NATURE

SATURDAY, DECEMBER 1, 1928.

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Science and the Public.

THE occasion for another article on a familiar subject is the Prime Minister's inaugural address to the University College of Wales, Aberystwyth, on the contributions of science and statesmanship to the problems of civilisation. Mr. Stanley Baldwin makes no claim to the title of 'man of science.' One hopes that he possesses what in political circles are known as the 'best brains.' If he does, he would be the last to proclaim the fact. But he does possess in a high degree that Greek quality which Matthew Arnold translated as "sweetness and light," and that Roman virtue extolled by the dying Antoninus Pius, *aequanimitas*. Apart from his official position, anything he says on the relations of science to the public will be heard with respect.

Learning, Mr. Baldwin told the Aberystwyth students, is less aggressive than it was fifty years ago, because scientific men realise more the limitation of their own work. The world of knowledge, like a particle of radium, is in a state of rapid dissolution. Mr. Baldwin admits that with his "slow working mind" he no sooner begins to understand an accepted explanation than it is obsolete. This fills him with discouragement. His mind is not nourished by the débris of discredited theories, which is spoon-fed to the public. There is no finality. "We cannot catch up with knowledge," Mr. Baldwin says. Life is like a greyhound race, without a dog's chance of catching the electric hare, running in a groove which we call "the laws of science," and controlled by another intelligence, remote, inscrutable.

When Mr. Baldwin turns from knowledge to those possessing knowledge, what does he find ? Experts differ. He goes to economists for advice on safeguarding and finds that no two agree. If he seeks advice on the gold standard, the experts reply with different voices. Generalisations or ghostly abstractions are offered to him instead of practical advice. But, as he says, politicians have to deal with men, swayed by good or bad passions, by ignorance, and ignorance played upon, not with figments of the imagination such as "the economic man."

This is a well-worn theme on which happy warriors have contended in innumerable college common rooms and other places where they argue. Happily, as George Eliot observed, the blessed work of helping the world forward does not wait to be done by perfect men—or by perfect scientific or economic theories. Men of science will agree with the Prime Minister that the methods of the physical laboratory are not the methods to be applied in dealing with human nature. But they ask—and

this Mr. Baldwin seems disposed to concede—for "some preparation of the human mind," for the new world which science is creating, not so much a concrete knowledge of science as a scientific outlook, a scientific habit of thought, or, at the worst, a conviction that there is such a subject, like the Eton boy's conviction about Latin.

On the day following Mr. Baldwin's address, Mr. J. B. S. Haldane lectured to the Fabian Society on "Science in Western Civilisation," his thesis being that western civilisation is based on applied science and the future depends on how science is applied to human life. At present, the policy of most States is framed by politicians, carried out by civil servants and interpreted by journalists, all equally ignorant of science. Here is a counter-indictment by a distinguished man of science to the Prime Minister's charges. Mr. Haldane makes no high demands. He would be satisfied if the Cabinet contained one member with a knowledge of science equivalent to a second class in the Natural Science Tripos, Part 1, at Cambridge! Mr. Haldane gave some examples of official ignorance of science during the War. Could not the Prime Minister, without excluding from our civil departments the fine flower of the "grand old fortifying classical curriculum," take steps to ensure that every Government office contains men of scientific training and attainment?

Mr. Baldwin, with curious prescience, observed in his address that professors of biology apparently think they are the elect of the earth. Not less than 50,000 original contributions on that subject are published every year, he said. Biology is an entrancing subject and Mr. Haldane is doing a good service, "one stroke of faithful work," in emerging from his laboratory and discontinuing for a space his vivisection experiments—on himself—in order to make suggestions on scientific lines for curing the world's evils. Incidentally he gave an illustration in support of the Prime Minister's argument that men of science are not always in agreement among themselves. Eugenists, after some years of discussion, were able to convince the Government that it was wise to promote "good births" by income tax adjustments. Successive Chancellors of the Exchequer, including Mr. Winston Churchill, have endorsed the principle. But on this question Mr. Haldane draws opposite conclusions to Major Darwin and Dean Inge. If the restriction of families is due to a desire on the part of the parents to leave their children a modest competence and to ensure their efficient education, why not, he asks, abolish hereditary wealth and provide first-rate schools for all children? That suggestion, addressed to an audience of socialists, may have been a sop for Cerberus. We shall not expect Mr. Haldane to perform an experiment on himself to establish this thesis, in a university the life-blood of which is provided by hereditary wealth. Mr. Haldane's main argument remains—that if western civilisation is to survive, the ruling class must be scientifically educated. The election of Mr. Hoover as president of the United States, calling to this high office for the first time a man of scientific training and outlook, is a world-portent more significant, perhaps, than the Russian large-scale experiment in scientific education for which Mr. Haldane shows some predilection.

One final observation. Would it not be possible to encourage a more active appreciation on the part of the public of the benefits which science is daily conferring on the community—in the reduction of labour, in the cure of diseases, in transportation, and a hundred other aspects of human life? Consider broadcasting, for example. The British Broadcasting Corporation, by a broadcast appeal, could secure within a few hours sufficient funds for some worthy memorial, expressing the people's gratitude for the lives and labours of those men of science who have made broadcasting possible—Faraday, Clerk Maxwell, Hughes, Marconi, Lodge, Fleming, and others. The Prime Minister said that he often felt that there is a real danger of the abundance of new knowledge impeding progress, that the apparatus accumulated by the scholar will be so great that he will not be able to move. Men of science will not endorse that view. Science is the golden girdle binding the world together. With every increase of the world's gold, as Sir William Jenner said, the metal loses something of its value; but every addition to the store of scientific truth adds to its value, serving as a stepping stone to further discoveries.

> Who loves not knowledge? Who shall rail
> Against her beauty? Who shall fix
> Her pillars?

T. LL. H.

Fossils and Stratigraphy.

Stratigraphical Palæontology: a Manual for Students and Field Geologists. By Dr. E. Neaverson. Pp. xiii + 525. (London: Macmillan and Co., Ltd., 1928.) 18*s*. net.

