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The Significance of Imperial Chemical Industries.

FOUR years ago a Labour Government, pledged to the ideal of international co-operation, in a fit of political expediency exercised the veto of the State to frustrate the attempt of the majority of the board of directors of the British Dyestuffs Corporation, Ltd., and the Interessen Gemeinschaft to reach a working agreement for the better production and distribution of their products. The succeeding Government, although not prepared openly to be a party to co-operation between powerful chemical groups in Great Britain and Germany, sold its holding in the British Dyestuffs Corporation (albeit at a great depreciation), and thus left the directors free to do as they pleased.

In the meantime, however, the various German chemical groups had amalgamated into the most formidable chemical combine in the world. The new combine has made possible the pooling of resources upon research problems of importance; there are no longer trade secrets to be withheld from any unit of the industry: the State and the universities have given the combine all assistance within their power to afford. Its financial resources are enormous. Obviously its competitive strength in relation to that of Great Britain has been considerably enhanced, and equally obviously it would be difficult for such a combine to make an agreement based upon complete mutuality with any specialised chemical group in Great Britain.

Evidently Sir Alfred Mond, now Baron Melchett of Landford, had these considerations in mind when he conceived the plan of a corresponding combination in Great Britain. If there is eventually to be an international chemical combine to include Great Britain, Germany, and the United States, the sooner the chemical industry of Great Britain attains to the dignity of a unit the more potent will be our influence in any greater combine. The energy with which Sir Alfred has initiated his project is illustrated by the report of Imperial Chemical Industries, Ltd., covering the year 1927, the first year of its existence. The merger now directly controls the British Dyestuffs Corporation, Ltd., Brunner Mond and Co., Ltd., Nobel Industries, Ltd., the United Alkali Co., Ltd., as well as thirty-five other lesser manufacturing and trading concerns, indirectly controls thirty other companies, and has interests in certain American undertakings. The original scope of the undertaking has thus been considerably widened, and the process of consolidation and expansion is steadily going on. Its

trading connexions extend to virtually every corner of the world map.

The authorised capital of the combine is £65,000,000, its assets nearly £70,000,000. The gross profit for the year was £4,567,225, excluding a capital profit of £1,000,000 arising from the realisation of certain investments of the member-businesses which has been placed to the reserve accounts. In the first year of its existence the merger is in a position to pay a dividend of 8 per cent on its ordinary capital, 7 per cent on its preference shares, and to bring its deferred capital into the dividend list, in spite of the fact that in 1927 Great Britain was only just emerging from the disastrous industrial struggle of 1926. The financial results obtained indicate that the member-businesses have made good use of the advantages offered by the pooling of resources, and in view of the absence of criticism in the country as a whole, it can be assumed that these advantages consist of greater efficiency in production and distribution of multitudinous products, and that the consumer has gained and not been exploited unfairly because of the decrease of competition. Fertilisers, for example, are being sold at four-fifths of the pre-War prices, a fact of tremendous importance to the farming community.

The production of the maximum amount of goods at the least price, at a profit calculated to inspire confidence in the investing public and consistent with proper conditions of life for the work-people of the merger, are, however, merely means to an end, judging from the public utterances of its chairman. He appreciates the wider implications of creative industry, that its proper function is to consider world problems as a whole, to serve mankind as a whole, and in order to do this all relevant factors must be taken into consideration and fully examined. He realises that there is likely to be short shrift for monopolies the activities of which are actuated by the same lack of principle as the average small business. For the modern monopoly is acquiring more and more the character of a public corporation, serving a public uncircumscribed by political boundaries, its activities directed more and more by creative minds fully aware of the responsibilities attaching to their task, with a higher ideal than mere profit-making; attracted to the great enterprise, in fact, by the tremendous scope it offers for scientific methodology, and the adventurous application on a grand scale of the discoveries of science.

Probably Mr. H. G. Wells regards the men whom Sir Alfred Mond has gathered round him as among the "more vigorous intelligences in the business directorates of to-day" who "are beginning to realise the uncompleted implications of their enterprise," and as such the most promising instruments in the "open conspiracy" for the "awaking of mankind from a nightmare of the struggle for existence and the inevitability of war," men who refuse to regard the environment as a static entity, whose struggle is directed towards a modification of their environment. Conspicuous on the façade of the austerely beautiful and noble building rapidly approaching completion on Millbank, which is to serve as the headquarters of Imperial Chemical Industries, Ltd., are some sculptured peacocks. These, says the architect, Sir Frank Baines, should not be regarded as symbolic of mere pride of achievement, but of the incorruptibility of the commercial ideals which it is hoped will actuate the infant enterprise.

It would savour too much of blind optimism to assert that this generation of English people realises fully the appalling reactions of science, applied in a spirit of brutal materialism, upon the life of nations, or that the attitude of mind towards science has completely changed. Science is still largely judged by the material benefits it confers on those who have the prescience to utilise its discoveries, or the material comfort it brings to the multitudes, not very much by the habit of thought it engenders. Its social implications are still unappreciated even by the large majority of scientific workers themselves. When science has relieved man of material cares—and at the present rate of progress of scientific discovery that is not an impossible achievement—it will still be confronted with the task of showing man how to live. "It is," as Prof. Whitehead has said, "among the merits of science that it equips the future for its duties." It can be truly said that it has equipped Imperial Chemical Industries for its future duties. This gigantic industry is based on science, and modern science with its progressive dynamic outlook forces its disciples along hitherto untrod paths in search of greater knowledge and towards greater power.

Nevertheless, we discern an unmistakable tendency in the new combine to leave the main direction of the enterprise to what may be called the financial as distinct from the scientific interest. Only a small minority of the members of the Board inspire us with the confidence that they have had the requisite training in, and possess the requisite knowledge of, science, to be able to appreciate the implications of a discovery. It

may be urged that this contingency is met by leaving the direction of certain of the subsidiary companies to leading scientific workers, and by the creation of the advisory research council, through which agency academic and industrial men of science will co-operate to keep the central board abreast of scientific progress. But is this enough? It has to be borne in mind that the Mond and Nobel companies, which acted as the nucleus for the combine, were founded and controlled by the great men of science after whom they are named. They did not receive their first stimulus from financiers; finance followed their brains, which is the habit of finance the world over. The operations of banks and financial trusts since the War have not inspired the masses of the peoples of Europe and the United States with a great deal of confidence in anything but their capacity to exact a steady toll on industry, whether industry is flourishing or depressed. Booms in trade have been over-financed, but at the first signs of depression, credits have been either withdrawn altogether or made available on such terms that industry and trade have still further declined. It would be interesting to know if Sir Alfred Mond and his colleagues consider that the possibilities of any situation which may arise in the chemical industry are satisfactorily met by the formation of the new Finance Company of Great Britain and America, on the board of which he and Sir Harry M'Gowan are to provide a liaison with Imperial Chemical Industries, Ltd.

From the growth of internationalism in industry and finance, Mr. Wells visualises "an effective world-control . . . of the production and main movements of staple commodities and the drift and expansion of population. . . . These things assured, the abilities and energies of a greatly increased proportion of human beings could be diverted to the happy activities of scientific research and creative work with an ever-increasing release and enlargement of human possibility." We are prepared to believe that Sir Alfred Mond is inspired by an idealism akin to this, that he realises that economic direction of world affairs must be based on the scientific study of all those factors fashioning the environment of man, that industry at its truest and best must be the prelude to man's highest expression. The men he has chosen to deal directly with these matters and to control certain factories and processes enjoy his confidence and inspire us with the same feeling. But there is no guarantee that the same relations will exist between his successors and them or their successors. He has not started a tradition through which the supreme direction of production will be vested in men with a scientific outlook and creative minds.

In addressing the delegates of the Imperial Agricultural Research Conference in October last, Sir Alfred referred to the difficulty experienced in wresting "from short-sighted treasuries the necessary funds for carrying out . . . experimental work, which in its ultimate effect must vastly increase wealth and happiness and economic prosperity, though to those of little imagination it appears to be a wasteful means of immediate expenditure." Is he certain that there is no danger of a similar short-sightedness afflicting members of a board on which the financial elements predominate? This is an age of bold experimentation. Can it be suggested that the substitution of some of the financial elements by scientific workers of proved aptitude for direction and control and one or two creative artists might be amazingly successful in carrying the merger forward in pursuit of an ideal for industry, an ideal which would act as a beacon for every other industry?

A. G. CHURCH.

The West African Negro.

The Peoples of Southern Nigeria: a Sketch of their History, Ethnology, and Languages, with an Abstract of the 1921 Census. By P. Amaury Talbot. Published for the Crown Agents for the Colonies. Vol. 1: *Historical Notes.* Pp. xii+365. Vol. 2: *Ethnology.* Pp. xx+423+67 plates. Vol. 3: *Ethnology.* Pp. x+425-976+66 plates. Vol. 4: *Linguistics and Statistics.* Pp. v+234. (London: Oxford University Press, 1926.) 4 vols., 70*s*. net.

THE Government of Nigeria is to be congratulated on its wise policy in relation to anthropology. Not only is the study of this subject encouraged in its officials, but also official anthropologists have been appointed both in the northern and southern provinces, and a census has been published for each. Instead of these latter being mere lists of names and numbers, they are in both instances (the other instance being Mr. Meek's "The Northern Tribes of Nigeria") mines of information which will be valuable alike to administrators and to all other workers and travellers in these vast and little-known districts.

The four volumes before us attest the great industry and the sympathetic observation of the author. Mr. Talbot's chief interest is in religious

matters, and the greater part of vols. 2 and 3, comprising together almost 1000 pages, is concerned with religion. This proportion is in no way excessive, for religion plays an immense part in the life of all primitive peoples, especially Africans. There can be no understanding of native life in any branch—government, law, social organisation, agriculture, or any of the arts and crafts—without some knowledge of the religious ideas of the people. The beliefs of the southern Nigerians are too numerous to classify here. Mr. Talbot, who describes gods, kings, and ancestors, has rather unfortunately retained the term 'juju,' a word used by so many authors with such different meanings, that in common parlance it conveys no more than something vaguely magical or supernatural; in these volumes it is used to signify a minor deity who may sometimes be extremely powerful, but whose worship is usually more localised than that of the major deities. *Per contra*, we may be thankful to Mr. Talbot for avoiding 'fetish,' another word which has done much to confuse our knowledge of West African religion.

While the older writers were horrified by the cruelty of West African worship, and could see no motive behind it but blood-lust, Mr. Talbot has much to say of the goodness of the gods and the 'juju,' who act as guardians of society, to whom the oppressed can appeal, and whom the guilty, however rich and powerful, will fear. He does not, however, deny the reality and the extent of these sacrifices, but points out that most of the victims were captives or criminals. In the same way the secret societies, though powers greatly to be feared, also act as police, punishing crime and executing criminals. In respect of the death penalty and human sacrifice, the influence of religious beliefs must be considered, for to the West African life after death is no shadowy possibility, but a reality of which he is convinced. Certainly, life in the spirit world is not so pleasant as life on earth, but reincarnation is part of the general plan, and among most tribes is believed to occur fairly speedily, the only exceptions being persons so evil that the survivors take special measures to prevent their rebirth.

When we consider that these African holocausts were believed to be necessary to the gods in order to ensure the fertility both of man and of the earth itself, and that the price paid by the victims was merely death and rebirth, the motive can no more be attributed purely to blood-lust than that of the Inquisitors who burnt bodies to save souls. Nor can these people be accused of being specially revengeful, for compensation for murder is accepted; among many tribes of the Ibo a woman is handed over, and sometimes after she has borne a child she is allowed to return to her own people. It is not stated that the child is counted as heir to the murdered man, but this is presumably so. But in spite of the real religious background, Mr. Talbot's statements that the Nigerians believe in the doctrine of Karma and the existence of a super-soul should surely be accepted with caution:

"The essential idea appears to be that of a spark of Divinity, or a monad, which exists in a very high spiritual state—with God, as it is put; an Ego, which sends down emanations through various planes and finally on to the earth. This stream of consciousness manifests itself in physical, ethereal, mental, and spiritual bodies by means of which it gains experience and gradually evolves from a condition which, though pure and full of possibilities, was only embryonic, into a developed perfection. There is a general credence among the wise or initiated in the evolution of a man from a stone up to divinity, and it is no doubt partly owing to this cause that the power of metamorphosis is believed in and that so much of the folklore consists of stories in which animals are endowed with almost human attributes. The acceptance of the idea of the immortality of the soul implies also a trust in morality" (vol. 2, p. 279).

It would have been more to the point had the author quoted details in the form of specific actions, ceremonies, and verbal formulæ, in support of these statements, instead of extracts from the writings of Oliver Lodge, MacDougall, and William James. Indeed, his own beliefs appear at times to impede his critical faculty, so anxious is he to give 'explanations' in terms of clairvoyance, spiritualism, metamorphosis, bilocation, and other so-called metapsychic phenomena, for the strange happenings such as communication with the dead, change into were-animals, persons seen at a distance, etc., devoutly believed by the natives to be true, and attested by them in law courts.

According to Mr. Talbot, the complexity of Nigerian culture is due to foreign influence, but on this subject he is very difficult to follow, for he quotes examples impartially from Egypt, Crete, the Hittites, Babylon, Greece and Rome, the Etruscans and Carthaginians, from Crô-Magnon and from Mexico, nor is it clear whether analogous conditions are noted or direct influence inferred. On the other hand, comparatively little attention is paid to contact with the east and north through the great Negro kingdoms of Songhai and Melle. Since Mr. Talbot leans strongly towards foreign

influences, it is a pity that he has not tabulated the intrusive elements in culture and indicated their possible routes.

Apart from these two features and the neglect to separate theory clearly from fact, which may be regarded as blemishes by critically minded readers, these four volumes contain a mass of interesting material, a large proportion obtained at first hand. There are some interesting notes on animal 'affinities' possessed by individuals or families; the correlation of such beliefs to more orthodox totemism, and the part played by reincarnation in both sets of beliefs, has yet to be worked out in detail. Southern Nigeria would appear to be a fruitful field for research.

The heads of most of the great States are divine or semi-divine personages, hedged about with powerful taboos, while some suffer a ceremonial death—the supreme penalty of divinity—lest they grow feeble and the land suffer accordingly.

The illustrations are excellent, and of unusual interest, especially those of the images of the secret societies, and of monoliths; while the diagrammatic distribution maps, and the tables of customs at the conclusion of most of the chapters, are of great value. B. Z. S.

Theories of Quanta.

The Quantum and its Interpretation. By Prof. H. Stanley Allen. Pp. xiii + 274. (London: Methuen and Co., Ltd., 1928.) 12*s*. 6*d*. net.

IN this book Prof. Stanley Allen gives an account of the quantum as it appears to an experimental physicist with strong theoretical interests. It differs from most books on the subject, first in omitting most of the mathematical proofs, and secondly, in not being confined to those theories which have enjoyed, or are enjoying, the sunshine of orthodox approval. The book is divided into three parts, of which the first—called "Fundamental Facts and Principles"—contains an account of the main facts and ideas in the various departments of physics, including magnetism, where Planck's constant makes its appearance. Prof. Allen has been very successful in giving an account of this work, largely on historical lines, well suited for the numerous students of physics whose mathematics is not strong enough to enable them to follow long calculations without losing the thread.

The only serious criticism one has to make is that it is a little too condensed for a student reading alone. For use in conjunction with lectures or other teaching it is admirable and fills an important gap. Apart from semi-popular works, most existing books are either too mathematical, too detailed, or both, for the average honours student. Prof. Allen explains both the original Sommerfeld quantum notation and the new Landé-Sommerfeld system. So much has been written in the former notation that some reference to it is necessary, but it is to be hoped that the confusion inseparable from two notations will not be continued by the text-books a moment longer than can be helped, now that substantial agreement has been reached.

The second part of the book is of a more speculative nature, and consists largely in an account of some of the more special theories, such as Whittaker's magnetic wheel, and the theory of unit magnetic tubes due largely to Allen himself. The third part is mostly a development of the first, including mention of a wide range of theories. There is a good deal not usually found in text-books, such as, for example, an account of Lewis and Adam's work on the numerical relation between h, c, and e. There is also a brave and not unsuccessful attempt to give a general idea of the matrix theory in its various forms. Indeed, the author has shown throughout great skill in giving the main lines of mathematical arguments without going into details. There is a brief but clear treatment of wave mechanics.

It is naturally the second part of the book which most invites criticism. The theories there described, however successful in their particular spheres, seem unlikely to be able to give a complete explanation of all the varied phenomena which involve Planck's constant. Indeed, from his introductory remarks, the author seems to admit as much, but he claims, and probably rightly, that some of the ideas they contain are likely to find a place in the final theory. This is especially true of the statical theories originally devised to explain chemical combination. The wave theory indeed marks a definite move in this direction, and recent work suggests the hope that we may soon have an adequate theory of at least the simpler molecules. Progress in this direction has suffered from the divergent training of mathematicians and chemists. Comparatively few of the former have been brought into sufficiently close touch with the chemical evidence to appreciate its weight and variety, and the latter do not usually put their theories into a form which lends itself to exact quantitative results. It cannot be too strongly emphasised that the chemical and spectroscopic results are equally important aspects of the same problem. The experience of the last few years has shown that

very varied theories can account for most of the spectroscopic facts with surprising success, and in spite of the triumphs of the wave theory, there is no certainty that the list is exhausted.

Much the same holds on the chemical side. It seems that the data in either branch are of too similar a character to discriminate sharply between a wide range of theories. The wave theory has indeed been much strengthened by predicting the otherwise unexpected diffraction of free electrons, but it should be remembered that the same could have been said of the old orbit theory and the Stern-Gerlach experiment, which is now equally well explained on the wave view. It is a better test of the fundamental truth of a theory that it should cover the simple facts over a wide range than the details of a special branch. The number of separate facts in, for example, spectroscopy, is apt to seem larger than it really is, owing to the enormous wealth of slightly varying examples. One will not feel confident that physics has finished with its period of Central American government by yearly revolution, until the ruling theory draws support from both parties in the State.

Prof. Stanley Allen devotes a chapter to an account of several theories of radiation which have been devised to explain the photo-electric paradox. The theories of guided quanta, propounded in different forms by Sir J. J. Thomson and L. de Broglie, get over the difficulty of reconciling photo-electric and interference phenomena by supposing the quanta to be systems or particles constrained to move along a Poynting vector of the classical wave system. It seems fairly certain that the solution of all problems in which many quanta are concerned can be found by treating the radiation as classical waves, reacting with the atoms in the manner considered by Schrödinger, except that for the interchange of energy between matter and radiation, and conversely, the intensities of the waves must be 'interpreted,' to use Darwin's term, as meaning the probabilities of the presence of a quantum which receives or loses energy as a unit. This purely mathematical treatment does not give any picture of what a quantum is, and it was to satisfy the instinctive desire that most experimental physicists feel for such a picture that the above theories, and the others described by Prof. Stanley Allen, were devised.

The crux is to give a detailed explanation of absorption and emission of radiation. If the theory can also explain the value of the non-dimensional quantity hc/e^2, so much the better. All such models imply the quantum as a 'something,' which must apparently be of small size, moving in a definite path. The best evidence for this is probably the Geiger-Bothe result, which follows immediately if quanta are like the particles of ordinary dynamics, and seems to require very special assumptions on any other view. In addition, most other views would make the conservation of energy only statistically true, and while this would get over certain difficulties, it is not likely to be accepted while any loophole of escape remains.

None of the models considered is completely satisfactory in detail, and many would lead to serious difficulties in other parts of quantum theory. They contain, however, some very promising features, and Prof. Stanley Allen has rendered a valuable service in bringing them together so that their strong and weak points can be compared.

G. P. THOMSON.

The Quest for Life.

Why I Believe in Personal Immortality. By Sir Oliver Lodge. Pp. viii + 152 + 4 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1928.) 5*s*. net.

THE present volume provides in a brief and concise form an account of the basis of what Sir Oliver Lodge calls his belief in personal immortality. A few new incidents are included for which the author pleads a 'supernormal' interpretation, but taken broadly, there is nothing in these which would compel the acceptance of that interpretation by unbiased minds.

The main point on which the discussion turns is Sir Oliver's view of the brain as the 'organ' of the mind. He conceives the mind or the soul in its early stages as 'unidentified,' by which he means, it would appear, that in this form it possesses none of the attributes of humanity, not having been yet incarnate. The psyche or mind is then imagined as leaking into the body destined to receive it. After a period of incarceration in matter, during which time the material body is used by the mind, the death of the former intervenes, and the now identified soul goes back whence it came, but this time carrying with it all the powers, experiences, and memories accumulated during its earth life. Thus, according to this view, the body is animated by a permanent entity which, seemingly devoid of personality at the beginning, acquires a personality through the hazardous adventure of earthly existence. This remarkable point of view (which certainly seems to add to the problem of life rather than to diminish it) is made

the basis of the now well-known spiritistic theories whereby the animating entities, once they have obtained conscious personalities, are able to maintain contact with one another, normally through the ordinary channels of communication, and supernormally through telepathy and telergy.

When lesions of the brain occur and the character and desires of the patient are altered, it is not, according to Sir Oliver, because the character has 'really' altered, but because the mechanism through which the real character functions is out of gear and deranged. It would thus appear that in accordance with this theory 'souls' and 'minds' are so intimately attached to their bodies that their progress is directly conditioned by them; for, should the mechanism fail to function, then the soul, which depends upon it for those experiences and memories which it is to carry over to its immortality, cannot fulfil what will doubtless be called its destiny, but will remain either wholly or partly unidentified. Indeed, it would seem that it follows from this argument that it is the body and not the soul that is important, since it is only through the body that the soul can function on this, its first personal plane. How far such a doctrine can be said to be more philosophical than the many which have preceded it is open to question, but as a support for so-called psychic phenomena it has decided advantages.

There is nothing in the book concerning these phenomena more startling or evidential than the records of cases published elsewhere. Moreover, Sir Oliver's rather persistent attacks on orthodox scientific caution regarding these occurrences are not justified and are sometimes unfair. The opposition and general disapprobation which Sir Oliver tilts against are not directed against the phenomena, which are admitted by all who have studied the subject, but against the wild interpretation of them and the faulty experimental methods employed in their investigation. Serious inquiry is, in almost every case, hampered by those responsible for the management of mediums, and the position of the scientific man desiring personal experience is often that of a spectator at performances which are mere travesties of scientific inquiries.

Belief in human immortality is not, it would seem, based on the evidential value of alleged psychic phenomena. In the present work Sir Oliver has partially revealed the true basis of his belief. Repelled by the sordid drama of human existence, by its waste, its greed, and its cruelty, his generous nature seeks another world where man's higher attributes may have a better opportunity. The same view has recently been rather pathetically voiced by a writer for whom Sir Oliver contributed a foreword with the statement that he was sure the messages were genuinely received and would be perhaps a help to people in their search for truth about our future state. After describing the glories of the world behind the veil, the writer tells of the mountains, seas, houses, and gardens of that land, but he adds that there are no storms in that country, no dustbins and no sinks! *Fere libenter homines id quod volunt credunt.*

Relativity.

(1) *The Mathematical Theory of Relativity.* By Prof. Th. de Donder. Pp. x + 102. (Cambridge, Mass.: Massachusetts Institute of Technology, 1927.) 2.75 dollars.

(2) *The Einstein Delusion and other Essays.* By L. A. Redman. Pp. 217. (San Francisco: A. M. Robertson, 1926.) 2.50 dollars.

