Bureau. Repertory of the Technical Resolutions concerning Charts and Nautical Documents adopted by the International Hydrographic Conferences. Pp. 48. (Monaco.) 50 cents.

Report of the Danish Biological Station to the Ministry of Shipping and Fisheries. 35, 1929. By Dr. A. C. Johansen. Pp. 110. (Copenhagen: C. A. Reitzel.)

Japanese Journal of Botany: Transactions and Abstracts. Vol. 5, No. 1. Pp. v+132+30. (Tokyo: National Research Council of Japan.)

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 59: The Analysis of the Sounds emitted by Aircraft. By Jūichi Obata and Yahei Yoshida. Pp. 143-185+plates 4-17. (Tōkyō: Koseikai Publishing House.) 1.29 yen.

Mémoires de l'Académie Polonaise des Sciences et des Lettres: Classe des Sciences mathématiques et naturelles. Série A: Sciences mathématiques. Vol. 1, 1929: The Ice Age in the Tatra Mts. By Eugenjusz Romer. Pp. 254+16 plates. (Cracovie.)

Œuvres d'Émile Godlewski, Père. Publiées par Ladislas Vorbrodt. Vol. 1 (1870-1890). Pp. viii+599. (Cracovie: Académie Polonaise des Sciences et des Lettres.)

Flora Polska. Tom. 4. Pp. iv+177. (Cracovie: Académie Polonaise des Sciences et des Lettres.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 8, Part 1, March. Pp. 90. (Tokyo.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 24, Part 5: Kurzrüssler aus dem japanischen Reich. Von Hiromichi Kôno. Pp. 153-242+2 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 236-240. 236: The Constitution of Carthamin, Part 1, by Miss Chika Kuroda; 237: The Constitution of Carthamin, Part 2, β-Carthamidin Methyl Ether and its Synthesis, by Miss Chika Kuroda; 238: On the Structure of Iron Oxide prepared by the Autoclave Treatment, by Tominosuka Katsurai and Tokunosuka Watanabe; 239: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 4, Die Einflüsse von Berylliumoxyd, Magnesiumoxyd, Zinkoxyd und Cadmium auf den Kobalt-Kupferkatalysator, von Shinjiro Kodama; 240: On the Spark Discharge between Concentric Cylinders in Air (Abridgement), by Takeshi Nishi and Yoshitane Ishiguro. Pp. 59-114+plates 4-13. (Tōkyō: Iwanami Shoten.) 1.00 yen.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 9, 1927. 3: Vattenstånden vid Rikets kuster. Pp. ii+21. 2.00 kr. Årsbok, 10, 1928. 5: Hydrografiska mätningar i Sverige. Pp. 25+4 planscherna. 3.00 kr. Årsbok, 10, 1928. 6: Aerologiska iakttagelser i Sverige. Pp. 37. 3.00 kr. Årsbok, 11, 1929. 1: Månadsöversikt över väderlek och vattentillgång jämte anstaltens årsberättelse. Pp. 99. 2.50 kr. (Stockholm.)

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 5, No. 4: Illumination from Sun and Sky in the Neighbourhood of Stockholm in 1928. By T. E. Aurén. Pp. 24+2 plates. (Stockholm.) 1.50 kr.

Classified List of Publications. Pp. 207. (Washington, D.C.: Carnegie Institution.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 6: Peruvian Cumbrous Bowls. By Isabel T. Kelly. Pp. 325-341. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 25 cents.

Proceedings of the American Philosophical Society. Vol. 69, No. 2. Pp. 19-97. Vol. 69, No. 3. Pp. 99-115. (Philadelphia.)

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 5, May: The Marine Uses of Nickel-Alloys. Pp. 137-176. (London: The Mond Nickel Co., Ltd.)

Early Navigators and their Voyages, Shipbuilding, Log Books, Pictures, etc. (Catalogue No. 525.) Pp. 88+12 plates. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, JUNE 6.

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

SATURDAY, JUNE 7.

GEOLOGISTS' ASSOCIATION (*June 7 to 10*) (at Star Hotel, Helston).—A Study of the Coastal Geology between Marazion and Porthleven, Cornwall.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Dr. G. C. Simpson: Thunder and Lightning (Boyle Lecture).

PHYSIOLOGICAL SOCIETY (in Physiology Department, Edinburgh University).