DURING the past thirty years many deep borings have been carried out in Great Britain. Some of these have been put down to tap deep-seated water-bearing formations; others have been made in search of hidden coalfields, particularly in the east and south-east of England. Since the

formations to be sought for lie buried under a thick cover of later beds, usually presenting a different lithological facies underground from that along the outcrops, the identification of stratigraphical horizons in these rocks by means of fossils becomes a matter of great practical importance, and in this direction the studies carried out by the Geological Survey have proved of immense value to the mining engineer in Kent and in the Yorkshire-Nottingham coalfield.

We have been led to make these remarks by the appearance of Dr. E. Neaverson's volume, in which he sets forth an account of the zonal methods employed by the stratigraphical palæontologist. This is an excellent book, and one that fills what has hitherto been a distinct gap in British geological literature. The author divides the volume into two parts: in the first portion he discusses at length the morphological features of the chief fossil groups, the preservation and occurrence of fossils, the relation of fauna to habitat and the geographical distribution and migration of plants and animals. He devotes an excellent chapter to the consideration of fossils as indices of horizon. In this the author shows that the use of fossils in stratigraphy is based upon the fact that organisms show progressive change as their history is traced upwards through successive series of strata. In other words, the observed facts of evolution and faunal succession form the basis of zonal stratigraphy. Thus, where the evolution of plants and animals has taken a definite direction, and after the different stages of morphological development have been worked out in detail through successive stratigraphical horizons in one area, they can be used to correlate the sequences of sedimentary rocks in another district. Here, in other words, is the dictum of William Smith, amplified and reinforced by the conceptions of the evolutionist. The author fully illustrates these views in dealing with the graptolites and ammonites.

The second portion of the volume is devoted to a description of the floras and faunas of the geological systems, beginning with the Cambrian; and these are lucidly described and with a wealth of detail. Here and there, however, one finds oneself not in complete agreement with the author. For example, the usefulness of the chapter on Carboniferous faunas, otherwise excellent, is diminished by the somewhat curt dismissal of the faunas of the marine bands which occur at various horizons in the Coal Measures, on the ground that "they have not yet been sufficiently investigated and no generalisation can be made in respect of them." There is probably no better or more widely known stratigraphical horizon in the British coalfields than the Mansfield Marine Band. It, or its equivalent stratum, is recognised in nearly every coalfield in England or Wales, and even in Scotland it probably has its counterpart in the well-known Skipseys Marine Band. In this connexion another regrettable omission is the absence of any reference to *Listracanthus*, a notable genus of fish confined to this horizon.

In a volume of this scope and character it is scarcely surprising to find minor errors creep in. There are several, and no doubt they will be rectified in a future edition of the work. One or two only need be pointed out. On p. 368, *Ostrea discoidea* Kitchin is said to be on Fig. 55. It should read Fig. 53, but in this the authorship of the trivial name is ascribed to Seeley. Again, on p. 373, *Saccocoma* is said to be associated with *Allovirgatites*, whereas on the table on p. 374 it is shown (correctly) as being confined to the Pectinatites Zone, the horizon of the Kimmeridge Oil-shales.

On p. 382 the author states that "in these Midland counties there is a thick clay series, extending through the Callovian, Divesian, Argovian, and Kimmeridgian stages, whose differentiation is almost impossible on lithological characters and is not always easy by palæontological methods." Surely no difficulty has ever been experienced whenever fossil material was available. Again, on the same page, it is stated that "it has only recently been recognised, by the application of palæontological methods, that the upper Kimmeridge Clay (Bononian Stage) is nowhere present north of Buckinghamshire," whereas in Norfolk and Lincolnshire borings have revealed a complete sequence from the Pectinatites Zone downwards through the formation. This zone is also exposed in the cliffs at Speeton in Yorkshire.

The volume is well illustrated and contains about 500 excellent figures of fossils, mostly of zonal value. Nearly every chapter is followed by a selected list of books of reference which should prove of the utmost value to the student. One is in full agreement with the author's injunction that every student should know the history of his science. He certainly will be impressed by the achievements of the early writers, and will soon perceive that many additions to knowledge "attributed to later workers could have been credited to the pioneers had the information been originally expressed appositely."

We heartily commend this volume to the student and to the general reader. J. P.

Newton and his Work.

Sir Isaac Newton, 1727–1927: a Bicentenary Evaluation of his Work. A Series of Papers prepared under the Auspices of The History of Science Society, in collaboration with the American Astronomical Society, the American Mathematical Society, the American Physical Society, the Mathematical Association of America, and various other Organisations. Pp. ix + 351. (London: Baillière, Tindall and Cox, 1928.) 22*s*. 6*d*. net.

"IT is with the belief that the publication of these papers will lead to a better comprehension of [Newton] . . . and to a more rational appreciation of his achievements, that the History of Science Society has arranged for the publication of this volume." With these words the president of that Society, Prof. David Eugene Smith, introduces the collection of papers read at the gathering held in New York on Nov. 25–26, 1927, to mark the bicentenary of the death of Sir Isaac Newton.

The contributions of the twelve authors are meant to appeal to the general reader rather than to those who are already familiar with one or more of the many fields in which the creative activity of Newton made its mark. The aim has been kept steadily in view, but at the same time there is much between the covers of the book that is of interest to the trained student, and one paper, dealing with the earliest disciple of Newton in America, contains much that is fresh to English readers.

Prof. D. C. Miller deals with the discoveries of Newton in optics. He makes it clear that the corpuscular structure of light rays ultimately formed part of Newton's theory, but is of opinion that the time has not yet come to assert that either a corpuscular or an ether theory, or both combined, will prevail when the tercentenary approaches. "The temptation to draw analogies between Newton's corpuscles and Planck's quanta, between 'fits of easy transmission' and waves, is confronted by difficulties so far insuperable, unless the new mechanics of Heisenberg and Schrödinger provides the necessary reconciliation." The author clearly sums up the specific contributions Newton made to optics, and adds references to what he did not do and to phenomena which he might have detected.