THE two books grouped together in this notice deal with relativity, but in quite different ways, and whilst the first forms a very important contribution to our knowledge of this subject, the second has only an ephemeral interest and can be disposed of quickly. It consists of a series of essays, the principal one dealing with relativity, the rest with various other topics, mainly mechanical. The tone is severely critical and dogmatic to a degree, not at all justified by the knowledge of the subject matter exhibited by the author. It is sufficient to state as an example that, in the essay on relativity, exhaustive reference is made to numerous popular writings on the subject, but scarcely any to the original publications of Einstein himself or his successors. Surely it is not too much to expect that a critic should show some familiarity with original sources, if he wishes his criticisms to be taken seriously.

The first book, by Prof. de Donder, already well known as the author of "La gravifique einsteinienne" and numerous other publications, is based upon a course of ten lectures delivered at the Massachusetts Institute of Technology during the year 1926. Owing to the restricted space at the disposal of the author, the treatment is very concise and makes considerable demands on the previous knowledge of the reader, but the book will make a strong appeal to all those who can follow the argument.

The first four lectures deal with the geometry and kinematics of relativity, and the next four with the development of the fundamental equations

and their application to the mass gravific field, the electromagnetic gravific field and their combination, the electromagnetic mass gravific field. A variational method is used throughout, which constitutes a relativistic generalisation of Hamilton's principle of least action, though in a modified form. The mode of presentation adopted in these chapters offers novel features and advantages from the didactic point of view. The ninth chapter gives applications to restricted relativity, including the determination of the mass formula of the electron, the mechanical force due to the electromagnetic field and the stress and momentum components and energy of that field.

In some respects the tenth chapter on relativistic quantisation is the most important in the book in view of the present state of the quantum theory. The author employs a generalised Hamilton-Jacobi characteristic equation together with a transformation of the characteristic function, analogous to that used by Schrödinger, to derive an invariant quadratic function of the derivatives of a wave function, and by applying his variational method to this invariant deduces a wave equation of a very general type consistent with relativity. By specialising this equation he is able to obtain the fundamental quantisation equation of the point electron, and for a Minkowski field this reduces to Schrödinger's equation. The method is extended to continuous systems, and leads to the interesting result that "Relativity is able, not only to furnish quantisation, but even to show that it is a consequence of the condition of *permanence* of statistical ensembles."

The book is clearly printed and commendably free from misprints, and should be read by every serious student of relativity.

Our Bookshelf.

The Determination of Minerals under the Microscope: with Special Reference to the Interpretation of Interference Phenomena. By Dr. John W. Evans. Pp. xii + 110. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1928.) 7*s*. 6*d*. net.

IN very clear and simple style this book describes the outline to be followed for the complete determination of the optical characters of minerals in thin sections, with some remarks on the application of the same methods to minerals in small grains. The title rightly emphasises the importance attached to the interpretation of interference phenomena, as Chapter vi. on the 'directions image' gives detailed instructions for the determination of optical characters from the interference figures by methods which are neglected altogether in some schools of petrology. The frontispiece gives a good reproduction of the polarisation colour scale seen when a quartz-wedge is viewed between Nicol prisms, both crossed and parallel, as recently published, by Drs. W. R. Jones and A. Brammall. Chapters vii. and viii., on dispersion and 'other determinations,' are less carefully written than the earlier chapters, and the diagrams illustrating the effects of dispersion on the interference figures are liable to be misleading, as it is not clear which of the two kinds of shading used is meant to represent blue colour and which red.

The book is intended primarily for students, and the author has taken great pains to give the student every assistance. It is even explained that ω is called 'omega,' and that "$V_\rho > V_\upsilon$ may be read V rho greater than V upsilon." One hopes that even in these days of non-compulsory Greek this kind of thing is unnecessary. Another attempt to assist the memory of the reader leads the author to speak of crystals as fast and slow instead of negative and positive. This seems an unnecessary departure from a convention which is universal, and is one of the few points of nomenclature in crystal optics on which there is international agreement. The adoption of an analogous device in France to that suggested by the author would lead them to write of positive and negative crystals as 'grands et petits.' These, however, are trivial points. The student equipped with an efficient microscope will find this an admirable laboratory hand-book, and both author and publishers are to be congratulated on its excellence.

Metaphysics and Modern Research. By I. C. Isbyam. With Introduction and Introductory Essay: The Quest of Spiritual Truth, by Louis Zangwill. Pp. xvi + 494. (London: The C. W. Daniel Co., Ltd., 1927.) 15*s*. net.

THIS book is to be welcomed as a definite attempt to estimate the implications of modern research on philosophy. The author claims that his position rests on Plato, Kant, Leibniz, Bergson, and we are certainly in agreement with him when he maintains that recent advance in physical science has weakened materialistic views to an extent not yet generally appreciated. An introductory essay by Louis Zangwill is of special help to the less experienced student in showing him the unexpected paths that have been traversed in the quest of spiritual truth. This treatment is partly historical and has special reference to the philosophers already mentioned.

The work itself really consists of three books—I. "The Ego and Physical Force"; II. "The Ego and Spiritual Truth"; III. "The Self-Seeker and his Search." The argument is sustained largely by duologue, and the position of "I" naturally has to be faced; for surely no philosophical system can ignore the problem of solipsism. An interesting development is the idea of orders of ego, in which Mr. Isbyam postulates ego-entities of the first order—physical force; of the second—the impulse to use it; of the third—the emotions which order these impulses; the fourth order—of

purpose; and the fifth—beauty, love, spirit, truth. There is much in Mr. Isbyam's treatment of happiness as discipline of soul, and we believe that to many his advice will be welcomed, to fix attention on those who, because they harbour the spiritual entities so well, can keep their minds adjusted to the never-ending flux of all existing things, with ardour ever new.

The volume is further enhanced for the non-specialist by the inclusion of two appendices on the principles of relativity and quanta.

H. D. A.

La fabrication chimique de l'or. Par Jollivet Castelot. Texte français (traductions anglaise, allemande, espagnole). Pp. 126. (Douai: Chez l'Auteur, 19 Rue Saint-Jean, 1928.) n.p.

M. JOLLIVET CASTELOT claims to have succeeded in preparing gold by the action of arsenic and antimony sulphides on silver at 500–1100° C. M. A. Ballandras, a chemical engineer, has verified this result, obtaining colour reactions varying from light yellowish-black to peach-pink, a dark-black powder with a green reflection, and glossy flakes capable of taking a high polish. M. L. Outon, a pharmacist, has repeated the experiment with amazing results. All these gentlemen are to be congratulated on their spagyric achievements if not on their perception of the ridiculous—the inventor in particular, since although not unaware of the economic advantages of the reaction, he has confined himself to the simple search for truth. The yield of gold appears a little low, but doubtless could be improved. Modifications consist, for example, in the addition of tellurium or tin. It is somewhat to be regretted that alchemical prowess should be dissipated in the preparation of so inexpensive a material as gold, particularly if its manufacture on the large scale is to be ignored; radium, for example, costs a great deal more, and a catalytic or any other means for its preparation which would eliminate the somewhat tedious cultivation from uranium would be much appreciated. Even the production of any metal, however base, from gold itself would at least have about it an engaging air of novelty. M. Castelot "emits the hypothesis that the arsenic acts as a catalyser and the sulphur as a ferment in the transmutation." Such a statement is indeed amazing; more amazing, perhaps, than M. Castelot would admit.

A. A. E.

The Composition of Water. By Prof. J. R. Partington. (Classics of Scientific Method.) Pp. viii + 106. (London: G. Bell and Sons, Ltd., 1928.) 1*s.* 6*d.*

THE editor of these "Classics of Scientific Method" suggests that "a reader who takes up a volume of the series, dealing with a branch of science of which he is ignorant, will be able, without further aid, to trace the steps by which the human mind has passed from chaotic ignorance to ordered knowledge." The first impression of the reviewer was that this purpose had been admirably fulfilled in Prof. Partington's monograph on "The Composition of Water"; but closer study shows that, in order to make full use of the available material, he has thought it necessary to discuss the phlogiston theory, and to tell the story of the 'water controversy,' in which the question at issue was one of priority between Cavendish, Lavoisier, and James Watt. This policy has reduced the value of the monograph as a guide to 'the man in the street,' who does not want to be dragged up every blind alley that has been entered, even by the most distinguished pioneers. On the other hand, the monograph is an ideal one for the serious student of historical chemistry, since the standard is as high as that of the Alembic Club reprints, but the material is presented in the more attractive form of a continuous illustrated narrative.

Selene: or Sex and the Moon. By Prof. H. Munro Fox. (Psyche Miniatures, General Series No. 15.) Pp. 84. (London: Kegan Paul and Co., Ltd., 1928.) 2*s.* 6*d.* net.

THIS interesting book is written for the general reader with no special knowledge of biology; it is intended to arouse interest as well as to impart information on the subject. Prof. Munro Fox deals with the historical and the mythical aspects of the problem before directing the attention of the reader to authentic cases of animals obeying a lunar rhythm in reproduction.

The accounts of the sea-urchin at Suez and of the Palolo worm of Fiji summarise well what is known to science to-day as regards these two animals; but the treatment of the behaviour of the Californian smelt includes only the work of the Thompsons in 1919 and not of Clark in 1925. Clark showed quite clearly that the Californian smelt is a tidal form, that is, makes two spawning runs each lunar month during the breeding season. The possible causes of the lunar rhythm are discussed, such as tide and moonlight.

Apart from the fact that the references to the Californian smelt are now discredited, the book is worth reading for its lucid and concise exposition of the problem.

Does the Earth Rotate? By William Edgell. Reprint. Pp. 69. (Radstock, Som.: The Author, Westfield House, 1927.) n.p.

THIS book is pure paradox; it takes us back to pre-Copernican days, and asserts that the earth is flat and stationary, with the heavenly bodies within a few thousands of miles of it. Incidentally the author quotes astronomical facts incorrectly, giving the earth's rotational speed as 18 miles a second, that being actually the orbital speed. The difficulties alleged about falling bodies with a moving earth were of course in the minds of thinking men centuries ago, but were completely removed by the discovery of the true laws of force and motion.

The only service the book can do is to direct the attention of teachers to some points that may be difficult to beginners, and lead them to explain these points more fully and clearly.

A. C. D. C.

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.*]

Monomolecular Films.

IN a recent communication to the Société Française de Physique (*cf. Le Journal de Physique et le Radium*, March, vol. 9, p. 37S ; 1928), Mr. H. Devaux describes a continuation of his beautiful work on monomolecular films, in this case for films on mercury. He states that "Dans les cas, très nombreux, où l'on obtient une lame très mince continue, liquide ou solide, on peut tenter la mesure de l'épaisseur minimum réalisable. Cette mesure m'a donné des résultats satisfaisants quand j'employais le benzine comme dissolvant, par exemple pour l'acide abiétique. Au contraire, pour les substances présentées en dissolution dans l'eau j'ai trouvé des lames toujours trop étendues, qui auraient fait attribuer à la substance un diamètre moléculaire très inférieur au diamètre théorique. En voici des exemples :

Lame de saccharose	0,20 à 0,40.10^{-7}	au lieu de	0,73, diamètre théorique.
Glucose . .	0,14 à 0,21	,,	0,58, ,,
Glycérine . .	0,06 à 0,08	,,	0,50, ,,
Gomme arabique .	1,2 à 1,3	,,	?

"Résultats analogues avec la dextrine, l'amidon, l'albumine (environ de 1,5.10^{-7}), le tanin, l'acide picrique.

"Il est évident que pour toutes ces substances l'emploi de l'eau avait provoqué l'altération du mercure, de sorte qu'une impureté expérimentale augmentait indûment la surface."

Since 1926 we have been investigating thin films of various substances on mercury, the original object being to obtain further information on the molecular dimensions of cellulose and its derivatives. The investigation was extended to cover other 'high molecular compounds,' and the results seem of sufficient interest to permit brief description of the method and of their relation to Mr. Devaux's conclusions. The method consisted in allowing drops of solutions of the substances of varying concentration to spread on a mercury surface cleaned by the sweeping procedure, the amount of substance being insufficient to cover completely the liquid surface. The film area was developed with talc powder and measured by a planimeter. On plotting the thickness of the film calculated by *assuming* the density of the massive material against concentration, a point is arrived at where this thickness value becomes independent of the concentration (or dilution). The limiting values for cellulose nitrates out of *acetone* were of the order 3 to 5 A. The value found for stearic acid out of ether at 25° was 22 to 24 A., for oleic acid 11·2, for elaidic acid 12·2 A., for *n*-capric acid 13·6 A.

These results indicated that the fatty acids gave values comparable with those obtained by Langmuir, Adam, and others, so that these substances were apparently ordering themselves to oriented monomolecular films, not quite in the closest packing possible, but approaching it. On the other hand, the very low values for the 'high molecular' bodies either mean a casual net-work structure, of great porosity, or a molecular dimension which cannot be the *length* of the molecule, but may be the thickness of a polymeric chain or sheet. The former conclusion is in disagreement with the reproducibility and the behaviour of the films to compression by an encircling oil film. The latter view seems in accord with certain theories at present developing on polymerisation, and with the atom-group orientation theory of colloid micelle formation suggested by one of us in a previous letter to this journal ("The Nature of the Emulsoid Colloid State." S. E. Sheppard, NATURE, Mar. 17, p. 73; 1921).

By the same method we have obtained values of the minimum thickness for proteins out of water of the order 6 to 7 A. This is in good accord with the values for protein films on water obtained by E. Gorter and F. Grendel (*Trans. Farad. Soc.*, **22**, p. 477 ; 1926).

In view of the similarity of our results in non-aqueous solution to those obtained in aqueous solution, we suggest that Mr. Devaux's results do not necessitate his conclusion, "pour toutes ces substances," etc.

The tendency for strongly bipolar molecules, such as the fatty acids, to end-on orientation, at either a water or mercury surface, need not be expected in more complex bodies, such as the carbohydrates and proteins, which possess a multipolar structure, relative to simple dipoles. This conclusion is not incompatible with Mr. Devaux's suggestions concerning the effect of ionisation, and is in good accord with his remarks in a previous communication (Communication to the Société Française de Physique, Séance du 17 Février, 1928, *Journal de Physique*, p. 34S ; 1928) concerning the formation and function of monomolecular films at the surface of living cells. We expect to present this material in conjunction with some work by Mr. A. H. Nietz at the Symposium on Polymerisation of the American Chemical Society in September of this year.

S. E. SHEPPARD.
R. L. KEENAN.

Eastman Kodak Company,
Rochester, N.Y., May 23.

Active Nitrogen.

DR. H. SPONER, in an article published some time ago (*Zeit. f. Phys.*, vol. 34, p. 622 ; 1925), advanced the hypothesis that active nitrogen is simply an atom of nitrogen, basing her argument on the parallel properties of active nitrogen and active hydrogen. The hypothesis seems to have found favour with many physicists. Now it is known that active hydrogen shows Balmer lines strongly, and if active nitrogen is also atomic in structure, this may also show the lines of atomic nitrogen. In order to test this point we have photographed the spectrum of active nitrogen in the near infra-red, after an exposure of 42 hours on neocyanine plates. A new band system, extending from 7500 A. to 8900 A., has been discovered. The well-known group of lines of atomic nitrogen discovered by C. C. Kiess (*J.O.S.A.*, vol. 11) about the region 8200 A. is absent, though the exposure was long enough to photograph a weaker band in the vicinity.

This new band system photographed by us for the first time in the spectrum of active nitrogen, was first noticed by A. Pfund (*J.O.S.A.*, vol. 9, p. 193) and Coblenz, a few years ago in their investigations of the infra-red radiations of nitrogen by the galvanometric method, and recently Poetkar (*Phys. Rev.*, Dec. 1927) has photographed it by using ordinary nitrogen discharge tubes. We have also obtained these bands in the ordinary discharge tube of nitrogen. There is no doubt that they owe their origin to the N_2-molecule. There are some indications that this band system is present in the solar spectrum, and may provisionally be identified with the band noted by Meggers about 8230 A. ; and is due to the absorption of solar light by atmospheric nitrogen. Prof. M. N.

Saha is of opinion that these bands may owe their origin to the transition of the valency electron of one of the atoms to the metastable state ($^4S_2$, $^2D_2$ . . .), and hence they occur in the infra-red. According to Hund and Mullikan, such transitions are not only allowed in the molecular spectra, but also occur very strongly. These bands are therefore presumably analogous to A, B, a bands of oxygen, which are obtained in absorption and must therefore correspond to the forbidden electron transitions of the oxygen atom. But this suggestion can be tested only by a laboratory experiment on the absorption bands of nitrogen. Without going into details regarding the nature of active nitrogen, we are inclined to the view that it is a diatomic rather than a monatomic molecule of nitrogen. An attempt is being made to photograph the spectrum of active nitrogen in the Schumann region in search of the resonance lines of nitrogen.

Our attention has been directed to a note of Prof. J. C. McLennan, and Messrs. R. Ruedy and J. M. Anderson, published in NATURE of April 7, on the spectra excited by active nitrogen. These authors could easily obtain the lines of zinc and mercury corresponding to 8·4 volts, but were unable to excite the lines of either krypton or xenon. From this fact they conclude that only those substances become luminescent which combine chemically with nitrogen, and hence the activity is to be ascribed to chemiluminescence. We wish to point out that the resonance lines of both krypton and xenon, discovered by G. Hertz (*Naturwiss.*, p. 648 ; 1926) all lie in the Schumann region:

		Resonance Potential.
Krypton . .	1235·8	9·99
	1164·9	10·66
Xenon . .	1469·5	8·40
	1295·7	9·53

Prof. McLennan and his collaborators evidently did not work in this region. The next higher group of lines lies in the infra-red, and requires a potential of about 11 volts for excitation. It is not, therefore, surprising if they failed to obtain any impression of these lines on their plates, because on the present-day theories of active nitrogen, it is loaded to an energy content of about 11·4 volts.

We also feel, though here we tread on rather delicate ground, that the exposure of 12 hours given by these authors was not enough to bring out lines of inert gases if any were present, for they do not seem to have noticed the new band spectrum of active nitrogen in the infra-red, which we have photographed. So that the conclusion of Prof. McLennan and others regarding the chemical origin of the phenomenon associated with active nitrogen does not appear to be quite justified.

P. K. KICHLU.
D. P. ACHARYA.

Department of Physics, Science College,
Patna, India, May 10.

Is Crystal Reflection of X-Rays entirely a Classical Phenomenon ?

ACCORDING to recent papers by Waller (*Phil. Mag.*, **4**, 1228) and Wentzel (*Zeit. f. Phys.*, **43**, 1, and **43**, 779), the regular reflection of X-rays can be treated as a purely classical phenomenon and the modified scattering of the Compton effect can be disregarded. If this is so, then the values of the atomic structure factor for a given atom (or F values) at various angles of reflection have the property that

$$-(1/Z)\sum_{n=1}^{n=\infty}(-1)^n F_n \not> \tfrac{1}{2} \quad . \quad . \quad . \quad (1)$$

where F_n is the F value for the nth order reflection from planes of which the grating space is D, and Z is the number of electrons in the atom. The proof is indicated as follows : Let an electron be at a distance a from the centre of an atom, this centre being in a crystal plane and a being perpendicular to the plane, then (see Compton, " X-Rays and Electrons," p. 121) the structure factor for this electron is $\cos(4\pi a \sin\theta/\lambda)$. If in addition the centre of the atom is vibrating, due to heat motion, and carries the electron with it, the structure factor becomes

$$\text{exp.}\,(-b\sin^2\theta/\lambda^2)\cos(4\pi a\sin\theta/\lambda).$$

For reflection we have $n\lambda = 2D\sin\theta$, and hence

$$F_n = \text{exp.}\,(-\alpha n^2)\cos\beta n \quad . \quad . \quad . \quad (2)$$

where $\alpha = b/4D^2$ and $\beta = 2\pi a/D$. Substituting in the left side of (1), the series may be written

$$S=\sum_{n=1}^{n=\infty}[\text{exp.}\{-\alpha(2n-1)^2\}\cos\beta(2n-1) - \text{exp.}\{-\alpha(2n)^2\}\cos\beta(2n)] \quad (3)$$

since Z in this case is unity. By Cauchy's theorem $S \not> I$ where

$$I=\int_0^\infty[\text{exp.}\{-\alpha(2x-1)^2\}\cos\beta(2x-1) - \text{exp.}\{-\alpha(2x)^2\}\cos\beta(2x)]dx. \quad (4)$$

Evidently

$$I=\tfrac{1}{2}\int_0^1 \text{exp.}\,(-\alpha x^2)\cos\beta x\,dx. \quad . \quad . \quad (5)$$

By the mean value theorem

$$I=\tfrac{1}{2}\,\text{exp.}\,(-\alpha u^2)\cos\beta u \quad . \quad . \quad (6)$$

where $0<u<1$. Now $\text{exp.}\,(-\alpha u^2)<1$ for $\alpha>0$ and $\cos\beta u \not> 1$. Hence $I \not> 1/2$ and also $S \not> 1/2$, so that (1) is proved.

We have plotted the F values as found by Havighurst (*Phys. Rev.*, **28**, 875) for (Na + Cl) against $\sin\theta$ and drawn a smooth curve passing through the experimental F values and through an F value of 28 for $\sin\theta = 0$. For the large angles we have extrapolated to $F = 0$ at $\sin\theta = 0{\cdot}81$. We have read off sets of F values for different values of D, that is, for different values of $\sin\theta_1$, the value of $\sin\theta$ for first order reflection and have calculated the values of the left side of (1), which we shall represent by A, for various values of $\sin\theta_1$. We obtain the following table :

$\sin\theta_1$.	A.
0·05	0·497
0·10	0·558
0·126	0·487
0·15	0·430

For $\sin\theta_1 = 0{\cdot}10$, A is definitely greater than 1/2 in opposition to the requirement of the classical theory as given in (1). This matter will be discussed more fully in a paper appearing elsewhere.

G. E. M. JAUNCEY.
W. D. CLAUS.

Washington University,
St. Louis, U.S.A.,
April 25.

The Palæolithic Implements of Sligo, Ireland.

THE communication of Profs. Jones and Boswell in NATURE of June 2 does not, in my opinion, supply good reason for departing from my announced intention to wait until the autumn of this year before replying to criticisms and detailing the geological evidence on which my claim is based. A paper will then be read before the Society of Antiquaries of London. Nevertheless, there are one or two state-

ments in their letter upon which I will briefly comment now.

At Rosses Point, Profs. Jones and Boswell have ascertained, by counting, that there still remain ten slabs of the cherty roof-blocks of large size. They compare this number with the twenty-six slabs of the re-deposited dolomitic floor-stone, and appear to attach importance to the latter's preponderance. Of course there is a preponderance. Furthermore, this preponderance will tend to become greater as time goes on and as more and more of the floor-stone becomes detached and re-deposited by the waves during storms. If Profs. Jones and Boswell were to study my photograph of the site, taken before any of the blocks had been disturbed, they could draw the following section :—

(*a*) Re-deposited dolomitic floor-stone.
(*b*) Collapsed roof-blocks of cherty limestone.
(*c*) Flakes, implements, and cores.
(*d*) Dolomitic floor-stone, *in situ*.
(*e*) Cherty limestone.

Such a section bears an interpretation alternative to that offered by them.

Profs. Jones and Boswell give their opinion that rapid coastal erosion is taking place in the Sligo area, and in support of this contention they instance, on Coney Island, a concrete emplacement now overhanging the cave at the north-west corner of the island, which, they state, once formed the base of a beacon since moved inland owing to encroachment by the sea. If they had sought their facts from the builders (as I have done) they would have ascertained :

1. The emplacement did not serve, and was not intended to serve, as the foundation for a beacon.

2. It was a platform made flat for the use of the men who pump sea-water for the containers of the beacons situated farther inland.