TUESDAY, JUNE 10.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—R. H. Stoughton: The Cytology and Morphology of Bacteria, with Special Reference to *Bacterium malvacearum*.

WEDNESDAY, JUNE 11.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—The late Dr. H. von Ihering: Land-Bridges across the Atlantic and Pacific Oceans during the Kainozoic Era.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—Round-table Conference on Electroplating Problems.

THURSDAY, JUNE 12.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Northern Irish District) (at Corporation Gasworks, Belfast), at 3.

ROYAL SOCIETY, at 4.30.—Sir Sidney Burrard: The Geographical Representation of the Mountains of Thibet.—Prof. E. G. Coker and G. P. Coleman: Cleavage Tests in Timber.—M. C. Johnson: Experiments on the Exchange of Energy between Gas, Solid and Adsorbed Layer *in vacuo*.

FRIDAY, JUNE 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5.—T. Thomas: An Experiment in Keratoplasty.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—E. J. Williams: (*a*) The Induction of Electromotive Forces in a Moving Liquid by a Magnetic Field, and their Application to the Investigation of the Flow of Liquids; (*b*) The Motion of a Liquid in an Enclosed Space.—Prof. E. V. Appleton: Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere.—Prof. C. R. Darling: A Simple Method of Showing the Modes of Vibration of a Wire.—Demonstration by Dr. H. R. Lang on A Modified Callendar Recorder for the Automatic Control of a High Temperature Oil Bath.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. Clay: Unemployment.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—N. Ashbridge: The History of Broadcasting in this Country.

PUBLIC LECTURES.

FRIDAY, JUNE 6.

UNIVERSITY COLLEGE, NOTTINGHAM, at 7.—Prof. A. Einstein: Lecture (in German).—Dr. H. L. Brose: An English Rendering of Prof. Einstein's Lecture. In chair: Prof. H. H. Turner.

THURSDAY, JUNE 12.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Col. L. W. Harrison: The Development of the Modern Treatment of Syphilis.

CONGRESSES.

JUNE 4 TO 9.

ROYAL INSTITUTE OF PUBLIC HEALTH (at Portsmouth).

Friday, June 6, from 9.30 A.M. to 1.—Dr. C. K. Millard and others: Discussion on The Slum Problem.

Dr. C. O. Stallybrass: Variations in Virulence during the Course of Epidemics.

Col. R. J. Blackham: Acid Milks in Health and Disease.

Brig.-Gen. J. Charteris: The Design and Requirements of Slaughter-houses.

A. Moore Hogarth: The Rat Menace.

W. Buckley: National Health and our Milk Supply.

Surg. Commdr. H. D. Drennan and others: Discussion on The Health of Dockyard Workers.

Dr. H. M. Vernon: New Methods of Heating Buildings and their Influence on Comfort.

Dr. R. P. White: Sensitisation of the Skin.

Dr. Letitia D. Fairfield and others: Discussion on The Slum Child.

Miss Doris M. Odlum: Home and the Adolescent.

W. Clarke Hall: The Problem of the Delinquent Child.

Miss B. M. Johnson: The Hygiene of the Domiciliary Labour Room.

Dr. Olive B. Sharp: Ante-Natal Treatment in Connexion with Venereal Disease.

Dr. J. Watt: The Provision of Institutional Treatment for the Tuberculous.

Dr. R. R. Trail: The Results of Sanatorium Treatment; Immediate and Ultimate.

Dr. Rollier: The International Factory Clinic for Indigent Patients suffering from Surgical Tuberculosis.

Friday, June 6, from 10 A.M. to 1.—Squadron Leader A. F. Rook: Sanitation in Desert Operations.

Surg. Commdr. J. A. O'Flynn: The Control of Malaria at H.M. Naval Base, Singapore.

Surg. Capt. L. M. Morris: Recruiting—Review of Modern Requirements.

Wing Commdr. H. A. Treadgold: The Conditions of the Heart found in Recruiting.

Dr. G. C. Low: Climatic Bubo—Its Diagnosis and Treatment.

JUNE 6 TO 10.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (at Brighton).

Monday, June 9 (in Royal Pavilion), at 10 A.M.—Induction of President.—H. A. Norman: Presidential Address.

JUNE 10 TO 13.

INTERNATIONAL SOCIETY OF EXPERIMENTAL PHONETICS (at Bonn).

JUNE 16 TO 25.

WORLD POWER CONFERENCE (at Berlin).