Prof. G. D. Birkhoff gives a clear explanation of Newton's 'philosophy of gravitation,' and briefly indicates how the accumulation of results in experimental physics led to a modified view of the physical universe and to modern relativity ideas. Prof. W. W. Campbell follows with a most interesting paper on Newton's influence upon the development of astrophysics. Newton's "views as to the nature of light seem to have much in common with those held by physicists in the last two or three years—by De Broglie, Schrödinger, and others. . . . To me it is clear that Sir Isaac Newton was uniquely the great pioneer of astrophysics." Prof. M. I. Pupin takes Newton's dynamics as his subject, and gives reasons for the hope "that a new dynamical science will soon be born, and that, like Maxwell's dynamics, it will be another daughter of Newton's dynamics." Prof. E. W. Brown's contribution is entitled "Developments following from Newton's Work," and its gist is summed up in his final words: "Newton's name runs no danger of being forgotten when his work is subjected to the acid test for all scientific work, namely, its capacity for further development."

Prof. Florian Cajori adds to his reputation by a valuable piece of research into the causes of Newton's delay of two-score years in announcing his law of gravitation. He opens with a careful study of what was known in England about the size of the earth, before the days of Picard's measurements, and gives tables of his results in a form suitable for rapid reference. Finally, having shown clear reasons for rejecting the attribution of the delay to any great error in the value for the size of the earth used in 1666, he finds the cause in "theoretical difficulties involved in the earth-moon test," thus ending with a decision in favour of the Adams and Glaisher explanation in 1887. Prof. Cajori follows this paper with a few pages on the moot question: Did Newton perform partial differentiation and deal with partial differential equations?

Prof. P. R. Heyl pays a tribute to Newton's experimental skill, and Prof. L. C. Newell dwells upon the aim Newton had in view when he applied the talents he had acquired to the problems of the chemistry of his day. In whatever field Newton laboured he remained "a philosopher, searching experimentally for a fundamental interpretation of broad relations in natural phenomena." For example, in the "De Natura Acidorum" he speculates on the operation of the force of residual affinity, and on that subject we still await a Newton "to order our knowledge with a philosophy." In his speculations on the nature of fire he went as far as was possible before the discovery of oxygen.

Mr. G. E. Roberts, a former Director of the United States Mint, contributes an interesting

sketch of Newton's work at the Mint. His office of warden, says Macaulay, "had become a mere sinecure, and had been filled by a succession of fine gentlemen who were well known at the hazard table of Whitehall, but who never condescended to come near the Tower." In the opinion of this modern financial expert, Newton proved himself to be "a financier of foresight, and one with a firm grasp of a large problem."

Finally, we have an attractive paper by Mr. F. E. Brasch, the Librarian of Congress, on John Winthrop, Newton's first critical disciple in the American colonies. John Winthrop, at the age of twenty-four years, was made professor of mathematics and natural philosophy at Harvard, and was the first to make fluxions a subject in the college course. He was the direct descendant of two Winthrops who were elected fellows of the Royal Society in 1663 and 1734 respectively. For his own work on transits of Mercury and Venus, amongst other things, he was himself elected fellow in 1766. His last communication to the Royal Society was in defence of Newton against a statement made by Castillon in his "Life of Newton."

It is interesting to learn that at the exhibition of Newtoniana held in connexion with the celebrations were shown two volumes presented by Newton himself to the Library of Yale College—the "Principia" (1713), and the Latin edition of the "Optics" (1706), for the preparation of which Dr. Samuel Clarke received £500 from the author.

Polar Geography.

(1) *Problems of Polar Research: a Series of Papers by Thirty-one Authors.* (American Geographical Society Special Publication, No. 7.) Pp. v + 479. (New York: American Geographical Society, 1928.) 5 dollars.

(2) *The Geography of the Polar Regions.* Consisting of A General Characterisation of Polar Nature, by Otto Nordenskjöld; and A Regional Geography of the Arctic and the Antarctic, by Ludwig Mecking. (American Geographical Society Special Publication, No. 8.) Pp. viii + 359. (New York: American Geographical Society, 1928.) 4 dollars.

(1) THIRTY-ONE authors, most with personal experience of the polar regions and each an expert in some branch of research, have contributed to the first of these volumes. The result is a collection of papers of the highest value, which reflects great credit on the enterprise of the American Geographical Society. There must obviously be a certain overlap among several of the papers, just as certain topics are overlooked, but this does not detract from the value of the collection.

The first paper is suitably by Dr. F. Nansen and contains a summary of his views on Arctic oceanography based largely on papers previously published in Norwegian and German. This paper contains a coloured map of North Polar regions. Other notable papers are by Sir Douglas Mawson on the unsolved problems of Antarctic exploration, Dr. E. von Drygalski on Antarctic oceanography, Dr. K. Rasmussen on future research in Eskimo problems, and Mr. V. Stefansson on the utilisation of Arctic resources. There are also several papers by Russian authors based on the work of the Russian icebreakers north of Siberia, expeditions the results of which have so far been little accessible to English students.

Biological problems are also treated at some length, and there are articles on polar flying by Comdr. R. E. Byrd, Mr. L. Ellsworth, Sir G. H. Wilkins, and General U. Nobile. Sketch maps are numerous and bibliographical notes are copious.

The volume is one of the few available, outside purely technical results, that treats polar research from the point of view of the problems to be solved with no attention whatever to heroic endeavour or sensational achievement.

(2) The second volume consists of two translations, Dr. O. Nordenskjöld's "Polarnaturen," a Swedish work published in 1918, and Dr. L. Mecking's "Die Polarländer," published in German in 1925. Dr. Nordenskjöld's book has been partly revised in translation and is based on a series of lectures. It is a valuable sketch of the main features of polar physical geography, including climate and natural history, based on the author's own wide experience in north and south.

Dr. Nordenskjöld does not attempt a full explanation of the Antarctic blizzards, but he contrasts the southerly winds on the edge of Antarctica with the outflowing winds from Greenland. The latter he describes as typical föhns, but finds that similar effects are lacking on the border of the southern continent, and suggests that the fundamental explanation of the lack of a maritime climate in the Antarctic coastal belt is due to the vastness of the ice-sheet and its dominating effect on the climate. Yet föhn effect, or winds with those characteristics, have been noted in Victoria and Wilhelm Lands, where the descent is abrupt. In the chapter on land-forms a theory of the formation of the strand flat as due to frost weathering along the edge of a shelf-ice or ice-foot is indicated but not elaborated.

In fact, Dr. Nordenskjöld's course of lectures is too short for all the valuable ideas it contains.