3. The cave was in existence immediately below the emplacement at the time of its building.

4. Poteen used to be made there !

All we can say with certainty is that the front of the cave has given way along a joint-plane subsequent to the building of the emplacement, and that there is no evidence of a recent date for the formation of the cave in question. There have been occasional falls of cliff along the Carboniferous Limestone coast-line of Gower, Wales. But Paviland Cave is palæolithic.

I may say that I have obtained additional archæological and geological evidence in support of my claim, but, with regard to the cultural age of the implements (as I took the opportunity to inform the Royal Irish Academy's delegation in April), it is not improbable that they will prove to be older than originally suggested. The impression I first gained was that the industry should be correlated with the massive Chellean culture stage as typified at Cromer, Norfolk. Though my opinion, in this respect, differs from that of my collaborator, Mr. Reid Moir, the fundamental importance of my claim—*i.e.* to have discovered traces of palæolithic man in Ireland and to have established an inter-glacial period for that country—remains unaffected.

J. P. T. BURCHELL.

June 6.

The Buoyancy of Whales.

I AGREE with Sir Sidney Harmer (NATURE, May 12, p. 748) that as the whale descends its chest is compressed and the density of its body is consequently increased. It is owing to this very fact (that is, its increased density) that the whale has difficulty in regaining the surface after descending to a great depth, and that there is consequently a limit to the depth to which it can safely descend.

Compression of the chest, however, does not account for all the phenomena. If nothing else took place, the dead whale would float when raised to the surface, and this is not the case, at any rate, not so far as I know. In explaining the facts it seems necessary to postulate the absorption or escape of the lung air. Death being due to asphyxia, as I am about to show, the latter possibility (that is, the escape of the lung air) seems not unlikely.

The whales I spoke of were not allowed to sink to the bottom, but were suspended by the whale-line and were hauled up as soon as possible. In whaling language they 'died on the first harpoon' ; that is to say, were only harpooned once, and after 'sounding' or going vertically down to a great depth, died under water. They doubtless died from drowning or asphyxia, as the whalers say. There is no other way of accounting for their death. The pressure of the water has evidently no injurious effect on them, and the injury done them by the harpoon—at any rate by the hand one—is not serious enough to cause death.

Sometimes, however, the Greenland whale died under water " on the third or fourth harpoon," when it was already far spent and about to receive the *coup de grâce* with the lance. A case of this kind came under my notice in 1886. It is recorded in the *Zoologist* of 1887, p. 97. Briefly, the whale received a fourth gun harpoon, descended a few fathoms, died under water, and floated up dead. Strange to say, it came up tail first. Its death seemed to be due to syncope, and the pressure of the water at the trifling depth at which it died did not seem sufficient to squeeze the air out of it. Consequently it floated up.

Sir Sidney Harmer seems unwilling to believe that whales use their lungs for hydrostatic purposes. I have shown that in recently dead whales the tendency of the body to float or sink depends on the state of the chest and lungs. It seems reasonable to suppose that the same is true during life. To arrive at the truth it is necessary to watch the whale when it is motionless, not when it is swimming about.

I have mentioned that the Greenland whale sometimes lies motionless at the surface with a part of its head above water and with its back awash. Scoresby tells us that when it is extended in this manner it " can sink downwards in the space of five or six seconds or less beyond the reach of its human enemies," and Beale, speaking of the sperm whale, says, " occasionally when suddenly disturbed the whale has the power of sinking quickly and directly downwards in the horizontal position."

In conclusion, I think the air in the lungs of the whales in the intervals between the respirations must be in a state of compression, and that it is owing to this that each time the animal breathes an appearance is produced resembling a puff of steam escaping from a boiler.

R. W. GRAY.

Exmouth, May 31.

Physics and Metaphysics.

THE writer of the review of " A Short History of Physics " (NATURE, May 26) suggests an interesting speculation (p. 824) as to whether the great physical scientists " have not usurped the place of the metaphysicians," since " some modern theories make almost impossible demands upon the imagination of those without more than a fair amount of mathematical knowledge."

On the other hand, Mr. Selby's illuminating summary of " The Quantum Postulate and the

Atomic Theory," p. 828 of the same issue, indicates an interpretation of physical phenomena essentially the same as the older physiological theory of experience. There is nothing metaphysical in the conclusion that the limiting subjective unit is a *minimum sensibile*, for the individuality associated with events is still our three-dimensional brain-consciousness. If there be metaphysical regions, that is, states of energy, beyond or within those we term physical, we should have to evolve finer sense perceptions in order to become aware of them; and what is now hypothetically metaphysical would have become physical. Present interpretations of physical theories, however, do not appear to suggest the possibility of such evolution.

That one state of matter permeates grosser states of lower atomic velocity is a fact quite unrelated to our present powers of sense perception. We can enhance these powers to some extent by means of radio instruments, and experience a vicarious sensation of being in two places at once; but we cannot see *simultaneously inside and around* our physical bodies or the earth, and, therefore, we are unable to know what, if any, is the subjective state of high-power radioactive substances. Absolute permeability, absolute velocity, absolute time or absolute consciousness is as incomprehensible to our present organs of perception as 'absolute size'—a contradiction in terms, for size can relate only to a three-dimensional form of physical matter in space, and particles must become blended with energy at infinity. A formless, synthetic, immaterial substance of absolute and, therefore, ubiquitous density would be a state of absolute subjectivity, 'absolutely' *meta*physical for us.

W. W. L.

May 25.

Activation of Hydrogen by Electric Discharge.

MY attention has just been directed to the correspondence under this heading in NATURE of Jan. 21 and Mar. 10. Dr. Lunt has kindly summarised the experimental evidence which leads to the rejection of explanations of the type proposed by Mr. Glockler, and in this connexion I have nothing to add.

It is important to note, however, that in a large number of experiments, described very briefly at the commencement of my paper and in greater detail in the thesis, no activation could be detected. It appears that evidence of activation may be obtained only when the detecting agent is sufficiently close to the discharge tube and at pressures below about 5 cm. of mercury. Paneth and his co-workers, in a paper published at the same time as mine, also report failure to obtain active hydrogen by many of the methods described in the literature of the subject. It seems probable, indeed, that the greater part of the previous work describing methods of preparation and properties of active hydrogen other than monatomic hydrogen obtained at extremely low pressures may prove to be without value. If this be so, my subsequent experiments, together with those of Dr. E. J. B. Willey, who reports the formation of active hydrogen in the 'condensed' discharge as used for the production of the nitrogen after-glow, constitute the principal evidence for the existence of this substance. Further details concerning the active hydrogen which Dr. Willey has obtained would, therefore, be of great interest.

In the March issue of the *Journal of the American Chemical Society*, Messrs. Smallwood and Urey also describe unsuccessful attempts to prepare active hydrogen by the usual methods. In their paper it is stated that my results are open to criticism on the ground that I did not sufficiently guard against the possibility of sulphur dust being blown back into the discharge. This is incorrect, for adequate precautions were taken to prevent any accident of the nature described.

G. A. ELLIOTT.

Department of Chemistry,
University of Western Australia.
April 28.

Subsidiary Rectangles as Applied to the Formation of Magic Squares.

IN NATURE of Jan. 14 I gave an 'associated' rectangle 8×3, which is the smallest rectangle that will also provide the property, that the diagonals one way also sum to the same amount as the rows. I give below a similar rectangle in the smallest possible numbers (non-consecutive).

In NATURE of Feb. 4 I gave the smallest similar rectangle with consecutive numbers, 9×3 for order 27.

As the diagonal property is not necessary in order 27 with rectangles 9×3, and order 30, with rectangles 10×3, can only be constructed with non-consecutive numbers, order 33, with rectangles 11×3, is the smallest order in which the diagonal property is essential in the rectangles 11×3, with consecutive numbers, for the formation of associated pandiagonals.

I give the three additional rectangles, where in each case the diagonals from left to right sum to the same amount as the rows, and the rectangles are each associated.

8×3

12	20	18	11	3	27	19	2	
4	13	23	6	22	5	15	24	
26	9	1	25	17	10	8	16	

10×3

20	25	6	2	19	11	15	4	31	27	
23	22	14	29	8	24	3	18	10	9	
5	1	28	17	21	13	30	26	7	12	

112×42

160×48

11×3

21	29	26	20	9	1	11	10	12	16	32	
28	4	3	7	19	17	15	27	31	30	6	
2	18	22	24	23	33	25	14	8	5	13	

187×51

J. C. BURNETT.

Barkston,
Nr. Grantham, Lincs,
May 15.

Rainbow Visible after Sunset.

IT may be of interest to record that about sunset on Monday, June 4, there was a fine rainbow here which persisted until the sun was well below the horizon. The last trace of it vanished at $20^h\ 11^m$ G.M.T., at which time the altitude of the true sun was approximately *minus* 1° 30′. Making a generous allowance for refraction, this would still put the upper limb of the apparent sun very appreciably below the horizon. This is perhaps the more remarkable in that there was a low bank of cloud along the western horizon. The great altitude of the top of the bow was very striking, and it did not, of course, reach down to ground level, but faded out at a considerable height, which there was not time to measure. My longitude and latitude were $4^m\ 28^s$ E., 51° 21′ N.

B. M. PEEK.

Gorse Cliff,
Herne, Kent,
June 12.

The Physiological Effects of Flying.[1]

By Group-Captain MARTIN FLACK,
Director of Medical Research, Royal Air Force Medical Service.

THE first observations upon the effects of flying seem to have been made in 1783, when some sheep and fowls were sent up in a balloon to a height of several hundred feet. Apparently, upon its descent, the observers were delighted to find that the aerial flight had induced no ill-effects. In December of this year, however, after an ascent to about 10,000 feet, a human observer is reported to have experienced considerable discomfort from the effects of cold as well as pain in the right ear.

The stimulating effects of low altitudes are recorded in a handbook on aeronautics published in 1786. "The spirits are raised by the purity of the air and rest in a cheerful composure." The author noted that all worries seemed to disappear as if by magic, so that ballooning came to be regarded as having a therapeutic value. This stimulating effect of altitudes up to 10,000 feet is still well known, many pilots stating that they experience a great desire to sing.

Between 1783 and 1903—the date of the first flight of the Wright brothers—the study of the effects of altitude was the chief point of physiological interest in aeronautics; but with the coming of the aeroplane many other problems have come into existence. Of first importance are those connected with the ability of man safely to fly a machine, of which he himself represents at present the controlling and co-ordinating mechanism. In addition, however, we have the question of the effects of flying from the point of view of the ordinary passenger.

As a general rule, passenger flying consists in what is known as 'straight flying,' no 'stunts' or aerial acrobatics being indulged in. The machine takes off, rises to a thousand feet or so, and proceeds direct to its destination. To many, the idea of aerial progress in a state of unstable equilibrium appears fraught with peril compared to usual forms of motion upon the earth's surface. Yet, with the increasing safety of machines, aviation must now be considered little if any more dangerous than motoring, especially in these days of speed and congested traffic. All machines for public transport are most carefully tested and inspected, and designers and constructors of aeroplanes are constantly seeking ways and means of making flying more and more safe.

An opinion as to the security of flying must not be formed from the number of accidents which occur in military flying. Such flying is totally different from civilian flying, involving considerably greater risks. The comparative safety of civilian flying is in part attributable to the careful medical selection of pilots. Pilots are not permitted to carry passengers or goods without the most searching medical examination, and are not passed for service until they have received a certificate of airworthiness in exactly the same manner as the aeroplane itself. The British company, Imperial Airways, Ltd., has recently carried more than 60,000 passengers and flown more than 3 million miles without serious accident. This point is emphasised, because the enjoyment of flying as passenger depends largely as to whether or not the passenger enjoys a feeling of security.

The other chief factor is the state of the atmosphere. If the weather is 'bumpy,' a passenger may become 'air-sick,' more especially when travelling in an enclosed cabin. As with sea-sickness, many people anticipate being 'air-sick,' and in this frame of mind the malady is prone to occur. Save in exceptionally bad weather, there is no reason why the average person should be 'air-sick,' the number of individuals liable to air-sickness being considerably less than those liable to sea-sickness. The best guide as to whether one is liable to air-sickness is previous experience in regard to swings, trains, and scenic railways. Only those who are liable to discomfort nausea on these are likely to suffer from air-sickness. There is no direct connexion between air-sickness and sea-sickness save perhaps that the person who becomes severely and intractably sea-sick is possibly likely to suffer from air-sickness. The subject who is just ordinarily sea-sick will not necessarily be 'air-sick.' The liability to air-sickness among the general population is considerably over-rated. Nor, it must be emphasised, is there any connexion between 'giddiness' when looking down from a height and a liability to 'air-sickness.'

At the heights of average aerial travel, that is, up to five or ten thousand feet, there are no effects from altitude upon the average passenger, nothing beyond a slight deepening of breathing being noticed, frequently attended, as already noted, by an exhilaration which often manifests itself in a desire to sing. Civilian passenger machines do not ascend high enough to induce anything akin to 'mountain sickness,' neither are the average altitudes reached sufficient to induce harm in people who are suffering from lung or heart ailments of such a degree as to enable them to pursue an average everyday life on the ground.

With regard to flying as pilot, various points must be taken into consideration, since it is upon him that the safety of the aeroplane rests.

Simple flying calls for certain co-ordinated limb movements which are initiated as the result of sensory impressions. Of such impressions those of vision are the most important, since without good visual judgment accurate flying is not possible. In fog and cloud flying, a pilot has to rely upon the information obtained from instruments by the use of his eyes. The same is true in a large measure of night flying, although here a certain amount of visual information is generally also available from external sources (horizon, stars, etc.). In all

[1] Substance of two lectures delivered at the Royal Institution on Mar. 22 and 29.

stages of flying experience, therefore, a pilot is dependent upon visual information, gathered either from objects outside or from instruments within the machine. In particular this is true during the stage of training, when all co-ordinated movements are initiated consciously. With growth of experience the pilot derives an increasing amount of information from the nerves of 'deep' sensation, namely, the 'feel' of the control column, rudder bar, and seat, and, as a result, comes in time more or less automatically to initiate the appropriate co-ordinated movements necessary for the accurate control of his machine.

Information is also derived from the 'feel' of the wind and varying air currents upon the face. Auditory sensations, however, do not play a great part in flying, although good hearing is necessary for the correct appreciation of the 'note' of the engine, as well as for the reception of wireless and so forth.

Besides the faculty of correct perception, a pilot must be capable of accurate co-ordinated performance with his limbs as the result of his perception. Delicately co-ordinated movements of arm and leg are necessary for the accurate control of an aeroplane. Some individuals are incapable of achieving this delicacy and are consequently heavy handed or heavy footed, or both. Other individuals are incapable of combining arm and leg movements with sufficient accuracy owing to an inability to perform successfully two relatively simple movements at the same time. The examination of the responses by means of a special apparatus—the Reid apparatus for testing flying aptitude—for the purpose is of great value in ascertaining a pilot's powers of performance.

Lack of aptitude for flying, therefore, may be due either to defective afferent impressions—chiefly from the eyes and the muscles, or to defective co-ordinated movements.

Further, to be a safe pilot, an individual must possess accuracy of judgment and coolness in emergency, also great powers of physical endurance to enable him to withstand high altitudes or long hours, as well as the effects of quick rotary movements in aerobatics and the effects of gravity after diving quickly or when rapidly turning at full speed at a sharp angle.

The effects of altitude call for especial consideration from the point of view of the pilot. In addition to the effects of diminution of oxygen supply, the effects of extreme cold and the actual diminution of the air pressure have to be considered.

The main effects of diminution of pressure in itself are due to the expansion of the air enclosed within the middle ear. This tends to expand as the pressure is reduced, but the pressure of such air is, generally speaking, automatically adjusted by swallowing. Therefore, only subjects suffering from catarrh of the Eustachian tubes leading from the throat to the middle ear are likely to suffer any inconvenience from this cause. The same is true when atmospheric pressure is again increased on coming down from average heights (1000-2000 feet). The movement of swallowing again automatically adjusts the pressure. When descending from greater heights, the increased pressure on the ear drum through the outer ear may be counterbalanced within the middle ear by gently blowing up the ear drums, while holding the nose, by the movements of forced expiration, a device well known to all pilots. Where Eustachian obstruction exists, however, a pilot may suffer considerable inconvenience during descents, especially if undertaken too rapidly. Diminution of pressure also causes any gas within the intestines to expand. Although in some cases this may affect breathing by hampering the action of the diaphragm, generally speaking, as the amount of this gas is not normally large and its expansion induces peristalsis of the bowels, it is soon voided from the body and inconvenience from this cause is rare. The idea that at great heights there is a danger of trouble arising in the body from the release of gases into the blood owing to the diminution of pressure, such as takes place in the diver or compressed air worker, is erroneous. In the case of airmen the diminution of pressure at present is not sufficiently great or rapid to bring about any liberation of gases held in solution in the blood plasma.

Since 1878 it has been known that the chief cause of 'mountain sickness' or 'altitude sickness' is lack of proper oxygenation (anoxæmia) of the body owing to the rarefaction of oxygen in the air breathed. Experiments conducted in rarefaction chambers, as well as at high altitudes, such as Pike's Peak and Monte Rosa and the Andes, have fully proved this point. In respect of life at high altitudes, however, a certain degree of bodily acclimatisation takes place after the first few days, which is not the case in respect of flying. In an aeroplane, the length of stay at high altitudes is not sufficient to induce any acclimatisation, beyond possibly a transitory concentration of the blood plasma. This will be appreciated when it is realised that a man who flies 240 hours yearly in reality only passes 10 days out of 365 reaching and returning from his maximum heights.

In high flying the cause of trouble is the demand by the body for a normal supply of oxygen under conditions where the head of pressure of the 'pressure feed' is failing. At 19,000 feet, although the percentage composition of the air is unaltered, the total atmospheric pressure is only half normal; that is, the pressure which drives the oxygen into the blood is only half the normal, and accordingly the body will receive only half the amount to which it is accustomed—actually less, since here no allowance is made for the pressure of water vapour. The gradual failing of the pressure feed of oxygen to the body with increasing height necessitates deeper and deeper breathing to get in the required amount of oxygen and a proportionately quicker rate of heart beat to keep up the circulation of the blood, which carries the oxygen to the seats of combustion. For this work alone, more and more oxygen is required in an atmosphere in which oxygen is progressively diminishing. This throws a certain strain upon the muscular mechanism of respiration and upon the circulation; a strain

which is increased owing to the relatively immobile position of the pilot. Unless, however, such strain is unduly severe or prolonged, it is readily tolerated by the body up to heights of 18,000 or 19,000 feet, provided that the respiratory and circulatory mechanisms are properly tuned up.

If the embarrassment of the respiration and circulation were the only effects of altitude, then until this became really excessive, the administration of oxygen to pilots, although an advantage as conserving the normal action of the lungs and heart, would not be altogether a necessity. A more subtle, and therefore often a less appreciated, danger exists which renders the administration of oxygen necessary, namely, a dulling of perception and judgment in addition to a gradually increasing general muscular weakness.

This dulling of perception and judgment begins lower, in most people after 12,000 to 15,000 feet. The pilot himself may not be, and usually is not, aware of it, and even possibly has an extra feeling of confidence. This may be exemplified by an observer who, during the War, returned from high flying reconnaissance, thoroughly pleased with himself, only to find later that he had taken 18 photographs on the same plate; and by a pilot, who, meeting enemy aircraft at 19,000 feet, in spite of the protests of his observer, cheerfully waved his hand to them but took no further action. Nearly all pilots notice the tendency to somnolence at high altitudes; many have difficulty in finding their way, being able to see the ground but not to read their maps. As a rule, scout pilots are less affected by altitude than high reconnaissance pilots, since they do not maintain high altitudes for the same length of time. At great heights it takes longer to see, to hear, and to act. The lessening of muscular power is more obvious; most pilots are aware of the difficulty of swinging a gun or even drawing the shutter of the camera at very high altitudes.

With aircraft going possibly to 30,000 feet or more, the danger to the pilot is greatly increased, and the use of oxygen is absolutely necessary. The effects of altitudes of 25,000-28,000 feet have been long known. Glaisher in 1862 noticed that at 26,000 feet, although he could see his instruments, he could not read them. Shortly afterwards he became paralysed in his hands, as did his assistant, who, however, managed to pull the valve rope with his teeth. In 1875 three Frenchmen, Croce, Spinelli, and Tissandier, made their famous ascent, only Tissandier surviving. Although warned of the necessity of using oxygen, they were all paralysed before they realised the necessity of taking it. Tissandier gave a graphic account of his experience, from which the following is quoted: "At 26,000 feet the condition of torpor which comes over one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. On the contrary, one feels an inward joy. There is no thought of the dangerous position; one rises and is glad to be rising." The balloon ascended to 28,820 feet, and then descended.

Recently, in November 1927, Capt. Gray, of the United States Army Aviation Service, after ascending to 42,470 feet, lost his life during the descent at about 29,000 feet owing to his oxygen running out, probably owing to a miscalculation in the time of climbing and descent.

Oxygen abolishes the troubles of altitude which are due to oxygen want. The man with oxygen perceives and acts far more quickly and accurately than does the man without oxygen. It is for this reason that during the War all long-distance bombers and high photographic aircraft, both enemy and British, were eventually equipped with oxygen apparatus. On such aircraft the use of oxygen is an absolute necessity if really efficient service is to be rendered.

When oxygen is carried it should be used throughout the flight, beginning before the aircraft leaves the ground. It should not be reserved until the individual feels he wants it, since the effects of want of oxygen which matter most are apt to be unnoticed by the individual.

The best method of taking oxygen is by means of a mask. This is more satisfactory than by a pipe, because it ensures a larger amount of the oxygen delivered reaching the lungs; moreover, there is not the same danger of the tube being blocked by frozen condensation, water, or saliva. Further, a mask also protects the face from frost-bite. Instead of the usual mask some prefer a combination of mask and pipe, since it can be discarded more quickly should this be necessary.

The advantages derived from the use of oxygen at high altitudes may be summarised as follows:

1. It keeps a man alert and in a condition in which quickness of perception, accuracy of judgment and action are preserved to the full.
2. It gives a man more power to control aircraft, and gives the tactical advantages of height without its disadvantages.
3. It abolishes the disagreeable symptoms—headache, lassitude, etc.—which are so frequently experienced during and after flights at high altitudes.
4. It keeps the heart and respiration efficient for a much longer period and prevents their over-strain.
5. It helps to keep the body warm.

In addition to the effects of oxygen want, the effects of the cold of altitudes must also be borne in mind, since these in themselves tend to throw added strain upon the respiratory and circulatory mechanisms as well as inducing numbness and sensations of fatigue.

For success in flying, therefore, nervous stability, respiratory and circulatory efficiency are essential. It must be recognised that flying, especially military flying, imposes a very definite stress upon the body, especially when flights are made without the aid of oxygen for long periods at relatively high altitudes. When to this is added the stress of offensive and defensive warfare in the air, it is obvious that bodily strain or breakdown as the result of stress is likely to ensue if too prolonged.

The Correlation of Solar and Terrestrial Magnetic Phenomena.

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

SCHWABE'S discovery of the eleven-year sunspot cycle was soon followed by the recognition of a parallel cycle in the variations of the earth's magnetic field. Since then long series of solar and terrestrial observations have been accumulated. Magnetic observations, though still generally made in the manner introduced by Gauss, have been extended widely over the earth, while remarkable developments in the technique of solar observation have provided a wealth of detailed knowledge of solar phenomena. Yet although great advances have been made in establishing correlations between the two sets of data, some of the principal relationships remain obscure, and some important lines of investigation have yet received little attention.

The great complexity of both sets of phenomena accounts for this position of affairs. As regards the magnetic variations, observations over many years had to be collected from numbers of widely separated observatories, each contributing three distinct continuous records (for the three components of magnetic force) before it was possible to grasp the main features of the phenomena, and distinguish between what is characteristic of a general world-wide system, with its intensity waxing and waning more or less as a whole, and what is merely transient and local. As regards observation of the sun, though any terrestrial observatory has the whole solar disc at once in view, it has required the work of generations of observers to afford our present immense but incomplete knowledge of the remarkable happenings over that great surface.