Dr. Mecking's book occupies the greater part of this volume. Beyond a few general chapters it is occupied with regional descriptions. It is a useful storehouse of facts enhanced by good photographs and a bibilography which is serviceable but not complete. Many minor matters would bear corrections, but complete accuracy is perhaps unobtainable in a book covering so wide an area. The statement that the polar landscape is "the quintessence of monotony in form and colour" could not have been written by anyone with a wide experience of polar regions. R. N. R. B.

History of Medicine.

A Short History of Medicine: introducing Medical Principles to Students and Non-Medical Readers. By Dr. Charles Singer. Pp. xxiv + 368. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 7*s.* 6*d.* net.

THE numerous readers of NATURE, medical and otherwise, who are familiar with Dr. Singer's valuable contributions to the history of medicine, will welcome the appearance of this volume in which he has admirably succeeded in his attempt to trace the history of medicine as "a Rational Discipline involving many and perhaps all the sciences."

The work is divided into six chapters of unequal length, devoted respectively to Greek medicine down to the year 300 B.C., the Heirs of Greece, including the Alexandrian School and medicine in the Roman Empire, with special reference to Galen; the Middle Ages from about A.D. 200 to about A.D. 1500; the rebirth of science from about 1500 to about 1700; the period of consolidation from 1700 to 1825; and the period of subdivisions from 1825 down to the present day.

Although the author lays stress on the fact that the narration of the earlier times is so condensed that more than half the book is devoted to modern medicine, ample justice is done to the earlier workers. Not only is the debt of medicine to the Greeks and their contemporaries recognised, but also the important part played by the Romans in the organisation of medical science is emphasised, especially in departments relating to public health.

The chapter on the Middle Ages contains a description of the period of depression from about A.D. 400 to about 1200 during which all theoretical knowledge was allowed to lapse, superstitious practices crept in and, apart from the School of Salerno, medicine surrounded by sacred associations deteriorated into a collection of formulæ. Then follows an account of Arabian medicine and the medieval awakening, in which the universities, especially Bologna, where public dissections were first performed, played a prominent part. In the revival of learning which took place in the fifteenth century and involved anatomy, physiology, and internal medicine as well as other branches of science, an important place is assigned to the anatomist Vesalius, whose masterpiece, "The Fabric of the Human Body," is regarded by the author not only as the foundation of modern medicine as a science, but also as the first great achievement of science itself in modern times, ranking with the treatise of Copernicus on "The Revolutions of the Celestial Spheres," which was published in the same year, 1543. The influence exercised on medicine in the seventeenth century by natural philosophers who were not medical men, such as Galileo, Boyle, and Newton, is illustrated by the work of Sanctorius, whose experiments laid the foundation of the modern study of metabolism, the microscopical investigators Malpighi and Leeuwenhoek, and others.

The first half of the eighteenth century was mainly occupied by two great medical figures, Hermann Boerhaave, who is described as the greatest physician of modern times and the pioneer of medical instruction in Europe, and Albrecht von Haller, one of the most voluminous of scientific writers, who won special distinction as a physiologist.

The last chapter, which occupies nearly half the book, deals with the development of preventive medicine, in which Great Britain was the leader from the first—embryology, chemical and experimental physiology, cellular pathology, the germ origin of disease, anæsthesia, modern surgical advances, bacteriology, the study of immunity, the conquest of the tropics, treatment of insanity, revolution in nursing, and medical statistics.

In the epilogue Dr. Singer deplores the lack of literary expression characteristic of a large proportion of modern scientific writers, due to the increasing neglect of the humanities in the adolescent stage of mental development.

The book is well printed, lavishly illustrated, and provided with a full index, the value of which is enhanced by the dates being fixed to the names of all persons mentioned in the text. The many readers who derive profit and pleasure from the present work will be glad to learn from the preface that Dr. Singer is engaged in a history of the biological sciences treated on somewhat similar lines.

Our Bookshelf.

The Geology of Venezuela and Trinidad. By R. A. Liddle. Pp. xxxix + 552 + 85 plates. (Fort Worth, Texas: J. P. MacGowan; London: Thomas Murby and Co., 1928.) 33*s.* 6*d.* net.

VENEZUELA is a country now of special interest both in economic and academic geology. In this volume Mr. R. A. Liddle states the facts collected in that country and Trinidad during five years' field work for an American oil company in 1920–25. The book is useful from its mass of facts, which are systematically stated and tabulated. It is illustrated by numerous sketch maps and illustrations. The author shows that the country consists of a basis of metamorphic rocks, which are covered by rare Silurian or Ordovician beds, and some Devonian. An extensive series, which he calls the Old Red Series, from its apparent age, would be more appropriately called the New Red Series. There are no marine Jurassic rocks, but a varied series of Cretaceous, which are covered unconformably by a succession of Eocene. After another unconformity and some Oligocene rocks follows the Miocene, which is described as the characteristic formation of Venezuela. It was followed by great earth movements and uplifts. The Pliocene was a period of erosion, while the Pleistocene in the southern part of the country is a vast tract of alluvium with broad sheets of outwash gravel from the Andes. The author's view that some of the garnetiferous schists are of Cretaceous age is based on evidence that appears quite inadequate. The account of the tectonic structures is not very clear. The bibliography is irregular and inaccurate. Misprints are aggravatingly numerous, but perhaps the author was unable to see proofs. There is no reference to the work of some other geologists who were engaged in Venezuela and Trinidad at the same time.

Geometrische Optik. Von Dr. H. Boegehold. (Sammlung Borntraeger, Band 11.) Pp. 375. (Berlin: Gebrüder Borntraeger, 1927.) 13·50 gold marks.

So many books have been devoted to the subject of geometrical optics—the principles of which are already well defined—it is often difficult to find much variation in the presentation of the material or justification for its republication; the illustrations have often a too familiar appearance. No charge of this kind can be brought against the "Geometrische Optik" of Dr. Boegehold. If some of the illustrations seem familiar, it is because they have been reproduced from the original works of the pioneers of optics, to whom the elucidation of the principles discussed is originally due. The author has invested a subject which usually involves laborious study with a historical interest, which makes the perusal of the descriptive portions a pleasure.

The mathematical treatment does not require any very special equipment. To some extent this is due to the extensive use of the simple trigonometrical system commonly used by manufacturers. As stated by the author, it is only in the last chapter that some difficulty may be experienced, owing to the omission of intermediate steps in the development of the formulæ. Students will find the practical examples of trigonometrical computation particularly instructive.

A feature of the work is the association with each diagram and illustration of a clear and concise description. There is provided a list of reference works, both historical and modern, together with a satisfactory subject index. J. W. F.

Manuel du relieur. Par J. Lemale. (Bibliothèque Professionnelle.) Pp. 350. (Paris: J. B. Baillière et fils, 1927.) 22 francs.

THIS is a clearly written book by a high authority on practical bookbinding, suitable for amateur or professional. It does not enter into either mass binding or casing for the trade, or the refinements of finishing dear to the high-class amateur. The attempt to illustrate the various manual processes by photography might perhaps have been more successful had the photographs been better reproduced in the printing; as they are, they are less clear than the line drawings in Mr. Cockerell's well-known book.

For English readers, who presumably would be either bookbinders or bibliographers, the most useful parts of the book are likely to be the glossary of technical terms, and the French names for the various sizes of paper and the measurements of the corresponding formats. The diagram explaining the terms applied to the various regions of a bound book is good and clear.

Flandern. Von Prof. Dr. Wilfried von Seidlitz. (Die Kriegsschauplätze, 1914–1918, geologisch dargestellt, in 14 Heften, herausgegeben von Prof. Dr. J. Wilser, Heft 8.) Pp. viii + 82. (Berlin: Gebrüder Borntraeger, 1928.) 10·40 gold marks.

THE exorbitant charge of 10·40 gold marks for this paper-bound pamphlet of 82 pages, with a dozen crude figures in the text, is probably due to some sale being assured as part of a series which contains some important works. The book is a useful summary of the geology of Flanders, and includes an instructive table (pp. 14-15) of the Belgian Kainozoic deposits. The book refers to the military engineering in the War, and to the victory at Messines having been achieved by the British mining having, unnoticed and unheard, deposited a million kilograms of explosive 20 metres below the lowest German counterworks.

Criminology. By Horace Wyndham. (Benn's Sixpenny Library, No. 27.) Pp. 79. (London: Ernest Benn, Ltd., 1928.) 6*d.*

THIS small book on criminology is a very interesting and well-composed account of the history of crime mainly in Great Britain. The conditions described even so recently as a hundred years ago will make many people's hair stand on end, and show how urgently penal reform was needed, and, for that matter, still is needed. The author, like many people of the present day, considers that capital punishment should be abolished.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Tidal Bore in the Trent.

THE accompanying photograph (Fig. 1) which was taken by me on Aug. 18 last at Knaith, five miles above Gainsborough, conveys an idea of the appearance of the tidal bore in the River Trent. Gainsborough is the most convenient stopping place for the visitor who desires to witness one of the most striking phenomena in the natural scenery of Great Britain. It is a sight which never palls, and at each high spring tide a group of residents gather on the bank at Gainsborough and at every village for twelve miles down the river. Visitors from distant parts of the country are, however, scarce, and this, I think, is largely owing to want of guidance as to dates when the display can be reckoned on with certainty.

FIG. 1.—Tidal bore in the River Trent at Knaith.

Sufficient information can be gleaned from the table of the time of high water at certain ports which appears on the fourth page for each month in "Whitaker's Almanack." Days when very high tides are expected at London Bridge are marked with an asterisk, and on these days 'a good eagre' is expected in the Trent. The hour of high water at Hull is given on the same page, and this is the time when the visitor should take station on the riverside path below the end of Bowling Green Road, Gainsborough. It must be remembered that the time given in "Whitaker's Almanack" is G.M.T., so that one hour must be added for the months when Summer Time is in operation. The earliest and latest hours are approximately 6 A.M. and 9 P.M. G.M.T. From April to September inclusive there is enough light to see both morning and evening eagre. March and October are good for height of tide, but light is failing in the evening, and from November to February, both inclusive, conditions are unfavourable for the spectacle.

On the occasion of my latest visit to the Trent I arrived at Gainsborough on Aug. 16, the day after new moon, and saw the eagre on this and three following days. Morning and evening I met the eagre some miles below Gainsborough, and as soon as it had passed I motored to a point higher up the river and met it again, and so on as far as Torksey, ten miles above Gainsborough. The near view is splendid, from the fury of the waves lashing the bank, and the foaming 'whelps' which rear their crests above the shallows. The distant view, less easy to obtain in this flat country, is almost equally striking in a different way, the whole disturbance merging in one broad bright band extending from bank to bank which sweeps majestically up the river. The length of course run by the eagre is fully five-and-thirty miles from its beginning near the outfall into the Humber estuary, and all the way the coming of the tide is heralded by the warning cry 'ware eagre.'

VAUGHAN CORNISH.

Inglewood,
Camberley, Surrey.

Absolute Magnitude Effects in Stellar Spectra.

IT is known from the fundamental work of Adams and Kohlschütter and their followers that certain pairs of lines in stellar spectra change in relative intensity with absolute luminosity, and this has formed the basis of the method of 'spectroscopic parallaxes.' The method has been hitherto empirical, stars of known luminosity being used as a basis to determine the luminosities of other stars from calibration curves. Saha's researches on high-temperature ionisation, whilst not removing the empirical basis, afforded a general qualitative explanation of many of the results observed. They showed that the lowered value of surface gravity g in giant stars as compared with dwarfs must cause reduced pressures in the atmospheres of giants with consequent increased ionisation and hence increased intensity of enhanced lines (Pannekoek, *B.A.N.*, **19**).

Certain anomalies, however, remained. The Balmer lines, for example, have been long known to increase in intensity in giant stars, whilst, originating as they do from neutral atoms, they should on the simple theory decrease. Again, the lines of Sr^+ always increase in intensity with increasing luminosity, whilst on the simple theory they should decrease at temperatures above the temperature-maximum in the stellar sequence. Lastly, Miss Payne (*Harvard Bulletin*, No. 307, 1927) has found that the lines of all neutral atoms increase in intensity with increasing luminosity, in opposition to the predictions of the simple theory.