In the detailed study of the relationships between the two groups of phenomena, statistical methods based on the use of the Wolf-Wolfer sunspot numbers have been very fruitful. These numbers characterise the state of the sun's surface on each day in one important respect, namely, the number and area of the dark and relatively cold regions of the surface. Daily areas of the bright patches called faculæ, though available in the volumes of Greenwich observations, have been less used: there is a considerable degree of correlation between them and the sunspot numbers. Such 'daily character' figures for the sun have been compared with magnetic data chosen to represent the character of a day from the magnetic point of view. At first the magnetic data used for this purpose were generally drawn from the records of a single observatory (such as the daily range in the magnetic declination), but the need for some index less dependent on local and accidental changes at a single station gradually became felt. About twenty years ago a scheme was put into operation by which many observatories contribute data on which international daily magnetic character figures are based. These are designed to represent the degree of world-wide magnetic activity or disturbance present on each Greenwich day; they are not founded on any definite physical estimate of the degree of disturbance, but on a general impression of the smoothness or irregularity of the continuous records at each observatory. Attempts have been made, and are continuing, to devise a practicable quantitative method of assigning such figures, but no plan has yet met with general approval.

While the present system certainly has defects, in that in different years, or even in different months of the same year, the same character figure may be used for days experiencing different amounts of disturbance, yet these magnetic figures have proved of great value in the study of solar and terrestrial relationships. The outstanding example of their usefulness is Chree's demonstration, based upon them, of the tendency for unusually quiet or unusually disturbed magnetic conditions to recur after the lapse of one or more solar rotation periods. This 27-day recurrence tendency had been recognised by Maunder (and by some earlier workers), who brought forward very strong evidence in support of it, drawn from the Greenwich records of magnetic storms; but conviction of its reality became general only when Chree's important work confirmed it in an indisputable way.

This recurrence tendency throws light on the failure to find much correlation between the *daily* magnetic character figures and the *daily* sunspot numbers, a failure which at first sight seems remarkable in view of the increase in frequency of magnetic disturbance in years of high sunspottedness. The recurrence tendency, as clearly interpreted by Maunder, shows that the solar agent that produces terrestrial magnetic disturbance must proceed from some limited region of the sun's surface, and travel outwards from the sun in a confined stream, affecting the earth only when it is swept over by the stream, which rotates with the sun (though of course lagging behind the radius through the point of emission). Magnetic disturbance is, therefore, an indication of the impingence upon the earth of some solar emission, which must be of a corpuscular nature; nothing happens when the sun is not emitting the corpuscles, but, equally, nothing happens upon the earth even when the streams are issuing from the sun, except when they chance to encounter the earth. Even if sunspots were the source of such streams, the daily sunspot numbers would not be expected to show a close correlation with the daily magnetic character figures, because a spot contributes to the sunspot number during the whole period of its passage across the visible disc of the sun, whereas the supposed streams issuing from it would appear capable of affecting the earth during at most two or three days.

It is certain, however, that the streams in question do not always issue from sunspots, because magnetic storms are sometimes observed when sunspots have been absent from the sun's disc for some days. Moreover, modern theories of

the sun's atmosphere render it likely that corpuscular emissions are due to a local and temporary rise in the radiation pressure, arising from an unusually bright region of the surface. Pike has shown that a dark region or spot behaves like a centre of attraction rather than of repulsion; chromospheric matter tends to flow towards it and not away from it. This accounts for the arched forms shown by many prominences; it would seem that the apparent attraction of the dark spots, and the deflecting influence of the magnetic fields associated with them, must often prevent the ejection of chromospheric matter right away from the sun. The frequency of such complete expulsion, as judged from the records of magnetic disturbance, is somewhat difficult to explain on the basis of our present knowledge of solar atmospheric conditions; but it would seem likely that bright regions associated either with no dark spots, or with several small dark spots rather than one or two large ones, would offer the most favourable conditions. This inference seems to be in agreement with a recent examination by Greaves and Newton of the solar conditions prevailing at the time of the greatest magnetic storms observed at Greenwich.

Whatever may prove to be the local conditions causing the emission of corpuscular streams from the sun, the emitting regions have the best chance of affecting the earth when they are fairly near the centre of the sun's disc. Consequently, the magnetic character figure for any day is likely to be associated with the presence of bright regions, perhaps of some special type, near the centre of the sun's disc, not necessarily on the same day but rather at a date preceding it, by an interval equal to the time taken for the solar agent to travel from the sun to the earth. The length of this interval is unknown, but there are some grounds, both theoretical and observational, for estimating it as from two to four days. As a means to a clearer understanding of the mode of action of the sun in producing magnetic disturbance, it is desirable to have a new set of solar daily character figures having special reference to the presentation of bright solar regions towards the earth. The Solar Physics Commission of the International Astronomical Union, and the International Research Council's Committee on Solar and Terrestrial Relationships, will discuss this proposal at Leyden in July, and it is to be hoped that some simple scheme will be devised for choosing solar daily character figures which will prove to be more closely correlated than the daily sunspot numbers are with the daily magnetic character figures.

There appears to be need also for a second set of magnetic character figures, or, as it is convenient to term them (to distinguish them from those already assigned under the international scheme), daily magnetic indices. The present character figures represent the degree of magnetic disturbance, but there are daily variations which go on independently, whether disturbance is present or not; the disturbance changes are simply superposed on the other daily changes, which are seen in their pure form on quiet days. For the sake of brevity it is convenient to refer to the two sets of changes, and the corresponding varying magnetic fields, by the symbols D (disturbance) and Sq (the solar diurnal variations seen in isolation on quiet days, though coexisting with disturbance on other days). The D and Sq fields both show a variation of average intensity in rough parallelism with the sunspot cycle, but in most respects they are strikingly different—in their distribution over the earth (and the change in this distribution throughout the year), and in their fortuitous variations of intensity from day to day. The fortuitous variations of intensity of D are represented by the magnetic character figures, but at present we have no index of the day-to-day variations of intensity of the Sq field. In the latter case the range of variation is much less than for magnetic disturbance, but the changes are both interesting and important; as yet very little attention has been given to them. They appear to be correlated only slightly with those of D.

In various papers I have indicated reasons for believing that the D and Sq fields are associated with different types of solar emissions, the variations of which determine the changes of intensity of D and Sq. As already stated, the D variations depend upon the impingence on the earth of corpuscular streams from the sun, while Sq appears to depend on the sun's ultra-violet radiation. In both cases the solar influence is exerted largely by the ionisation which it produces in the earth's outer atmosphere. If this hypothesis is correct, changes in the sun's ultra-violet radiation will affect the intensity of the Sq variations all over the earth. This appears to be the case with the eleven-year changes of average intensity of Sq, and is probably true also for the fortuitous variations, though this has not yet been definitely established. The difference between the nature of the solar influences which determine D and Sq renders natural the contrast between the character and changes of these two magnetic phenomena; it also indicates the desirability of a daily index of the intensity of Sq as well as of disturbance. One immediate application of such indices would be their comparison with the measurements of the sun's ultra-violet radiation which were commenced by Pettit at Mount Wilson in 1924; this work has shown that the radiation may vary considerably from day to day, and there is also an indication of a long period variation following the sunspot cycle. It is important to ascertain how closely the day-to-day variations of this radiation are in agreement with those of Sq.

Many other phenomena which, like Sq, are associated with the upper atmosphere, should also be compared with the variations of Sq as well as of D; among them may be mentioned the zone content, the intensity of the luminosity of the night sky in different spectral regions, and the transmissibility of radio waves of different frequencies. It will also be of interest to examine the correlation between the changes of Sq and D; it may well be that the sun's ultra-violet radiation will show a

close correlation with the sunspot numbers and the proposed new solar character figures for bright regions near the centre of the sun's disc, and that the comparative lack of association between *Sq* and *D*, and the greater range and abruptness of the changes in the latter, are due to the special feature that these depend on the conjunction of the earth with a limited solar stream.

For these reasons it seems likely that in time international co-operation will be desirable to assign to each day a magnetic index referring to the intensity of *Sq* on that day; but before such a proposal can profitably be discussed in detail, preliminary investigations of the *Sq* variations are necessary to ascertain how they affect different magnetic elements and different observatories. Mr. J. M. Stagg is at present co-operating with me in the first of such studies, confined to data from Greenwich and Eskdalemuir, on purely quiet days.

Obituary.

DR. JOHN HORNE, F.R.S.

IT is seldom that the death of a man more than eighty years of age can so truly be described as an irreparable loss to his science as can be said of John Horne, who has passed away with full mental powers and while completing a work on the geology of Scotland, which would no doubt have been a masterly digest of the voluminous and scattered literature, a luminous statement of the problems, and have been inspired by his contagious enthusiasm.

John Horne was born beside the Campsie Fells, near Glasgow, on Jan. 1, 1848. He was educated at the High School and University of Glasgow, but he did not graduate, as at the age of nineteen years, on the establishment of the Scottish Geological Survey in 1867, he was appointed one of the original members of the staff. His life was spent in its service, and after his retirement he often acted as its unofficial adviser.

Horne's two most important contributions to geology were his preparation of the memoir on the geological structure of the North-west Highlands of Scotland, which was written by himself and five colleagues, and the large volume, in collaboration with Peach and Teall, on the Silurian rocks of Scotland (vol. 1, 1899), which described in detail the structure of the Southern Uplands. In both cases Horne convinced Sir Archibald Geikie that Lapworth's interpretations were correct, and thus led to the abandonment of the previously accepted theory of the structure of north-western Scotland and to the scrapping of the Survey maps of large parts of the Southern Uplands.

Horne worked on all branches of Scottish geology. He was probably most interested in the pre-Palæozoic rocks and in glacial problems, and he was the author of the report of the British Association Committee supporting the direct marine origin of the high-level glacial clays at Clava. His greatest single achievement was his administration of the Geological Survey of Scotland from 1901 until 1911. He was a tactful genial chief who gained the enthusiastic support and affection of all his staff; he was an active reformer and secured the great improvement in the Scottish maps by the introduction of colour printing. His success in gaining the confidence of the Scottish coalowners secured for the Survey full and harmonious co-operation with the mining industry. In his association with others he was helped by his keen sense of humour; he had an inexhaustible fund of racy anecdotes, which he told brilliantly. His death will be widely felt as a personal loss, for he had great gifts of friendship. He was respected and beloved by all who knew him well.

The wide recognition of the importance of Dr. Horne's work is shown by his many distinctions. He was elected a fellow of the Royal Society in 1900; he was LL.D. of three Scottish universities; he was president of the Royal Society of Edinburgh (1915–19), president of the Geological Section of the British Association at the Glasgow meeting in 1901, chairman of the council of the Royal Scottish Geographical Society, and he received the Wollaston and Murchison Medals of the Geological Society.

While on the Survey, Horne formed his beautiful and fruitful friendship with B. N. Peach. They first worked together in southern Scotland, but as Horne was dissatisfied with the official treatment of some of their results, he persuaded Peach to join him in some unofficial work; to go as far from Edinburgh as was possible in Scotland, they selected the Orkneys and Shetlands. His literary co-operation with Peach began with short papers in 1880 on the glacial geology of the Orkneys and Shetlands and on the North-west Highlands in 1883; it was continued in important memoirs on the Orkneys and Shetlands and Caithness, the Canonbie coalfield, and the volcanic rocks of the Old Red Sandstone.

According to a popular fallacy, Horne was the patient persevering plodder, whose main usefulness was as the amanuensis of his brilliant associate. Horne brought to the work keen insight, a sound, steady judgment, and powers of searching criticism which he applied remorselessly to every problem on which he worked. He was the leader in their joint work. After their retirement from the Geological Survey, Peach and Horne began together a "Geology of Scotland," which was put aside time after time because Horne would not accept some of Peach's views and could not get a satisfactory statement of his opinion for publication. The book was taken up again after Peach's death two years ago, but the interval has not been sufficient for its completion. The manuscript, it may be hoped, is sufficiently far forward for publication, for it should prove of the greatest value to geology, and a worthy monument to its author.

Horne's name will endure beside those of Lapworth and Judd as the men who, by their accuracy of insight and originality of conception, have left their mark most deeply on Scottish geology.

J. W. GREGORY.

MR. W. E. PLUMMER.

BY the death, on May 22, of Mr. William Edward Plummer, Director of the Liverpool Observatory, at the age of seventy-nine, there passes an astronomer of a bygone generation who did his full share of work for the science. His work lay in various fields, and it was his fortune to be one of the earliest of those who practise the newer astronomy of the photographic plate and its measurement.

Greenwich Observatory has been the nursery of many who have proved to be competent astronomers and have held responsible positions in other British or Colonial observatories, and Plummer was one of these. In 1864, at the age of fifteen, he obtained employment as a computer in the Royal Observatory, and spent four years, doing the routine arithmetic known as reduction of observations, when he was recommended for a post then vacant in Mr. Bishop's observatory at Twickenham. This was a private observatory built by Mr. George Bishop, a successful business man, at his house in Regent's Park, London, made famous in the middle of last century by the labours of Dawes, Hind, and others, whose services he retained consecutively as observers, which on the death of the founder in 1861 was removed to Twickenham by his son George Bishop, junior. In 1853, Hind, who was then in charge and had been specially active in the discovery of minor planets, was appointed Superintendent of the *Nautical Almanac* Office, but he nevertheless continued to exercise a general superintendence of the observatory, the actual observers being in succession Pogson, Vogel, Marth, Talmage, and, after 1868, W. E. Plummer.

Though Hind was then acting in an advisory capacity, it seems evident that Plummer was responsible for the actual conduct of the observatory, and to him, therefore, must be given the credit for the results, though he always acknowledged his indebtedness to Hind for whatever skill he had as an observer. It was an avowed principle of the elder Mr. Bishop that the observatory "should do something," and during Plummer's tenure of office the subject selected was apparently cometary astronomy, and so early as 1870 a paper was contributed to the *Monthly Notices of the Royal Astronomical Society*, "On the Orbit of the Comet of 1683," that Plummer had recomputed from Flamsteed's observations at Hind's suggestion. This was followed by other papers of similar kind, and though the preparation and publication of engraved charts of the stars within 3° of the ecliptic, which had been a staple work of the observatory, was continued, the computation of elements of orbits of comets, ephemerides, and other cometary investigations, formed a large part of Plummer's work during the six years he was at Twickenham.

Mr. Bishop's observatory was closed at the end of 1876, but in 1874, Plummer had been chosen by the Rev. Charles Pritchard, Savilian professor of astronomy at Oxford, as his assistant in the University Observatory which was then being built, his appointment dating from September 1874, though he began to give help on the completion of the establishment earlier. His work at Oxford was naturally the carrying out of the researches initiated and organised by the professor; measures of photographs of the moon, wedge photometry that was used for the determination of the magnitudes of all naked-eye stars from N.P.D. 0° to 100°, which was published as the "Uranometria Nova Oxoniensis," and photographic stellar parallaxes, all of which were pieces of work of a novel kind requiring skill and resource in their prosecution. The last named may be the first research of the modern type which depends on the measurement of photographic plates. He represented the Oxford University Observatory at the meeting of the Permanent Committee of the Astrographic Chart in Paris in 1891, when decisive points for beginning the work were settled.

There is ample evidence of the esteem in which Plummer was held by Prof. Pritchard and how much his work was appreciated. The University of Oxford recognised the value of his services by bestowing on him the honorary degree of M.A. Two rather extensive investigations were made by him and published under his own name whilst at Oxford; in the *Monthly Notices* for February 1881 he discussed the motion of the Companion of Sirius, comparing its observed positions with those given by the orbit predicted from the variations in the position of the primary, and arrived at the conclusion, before suggested, that the small star observed may not be actually the perturbing body; the other was a determination of the solar motion from stellar proper motions, published in vol. 47 of the *Memoirs R.A.S.*, which modified previous results similarly obtained only slightly.

In 1892, the year before Pritchard died, Plummer was invited by the Mersey Docks and Harbour Board to be Director of its observatory at Bidston, Birkenhead, and here he remained until the end of his life. The duties of the post are mainly connected with the needs of the port, and include the determination of time, the testing and rating of chronometers for the mercantile marine, the keeping of meteorological records, and attention to a seismograph. But besides the instruments that these tasks require, the observatory possesses an 8-inch equatorial, and for many years this was used for the observation of comets as they appeared, of occultations of stars, and for other purposes, but circumstances of the War and Plummer's advanced age prevented such observations recently. He contributed the annual report on cometary astronomy to the *Monthly Notices* up to the year 1912, and wrote papers on the same subject for the local astronomical society, in which he took much interest, being its president for several years. He held the honorary position of reader in astronomy in the University of Liverpool, and

his efforts in the cause of local scientific education received recognition by the award to him of the Kingsley Medal by the Chester Literary and Philosophical Society.

Plummer took an early interest in seismology, and was for many years a member of the Seismological Committee of the British Association. Before the beginning of his final illness, he co-operated actively in the foundation of the Tidal Institute, the work of which is already proving to be of importance.

Mr. Plummer leaves a family of two sons and a daughter: the elder son, Prof. H. C. Plummer, was Royal Astronomer of Ireland in the years 1912-21, and is now professor of mathematics in the Military College of Science, Woolwich.

DR. EDGAR WILLIAM WILLETT, who died at Hartfield, Sussex, on April 12, aged seventy-two years, was a son of the late Mr. Henry Willett of Brighton, and inherited his father's interest in geology. In 1881 he explored the mammal deposit in the Purbeck Beds at Swanage, and read a paper on a jaw of Triconodon to the Geological Society. In 1901 he investigated the occurrence of glossy flint implements in a gravel pit in Savernake Park, and read a paper on the subject to the Royal Anthropological Institute.

WE regret to announce the following deaths:

Mr. Cyrus C. Adams, of New York, geographer and formerly associate editor of the *Bulletin* of the American Geographical Society, aged seventy-eight years.

Dr. Bird T. Baldwin, head of the Iowa Child Welfare Research Station at the University of Iowa, and a past secretary and chairman of Section Q of the American Association for the Advancement of Science, on May 12, aged fifty-three years.

Prof. Gaetano Lanza, Cavaliere dell' Ordine dei Santi Maurizio e Lazzaro, emeritus professor of theoretical and applied mechanics at the Massachusetts Institute of Technology, on Mar. 21, aged seventy-nine years.

Prof. R. Lepetit, president of the Italian Society of Chemical Industry, known for his work on the synthesis of indigo and for the production of 'Italian green,' on Mar. 27, aged sixty-two years.

Prof. I. P. Roberts, formerly professor of agriculture, dean of the New York State College of Agriculture, on Mar. 17, aged ninety-four years.

Dr. Joseph Nelson Rose, associate curator of botany in the U.S. National Museum, an authority on the Cactaceæ and other Mexican and South American plants, on May 4, aged sixty-six years.

Prof. Arthur Schönfliess, of the University of Frankfurt on Main, the well-known mathematician, author with Prof. Nernst of "Einführung in die mathematische Behandlung der Naturwissenschaften," which has run into ten editions, on May 27, at the age of seventy-five years.

News and Views.

THE physical inheritance of man having been placed in proper relation to its animal ancestry, Sir Arthur Keith turns to man's mental attributes, and at the University of Manchester on May 9 delivered what may be regarded as a supplement to his British Association address at Leeds. The spiritual characteristics of mankind have always proved the most obstinate to be enrolled under the banner of evolution, and Sir Arthur's frank statement of his conclusions has given rise to much newspaper controversy, some of which scarcely did justice to his views. The Manchester lecture appears under the title "Implications of Darwinism" in the *English Review* for June; but the title might as well have been "The Uniqueness of Man's Spiritual Attributes," for care is taken to show that the crude mental inheritance derived from his animal ancestry is overlaid in man by a more perfected control. It comes to this: that while man's brain, and with it man's mentality, are grounded upon those of his ancestral apes, the balance has been altered by the expansion and finer development of the brain matter, so that what are looked upon as higher centres predominate over the lower or crude animal centres.

SOME of the specific points made by Sir Arthur Keith may be instanced. He rejects duality in the brain: there is here no compound of substance and spirit, but a living organ and its essential manifestation—"mind, spirit, soul are the manifestations of a living brain just as flame is the manifest spirit of a burning candle." Human nature is in its basis animal. There is the same sort of drive induced by the primary instincts of hunger or sex, and the more primitive the race of mankind the more bestial is the response to the urge. But repression is the normal means of human progress, and the higher the stage of civilisation the more the elemental instincts are held in control by the development of the higher powers of reason. Yet a complete rationalising of mankind is impossible and undesirable, since a complete subordination of the primary instincts would mean race suicide. "Our aim should be not to eradicate the animal propensities within us, but to bend them so as to serve best the interests of both individual and country."

ALTHOUGH the British School of Archæology in Jerusalem was established in 1919 only, it has already done much valuable work in archæological exploration. The discovery of the Galilee skull is alone of sufficient importance to justify its existence. It has, however, done much more. As the headquarters of British students and in some sort a centre of British society in Palestine, it has both served science well and also enhanced British prestige among the people in a way that is difficult for those unacquainted with conditions in the Near East to appreciate. Under the Directorship of Prof. John Garstang, the School was also responsible for the functions of a department of antiquities, but the double duties were made distinct in 1926, when a separate organisation for the record and preservation of archæological remains was set up. In the following year the Government grant of £500, upon which the School had been largely dependent, was discontinued. Now, therefore, the School is entirely dependent upon

voluntary subscriptions, and there is considerable danger that its activities may come to an end unless a guarantee can be obtained that an adequate annual sum will be forthcoming. An appeal has been issued asking for a sum of £1150 per annum, but the particulars given in the statement show that this is sufficient for bare maintenance only, and that for anything like effectual performance of its functions, at least £2000 per annum is required. It would be less than creditable to Great Britain if the School of Archæology in a mandated territory, in which other nations maintain centres for organised research, had to be discontinued. Further, Palestine, it is scarcely necessary to point out, is a country not only intrinsically of the greatest archæological and historical importance, but it is one to the culture of which the English-speaking peoples owe much through the traditional position of the Bible in their life and literature. Subscriptions may be sent to the British School of Archæology in Jerusalem, c/o Palestine Exploration Fund, 2 Hinde Street, London, W.1.

FURTHER broadcast messages from General Nobile give an account of the wreck of the *Italia*. The airship appears to have lost buoyancy and descended rapidly, striking the ice. More than half the crew reached the ice in safety, although two were injured. The wreck, with the remaining seven of the crew, was carried onwards. These men are probably on the ice to the east of the main party, but their position is unknown. The greater part of the expedition's stores is with them. Whether the shipwrecked men reach land or remain on the drifting ice, their rescue is not improbable provided they manage to secure food from seals or polar bears. General Nobile, however, seems to lack firearms, and there is no one with the party who is versed in Eskimo methods of hunting. Captain Sir Hubert Wilkins, writing in the *Times*, points out that the expenditure of energy of the shipwrecked men will be small if open water prevents their travelling over the pack and that consequently a small amount of food should suffice. The large aeroplanes now on their way to Spitsbergen will be useful in locating the parties and dropping food and firearms, but a combination of the efforts of ship and dog teams indicates the most likely road to safety.

THE British Non-Ferrous Metals Research Association has just published its eighth Annual Report, from which it appears that its expenditure on experimental work during 1927 amounted to no less than £20,000. As an example of the practical results obtained, the research on lead cable sheathing has led to the discovery of ternary alloys which are greatly superior to the usual sheathing material, and the Post Office has now ordered a new submarine cable to be sheathed with one of them, and manufacturing production has been begun. These new alloys have been protected by patent. The work on alloys suitable for exposure to high temperatures has also made important progress, and is closely connected with an investigation of the causes of wastage of locomotive firebox stays, a subject of great importance to railway engineers. The systematic study of the effect of various impurities on copper, and application of spectroscopic methods to the laboratory analysis of metals and alloys, are among the other interesting subjects of research in hand. It has been the experience of this and other research associations that the direct communication of the results of laboratory research to manufacturers does not always lead to their full utilisation, and it has been found desirable to set up a new Development Section, the function of which is to assist members to apply in their works the scientific results obtained by the investigators. This Section, staffed by qualified men, has already proved a great success, and its work will be followed with interest by all who are concerned with the proper utilisation of the results of science by industry. It is certain that the gap exists, and this effort to bridge it deserves success.

AN earthquake of moderate intensity was recorded at Kew Observatory at 6 hr. 26 min. 18 sec. G.M.T., on June 15. The epicentre was about 7000 miles away, but the initial impulse was too small to give any indication of the bearing. The earthquake that disturbed the greater part of southern Mexico late in the evening of June 16 was registered at Kew Observatory on June 17 at 3 hr. 31 min. 49 sec. G.M.T. The records indicate that the epicentre must have been under the Pacific Ocean off the coast of Mexico (near lat. 15° N. long. 100° W.). The earthquake was evidently of a strength far greater than the first accounts seem to indicate. From the seismogram obtained at the Government station at Tucubaya it is inferred that the epicentre lay 262 miles south-east of Mexico City, and this agrees nearly with the statement that the damage was greatest in the town of Oaxaca, which lies about 230 miles south-east of that city. It is probable, however, that the focus extended a considerable distance to the north-west of Oaxaca, for in Mexico City many lightly constructed houses collapsed and water-pipes burst, while the shock continued of great strength for about four minutes. At the Oxford University Observatory, a great earthquake, with its epicentre 82½° distant and probably in Central America, was recorded at 3.20 A.M. on June 17.

THE Bill to regulate the date of Easter Day and days dependent thereon came before the House of Commons on June 15 and received a third reading. The Bill as it now stands provides that Easter Day shall be the first Sunday after the second Saturday in April in the calendar year next but one after the commencement of the Act and in all subsequent years. A further clause provides that the Bill shall come into operation on a date to be fixed by Order in Council, but not until a draft Order has been approved by both Houses of Parliament.

AT the invitation of the Rector and the Senate, Sir J. C. Bose delivered a series of two lectures before the University of Vienna on June 9–11. The first, on "The Plant as a Sensitive Structure," illustrated by experiments, demonstrated identical physiological mechanism in plants and in animals. The

second, on "The Action of Drugs and Alkaloids on Pulse-Beats of Plant and Animal," was given before members of the Faculty of Medicine, who were greatly interested in the effect of new Indian drugs on the animal heart, demonstrated by the resonant cardiograph, recently constructed at the Bose Institute. Much interest was also shown in the extreme delicacy of a battery of new instruments by which the activities in the interior of the plant may be shown. The infinitesimal contraction recorder measures the contraction of a single cell under stimulation; the pumping action of the active layer in propulsion of sap in plants was visibly demonstrated by an apparatus which magnified invisible cellular pulsations more than a million times. In recognition of the importance of his discoveries in advancing knowledge of plant physiology, Sir J. C. Bose has been elected a foreign member of the Academy of Sciences, Vienna.

PROF. RUGGLES GATES, professor of botany at King's College, London, sails for Canada on June 23 on an expedition down the Mackenzie River. A permit has been received from the Canadian Government to carry on botanical and anthropological investigations in the North-West Territories and Mackenzie River District. He is taking a cinema camera and 3000 feet of film, in addition to photographic apparatus and collecting materials, which will be admitted free of duty. The intention is to compare the flora of this region with the tundra of Russian Lapland, and to make an anthropological study of Eskimo and half-breeds in comparison with the Ojibway Indians of Northern Ontario. It is hoped to include in this study the blood groups, as well as skin, hair, and eye characters. The Royal Botanic Gardens, Kew, is supplying plant-drying apparatus, and the Governor of the Hudson's Bay Company has made a grant towards the expenses of the expedition. Mr. K. Mellanby, a young botanist from Cambridge, will accompany Prof. Ruggles Gates.

IN December last there was published in New York the first number of an illustrated monthly journal bearing the name *Evolution*. It has the active support of the leading biologists of the United States. Its editors announced in the first issue that *Evolution* "will carry the positive message of facts from every field of natural science and leave it to the reader to make his own mental readjustment." A survey of subsequent issues shows that this policy is being successfully carried out by zoologists and anthropologists of the highest standing, and for the modest sum of ten cents the American public can learn what scientific men have to teach concerning man's origin. The chief aim of *Evolution* is to deprive "fundamentalists of having a strategic advantage in their nearness to the public ear, men of science being separated from the masses by their vocabulary, dislike of publicity, and absorption in work." It is, perhaps, too much to hope that this new venture will gain the ear of Fundamentalists, but it will certainly provide its readers with sound science plainly stated, and hence we wish it every success.

IN connexion with the physical and chemical survey of the coal resources of Great Britain, the Department of Scientific and Industrial Research has recently appointed a committee to deal with the South Wales Coalfield. The committee includes representatives of the Monmouthshire and South Wales Coal Owners' Association, the South Wales Institute of Engineers, the Geological Survey of Great Britain, and the Department of Scientific and Industrial Research. Similar regional committees are already at work in Durham and Northumberland, Lancashire and Cheshire, South Yorkshire, Nottinghamshire and Derbyshire, North Staffordshire, and in Scotland. The object of the survey is to investigate the characteristics of the various coal seams with the view of their utilisation to the best advantage. Local laboratories are established in each area for the examination of samples and, when necessary, large scale investigations are carried out at H.M. Fuel Research Station or elsewhere. The work of each committee is to advise as to which seams should be investigated, to recommend what large scale work should be undertaken, and to bring to the Department's notice any problems of particular local interest which may require investigation.

FOR fifty-eight years the Pharmaceutical Society of Great Britain has published annually a *Year-Book of Pharmacy*. The interest taken in pharmaceutical and pharmacological research and the development of the pharmacological activities of the Society, indicated by the recent establishment of pharmacological laboratories, have rendered it desirable that recent work should be published or reviewed more promptly than can be the case with a yearly publication. The Society is therefore issuing a *Quarterly Journal of Pharmacy and Allied Sciences*, incorporating the *Year-Book of Pharmacy*, the first number of which we have recently received. The first 60 pages are occupied by original papers on pharmacology and pharmacy: the remaining 100 pages are devoted to abstracts on the chemistry of drugs, pharmacognosy, pharmacy, pharmacology and therapeutics, clinical tests and new remedies. Among the papers in the first part, the following may be noted: the pharmacological assay of digitalis by different methods, by J. W. Trevan, E. Boock, J. H. Burn, and J. H. Gaddum; a method of assay of the antirachitic vitamin D, by K. H. Coward; the growth-promoting properties of vitamin D, by A. L. Bacharach; strychnine hydrochloride: its composition and solubility, by J. E. Driver and S. P. Thompson: the solubility and rate of solution of arsenious oxide B.P., by G. E. Trease. In her paper Dr. Coward advocates the use of a 'unit' of vitamin D activity: it is suggested that the standard be a stable preparation of irradiated ergosterol, and that 0·0001 mgm. of this preparation be taken as the 'unit.' This quantity will suffice to give healing of rickets in rats maintained on a rachitic diet, when administered to the animals daily for 10 days. The *Journal* should be read by all pharmacists and pharmacologists: it should be especially useful to those interested in the methods of biological assay, which are assuming an increasing importance in pharmacology. We shall await further numbers with interest.

THE King has approved of the following title being taken by the Right Hon. Sir Alfred Mond, Bart.: Baron Melchett of Landford, in the County of Southampton.

THE Institution of Electrical Engineers will hold a conversazione at the Natural History Museum, Cromwell Road, S.W.7, on Thursday July 5, at 8.30 P.M.

PROF. J. C. McLennan, professor of physics in the University of Toronto, will deliver the Bakerian Lecture before the Royal Society on June 28; he will take as his subject "The Aurora and its Spectrum."

THE diploma of honorary membership of the University of Innsbruck has just been conferred on Mrs. Ogilvie Gordon in recognition of her valuable geological researches on the Dolomites of South Tyrol. Mrs. Ogilvie Gordon has also been nominated as an honorary correspondent by the Geological Survey of Austria.

THE appointments to scientific and technical departments made recently by the Secretary of State for the Colonies include a cotton investigator, Mr. T. C. Cairns, and a game ranger, Captain J. Minnery, to Tanganyika Territory; a live-stock officer, Mr. W. D. D. Jardine, to Kenya Colony; an assistant conservator of forests, Mr. D. McIntosh, and an assistant manager, oil palm plantation, Mr. I. G. C. Squire, to Sierra Leone.

THE Albert Medal of the Royal Society of Arts for the current year has been awarded by the Council, with the approval of the president, H.R.H. the Duke of Connaught, to Sir Ernest Rutherford, Cavendish professor of experimental physics in the University of Cambridge, "for his pioneer researches into the structure of matter." The Medal was founded in 1863 as a memorial to Prince Albert, for eighteen years president of the Society, and is awarded each year "for distinguished merit in promoting Arts, Manufactures, and Commerce."

KING Edward's Hospital Fund for London has arranged, by courtesy of a number of firms, a series of visits to factories in and around London which are the sources of many of the amenities of modern life and will be of interest to scientific workers. The programme includes the following works: Osram (General Electric Co., Ltd.) Lamp Works, Brook Green, Hammersmith (June 27); The Gramophone Co., Ltd. ("His Master's Voice"), Hayes, Middlesex (July 4); Kodak, Ltd., Wealdstone, Middlesex (July 11); Messrs. Bryant and May, Ltd., Fairfield Road, Bow (July 18); United Glass Bottle Manufacturers, Ltd., Anchor and Hope Lane, Charlton (July 25); Messrs. J. Lyons and Co., Ltd., Ice and Confectionery Factories, Greenford, Middlesex (July 30 and 31). Full particulars of the visits can be obtained from the secretary of the Fund, 7 Walbrook, E.C.4.

THE Liverpool meeting of the Institute of Metals, to be held on Sept. 4–7, is evidently proving attractive; already more than two hundred members—including many from overseas—have indicated their intention of taking part. The papers to be presented include a valuable series dealing with the die-casting of alloys, as well as the eighth report to the Corrosion Research Committee. A full discussion of corrosion problems will form a feature of the meeting, as is appropriate in a maritime centre such as Liverpool. On July 4 an election of members is taking place in connexion with the Liverpool meeting, full particulars of which can be obtained from Mr. G. Shaw Scott, Secretary, Institute of Metals, 14 Members' Mansions, Westminster, London, S.W.1.

THE Swiss Society of Natural Science is holding its annual conference this year at Lausanne on Aug. 30–Sept. 2. The provisional programme which has been issued announces papers by Prof. E. Bosshard, of Zurich, on chemical industry, its past and future; Prof. C. Schröter, of Zurich, on a journey through Java in 1927; Prof. M. Askenasy, of Geneva, on the aims of research on tumours and the results already obtained; and Prof. A. Reymond, of Lausanne, on occult science in antiquity. The proceedings of the meeting will be organised in seventeen sections, covering all branches of science, pharmacy, engineering, the history of medicine and of science, etc. Communications for the sections should be notified to Prof. A. Maillefer, Musée de Botanique, Palais de Rumine, Lausanne, by June 30. Some beautiful and interesting excursions are promised. Full particulars of the meeting can be obtained from the president, Dr. J. Amann, 2 Avenue Rambert, Lausanne.

A recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., announces a gift by Mr. Jeremiah Milbank of 250,000 dollars for an international research upon infantile paralysis. Dr. William H. Park, of New York University, is chairman of the committee, and the universities of Chicago, Columbia, Harvard, New York, and Brussels, the Lister Institute of London, and the Metropolitan Life Insurance Company, will participate in the work.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time assistant-master for science and mathematics at the London County Council Beaufoy Institute, Prince's Road, Vauxhall, S.E.11—Education Officer (T. 1*a*), The County Hall, Westminster Bridge, S.E.1 (June 26). An assistant lecturer in physiology and an assistant lecturer in biochemistry at the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (June 28). A full-time teacher in the mechanical engineering department of Lincoln Technical College—The Principal, The Technical College, Lincoln (June 28). Two lecturers at the Municipal Technical College, Swansea, with qualifications in two of the following three subjects: chemistry, botany, pharmacy—Director of Education, Education Office, Dynevor Place, Swansea (June 28). A full-time assistant lecturer in engineering at the Technical College, Cardiff—The Principal, The Technical College, Cardiff (June 30). Principal of the Wigan and District Mining and Technical College—Registrar, Wigan and District Mining and Technical College, Wigan (June 30). An assistant master at

the Rugby College of Technology and Arts, with good chemistry qualifications and subsidiary physics—The Organiser of Further Education in Rugby, 61 Clifton Road, Rugby (July 4). A lecturer in agricultural zoology at the University College of the South West of England, Exeter (for work jointly with the Seale Hayne Agricultural College, Newton Abbot)—The Registrar, University College, Exeter (July 4). An assistant lecturer in zoology at the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (July 5). A reader in materia medica and therapeutics at the University of Manchester—The Registrar, The University, Manchester (July 7). A technical officer at the Royal Aircraft Establishment, South Farnborough, for design and experimental work in connexion with electrical equipment for use on aircraft—Chief Superintendent (No. A 282), Royal Aircraft Establishment, South Farnborough, Hants (July 14). Candidates for not less than two vacancies for geologists on the Geological Survey of Great Britain—The Director, Geological Survey and Museum, 28 Jermyn Street, S.W.1 (July 14). A non-established draughtsman in the Ministry of Agriculture and Fisheries—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (July 26). A senior lecturer in physics and applied mathematics at the Huguenot University College, Wellington, C.P., South Africa—The Registrar, Huguenot University College, Wellington, C.P., South Africa (Aug. 31). A professor of mathematics at the University College, Pietermaritzburg—The Registrar, Natal University College, Pietermaritzburg, Natal (Nov. 1). A zoological laboratory steward at University College, Hull—The Secretary, University College, Hull. A full-time science master at the Technical Institute, Tunbridge Wells—Dr. J. Lister, Technical Institute, Tunbridge Wells. Three junior assistants at the Directorate of Ballistics Research, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A capable research chemist or physicist in a research laboratory in London—Box No. 71, c/o NATURE Office, St. Martin's Street, W.C.2. A junior assistant at the Directorate of Metallurgical Research, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

METEORS AND SKJELLERUP'S COMET.—Mr W. F. Denning writes: "The only nights favourable at Bristol for the observations of meteors, possibly connected with Skjellerup's comet, of last December, were June 10 and 11, which provided two excellent opportunities. The cometary orbit, however, approaches the earth's path to the nearest point on about June 7–8, so that this date had passed before the weather permitted suitable watching of the skies. Very few meteors were seen on June 10 and 11, and two only, out of about twelve observed, were directed from the region in which the cometary radiant was placed. There may have occurred a shower on preceding nights, but no information has come to hand with details of successful results, and I fear that none were obtained.

"Four fairly bright meteors were observed at Bristol, and as they may have been recorded elsewhere, I give their apparent paths:—

	G.M.T.	Mag.	From	To
June 10	11.5	1	313° + 69°	23° + 70°
,, ,,	12.5	Jupiter	325 + 56½	334 + 52
June 11	11.27	Jupiter	243 − 19	234 − 8
,, ,,	12.10	Jupiter	310 + 32½	308 + 31

The first two were observed by me; the others by an assistant. The radiants of the meteors were probably 251° − 25°, 310° + 62°, 251° − 25°, and 314° + 34°."

COLOUR PHOTOGRAPHY OF THE MOON.—Mr. F. J. Hargreaves, Director of the Photographic section of the B.A.A., was one of the first to obtain successful colour photographs of the moon; these were exhibited at a meeting of the B.A.A. some two years ago, and led to the conclusion that the colour of the greater part of the moon's surface resembles that of a weathered stone wall of a light brown or yellowish tint.

Mr. Hargreaves contributes an article on his photographic methods to the March number of the *Taylor-Hobson Outlook*, illustrated by two photographs; one is of the moon (not coloured) taken with a 6½-inch mirror and an equivalent focal length of 25 feet; the exposure was 2 seconds; a large amount of detail is visible both in the dark and brighter regions. The other is of the Andromeda nebula, exposure 1½ hours, focal length 20 inches; a good deal of detail is visible, the dark spaces between the whorls of the spiral being plainly discernible. It is noted that the picture of the farther edge of the nebula is some thirty thousand years older than that of the nearer edge.

These pictures are the more creditable in that the mounting of the equatorial is of the simplest character and almost entirely home-made. It will be remembered that the comet Grigg-Skjellerup at its return last year was first detected on Mr. Hargreaves's plates, although the huge instruments at the Yerkes and Bergedorf Observatories were already engaged in the search.

THE DISTANCES OF THE SPIRAL NEBULÆ.—An article by R. Hess in *Astr. Nach.*, 5561, brings out an interesting point regarding Dr. Hubble's estimates of the distances of the spirals. Hubble began by tabulating the apparent and absolute magnitudes of seven objects, including the Andromeda nebula, the two Magellanic clouds, and M 33. He thus deduced the average absolute magnitude of a spiral nebula as − 15·0; he used − 15·2 in deducing the distances of the fainter spirals from their apparent magnitudes. Mr. Hess points out, however, that in our star system there is a correlation between apparent and absolute magnitude; this feature also appears among the seven objects used for getting the scale; those with fainter apparent magnitude have also fainter absolute magnitude. Thus it is unsafe to use the value − 15·2 derived from bright spirals as the correct mean to take for much fainter ones.

Mr. Hess admits that the material is insufficient to obtain the law of correlation, but he has made a preliminary attempt. He gives the following example of its application. Dr. Hubble estimated the distance of spirals of apparent magnitude 16·7 (which need an exposure of an hour with the Mt. Wilson 60-inch reflector) as 80 million light years. Hess's correlation law would reduce this to ten million light years, which would make the distribution of spirals in space some 500 times as dense as Hubble's value. No claim of accuracy is made for the correlation law deduced by Hess, but he seems to be correct in indicating the need for assuming such a law, which would lead to an appreciable diminution of Hubble's estimates for the fainter spirals.

Research Items.

BENGALI MARRIAGE AND COGNATE CUSTOMS.—Mr. M. M. Chatterji has published a number of notes on Bengali customs in the *Journal of the Asiatic Society of Bengal*, vol. 22, N.S., Pt. 6, which for the most part deal with rites and ceremonies connected with marriage. Prostitutes are devoted to their profession by a ceremonial or 'mock' marriage which is intended to preserve the religious purity of the system by an implied consent of the human or inanimate husband. The prostitute bears the mark of vermilion powder on her hair and the iron bangle on her left wrist which distinguish the married woman. The marriage may be with a degraded or pretended Brahman, with an idol, public or private, or with a long-lived shrub such as the tube-rose, of which the preservation becomes an anxious care. Should an idol which has been married be destroyed, as sometimes happens in the case of the private effigy, the surviving wife has to abandon all signs of wifehood. In the initiation into wifehood, on the appearance of the signs of puberty, the woman is segregated, not being allowed to see the sun or a male, in a cell or narrow room formed by a barricade in the corner of a room of two lines of bamboo branches on mud pedestals. She is under the supervision of a board of five women, of whom the chief must be a woman all of whose children are alive or, failing that, whose first-born child is alive. The girl's diet is carefully regulated, consisting mostly of uncooked vegetables and milk and its preparations. An important part of the observance is a bath on the fifth day in the unexcavated tank, which is not a tank but a platform of mud, which also appears in the ante-nuptial bath taken by both bride and bridegroom before marriage, when water is poured over the bathers. In the puberty custom, the girl's companions pelt one another with mud while the girl picks up clams which have been spread out on the bath and water poured over them. This may be regarded as indicating that originally this bath must have taken place in a stream or river.

HOURS OF WORK.—Report No. 47 of the Industrial Fatigue Research Board (London: H.M. Stationery Office), by Dr. Vernon and others, consists of two studies on hours of work, namely, the five-hour spell, and the two-shift system. It is found that the adoption of a rest pause within the 5-hour spell—with opportunity for refreshment—is desirable both for physiological and psychological reasons. The rest pause increases the efficiency of the workers, for, in various occupations the immediate effect of a rest pause was to increase the output. There is, however, a number of semi-continuous occupations where the rest pause is not practicable because the loss of time involved is greater than the nominal rest pause. It is suggested that it might be possible for different groups to take their rest successively. The two-shift system is the centre of much difference of opinion. Contradictory assertions are often made as to the effects of this system, assertions which it is difficult either to prove or disprove. This report is interesting for its negative character. Neither system seemed to show significant differences in any measurable standard, nor was there any difference in sickness. Where either system was in regular operation, workers seemed to adapt their habits and to be satisfied: a change over from one to the other was usually unpopular, and in some cases resulted in a high labour turn-over. The problems involved seemed to be rather of a social character and to be dependent on local conditions.

ANIMAL LIFE IN A PHILIPPINE HOUSE.—The various kinds of animal life that occur in a nipa dwelling-house in the Philippines form the subject of an interesting paper by Dr. F. X. Williams in the *Philippine Journal of Science*, vol. 55, January 1928 (pp. 53-118). During a residence of two and a half years, Dr. Williams has been able to record quite an extensive fauna sharing his dwellings in those islands. Scorpions, spiders, and centipedes are prevalent, and among the latter creatures a large species is recorded which was found in the nest of a sparrow, clinging around the bird's body with its head imbedded in the sparrow's side: the bird, it may be added, died from the attack. Termites are dealt with in some detail, and the author records the behaviour of the predaceous fly *Bengalia*, which he noted seizing these insects and carrying them near by to suck out their body-fluids. An unknown beetle larva living as an ectoparasite of a termite is figured. Wasps, bees, and ants are favourite groups with the author, who records a number of interesting observations on their economy. Among vertebrates, lizards are among the most constant representatives of a tropical house fauna. The so-called 'talking lizard' (*Gecko gecko*) is perhaps more often heard than seen, and is eager to devour such large insects as hawk moths and *Oryctes* beetles, or even small birds and bats. Among birds that live in houses of their own accord, the only truly domiciliary kind is the common sparrow (*Passer montanus*), while bats of several species are more frequent inhabitants.

BRITISH SPECIES OF PROTURA.—The Protura or Myrientomata are very minute, fragile wingless insects which remained unknown to science until the year 1907, when Silvestri erected a separate order for this reception. In the *Entomologist's Monthly Magazine* for May, Mr. H. Womersley describes three new British species of the genus *Acerentomon*, all from the southern counties of England. The descriptions are based upon single examples in each case, and although all three specimens were immature, the characters relied upon are stated to be constant throughout the different instars of any particular species, and are therefore to be considered specific. Mr. Womersley also provides a key to the British members of the order, and enumerates fourteen species up to date, of which eight belong to the genus *Acerentomon* Berl., three to *Acerentulus* Berl., one to *Parentomon* Wom., and two to *Eosentomon* Berl.