In a paper recently communicated to the Royal Astronomical Society, I have developed a method for treating stellar absorption lines taking account of the optical depth at which they originate—more precisely, of the optical thickness τ_0 of the layer in which they originate. It is found possible to define a depth $\tau = \tau_0$ such that the behaviour of the N atoms between $\tau = 0$ and $\tau = \tau_0$ determines the behaviour of the corresponding spectral line. The value of τ_0 depends on the part of the line-contour concerned, being greater in the wings than in the centre, but it is quite determinate. The method lends itself to the discussion of absolute magnitude effects, and it is found possible to calculate dN/dg at constant temperature, keeping τ_0 constant.

If dN/dg is negative, the line should increase in intensity as g decreases, that is, from dwarfs to giants; and vice versa if dN/dg is positive. In calculating dN/dg two alternative assumptions may be made: either we may take κ, the coefficient of general absorption of the stellar atmosphere, to be constant, or we may attribute opacity to photoelectric processes and put $\kappa = \alpha P/(kT)^{9/2}$ according to the calculations of Kramers and Eddington, α being a universal constant, T the temperature, and P the electron pressure.

If κ is taken as constant, the sign of dN/dg is found in every case to be in accordance with the qualitative predictions of the simple Saha theory; for neutral atoms we find $dN/dg>0$, which is, however, in contradiction with observation. But if we take $\kappa = \alpha P/(kT)^{9/2}$, dN/dg is found to be negative. This is in agreement with observation. Thus observation decides against the assumption $\kappa =$ constant and in favour of the physically acceptable law $\kappa = \alpha P/(kT)^{9/2}$. The origin of this marked difference resides in the differing behaviour of P_0, the partial electron pressure at the constant optical depth τ_0, on the two assumptions.

The strontium anomaly is similarly removed when we take $\kappa = \alpha P/(kT)^{9/2}$. Whether the observations confirm the values of dN/dg in amount as well as in sign cannot be stated until more detailed spectro-photometric determinations of line-contours are available for sequences of stars of constant T but differing g. The theory predicts, however, that the Balmer lines should be much more sensitivé to g in stars of low effective temperature than in the earlier types, as appears to be the case.

The new formulæ, if confirmed by observation on stars of known g, will afford a method of comparing the g-values of any two stars of the same temperature, and so ultimately give a rational basis to the determination of spectroscopic parallaxes. The possibility of thus determining g-values from line-intensities was pointed out some years ago by Pannekoek.

Full details will be communicated to the Royal Astronomical Society.

E. A. MILNE.

The University, Manchester,
Nov. 15.

Vortices on the Monsoon Front.

THE south-west monsoon advances in most years from the south-east Arabian Sea first towards Malabar and then gradually northwards along the west coast of the Indian Peninsula with a clear discontinuous boundary, the monsoon air being relatively cool, moist, and highly unstable, and the air on the other side hot, dry, and less unstable. It has been known to move northwards in some years with a well-marked 'depression' in front, a few hundred miles in diameter, and cause a burst of the monsoon on the west coast, but it was never recognised that innumerable little whirls, 20-30 miles in diameter, formed on the discontinuous boundaries, and passed undetected, except those which left their traces in the Colaba autographic records. Even at Colaba they were unknown until two very typical vortices passed through Bombay on June 17, 1927, and forced attention to their existence. A search was made of the past records, and several others were discovered to have passed through Bombay in previous years. They were looked for during the burst of this year's monsoon, and a feeble one was noticed passing through Bombay shortly after midnight on June 11.

The monsoon fronts undoubtedly represent typical discontinuities in the tropics analogous, though not quite similar, to the polar fronts in the extra-tropical region, the theory of which has been so elaborately developed by the Norwegian meteorologists. The vortices formed on the monsoon fronts are therefore of peculiar interest; for, when the detailed synoptical investigations of the fronts are available, they will eventually be found to be waves as well as vortices like those on the polar fronts (V. Bjerknes, *Geofysiske Publikationer*, vol. 2, No. 4), and thus throw considerable light on the nature of the transition layer between the different air masses.

Assuming that the vortex, which passed through Bombay between 7 and 8.30 A.M. on June 17, 1927, had travelled with the velocity of the mean wind which prevailed before and after its passage, it would appear that it had a diameter of about 22 miles. The sharp rise in wind velocity from 15 to 57 miles per hour, followed by a sharp fall to 12 miles and another sharp rise to 48 miles, and then a quick return to normal condition, all occurring within an hour and a half, during which the direction changed from south to north through west, and pressure dropped by 0·173 inch of mercury, suggest that the centre of the vortex must have passed within 2 or 3 miles of the Observatory. The velocity distribution in this vortex can be very approximately represented by that of a Rankine's combined vortex. A velocity of 50 miles per hour in its ring of maximum velocity will thus account for a central barometric depression of 0·19 inch of mercury. In a similar manner the observed barometric depression in the other vortices which passed through Bombay could be explained by working out a theoretical vortex having approximately the observed distribution of velocity. There can thus be very little doubt that all of them had the structure of an atmospheric vortex.

The air temperature near the ground during the passage of the vortex of June 17, 1927, dropped from 79·5° F. to 77·3° F. This vortex was followed by another after about 14 hours, and the temperature again dropped, from 79·7° F. to 76·5° F. The succession of vortices, some well defined and others not so well defined, which passed through or near Bombay in this year, and also in some previous years, during the northward movement of the monsoon fronts along the west coast, lends strong support to the view that they are also waves on surfaces of discontinuity. A detailed account of these vortices will be published in due course.

S. K. BANERJI.

The Observatory, Bombay,
Oct. 17.

THE interesting letter of Dr. S. K. Banerji on the appearances of vortices at Bombay before the arrival of the monsoon is based for its theory on a fairly strict acceptance of V. Bjerknes' view that a cyclone is a product merely of dynamical instability of Helmholtz waves on a widely extended front between cold and warm air. But many still accept the earlier view, due to Dove, Helmholtz, Margules, Bigelow, Exner, and others, that a cyclone merely requires the juxtaposition of two air-masses at different temperatures, the latent heat of condensation providing energy in addition to that from the descent of the centre of gravity of the system when the cold air flows under the warm. The conventional statement regarding the area in front of the oncoming monsoon when disturbed was that it is one 'of squally weather in which a storm may be forming'; and the corresponding explanation was that at first light variable airs prevailed there for two or three days, so that the air near the sea surface became very hot and moist, conditions favourable for instability.