OXYGENATION IN RESEARCH.—L. R. Cleveland (*Science*, vol. 63, pp. 168-170; 1928), who by confining termites in oxygen at a pressure of 60 lb. per sq. in. for one hour has removed their protozoa without injuring the termites, suggests that a similar technique may be helpful in other investigations. He points out that it is an important and difficult problem to keep silkworms free from the protozoan *Nosema*, and that possibly by confining the eggs or cocoons of the silkworm in oxygen under pressure, this protozoan menace to the silk industry may be abolished. More than three hundred species of microsporidia, one or more species of the flagellate *Hexamitus*, and two genera of ciliates—*Ichthyophthirius* and *Chilodon*—are parasitic on fishes. It is known that *Hexamitus* can be killed by oxygenation and without the slightest injury to its hosts, and perhaps the other protozoan parasites of fishes as well as the trematode *Gyrodactylus* and the moulds (*Saprolegnia*) may be dealt with in the same way. By confining in oxygen under

pressure insects concerned in the transmission of protozoa, it may be possible to obtain protozoa-free insects required for experimental work, and the method might be helpful in destroying the insects which infest grain and nuts. The fact that different protozoa react differently to oxygen, and that the death points are fairly separated, renders possible the removal of only some of the protozoa while leaving others, and hence observations on how the presence of one protozoan inhibits the multiplication of another. Dr. Cleveland further suggests that many of the examples of symbiosis should be re-investigated, *e.g.* insects with intestinal yeasts, or with intracellular yeasts and bacteria, to ascertain how, if at all, the micro-organisms aid their insect hosts or partners.

SEXUALITY IN THE MYCETOZOA.—The striking differences in structure exhibited by the various stages in the life-history of the slime-fungi have attracted the attention of many investigators, and although sexuality in the group was discovered by Jahn (1911) and recorded for several species, it has been left for Wilson and Cadman to work out a completed sequence of events and publish a detailed description of the whole process (*Trans. R. S. of Edin.*, vol. 55, part 3, No. 24). The complete life-history has been worked out for *Reticularia Lycoperdon* Bull., particular attention being paid to the accompanying cytological changes. This species differs from many others of the group in the absence of myxamœbæ and resting stages such as cysts or sclerotia in the life-history. Spore germination seems to depend on the osmotic pressure exerted by the surrounding liquid, and not on the presence of bacteria. The spores are uninucleate, and on germination give rise to small amœboid masses of protoplasm which pass into the flagellate form. On swarming, these cells withdraw their flagella, and then divide karyokinetically in a transverse plane. After a number of divisions the swarm cells become gametes, which fuse in pairs seemingly accidentally. Before the final fusion of the nuclei of two gametes, other swarm cells, from three to eight in number, are drawn into the fusion cell, the process being regarded by some authorities as 'ingestion,' by others as 'coalescence.' Wilson and Cadman consider the fact that the fusion cell is dominated by a diploid nucleus, and the entering swarm cells by haploid nuclei, constitutes a physiological difference between the two protoplasms sufficient to prevent their coalescing and become one. That this view may be the correct one is suggested by the fact that the nuclei of the entering swarm cells are digested in vacuoles and absorbed.

A BACTERIAL DISEASE OF COTTON.—The bacterial disease of cotton known as Angular Leaf Spot has recently assumed serious proportions in the Sudan. Hitherto, successful methods for its control have not been devised because the conditions for favouring or checking the disease were unknown. It could become prevalent under widely different climatic conditions, varying from desert to wet tropics, and further, its occurrence was independent of air temperature and soil acidity or alkalinity. R. E. Massey, however (*Annals of Botany*, **41**, 497), has demonstrated a close correlation between soil temperature and the incidence of the disease. The experimental work was carried out on seedlings in boxes and also in the field, the temperature readings being taken at a uniform depth of 2 in., namely, that at which the seed is planted. Infection appears to be confined to a definite range of soil temperature. Whereas at 11°-20° C. it is slight, and not usually serious if conditions are favourable for the growth of the seedling, at 21°-26° C. infection is severe. At still higher temperatures, however, the intensity decreases, at 28° C. little or no infection being obtained, and at 30° C. the plant is generally immune. Preliminary experiments were also carried out with artificial inoculation, healthy seedlings being sprayed with water containing a suspension of the bacteria. If a cooling current of air was directed along the spray so that the soil and air temperatures were reduced from 34° to 22° C., marked infection was obtained. This furnished indirect support to Faulwetter's theory that splashing of raindrops was a means of transmission of the disease.

TRIASSIC FAUNA OF NORTH AMERICA.—In a monograph on the Upper Triassic marine invertebrate faunas of North America (*Prof. Paper*, 141, U.S. Geol. Surv.; 1927), J. Perrin Smith gives another instalment of his long-continued researches on the marine Trias. 314 species are described and illustrated by 121 plates. A summary of the geographical relationship of the faunas of the Triassic zones is given, and it is shown that at some periods the American Sea was connected with the Arctic and Oriental, at other times with the Mediterranean Sea. Some of the faunas have a wide distribution; that of the lower Noric coral zone extends from the Mediterranean region to California, and from thence to Alaska and the Himalayas. In all these regions it is characterised by the abundance of reef-building corals related to modern forms, which flourish only where the temperature is not lower than 74° F., and it is probable that this temperature extended up to Alaska. The ammonites form a large part of the Triassic fauna, and according to the author belong to two main stocks only, both descended from Carboniferous goniatites; one from the Gephyroceratidæ, the other from the Gastrioceras branch of the Glyphioceratidæ. In the Upper Trias there are numerous ammonoids showing dwarfed, degenerate, or reversionary characters, suggestive of racial old age.

MAGNETIC DECLINATION TABLES FOR THE MINING INDUSTRY.—For some years past, in response to appeals from mine-surveyors, particulars of the magnetic declination during each week have been supplied to the *Colliery Guardian* for speedy publication. As the usefulness of the data became familiar to surveyors, the need for modifications of the original scheme, and of additions to it, began to be felt. During the past year or more the subject has been much discussed in mining societies and publications, and representative requests for changes in the data supplied have been formulated and communicated to the Government departments concerned. These are the Royal Observatory, Greenwich, which is responsible for what is now the only complete magnetic observatory in southern England, at Abinger; and the Meteorological Office, which is responsible for the magnetic observatory at Eskdalemuir, just north of the Scottish border. Both observatories now provide data for each hour (originally only averages over two hours were published), these being mean values over the interval from one exact Greenwich hour to the next. The declination is given to the nearest half-minute of arc. Moreover, an indication is given, by attached symbols or special type, of the occurrence of unusual variation, within three intervals of range, in the course of any hour. This makes it possible for a surveyor anywhere in England or southern Scotland to form a rather accurate estimate, on any not too disturbed day, of the correction to be applied

to a magnetic bearing for the departure of the declination at that hour from the mean of the day or year. Further, arrangements have been made by which duplicates of the original magnetographs can be purchased from the observatories at a small cost, so that for any special purpose still more accurate knowledge of the changes of declination may be gained than is permitted by the hourly tabulations.

MULLER HOT CATHODE TUBE.—The X-ray tubes made by Messrs. Muller of Hamburg can now be obtained in Great Britain from Messrs. Watson and Sons (Electro-Medical), Ltd., of Sunic House, 43 Parker Street, Kingsway, and are described in a small booklet published by that firm. In these tubes the electrons which constitute the cathode stream are generated by a filament heated by a separate current, as in the more familiar Coolidge tube. The Muller tubes have, however, several distinctive features. The residual gas is helium, which, it is claimed, reduces the chance of molecular collision and also allows of a pure electronic discharge at a higher pressure than is possible with air. In practice, it is found that the helium-filled tube seldom breaks down from perforation. Several of the tubes are constructed on the line-focus principle. The filament of the cathode is so placed that the electrons emitted are projected on to the anode in the form of a line instead of a spot. The anode is made with the surface of the target more nearly at right angles to the incident beam than is usual, so that the line-focus, viewed from the direction of the principal ray of the X-ray beam, appears as a spot. Since X-rays are emitted in uniform intensity over an angle of nearly 180°, this arrangement does not reduce the intensity of the radiation to any extent, whilst the heat of the discharge is distributed over a wider area. Such a line-focus tube can therefore carry a heavier current than the corresponding tube of the ordinary type, without risk of overloading. It is necessary to take particular care in the centring and aligning of tubes of this type, as a loss of detail is noticeable if the tube is rotated to any degree, a loss which may be accompanied by somewhat curious astigmatic effects.

CRYSTAL STRUCTURES OF BENZENE HEXABROMIDE AND HEXACHLORIDE.—Hendricks and Bilicke (1926) showed that benzene hexabromide and hexachloride both have four molecules in the cubic unit of structure. The crystal structure of these compounds is further discussed in the *Journal of the American Chemical Society* for March by R. G. Dickinson and C. Bilicke, who have obtained new X-ray data. The centres of the four molecules in the unit are at points equivalent to either $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ or (0,0,0), and the six bromine atoms nearest to these points form a regular octahedron or a ring in which the atoms are not coplanar, respectively. Stereochemical considerations favour the latter configuration, since if the cyclohexane ring has its centre at (0,0,0), the halogen atoms fall very nearly in tetrahedral directions from the carbon atoms and at distances of 1.94 A. from them. The configuration of the hexachloride molecule is shown by the experimental data to resemble closely that of the hexabromide.

A QUANTITATIVE STUDY OF THE PHOTOCHEMICAL ACTIVATION OF STEROLS.—Recent discoveries have shown that rickets can be cured by sterols which have previously been exposed to ultra-violet radiation. In the *Journal of the American Chemical Society* for March, R. J. Fosbinder, F. Daniels, and H. Steenbook describe an attempt to determine the amount of energy necessary to secure a definite deposition of calcium in the bones of a rachitic rat. Specially purified cholesterol was used and, after exposure in different parts of the spectrum, was tested physiologically. It was found that only wave-lengths shorter than 313 millimicrons were effective in the process of activation, and with the Hg line at 265 mμ. a minimum energy input of 234 ergs was required to give a positive test. The energy input required increased with the wave-length up to 2730 ergs at 302 mμ. Assuming the Einstein law and the complete utilisation of all the light absorbed for the production of vitamin D, the results indicate that $3{\cdot}2 \times 10^{13}$ molecules or 2×10^{-8} gm. of vitamin D is sufficient to initiate a cure of rickets. This result may be compared with that of Rosenheim and Webster, who found that 1×10^{-7} gm. of irradiated ergosterol was sufficient to give a positive test. In view of the minuteness of these quantities, it seems impossible to relate the gross chemical or physical properties of the irradiated material with its antirachitic action.

THE ROTATING LOOP WIRELESS BEACON.—The sixth special report of the Radio Research Board, by R. L. Smith-Rose and S. R. Chapman (London: H.M. Stationery Office, 1928. 2*s*. 3*d*. net), describes experiments carried out on a rotating loop beacon transmitter at Fort Monckton, near Gosport. The object of the investigation was to study the performance of the beacon when transmitting over land and sea, and in particular to ascertain the trustworthiness for navigation purposes of radio bearings taken under many different conditions. The experiments were made on board ship at many different distances from the beacon. The inaccuracies were found to be of the same order as those obtained in radio direction finding under the most favourable conditions. Up to distances of 50 miles, both by day and night the readings were sufficiently accurate for navigation purposes. Even at 50 miles the inaccuracy of the great bulk of the observed bearings was less than two degrees. When, however, the waves passed over land, appreciable errors occurred, and so it seems desirable that at least during the night time the path of the transmission should be entirely over the sea. The great advantage of the beacon system is that for reception only an ordinary radio receiving set is required. It is probable, therefore, that the beacon system will prove of great value in marine navigation. Experiments were also made with a closed loop instead of an open aerial, in order to compare the results obtained. The experiments prove that when an aerial is available it is always better to use it. Attempts were also made to improve the sharpness of the signal 'minima' by surrounding the whole of the rotating portion of the beacon by an open wire screen. A slight improvement in the sharpness of the minima was obtained, but it was largely masked by errors due probably to local conditions at Fort Monckton. The screen had certainly no detrimental effect on the radiation. It seems, therefore, that it would be possible to protect a rotating beacon from lightning by enclosing it within a symmetrical screen of vertical wires.

COAL CARBONISATION TESTS.—In amplification of the paragraph on the test of the 'Crozier' retort for low temperature carbonisation in our issue of June 9, p. 921, it may be said that the intermittent operation during the trial was enforced by the lack of electric power supply at Wembley. Although the retort is unsuitable for dealing with caking material, it is designed to deal with shales and lignites, and is claimed to be suitable for some British coals which are not now being carbonised.

Anthropological Research in Australia.

IT was announced in NATURE of Nov. 6, 1926, that the Rockefeller Foundation had made a grant of funds to the Australian National Research Council for anthropological research in Australia and the Pacific. With the help of these funds several important researches have now been carried out.

A systematic attempt is being made to collect as much information as possible about the surviving aborigines of Australia before it is too late. Mr. Wm. Lloyd Warner (University of California) has spent several months amongst the hitherto unknown natives of the north-eastern corner of Arnheim Land, where he has discovered an interesting form of social organisation and a highly elaborate system of totemism. He has now returned to the same region for a second season's work. Miss Ursula McConnel (University of Queensland) has spent some months making investigations amongst the Wikmankan tribe of the Archer River, Gulf of Carpentaria, and she will be continuing her work amongst the same people this year. Dr. A. P. Elkin (Universities of Sydney and London) is studying the natives of the Kimberley District of Western Australia. He has already obtained interesting and important results. His work will be continued for about eighteen months in all. Mr. C. W. M. Hart (University of Sydney) will be at work during 1928 amongst the natives of Melville and Bathurst Islands, North Australia. Mr. Donald F. Thomson (Universities of Melbourne and Sydney) is to spend twelve months amongst the natives of the eastern side of the Cape York Peninsula.

Outside Australia the chief problem that has been taken up has been the investigation of the Polynesian colonies in Melanesia. Mr. H. W. Hogbin (University of Sydney) has paid a short visit to Rennell Island and is now engaged in a systematic study of the people of Ontong Java or Luanuia, an outlying atoll of the Solomon Island group. The inhabitants are Polynesian in language, but have a very distinctive culture of their own, the affinities of which it is not yet possible to determine. Since the group was taken up by Messrs. Lever Bros., the population has decreased with extraordinary rapidity. Of an estimated population of five thousand in 1907, there only survive five hundred and sixty-eight, so that the present study of them is only just in time. Dr. Raymond Firth (Universities of New Zealand and London) left early in May for a year's field work in the outlying island of Tikopia — another of the Polynesian-speaking peoples of Melanesia.

The study of the native peoples of New Guinea is already being carried out by the Government anthropologists of the Territory of Papua and the Mandated Territory of New Guinea, but it is intended to supplement their work with that of special investigators. Mr. R. F. Fortune (Universities of New Zealand and Cambridge) is at present investigating the natives of the D'Entrecasteaux Archipelago.

In all the above-mentioned researches the aim is to study as completely as possible the language and customs of the people investigated. The Australian National Research Council has also provided for certain researches of more limited scope. The University of Adelaide has established a board for anthropological research and has carried out investigations in physical anthropology of the aborigines of South Australia and a study of the aboriginal music of the Arunta tribe. The Department of Physiology of the University of Sydney has initiated a series of investigations, still in progress, which have for their purpose the comparison of the physiology of the Australian aborignes with that of white people in Australia and in Europe. These investigations promise to give interesting results.

Optical Instruments for Research Laboratories and Works.

IT is not given to all men to be able to invent a proverb, but whereas it has been truly said that 'necessity is the mother of invention,' it has been the good fortune of Messrs. Adam Hilger, Ltd., to make invention the mother of necessity. There can be few persons responsible for the equipment of a physical or spectroscopic laboratory who will not realise the necessity of some of the beautiful instruments which have originated in the Hilger workshops.

The last fifteen to twenty years has seen an immense expansion in the range of products of this firm, disregarding the abnormal period of the War, and this growth of activity is reflected in the catalogue recently published.[1] In the early days, however, when the main products were confined to spectroscopic apparatus and optical work, the firm had the wisdom to build on a sound foundation of high quality work, and this reputation of thoroughness and consistency is still deservedly held at the present time. Hilger instruments have been concerned in many of the most important of modern researches, and the firm is entitled to an honourable place in the company of science, for it is true that the design and evolution of an instrument is a matter which often calls for the solution of problems quite as difficult as those in which the use of the finished instrument is employed.

The flattery of imitation cannot make the instrument maker vain; it calls not only for fresh invention but also for a continual improvement of his wares if he is to keep his lead. Of the various instruments wholly or largely originated by Messrs. Hilger, amongst which may be mentioned the group of wave-length spectrometers, the different spectrographs, the 'Twyman' interferometers, and instruments for spectrophotometry, ultra-violet refractometry, and the like, it is of the greatest interest to study the development of some of the leading types. The wave-length spectrometer has not only been greatly improved in convenience and optical performance, particularly in regard to stray light, but also the fundamental ideas in the design have been carried out in monochromators and various specialised forms of spectroscope, and the instruments have been adapted for spectrum photography and physical spectrophotometry.

In the class of spectrographs the new all-metal 'quartz' spectrographs will attract attention. They embody an optical system in which the number of component lenses has been reduced by the employment of aspherical surfaces, and it is claimed that a considerable improvement in the richness of spectrum detail has resulted, together with a possible increase in the range from 2000 A. in the ultra-violet to about 10,000 A. in the infra-red. It has been the general experience that quartz systems made from carefully selected material yield a degree of definition practically unattainable by systems made of glass, so that the performance expected of this instrument will certainly be of a very high order; it should be of great use in trying atmospheric conditions.

The spectrograph of standardised design with inter-

[1] "A General Catalogue of the Manufactures of Adam Hilger, Ltd." Pp. 8+D22+E36+F36+H32+K2+L7+M28+N14+iv. (London: Adam Hilger, Ltd., 1928.)

changeable optical systems is another new venture which should interest those who have no space for a multiplicity of instruments for different purposes, and the possibility of varying the optical and dispersion systems ought to be of the greatest interest to teachers.

Those interested in many recent advances in vacuum spectroscopy, X-ray work, physical photometry, and the like, will find new material of interest. Speaking generally, one great means of securing information about natural objects has been the production of visible pictures due to ordinary light; in this matter the limit of our resources has already been reached in regard to such possibilities as of resolution in microscopy, but when the range of radiation which we can employ for investigation directly or indirectly is extended far beyond the visible limit, our resources are indefinitely increased, and though the difficulties are great they will not be found to be insuperable. Such advances, then, are of fundamental importance.

The extension of so-called 'industrial research' has called for new instrumental developments. The 'Nutting' type of spectrophotometer can now be obtained in the form of a specialised industrial instrument complete in itself; the possibility of maintaining such an equipment in permanent adjustment should be valuable in a laboratory where absorption measurements are becoming of increasing importance in optical methods of control in manufacture. The optical system of the instrument is modified in the latest type by the introduction of a polarising prism into both of the separated beams.

There is still room for a satisfactory spectrophotometer which will produce a matching field of uniform colour without undue loss of light.

Amongst other newcomers to the catalogue we note the 'Mutochrome' and the 'Coverimeter,' names which those unfamiliar with the instruments should find intriguing enough. In the description of the Houston apparatus for investigating colour vision, we are told that a diagram can be produced to describe the colour vision of a subject which states results in 'an absolute manner.' There are not many matters in which Messrs. Hilger need be disillusioned, but this is one of them.

It might almost be considered that such an instrument as a measuring microscope had reached finality in design, but in recent years the present writer has been pointing out in lectures and in a book certain simple principles which should receive attention, although they had evidently been overlooked in many such instruments. It is gratifying to find that these principles have received full attention in a new photo-measuring micrometer of a very attractive design.

The fact that one or more Twyman interferometers will be found in almost every workshop in Messrs. Hilger's factory is a sufficient comment on the value and utility of these instruments. In the production of accurate optical parts for such instruments as these interferometers and the various other forms of interferometer of the Fabry-Perot and Michelson types, optical workmanship must touch the high-water mark of skill.

Work of the types which have been hinted at above means careful individual work. Especially in bringing out a new design for the use of workers in some branch of research, the maker is faced with problems which require time and patience for their solution; perhaps the first models may not meet all practical requirements; development work is essential, and yet in a way it is a 'liability'; it is like the injection of cold feed water into the boiler. The expense of development work must be borne by the better established branches of a business.

Yet there are ways in which such firms as Messrs. Hilger might perhaps make progress. Not for all are the marvels of precision, the charm of all possible refinements of workmanship, materials, and finish. How many of us have not learnt much of our optics with apparatus of the simplest description? On page D.10 we find a student's wave-length spectrometer of a simple type. Is it not possible that with care in design and with suitable choice of materials, a much wider range of apparatus could be made for students' use, which might not satisfy the requirements of research but would prove a godsend to teaching laboratories?

As the makers themselves state, this catalogue contains such instruments as are of most interest to chemists and physicists. The information is clear, precise, and usually sufficient; optical diagrams are given in many instances, and short bibliographies are often included in the descriptions. Special publications deal with particular groups of instruments of more restricted interest. Messrs. Hilger are to be congratulated on this catalogue. L. C. M.

The Etiolation of Shoots for Cuttings.

A RECENT paper by Dr. Edith Smith upon the vegetative propagation of Clematis (*Trans. Roy. Soc. Edinburgh*, **55**, Part 3, 643 - 664; 1928) again directs attention to the question of the etiolation of shoots used for cuttings. Dr. Smith finds it necessary to modify an earlier statement to the effect that clematis cuttings do not root at the node under ordinary conditions, as in fact many commercial houses still employ nodal cuttings with this plant. Normally, however, cuttings made an inch below a node root more readily. It was found, though, that after previous etiolation the stem rooted readily at the node. In an earlier paper from the Edinburgh Botanic Garden, Reed has described the ready rooting of cuttings of camphor after previous etiolation (*Trans. and Proc. Bot. Soc. Edin.*, **28**, 184 - 188; 1922–23). Knight and Witt have also rooted shoots of apple and plum more successfully after previous etiolation, and pointed out that in the etiolated shoots the roots did not emerge through the callus as in the normal case, but arose higher up the cutting and emerged through the cortex (*Journal of Pomology*, **6**, 47-60; 1927).

Priestley has described the ready rooting of etiolated shoots of broadbean and pea and correlated this with the development of an endodermis in these shoots upon etiolation (Master's Lectures, *Jour. Roy. Hort. Soc.*, **51**, January 1926). In etiolated apple shoots, however, he found no endodermis, and Knight, Reed, and Smith also do not find an endodermis developed in their etiolation experiments. Smith suggests that etiolation acts in two ways, first by exciting meristematic activity, and secondly by 'softening' the hard tissues of the fibres and the pith.

Probably modern experimental work upon propagation will find this a profitable line of investigation. It is by no means a new one. Goude recently described in the *Gardeners' Chronicle* (Jan. 14, 1928) the method used at the Danish Experiment Station at Blangsted for the successful rooting of scion varieties of apples. The one-year maiden trees are laid down and the lateral shoots earthed up; as these shoots then develop under etiolated conditions a ring of wire is bound tightly around them. Roots later develop above the ring. The same method for preliminary treatment of shoots before they were removed as cuttings was described admirably by Duhamel in "Physique des Arbres" in 1763.

University and Educational Intelligence.

CAMBRIDGE.—Mr. C. Tate Regan, director of the Natural History Museum, and Dr. R. J. Tillyard, chief entomologist to the Commonwealth of Australia, have been elected to honorary fellowships at Queens' College.

Prof. J. B. Buxton has been re-elected into the professorship of animal pathology. Mr. T. G. Room, St. John's College, and Mr. S. W. P. Steer, Christ's College, have been appointed university lecturers in mathematics.

Mr. W. Dawson, Gonville and Caius College, has been appointed to represent the University at the centenary of the College of Forestry, Stockholm, next October.

Mr. C. Forster Cooper has been elected fellow of Trinity Hall; Dr. D. R. Hartree, Christ's College, has been appointed University demonstrator in physics; Dr. F. C. Phillips, Corpus Christi College, has been appointed University demonstrator in mineralogy.

The Tyson Medal in astronomy has been awarded to J. C. P. Miller, Trinity College, and the Mayhew Prize in applied mathematics to M. J. Dean, Trinity College. The Rex Moir Prize in engineering, the John Bernard Seely Prize in aeronautics, and the Ricardo Prize in thermodynamics have all been awarded to H. L. Haslegrave, Trinity Hall.

OXFORD.—In default of other candidates, Viscount Grey of Fallodon, Hon. D.C.L., has been elected Chancellor of the University as from June 16.

The report recently issued of the Delegates of the University Museum directs attention to the completion, during the past year, of the Sir William Dunn School of Pathology, and the new laboratory for teaching and research in biochemistry. Separate reports are included of seventeen scientific departments, in which are given lists of accessions to the various museum collections, and of researches and publications by members of the staff and other workers in each department. The accessions are especially numerous in the collections of the Hope professor of zoology and of the keeper of the Pitt-Rivers Museum.

A proposal has lately been started for the establishment of a club for workers in the departments of the Museum and allied institutions. It is felt that much advantage would result from the provision of more opportunities for intercourse among such workers. The accommodation aimed at is naturally of a kind which it is not within the province of existing college common-rooms to supply.

ON Thursday, June 14, the Duke of Connaught made his first visitation to University College, Southampton, and opened the George Moore Botanical Laboratories. The new buildings have been made possible by a bequest under the will of the late Mr. George Moore, of Southampton, and have been designed by the staff of the College, and particularly Prof. S. Mangham, professor of botany, and Mr. E. E. Mann, lecturer in civil and mechanical engineering. The dimensions of the building are 120 ft. × 30 ft., and it runs east and west, the north side being glazed so far as possible to afford facilities for microscope work. There are two floors. The ground floor provides thirteen rooms, including a theatre, two lecture rooms, library, two laboratories for physiology, and a photographic dark room. The upper floor has seven rooms, including a large elementary laboratory, pathological laboratory, laboratory for advanced work in systematic and structural botany and plant biochemistry, an exhibit room, and the usual preparation rooms. Plant houses, partly glazed with Vita glass, have been built along the south front and western end, and the surrounding grounds will be developed as a botanical garden. In drawing up the plans of the building, full provision has been made for increased accommodation for research work. The Principal of the College stated in his report that the cost of the new building and its equipment was only about £5000. In his address, the Duke of Connaught congratulated the College authorities on their careful management of the College funds, and expressed the hope that further benefactions would be forthcoming to enable the College to develop and to claim full university status.

ABOUT four years ago, Christ's Hospital, Horsham, started training a few of its older boys in practical farming, with the view of their migrating to the Colonies. The scheme is financed by the income of a legacy of about £5000 bequeathed by an old scholar of Christ's Hospital for that purpose. It is now proposed to develop the science teaching at Christ's Hospital by taking in biology, mycology, entomology, and kindred subjects, to help boys to qualify themselves for scientific posts under the Colonial Office. The present accommodation for science teaching at Christ's Hospital is not adequate to modern requirement, and in making the necessary extensions the opportunity is being taken to provide for biological work. The cost of the extensions will exceed £30,000, and since it was felt that the scheme for biological training is of significance far beyond the school itself, an appeal was launched on speech day last year by the then Lord Mayor, Sir Rowland Blades. The Corporation of the City of London responded with a gift of £1050, and other city companies brought the sum up to £6000. The Prince of Wales, who is president of Christ's Hospital, has now given £500. This, with subscriptions from governors and ex-scholars, brings the fund to about £14,200. Extensive additions for science teaching and for practical domestic work, costing about £20,000, are also contemplated at the girls' school of Christ's Hospital at Hertford. The funds at present available will only permit of the commencement of work at the girls' school. We hope that the initiation of the important scheme for biological training at the boys' school will not be long deferred for lack of funds.

THE Educational Colonies and Self-supporting Schools Associations of Great Britain and India are appealing for support in an attempt to embody their ideals in a pioneer colony. The Associations aim at such a reform of existing educational systems as will ensure for each child a thorough training, manual, physical, and scholastic, and maintenance when necessary, to be paid for during or at the completion of the training by a short period of employment that would be profitable both economically and educationally. The plan for the pioneer colony is one which has formed the subject of prolonged inquiry by the "Poverty Problem Study" department of the University of Calcutta and of numerous addresses and brochures by Captain J. W. Petavel, R.E. (retd.), Prof. J. W. Scott, of University College, Cardiff, and others. It combines the principles of the Swiss labour colony of Witzwil with those of the garden city movement and the co-operative movement, and is based largely on the beneficial effects on children of open-air life in rural surroundings with plenty of manual labour under skilful direction, at manifestly productive and therefore interesting tasks. It is described at length in "The Plan of the Educational Colonies Associations" (pp. 288, price 1*s.* 6*d.*). The honorary secretary of the Association in Great Britain is Mr. J. B. Pennington, c/o East India Association, 3 Victoria Street, London, S.W.1.

Calendar of Customs and Festivals.

June 24.

ST. JOHN THE BAPTIST. MIDSUMMER DAY.—A peculiar method of marriage divination recorded for England, in a locality not specified, was that an unmarried woman fasting should set out a table on the eve of St. John with bread, cheese, and ale, and then sit down as if to eat, leaving the street door open. Her future husband would then enter, bow to her, fill a glass of ale, and retire, leaving it on the table.

The sowing of hemp seed to secure the appearance of the lover, which was employed on the eve of St. Agnes, was also used at midsummer. Both processes point to the belief in the activities of spirits at this time, while the former recalls some of the north country wake ceremonies. Similarly, it was possible to foretell death by watching in the churchyard to see at midnight the spirits of those who were to die within the next twelve months. In Wales, if a St. John's wort were named for each person in the house and hung up, the first to wither would indicate who would be the first to die.

Certain herbs, if gathered on midsummer eve, had magical properties, or their magical properties were enhanced; for example, fernseed, which conferred invisibility, the rose, St. John's wort, vervain, trefoil, rue, mugwort, etc. They gave protection against disease or against spirits and witches. Orpine was set in clay on a slate or potsherd, and was called the 'midsummer man.' As the stalk was found next morning to set to right or left, it showed whether the lover would be true or false, a custom suggestive of phallic significance. Many of the customs which are superficially purely divinatory have certainly originated in practices intended to secure the fertility of those taking part. For example, in Greece there was formerly practised a method of divining the name of the future husband with the assistance of apples dropped in a vessel of water fetched by a boy from a spring on St. John's eve.

A closely related custom of Macedonia is called ὁ κλήδονας or κλήδονα, names of which the meaning is connected with 'omen,' but by the peasants, by an association of sound and from a certain feature in the observance, is connected with 'lock.' It, even more than the bonfire, is the most important observance of the feast of St. John. On the eve, plants are marked by the women for gathering next morning, and a brass vessel is prepared with flowers into which each casts a trinket. This is locked with a padlock after it has been filled with water by a boy after due observances at each of three fountains. The vessels are carried in procession through the village on the following day, each being guarded by young men with wooden swords. When the vessel is opened on the following evening, extempore verses prognosticate the fortune of the owners as each trinket is taken out. The frequently ribald character of these verses and the water ceremonial unmistakably point to a fertility rite, while a recent writer has pointed out the significant resemblance of the details to those of Rumanian marriage customs (Beza, "Paganism in Roumanian Folk-lore," p. 54 *sqq.*).

MIDSUMMER FIRES.—The most significant and important observance at midsummer is the survival of the fire festival. The practice of lighting fires on midsummer eve is of wide distribution and great antiquity. As on May Day and other occasions, when similar ceremonial fires are lighted, the people both jump through them themselves and send their cattle through them. King Manasseh, it is recorded in the Old Testament, caused his children to pass through fires in the Valley of Hinnom, and Ovid ("Fasti," iv. 655) refers to the custom of leaping through the fire. Medieval writers speak of the rites of St. John's eve among the Teutonic and Scandinavian peoples, and ascribe to them a pagan origin and a connexion with the sun.

The lighting of midsummer fires, and the practices associated with them more or less common to all, are recorded of the peoples of eastern Europe, of every part of Germany, and Spain, Italy, and Sicily. In France, where in particular pagan customs have lingered side by side with the observances of the Christian Church, they are recorded from many localities, and in Brittany these fires are lit regularly as an accompaniment of the *pardons* which take place around about midsummer. Often the parish priest goes in procession with the crucifix and lights the bonfire with his own hands; otherwise it is usual for them to be lighted after the recital of prayers by an old man. In Upper Brittany the fires were built around a pole which was surmounted by a nosegay or garland supplied by a man named Jean or a woman named Jeanne. Flowers from these garlands were charms against disease, and brands from the fire were a protection against lightning and conflagrations. In some localities in Great Britain the records show that the bonfire was similarly built round a pole surmounted by a garland.

In both Great Britain and Ireland the midsummer fires continued down to recent times. The references of medieval writers show that the fire ritual consisted of three elements—the rolling down a hill of a wheel swathed in straw, to which a light was set; a procession with burning brands around the fields; and the bonfire itself. In the vale of Glamorgan, within living memory, if the wheel burned well until it reached the bottom it was held to foretell a plenteous harvest. In one record quoted by Frazer ("The Golden Bough," x. 103), the wheel was mounted on a pole projecting some three feet on each side, by which it was guided by young men. The aim was to roll the wheel, while it still blazed, into the waters of the Moselle, so as to secure an abundant vintage.

Further examples of the fire festivals in which these elements of the ritual appear have been collected by Frazer in "The Golden Bough," vol. x. From these instances, and more particularly from the form of the belief in the magical efficacy and purificatory powers of the midsummer fires which appears in Morocco, it would seem that the ceremonial is directed towards securing the prosperity of the crops and stock, by protecting them against the evil influences potent at this period. This seems more probable than that it is a survival of sun worship, as was suggested to the older writers by the presence of the wheel, or than that it is an act of worship of Baal, as was indicated by the interpretation of Beltane as Baal or Bel's fire.

June 29.

ST. PETER'S DAY.—Similar observances to those of St. John's eve took place on the eve of St. Peter. In Scotland fires were lighted on the hill-tops, and processions with torches took place. According to an ancient record, the boatmen of Gisborough, in Yorkshire, used to keep festival on this day, decking their boats, painting their masts, and "sprinkling their prows with good liquor." In Wales girls tied a small key on each wrist, and when in bed repeated the sixteenth and seventeenth chapters of Ruth nine times. The future husband would appear to them in a dream, and then the keys fell from their wrists.

Societies and Academies.

LONDON.

Royal Society, June 14.—**A. V. Hill**: (1) Myothermic apparatus. Improvements have made it possible to measure with relative accuracy, in the sartorius of the frog or any similar muscle, not only the heat suddenly produced by a single stimulus, but also that liberated over long intervals at rest or in recovery, or as the result of prolonged discontinuous stimulation. A Zernicke moving-coil galvanometer (Kipp) has been employed. The total heat has been measured from the area of the deflexion–time curve. The temperature of the muscle chamber has been maintained constant within 0·001° C. An 'all-metal' thermopile has been devised which responds quickly and is very completely insulated. A Ringer's solution containing phosphate (7 to 15 mgm. per cent) has led to improved performance in the isolated muscles employed.

(2) The rôle of oxidation in maintaining the dynamic equilibrium of the muscle cell. The resting heat-rate in oxygen of frogs' sartorius muscles agrees with existing determinations of the rate of oxygen consumption. The minimum resting heat-rate in the absence of oxygen is sufficiently accounted for by lactic acid formation. Stimulation produces an immediate increase in the anaerobic resting heat-rate. The total heat in eight hours may be as great as 5 calories per gram of muscle: the maximum rate may be as high as 1·4 calories per gram per hour. Resting anaerobic survival without stimulation leads gradually to the same high heat-rate. The effect of anaerobic stimulation in increasing the resting heat-rate can be reversed, partially or completely, by recovery in oxygen. The possibility of oxidation leads to the inhibition of reactions previously occurring. It is considered that the degenerative changes set up by anaerobic stimulation, or survival, proceed at a rate determined at any moment by the degree of oxygen want. Oxidation at rest is concerned with upholding the integrity of boundaries, or membranes, which are essential if the organised system is not to become a chaos of biochemical processes.

(3) The absolute value of the isometric heat coefficient Tl/H in a muscle twitch and the effect of stimulation and fatigue. Direct observations of T and H give a mean value of the isometric heat coefficient $Tl/H = 6{\cdot}16$, in close agreement with the value calculated from the lactic acid data of Meyerhof. Previous anaerobic activity, liberating a large fraction of the whole energy available, has little or no effect on the isometric heat coefficient. The effect, if any, is in the direction of a slight reduction; in extreme fatigue, however, the reduction is large. The results, therefore, of chemical studies of muscle (which have necessarily employed a large number of twitches) are applicable directly to a case of a single twitch.

(4) The absence of delayed anaerobic heat in a series of muscle twitches. In a series of muscle twitches, in the absence of oxygen, there is little or no heat production except during the contractions themselves: the 'total' heat is equal to the 'initial' heat. Hence the lactic acid formation—which must be accompanied by heat liberation—occurs entirely during contraction. The contrary conclusion of Embden, Lehnartz, and Hentschel, the experimental base of whose work has been criticised by Meyerhof and Schulz, rests on imperfect reasoning.

(5) The recovery heat-production in oxygen after a series of muscle twitches. The ratio (total heat in oxygen)/(total heat in nitrogen) for the case of a series of twitches, reckoning heat per unit of mechanical response developed, has a mean value of 2·07. This allows us to calculate the 'oxidative quotient for lactic acid,' and the result, 4·81, agrees well with the mean value, 4·7, of Meyerhoff and Schulz, deduced from experiments involving lactic acid and oxygen measurements. The 'isometric heat coefficient' Tl/H is the same in oxygen and in nitrogen, confirming the conclusion of Weizsäcker and others that the initial heat is entirely non-oxidative in nature.

A. V. Hill and W. Hartree: (1) The anaerobic delayed heat-production after a tetanus. The supposed long-continued anaerobic delayed heat-production after a tetanus is due to a misinterpretation of the permanent increment in resting heat-rate produced by anaerobic stimulation. Its earlier part is a genuine occurrence, but it is complete within a minute or two. It is very variable in amount, ranging from 5 to 46 per cent of the initial heat. It is probably due to the over-stimulation of some of the fibres of the muscle producing a delayed formation of lactic acid. There is no sign of an endothermic process occurring at any stage in, or after, contraction. A statement by Furusawa and Hartree that in purified nitrogen a muscle becomes gradually inexcitable, as a nerve is known to do, was not confirmed.

(2) Factors determining the maximum work and the mechanical efficiency of muscle. The 'efficiency' of a frog's sartorius muscle has been measured. Its maximum value, as the mean of 56 observations on 21 different animals, is 26 per cent, with an average deviation from the mean of only 2 per cent. This refers to the initial (anaerobic) process only: for the complete cycle (including oxidative recovery) the maximum efficiency is only 12½ per cent. In man the efficiency of muscular movement may be twice as great. In the frog the very low value is due to the extremely expensive nature of the process required per second to maintain a contraction. Contractions of short duration, therefore, are necessary and movement must be rapid. In rapid shortening, however, muscle 'viscosity' plays a very large part in reducing the work done—74 per cent of the mechanical energy of the initial process is degraded into heat. In man the maintenance of a contraction is far less expensive. Consequently, the most efficient contractions are of considerable duration (1·3 seconds) and viscous resistance absorbs a far smaller proportion of the mechanical energy.

C. H. Best and Ruth Partridge: The equation of motion of a runner exerting a maximal effort. Experiments in which external resistances of varying magnitude have been applied to a runner show that the maximum speed of the subject is decreased by the amount calculated from the equation of Furusawa, Hill, and Parkinson. This is a satisfactory demonstration that the internal resistance of the muscles is real, in the sense that it has identically the same effect as an external added resistance.

S. Dickinson: Dynamics of bicycle pedalling. The maximum speed of pedalling a bicycle ergometer has been determined as a function of the load applied to the wheel. The relation between maximum speed and load is linear, speed decreasing as load increases, according to equation $P = P_0 (1 - k/t)$, where P is force exerted on pedal crank, P_0, is 'theoretical maximum force' attained only at zero speed, k a 'viscosity' factor, the 'theoretical minimum time,' and t actual time of a single leg movement. The value of k was much the same in all subjects; P_0, the 'strength' factor, varies widely. Bicycle pedalling, like other movements involving external resistance, shows an optimum speed, at which mechanical efficiency is highest.

C. A. Seyler: The Dictyoxylon cortex of Lycopodiales as a constituent of coal. By the metallographic method of polishing and etching, the characters of secondary xylem in transverse, radial, and tangential sections of coal can often be observed. A band of clarain in the Deep Soft seam of the Middle Coal Measures at Grassmoor Colliery, Derbyshire, has been investigated. The band has the structure of a broken network of sclerotic fibres, enclosing in its meshes a thin-walled tissue, and has macroscopic and microscopic characters of a heterogeneous Dictyoxylon periderm.

B. Sahni: On *Clepsydropsis australis*, a Zygopterid tree fern with a *Tempskya*-like false stem, from the Carboniferous Rocks of Australia. Several large specimens of this plant, recently discovered in rocks of the Kuttung Series (Carboniferous) of New South Wales, are described. These specimens reveal an extraordinary type of stem organisation not previously observed in any palæozoic plant. The trunk must have stood upright and attained a considerable height, with a heavy crown of foliage at the top; it was a 'false stem' composed of numerous relatively weak, but erect, repeatedly forked leaf-bearing axes, which were embedded in a dense matrix of adventitious roots and aphlebiæ.

W. O. James: Experimental researches on vegetable assimilation and respiration (19). Carbon dioxide was supplied to *Fontinalis antipyretica*, in solutions with and without bicarbonates. The effect of moving both kinds of solution at different rates past the plant was also observed. Only with relatively rapid movement of the solutions was the assimilation rate independent of the presence of bicarbonate. The results are discussed in relation to the aqueous diffusion of carbon dioxide and its effect on the photosynthetic process.

A. W. Greenwood: Studies on the relation of gonadic structure to plumage characterisation in the domestic fowl (4). In four cases the successful implantation of testicular material from the hen-feathered strain of Campines into castrated Brown Leghorn males produced the normal male head furnishings and behaviour, but did not lead to change in plumage character. These results support Roxas' conclusion that 'hen-feathering' of male in hen-feathered breeds is due to endocrine difference between the two testes. Successful implantation of testis from a Leghorn male into a castrated hen-feathered Campine did not result in change in plumage as would be expected on the basis of the above hypothesis. The failure may have been due to insufficient amount of testis, since it was incapable of inducing normal development of head furnishings.

T. P. Hilditch; Relationships between chemical composition of vegetable seed-fats and their botanical origin. In any one of the four orders, *Palmæ*, *Cruciferæ*, *Umbelliferæ*, and *Myristaceæ*, the composition of the fatty acids of the seed-fats is of the same general type, but each order is marked by definite and specific characteristics in the composition of the fatty acids. Thus the *Palmæ* seed-fats almost always contain 46 to 50 per cent of combined lauric acid, with minor amounts of caprylic, capric, myristic, and palmitic acids and relatively small proportions of oleic acid; in the *Myristaceæ* seed-fats myristic acid predominates; in Cruciferous seeds there is usually 40 to 50 per cent of combined erucic acid, the remainder consisting of oleic and linoleic acids in varying proportions; and finally, Umbelliferous seeds appear to be characterised by the presence of an isomeric form of oleic acid, petroselinic acid (20 to 75 per cent), not yet observed in seed-fats of any other order, except the closely related *Araliaceæ*.

PARIS.

Academy of Sciences, May 21.—Emile Borel: The calculus of probabilities and arithmetic.—Maurice Hamy: A comparator, suitable for the measurement of filiform spectra, intended for the determination of the radial velocities of stars. The method is based on the direct comparison of a solar and a stellar spectrogram, both obtained with the same spectrograph and containing the same comparison lines.—Pierre Termier and Eugène Maury: New geological observations in eastern Corsica: attempt at a tectonic synthesis.—Louis Roy: The equations of small movements of elastic surfaces.—W. A. Tartakowsky: The determination of the whole of the numbers representable by a positive quadratic form, with more than four variables.—P. Vincensini: Certain congruences of normals.—Calugaréano: A class of equations of the second order integrable with the aid of polygene functions.—Vladimir Bernstein: Some relations between the growth of a holomorph function in a demi-plane and its growth in a series of isolated points.—Miécislas Biernacki: The lines of Julia of integral functions.—J. Delsarte: A group of functional rotations with one parameter and certain integro-differential equations connected with it.—Mlle. Nina Bary: The analytical structure of an arbitrary continuous function.—D. Pompeiu: Divergent numerical series.—Mandelbrojt: The composition of normal families [of functions].—J. Haag: The calculation of certain elastic deformations, with application to the inertia of spirals.—Benjamin Meisel: The relative motion of a liquid filling a rotating vessel.—A. Lambert: The precision of the measurements and its control in the operation of world longitudes. The differences of longitude adopted for the fundamental stations taken two at a time do not appear to admit of a systematic error of astronomical origin exceeding 0·02 sec., or of radiotelegraphic origin exceeding 0·01 sec.—A. Danjon: Polarimetric observations of the Pons-Winnecke comet (1927 *c*). The proportion of light polarised was 0·11. If all the light from the comet had been solar light diffused by a gas, the polarisation would have been 0·8 on June 20 and 0·6 on June 21.—Henri Mémery: The low temperatures of the month of May 1928 and diminution of the solar activity. The abnormal cold weather coincided exactly with a marked diminution in the sunspots.—L. Saint-Antoine: The dielectric constant of benzil. Fused benzil has a very high dielectric constant (13·04 at 95° C.), which varies rapidly with temperature. This affords an explanation of the exceptional electro-optical properties of benzil.—Rabinovitch: Quarter wave-length mica plates.—Paul Riou and P. A. Bérard: The absorption velocities of sulphur dioxide in alkaline solutions.—Jean Savard: The ultra-violet absorption curves of pulegone and isopulegone.—Mme. Lucie Randoin: The comparative influence of the lipides and glucides in the food on the evolution of *B*-avitaminosis.—E. Nicolas and J. Lebduska: The biochemical study of thiourea. Thiourea retards the coagulation of blood *in vitro*; its toxic action is very slight, and less than that of urea.—Bordier: Moiré effects are due to the production on the retina of circles of diffusion.—Marcel Labbé, Floride Nepveux, and Hiernaux: The influence of insulin on the disturbance of lipoid metabolism in severe diabetes.—L. Mercier: Three cases of congenital cataract obtained experimentally in the same strain of mice.—F. Heim de Balsac, E. Agasse-Lafont, and A. Feil: Pneumokoniosis in paving-stone workers.—C. Kling and A. Höjer: Researches on the mode of propagation of foot-and-mouth disease.—G. Ramon, R. Martin, and A. Laffaille: Contribution to the study of immunity towards the streptococcus called scarletinous.

Official Publications Received.

BRITISH.

Further Impressions of the Public Library System of the United States of America. By Miss K. E. Overbury and Dr. E. E. Lowe. Pp. 47. (Dunfermline: Carnegie United Kingdom Trust.)

British Research Association for the Woollen and Worsted Industries. Publication No. 94: A Survey of the Production and Utilisation of Wool. By S. G. Barker and Arnold Frobisher. Pp. 10. (Leeds.)

Education, India. Occasional Reports, No. 15: Rural Education in England and the Punjab. By R. Sanderson and J. E. Parkinson. Pp. ii+92. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1s. 3d.

FOREIGN.

Proceedings of the Imperial Academy. Vol. 4, No. 4, April. Pp. xi-xv+137-187. (Tokyo.)