I welcome Dr. Banerji's letter, however, for its reminder of the temperature contrast between this

hot moist air and the cool air of the moist monsoon current, so that when the monsoon wind advances under the heated air we shall have the essential conditions of a cold front with its attendant squalls and its tendency to produce the vortices of waterspouts. It will facilitate the production of rain if the hot air which is lifted by the cold is moist, at any rate in its lower layers; and it may be that cyclones only form when this moisture exceeds some limit. Also it would be interesting to see whether the direction of the front between these two air-masses is related with the direction in which the cyclone, when formed, begins to move—a matter on which light is badly needed. GILBERT T. WALKER.

The Heat of Dissociation of Nitrogen.

IN a recent letter to NATURE (**122**, 313; Sept. 1, 1928) E. Gaviola has presented some evidence indicating that the heat of dissociation (D) of N_2 is not more than 9·8 volts, as contrasted with the 11·4 volt value calculated by Birge and Sponer (*Phys. Rev.*, **28**, 259; 1926). It seems desirable to state that some months ago R. S. Mulliken and I independently reached the conclusion that the value of D for N_2 is probably about 9·5 volts. The evidence on which I reached this conclusion, which seems to me quite direct and unambiguous, is contained implicitly in a recent article by G. Herzberg (*Ann. d. Physik*, **86**, 189; 1928) on the negative N_2 bands.

Herzberg has greatly extended this system, obtaining 12 levels in the excited state (A'), as compared to the 5 levels available to Birge and Sponer. He is thus able to get a fairly trustworthy curve for the variation of the frequency of vibration with the vibrational quantum number (p. 205, loc. cit.). He then obtains, from this curve, 3·5 volts as the probable value of the heat of dissociation for this excited (A') level, with 3·7 volts as an upper limit. However, plots made by me of all known vibration curves indicate that they probably always have a point of inflection, and the true value of D for level A' is therefore slightly more than 3·7 volts, rather than less.

For a reason appearing below, I will assume 3·9 volts as an upper limit. Adding the electronic energy 3·2 volts, one obtains 7·1 volts as an upper limit for the total energy difference between the normal (X') level of N_2^+ and dissociation from state A'. If the products of dissociation from state A' are two normal atoms (N^+ and N), then 7·1 volts is also, within a few tenths of a volt, the normal heat of dissociation (D') of N_2^+. If the products of dissociation from state A' include one excited atom, D' is at least 2·4 volts *less* than 7·1 volts. By the argument presented below, this would give $D = 9{\cdot}5 - 2{\cdot}4 = 7{\cdot}1$ volts, an unreasonably low value. The probable products of dissociation from the various electronic levels are discussed in the accompanying letter by Prof. Mulliken.

The total energy necessary to obtain normal N^+ and N from normal N_2 is then given by either $I_m + D'$ or $D + I_a$, where I_m and I_a are the respective ionisation potentials of the neutral molecule (N_2) and neutral atom (N). Hence, by conservation of energy, $I_m + D' = D + I_a$, a relation used repeatedly by Birge and Sponer. I_m can scarcely be more than 16·9 volts (the experimental values range from 16·3 to 16·9 volts). We have just seen that D' can scarcely be more than 7·1 volts. Hence $7{\cdot}1 + 16{\cdot}9 = 24{\cdot}0$ volts, giving an upper limit for the potential at which N^+ ions might first appear, starting with normal N_2. Hogness and Lunn (*Phys. Rev.*, **26**, 786; 1925) observed N^+ ions at a minimum potential of 24 volts. Considering now the right side of the equation, we know that I_a is 14·5 volts (J. J. Hopfield, *Phys. Rev.*, **27**, 801; 1926). Hence D cannot well be greater than 9·5 volts.

This new value of 9·5 volts (or a few tenths of a volt less) is consistent with Sponer's theory of the origin of the α-group bands observed in the afterglow of active nitrogen, provided that one assumes that association to form the nitrogen molecule occurs only between one normal and one 2·4 volt (metastable) excited atom. It is also consistent with the quite different recent ideas on this subject given by Kaplan and Cario (NATURE, **121**, 906; June 9, 1928). This, however, is a matter which can more appropriately be discussed by those actively at work in the field.

Birge and Sponer used the value of D for N_2 in calculating indirectly the value of D for NO. The above lowering from 11·4 to 9·5 volts lowers the D of NO by half this difference, the new indirect calculation being thus 7·3 volts (or less). This agrees better with the later more reliable direct calculation of 6·8 volts, by Jenkins, Barton, and Mulliken (*Phys. Rev.*, **30**, 150; 1927). All recent work seems to indicate the approximate correctness of the value 7·0 volts for the D of O_2, given by Birge and Sponer. Hogness and Harkness (unpublished work) have recently checked the Birge and Sponer value of about 11 volts for CO. The probable values for the heat of dissociation of these molecules are therefore, in the opinion both of Prof. Mulliken and myself, O_2, 7·0 volts; CO, 11 volts; N_2, 9·5 volts (or slightly less); NO, 7 volts.

RAYMOND T. BIRGE.

University of California,
Sept. 28.

IN connexion with the assignment of quantum numbers for electrons in molecules (R. S. Mulliken, *Phys. Rev.*, **32**, 186; 1928), it is important, in considering a molecule in a specified electronic state, to know in what electronic states the atoms or ions resulting from its adiabatic dissociation would be (R. S. Mulliken, *Phys. Rev.*, November 1928). I have thus been led to a study of dissociation products and heats of dissociation for various molecules, and among other results have reached conclusions essentially the same as those stated in the accompanying letter by Prof. Birge. Only a few points concerning the nitrogen molecule will be given here; further discussion will be found in the articles cited.

As Prof. Birge points out, data on N_2^+ furnish strong evidence for a value of about 9·5 volts for the heat of dissociation (D) of neutral N_2. Three electron levels of N_2^+ are known at present, namely, two ^2S levels at about 16·9 and 20·1 volts (X' and A' levels of Birge), and a third, probably also ^2S, level at 24 volts, which is known from the work of Hogness and Lunn. The transition $A' \rightarrow X'$ corresponds to the 'negative nitrogen bands.' If we confine ourselves to a consideration of adiabatic processes of dissociation, definite theoretical limitations exist in regard to possible dissociation products. Thus, as Hund has shown (*Z. f. Physik*, **42**, 93; 1927), an unexcited (^4S) N atom and an unexcited (^3P) N^+ ion can give only *one* ^2S state of N_2^+ on adiabatic union. Other ^2S states must involve an excited atom or ion.