Zoopathologica: Scientific Contributions of the New York Zoological Society on the Diseases of Animals. Vol. 2, No. 1: The Treatment of Fish Diseases. By Ida Mellen. Pp. 31. (New York City.)

The Record of the Celebration of the Two Hundredth Anniversary of the Founding of the American Philosophical Society, held at Philadelphia for Promoting Useful Knowledge, April 27 to April 30, 1927. Proceedings, Vol. 66. Pp. xiii+750. (Philadelphia, Pa.)

CATALOGUES.

Geologie Deutschlands. (Lager-Katalog Nr. 196.) Pp. 290. (Leipzig: Max Weg.)

The Hump Method for the Heat Treatment of Steel. (Catalog No. 90.) Pp. 40. (Philadelphia, Pa.: Leeds and Northrup Co.; Birmingham: The Integra Co., Ltd.)

The Homo Method for the Tempering of Steel. (Catalog No. 93.) Pp. 28. (Philadelphia, Pa.: Leeds and Northrup Co.; Birmingham: The Integra Co., Ltd.)

Diary of Societies.

SATURDAY, JUNE 23.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—J. L. Henrard and J. T. Whetton: The Sinking of Londonderry Colliery, Seaham Harbour, Co. Durham, by the Freezing Process.—T. Greenland Davies: Extracts and Recommendations from the Report of the Water Dangers Committee.—Dr. John G. Kellett: The Physical Constitution of Coal and Coal Seams.—Dr. John G. Kellett: The Distribution of Ash in Bituminous Coal Seams.

MINING INSTITUTE OF SCOTLAND (in St. Margaret's Hall, St. Margaret Street, Dunfermline), at 3.—Discussion on David C. Gemmell's Paper on Supporting Underground Roadways with Steel Arches.—Discussion on J. A. Bernard Horsley's Paper on Design and Maintenance of Flame-Proof Enclosures, with Special Reference to Coal Face Machinery.—Discussion on T. A. Southern's Paper on Life Saving in Colliery Explosions and Fires.—John M. Williamson and John Bisland: An Experience of Machine Mining in a Highly Inclined Seam.—George W. Smith: A Trial Bore-Hole for Oil in South Africa and the Results.

PHYSIOLOGICAL SOCIETY (in the Department of Physiology, The University, Sheffield), at 3.—Demonstration by Benedict Finkleman: Preparation for the Measurement of the Excitability of the Cardiac Nerves of the Frog.—Demonstration by M. M. Croll: Specimens Illustrating the Relative Value of Different Methods for Demonstrating Nerve Fibres in the Pituitary.—F. R. Curtis and J. W. Pickering: The Effect of Pituitary Fractions on the Blood.—F. R. Curtis: The Action of Ephedrine and some of its Derivatives.—R. K. Christie and F. R. Curtis: The Effect of Ephedrine and its Derivatives on the Blood-Sugar.—John Freud: Biological Action of Iodides.—K. Furusawa: A Note on the Total Depolarisation of Crustacean Nerve.—M. Rabinovich: A Smooth Muscle Vagus Nerve Preparation.—W. Hartree and A. V. Hill: The Maximum Mechanical Efficiency of Muscles.—H. H. Dunlop: Adrenalin Dilatation.—G. A. Clark: The Action of Pituitrin on the Portal Circulation.—G. A. Clark: The Effect on Blood-Sugar of Interference with the Portal Circulation.—C. G. Imrie: The Action of Pituitrin in a Depancreatised Animal.—C. G. Imrie: Blood-Sugar and Hyperpnœa.—M. Hirst and C. G. Imrie: The Influence of Thyroid in Certain Types of Creatinurea.—G. P. Crowden and M. G. Pearson: The Effect of Morphia on the Adrenaline Content of the Suprarenal Glands.—E. C. Faves: The Pituitary and Nervous System in (*a*) Infantilism with Diabetes Insipidus, (*b*) Post Encephalitis Diabetes Insipidus.—May Mellanby and C. Lee Pattison: The Healing of Dental Caries.—N. G. Green and E. Mellanby: Vitamin A as an Anti-Infective Agent.—E. Mellanby, E. M. Surie, and D. C. Harrison: The Antirachitic Action of Ergot.

MONDAY, JUNE 25.

INSTITUTION OF MECHANICAL ENGINEERS (at Southampton) (continued on June 26, 27, 28 and 29).

TUESDAY, JUNE 26.

ROYAL DUBLIN SOCIETY (in the Science Room, Ball's Bridge), at 4.15.—Report of the Irish Radium Committee for the year 1927.—C. Boyle, M. Murphy, and H. A. Cummins: "Blossom Wilt" of Apple Trees and "Wither Tip" of Plum Trees, with Special Reference to two Biological Forms of *Monilia cinerea* Bon.—T. Dillon and E. F. Lavelle: A Suggested Method for the Utilisation of Seaweed.—A. G. G. Leonard and P. F. Whelan: Spectrographic Analyses of Irish Ring-money and of a Metallic Alloy found in Commercial Calcium Carbide.—L. B. Smyth: *Salpingium salinosum*, a New Carboniferous Coral.—L. P. W. Renouf: A Preliminary Account of Lough Hyne, Co. Cork.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at Scottish Centre) (continued on June 27, 28, 29 and 30).

WEDNESDAY, JUNE 27.

ROYAL SOCIETY OF ARTS, at 4.—Annual General Meeting.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College, Victoria Embankment).

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section).—Mrs. Isaacs and Drs. Hadfield and Potts: Symposium on Mental Hygiene of Pre-School Age.

THURSDAY, JUNE 28.

SOCIETY OF GLASS TECHNOLOGY (at the Applied Science Department of the University, St. George's Square, Sheffield), at 11.15.—General Discussion on Lessons from the Tour in Germany.—A. Cousen, H. W. Howes, and F. Winks: The Control and Distribution of Temperature in Lehrs.

ROYAL SOCIETY, at 4.30.—Prof. J. C. McLennan: The Bakerian Lecture on The Aurora and its Spectrum.—*To be read in title only*:—E. Jones: Photographic Study of Detonation in Solid Explosives.—Prof. E. T. Whittaker: On the Potential of the Electromagnetic Phenomena in a Gravitational Field.—B. Topley and J. Hume: The Kinetics of the Decomposition of Calcium Carbonate Hexahydrate.—L. W. Nordheim: On the Kinetic Method in the New Statistics and its Application in the Electron Theory of Conductivity.—P. K. Kichlu: First Spark Spectrum of Krypton.—Prof. R. W. Wood and V. Voss: The Fluorescence of Mercury Vapour.—E. Rudberg: The Velocity Distribution of Photoelectrons by Soft X-Rays.—I. M. Mathews: The Absorption Spectrum of Cæsium.—D. Jack: The Band Spectrum of Water Vapour. III.—F. W. P. Götz and Dr. G. M. B. Dobson: Observations on the Height of the Ozone in the Upper Atmosphere.—Prof. T. M. Lowry and M. S. Vernon: An Improved Method of Ultra-Violet Polarimetry. Anomalous Rotatory Dispersion of Sodium Tartrate.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Prof. Jurasz: Movable Kidney.

FRIDAY, JUNE 29.

ROYAL SOCIETY OF MEDICINE (Urology Section), 11 to 12.—Short Demonstration of Special Instruments.

SATURDAY, JUNE 30.

GENETICAL SOCIETY (at the John Innes Horticultural Institution, Merton, S.W.19), at 1.—Annual Meeting.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Leicester).

FRIDAY, JULY 6.

GEOLOGISTS' ASSOCIATION (in the Architectural Theatre, University College, Gower Street), at 7.30.—F. Gossling: The Geology of the Country around Reigate.—H. A. Hayward: The Geology of the Lower Greensand around Dorking, Surrey.

CONGRESSES.

JULY 9–14.

SEVENTH INTERNATIONAL CONGRESS OF PHOTOGRAPHY, 1928 (at the Imperial College of Science and Technology, South Kensington).—Dr. A. Steigmann: Theory of Photographic Sensitivity.—Dr. Lüppo-Cramer: The Herschel Effect as a Regression Phenomenon.—L. A. Jones and V. C. Hall: On the Relation between the Time and Intensity in Photographic Exposure.—Dr. S. E. Sheppard and A. P. H. Trivelli: A Comparison of some Developers for Sensitometric Standards.—Dr. S. E. Sheppard and Crouch: A Machine for the Automatic Development of Sensitometric Strips.—L. A. Jones: Systematic Nomenclature in Photographic Sensitometry.—L. A. Jones and Russell: The Expression of Plate Speed in Terms of Minimum Useful Gradient.—O. Sandvik: On the Measurement of Resolving Power of Photographic Materials.—L. A. Jones and Chambers: High-Intensity Time-Scale Sensitometer.—Dr. E. P. Wightman and Quirk: Intensification of the Photographic Latent Image.—Dr. A. Steigmann: Silver Iodide in the Full-Ammonia Emulsion.—Prof. Dr. Emil Baur: Sensitisation and Desensitisation.—Prof. Dr. A. Lottermoser: Observations and Measurements on the Light-Sensitivity of Silver Halide Sols.—Prof. Dr. Fritz Weigert: On the Light-Sensitivity of Photographic Layers.—T. Thorne Baker and Balmain: The Effect of Temperature on the Sensitivity of Selected Photographic Emulsions and the Influence of Wave-length on such Temperature Effect.—O. Bloch: The Interaction of the Silver Halides in Emulsion Form.—Dr. F. C. Toy, and others: On Turbidity.—Prof. Dr. J. Eggert: On Secondary Processes in the Exposure of Silver Halides.—Prof. Dr. R. Luther: Sensitometric Studies.—Dr. F. M. Hamer: A Chemical Study of Desensitisers. Part I. An Account of the known Desensitisers.—Dr. D. A. Spencer: The Ferro-Prussiate Process; The Ferro-Gallic Process; The Diazo-Type Process; A New Application of the Ferro-Gelatine Process; Printing in Colours with Diazo Compounds.—H. W. Lee: The Modern Super-Speed Lens.—S. Jasienski: The Stereoscopic Effect of High-Aperture, Long-Focus Objectives.—N. Fleming: The Photography of Sound Waves.—Dr. Anderson: The Testing of Photographic Shutters; Lens Interferometry.—Prof. Hartridge: The Focal-Plane Shutter.—Capt. C. J. P. Cave: The Photography of Inaccessible Interior Architectural Details with a Spot-Light.—G. Auborne Clarke: The Photography of Clouds.—Prof. E. G. Coker: Photography as an Aid to the Study of Mechanical Stresses.—O. G. S. Crawford: Archæological Photography from the Air.—Capt. M. Hotine: On Photographic Surveying.—Prof. Namias: On Positives by Reversal.—A. R. Hinks: The Work of the Wild Phototheodolite in the Shaksgram—W. M. H. Greaves: Astronomical Spectrophotometry.—Dr. E. Viterbi: The Fine-grained Emulsion and its Application to Spectrography.—Mr. Elwell: Paper on and Demonstration of Talking Film.—A. J. Bull: Tone Rendering by Half-Tone Processes.—H. M. Cartwright: (1) The Progress of Photogravure Etching; (2) A Method of Colour Correction.—A. A. K. Tallent: Latest Applications of Pyro-Tanning Processes.—E. L. Turner: Modern Photo-Engraving Screens.—William Gamble: The Present Position and Future Possibilities of Photo-Engraving.—H. N. Durham: Mercury Printing Processes.—F. J. Tritton: The Uses of Colour Photography in the Printing Trade.—Prof. Dr. E. Lehmann: On his Two-Colour Process.—Dr. R. von Arx: Dye-transfer Process from Dye Mordant Images.—F. G. Tutton: The Value of the Chromoscope in Commercial Colour Photography.—Commander H. E. Rendall: A Paper on Tri-colour

Cameras.—Dr. R. A. Houston: A Paper on the Colour Mechanism of the Eye.—Julius Rheinberg: Demonstration of Micro-Spectra Method of Colour Photography.—F. C. Tilney: Pictorial Photography: the Relation of Technical Advance.—H. Garnet and G. H. Oakden: The Original Binocular Stereoscopic Camera of John Benjamin Dancer.—Dr. E. Kuchinka: W. Fr. Voigtländer's Eight-inch Double-Objective, and other Large Objectives.

JULY 16–20.

BRITISH EMPIRE CANCER CAMPAIGN (at the Royal Society of Medicine).

Monday, July 16.

Reception of Overseas Delegates at Buckingham Palace by H.M. the King.

2 to 5.—Registration of Delegates at the Royal Society of Medicine.

9.30.—Reception of Delegates and Ladies by Sir John and Lady Bland-Sutton, 47 Brook Street, W.

Tuesday, July 17.

10 (Royal Society of Medicine, Barnes Hall).—Discussions on The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity. Opened by Prof. Regaud.—Cancer of the Cervix. Opened by Dr. M. Donaldson.—Cancer of the Rectum. Opened by Sir Charles Gordon-Watson.

10 (College of Nursing).—The Etiology of Cancer. Opened by Prof. J. Ewing.

2.30 (at Middlesex Hospital).—Bland-Sutton Institute of Pathology.—(1) Demonstration of unusual Tumours. (2) Relation of malignancy to histological appearances in Cancer of the Breast. (3) Studies of the Rous Sarcoma:—(*a*) Immunity. (*b*) Factors which influence the infectivity of the Rous tumour. (*c*) Initial stages of the tumour produced by cell-free filtrates. (*d*) Influence of physical and chemical agents. (4) Some experiments on lead therapy in Cancer. (5) The application of the Cinematograph to the study of tissue culture. Courtauld Institute of Bio-Chemistry.—(*a*) Demonstration of the metabolism of tumours following Prof. Warburg's views. (*b*) A trial of some unsuccessful methods for the sero-diagnosis of Cancer. (*c*) Routine observations performed on patients undergoing radical operations for Cancer. Barnato-Joel Laboratories.—Demonstrations will be given, mainly of a radiological character. These will include:—Effects of X-rays upon Tumour Growth. Effects of Radium rays upon Tumour and Normal Tissues. Experiments upon resistance in animals to human growth. Experiments upon the physiological action of X-rays. (In collaboration with the Physiology Department.) Operating Theatres.—Radical amputation of Breast by Diathermy, by W. Sampson Handley (and demonstration of cases in the Wards). Operations for Buccal and Abdominal Cancer by Gordon Taylor. Wertheim's hysterectomy, by Comyns Berkeley and Victor Bonney. Operations for Pharyngeal or Laryngeal Cancer by Somerville Hastings.

2.30 (at Radium Institute).—Demonstrations by Dr. Philip Gosse, Dr. Roy Ward. Radium and Radium Applicators. Radon "Seeds." Various types of seed introducers. Cases that have been treated with seeds. X-ray photographs, showing seeds in tumours. Operations on patients, introducing seeds. Demonstration of specimens in the Pathological Laboratory. Demonstration of the preparation and filling of Radon Seeds.—(At Royal College of Surgeons.) Lecture and Demonstrations by Dr. Murray.

Wednesday, July 18.

9.30 (Royal Society of Medicine, in the West Hall).—Discussion on The Classification and Treatment of Bone Sarcoma. Opened by Prof. Ewing. Special Demonstration on Bone Sarcoma.

9.30 (Royal Society of Medicine, Barnes Hall).—Discussion on Some Present Day Medical Aspects of Cancer.—Sir Thomas Horder: A Consideration of Cancer Cachexia.—Dr. Robert Hutchison: The Alleged Increased Frequency of Primary Carcinoma of the Lung.

9.30 (Royal Society of Medicine, Committee Room).—Discussion on Biological Effects of Radium and X-rays, with special reference to the Factors of Wave-length, Intensity of Radiation and Duration of Exposure. Opened by Prof. Regaud, Prof. Holthusen, Dr. D. Quick, Dr. Canti, Dr. Finzi, Prof. Lahm.

9.30 (College of Nursing).—Discussion on Occupational Cancer. Pathology. Statistics and Public Health. Opened by Prof. A. Leitch, Dr. T. H. C. Stevenson, Dr. J. C. Bridge, and Dr. S. A. Henry.

2.30 (at St. Bartholomew's Hospital).—Clinical Demonstrations:—Operations—Sir Charles Gordon-Watson: Insertion of Radium for Carcinoma of the Rectum.—Dr. Barris: Insertion of Radium by Vaginal Route for Carcinoma of the Cervix Uteri.—Dr. Donaldson: Insertion of Radium by Abdominal Route for Carcinoma of the Cervix Uteri.—Mr. Keynes: Insertion of Radium for Carcinoma of the Breast.—Demonstration of Cases—Prof. Gask: Cases of Carcinoma of the Tongue and other cases treated by Radium.—Sir Charles Gordon-Watson: Cases of Carcinoma of the Rectum treated by Radium.—Mr. Harmer and Mr. Rose: Cases of Malignant Disease of the Larynx treated by Radium and X-rays.—Dr. Barris and Dr. Donaldson: Gynæcological Cases treated by Radium and X-rays.—Pathological Demonstrations:—T. P. Dunhill: Carcinoma of the Thyroid—Macroscopic and Microscopic.—Dr. E. A. Carmichael: The Relationship of Cerebral Gliomata to Embryonic Glial Tissue.—Dr. Andrewes, Miss Fell: Tissue Culture in its relation to Malignant Disease.—Dr. Canti, Dr. Spear and Miss Cox: Effects of Irradiation on Tissue Culture.—Miss Strangeways: Comparative Demonstration of Leucocytes and Fibroblasts of the Rat cultivated *in vitro*.—Dr. Canti: Histological Demonstration of Carcinoma of the Cervix before and after Treatment by Radium.—Dr. Shore: Demonstration of Museum Specimens.—Prof. Hopwood, Dr. Levitt: Demonstration of Apparatus in connexion with Deep X-ray Therapy and Radium Therapy.

5—Tea in Library.—Dr. Canti: Cinematograph Demonstration of living tissues cultivated *in vitro*, and the action of Radium upon them.

2.30 (at St. Mark's Hospital).—J. P. Lockhart-Mummery, Sir Charles Gordon-Watson, and L. E. C. Norbury: Operations for Cancer of the Rectum (Perineal Excision) and Resection of the Colon. Demonstration of patients illustrating 5 to 10 year cures after Perineal Excision, and Demonstration of the Cancer follow-up System. Demonstration of Diagnosis by Barium, Enemata and X-rays, and by Sigmoidoscopy.—Dr. Cuthbert Dukes: Demonstration in the Cancer Research Department:—(1) Series of specimens showing early stages in the development of Cancer of the Large Intestine. (2) Specimens showing the intramural and extra-rectal spread of Cancer of the Rectum. (3) Specimens illustrating multiple tumours, obstructive tumours and unusual types of malignant tumours of the bowel.

Thursday, July 19.

9.30 (Royal Society of Medicine, Barnes Hall).—Discussions on The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity, contd.):—Cancer of the Breast. Opened by Prof. Burton Lee.—Cancer of the Buccal Cavity. Opened by Dr. Douglas Quick.—Evaluation of Statistics relating to Effectiveness of Treatment. Opened by Dr. Janet E. Lane-Claypon.

9.30 (College of Nursing).—Discussion on Methods of Treatment by Chemo-therapy, with Special Reference to Lead. Opened by Prof. Blair Bell.

2.30 (at the Cancer Hospital):—

A.—Surgical.

2.30–5.—Operations. Two Theatres. Demonstration of Cases of Cancer of the Buccal Cavity treated by Radium.

B.—Pathological.

(i) Experimental:—(1) Demonstration of animal tumours produced by various carcinogenic agents. (2) Demonstration of carcinogenic agents (shale oil, paraffins, acetylene tar, etc.). (3) Specimens of mule spinner's Cancer. (4) Betel-nut-chewer's Cancer. (5) Specimens of experimentally produced Cancer of gall bladder in animals. (6) Injected specimens showing vascular supply of tumours. (7) Spontaneous rat tumours. (8) Graphs showing incidence of tar tumours and effect of dilution of tar. (9) Charts of blood changes (due to X-rays) and microscopical specimens illustrating such changes in human cases and in the rabbit.

(ii) Clinical:—(1) Sero-diagnosis of tumours by a flocculation method. (2) Specimens of Cancer of Rectum of various types removed by the abdominal-perineal method. (3) Specimens of rare human tumours. (4) Demonstration of histological sections of kidneys from cases treated by colloidal lead.

C.—Radiology.

Deep therapy apparatus with special patient's turn-table. Paintings of cases of malignant disease treated by X-rays and patients showing the results of treatment. Demonstration of special skiagrams of tumours. Ionisation apparatus for the measurement of X-ray doses. Recording spectrophotometer for X-ray and Ultra-violet light spectra. X-ray distribution in irradiated media.

2.30 (at Westminster Hospital).—Stanford Cade and Arthur Evans: (*a*) Clinical demonstration of cases of Cancer of the Tongue and Mouth treated by Radium. (*b*) A case of lingual Cancer will be treated by Radium, to demonstrate the technique. Tudor Edwards—(*a*) Will demonstrate the transpleural approach of the thoracic part of the œsophagus and introduce Radium into the wall of the œsophagus.—(*b*) If available a malignant tumour of the lung will be excised.—Dr. Braxton Hicks and Dr. Hocking—(*a*) Will show specimen of (1) Chloromata. (2) Lung tumours. (3) Myxosarcoma and primary Cancer of the liver. (*b*) Demonstrate the manufacture of Uranium and give an account of its clinical uses in cases of Cancer.—Demonstration in X-Ray Department by Dr. Caldwell, Dr. Allchin, Dr. Kerley.

2.30 (at St. Mark's Hospital).—Repetition of Programme for July 18.

2.30 (at the Lister Institute).—Demonstration by Dr. Thomas Lumsden, assisted by Miss A. C. Kohn-Speyer. (1) Culture of Normal and Malignant cells in pure serum. (2) The Effects of anti-Cancer sera on such cultures, showing the existence of specifically anti-malignant-cell bodies. (3) Treatment of various rat and mouse tumours by injection of antisera into the tumours. Subsequent immunity. (4) Cure of small "metastases" by local vaccine treatment of a co-existing large implanted tumour. (5) Lantern slides illustrating vaccine treatment of implanted tumours and the mechanism of regression. (6) Demonstration of a new Sarcoma of the rat which grows progressively in 100 per cent of rats inoculated and never regresses.

Friday, July 20.

9.30 (Royal Society of Medicine, Barnes Hall).—Discussion on The Early Recognition and Treatment of Cancer of the Stomach. Opened by Sir Berkeley Moynihan.

9.30 (Royal Society of Medicine, West Hall).—Discussion on Diagnostic Methods in Relation to Cancer. Opened by Sir Thomas Horder.

9.30 (Royal Society of Medicine, Committee Room).—Discussion on The Effects of Radium and X-rays on the Blood Vascular and Lymphatic Systems, with Special Reference to Malignant Growths. Opened by Dr. F. Carter Wood, Dr. A. Lacassagne, Prof. Holfelder.

9.30 (College of Nursing).—Discussions on Geographical and Racial Prevalence of Cancer. Opened by Prof. Major Greenwood.—Public Action in Regard to Cancer. Opened by Sir George Buchanan.

Farm Laboratories of the National Institute for Medical Research (Medical Research Council), Mill Hill, N.W.7.—Demonstrations:—By Dr. W. E. Gye: (1) Improved methods of extracting infective material from tumours. (2) The effects of tumour ferments, probably oxidases, in abolishing tumour inducing power; and methods of counteracting the action of these ferments. (3) Destruction of infective power by means of antiseptics, and conditions which influence the result.—By J. E. Barnard: (4) Microscopic demonstration of extracts of tumours. (5) Exhibition of microscopic methods for the study of filter-passing viruses. (6) Demonstration of ultra-filtration methods.

2.30 (at Guy's Hospital).