As Birge notes in the accompanying letter, Herzberg's work leads to the conclusion that the best experimental value for the total energy ($T.E.$) required to ionise an N_2 molecule, excite it to state A', and dissociate it adiabatically, is (not more than) 24·0 volts. This value leads to $D = 9{\cdot}5$ volts, if the dissociation products of state A' are an unexcited atom and ion. If the latter supposition is correct, the dissociation products from the *normal* state X'

of N_2^+ must then, according to the preceding paragraph, include an *excited* atom or ion. Assuming a ^2D excited N atom and an unexcited ion, we have $T.E. = 24{\cdot}0 + 2{\cdot}39 = 26{\cdot}4$ volts for dissociation from state X', 2·39 volts being the energy interval between the low ^4S and ^2D states of the N atom. The observed value of $T.E.$ for state X', as obtained by Birge and Sponer by linear extrapolation of the ω_n curve, is 26·0 volts. Experiment and theory are therefore in excellent agreement if $D = 9{\cdot}5$ and if, as Herzberg has suggested, unexcited N_2^+ gives $N^+ + N'$ (N' indicates N excited to the ^2D state), while excited N_2^+ in state A' gives $N^+ + N$ (unexcited), on adiabatic dissociation.

The following table shows how the $T.E.$ values compare with values calculated according to each of the assumptions $D = 9{\cdot}5$ and $D = 11{\cdot}8$ volts. The agreement is good only if $D = 9{\cdot}5$. If the assumed dissociation products for states X' and A' are reversed, the agreement is very poor for D equal to *either* 9·5 or 11·8.

Electron Levels.		Total Energy to Excite and Dissociate (Volts).		
Designation.	Volts.	Observed.	Calculated.	
			$D = 11{\cdot}8$	$D = 9{\cdot}5$
$X'(^2S)$	16·9	26·0	28·7($N' + N^+$)	26·4($N' + N^+$)
$A'(^2S)$	20·1	24·0	26·3($N + N^+$)	24·0($N + N^+$)
Hogness and Lunn ($^2S?$)	24	> 24	28·7($N' + N^+$), or higher	26·4($N' + N^+$), or higher

In the case of Hogness and Lunn's 24-volt level, $T.E.$ for adiabatic dissociation is doubtless at least 26 volts. The energy of 24 volts becomes available, however, in *collisions*, and suffices in these circumstances for dissociation into $N^+ + N$. This fact is in good agreement with $D = 9{\cdot}5$, but is incompatible with $D = 11{\cdot}8$.

A study of experimental data on $T.E.$ values in relation to theoretically possible dissociation products for the electron levels of *neutral* N_2 gives additional evidence for the value $D = 9{\cdot}5$ volts. Details will not be given here, but may be found in the references cited, together with other evidence both for and against the value $D = 9{\cdot}5$.

R. S. MULLIKEN.

University of Chicago.
Oct. 2.

The Polarisation of Compton Scattering according to Dirac's New Relativistic Dynamics.

ACCORDING to the quantum-dynamical treatment of Dirac and Gordon, the state of polarisation of light scattered by free electrons is the same as on the classical theory. This result seems to be in agreement with experiments of Kallmann and Mark (*Zs. f. Phys.*, **36**, p. 120; 1926) and of Lukirsky (NATURE, p. 275, Aug. 25, 1928).

On the basis of the new relativistic quantum dynamics of Dirac, Dr. Klein and I have calculated the intensity of light scattered by free electrons at rest under the influence of a plane monochromatic radiation. The result for unpolarised incident radiation was given in a note in NATURE (Sept. 15, p. 398). Here the deviation from the Dirac-Gordon formula is not small for γ-rays at large angles of scattering, although existing experimental results seem unable to decide between the two theories. Recently I have examined on the new theory the question of polarisation of the scattered light more closely.

Experiments to determine the polarisation of the Compton scattered radiation are usually done in the following way. An incident beam of unpolarised light of intensity I_0 and frequency ν, sent along the x-axis is scattered by an electron at the origin. The scattered light again falls on another electron which lies on the y-axis at a distance r from the origin. The intensity of light, which is thus doubly scattered, in the plane parallel to the x-z plane through the second electron is examined at a distance r' from this electron. Thus, for example, if the polarisation of the scattered light is the same as on the classical theory, the intensity in the z-direction will be zero. On the new theory, however, the result is different, and we get the following expression for the intensity in the plane mentioned in a direction forming an angle θ with the z-direction:

$$I = \frac{e^8}{2m^4c^8r^2r'^2}\,\frac{I_0}{(1+\alpha)^6}\left\{\sin^2\theta + \frac{2\alpha^2 + 2\alpha^3 + \alpha^4}{2(1+\alpha)^2}\right\},$$

where $\alpha = \dfrac{h\nu}{mc^2}$, e, m denoting charge and mass of the electron, c the velocity of light, and h the Planck constant. The formula differs from that of Dirac and Gordon by the second term, which is independent of θ and is of the order of magnitude α^2, as was the case with the deviations between formulæ of the two theories given in our previous note. For a given frequency, therefore, a constant amount is superposed on the intensity of the Dirac-Gordon formula for all angles. The additional term is small for ordinary X-rays, but is of about the same order of magnitude as the first term for γ-rays. Thus for $\alpha = 1$, and 2, which correspond to the wave-lengths of 2×10^{-10} cm. and 1×10^{-10} cm. respectively, the second term is about 0·6 and 2 times the first at $\theta = 90°$ respectively.

The experimental results of Kallmann and Mark cannot decide between the two theories, since the wave-length used is too long to make the difference appreciable. On the other hand, Lukirsky's results seem to be in favour of the Dirac-Gordon theory, if the wave-length used in his experiment is between 0·07 A. and 0·1 A., as was mentioned in his note. For by using the mean value of these frequencies in our formula, we find the intensity at $\theta = 0°$ to be about 6·5 per cent of that at $\theta = 90°$, instead of 2·5 per cent as was found by Lukirsky. If the wave-length used were 0·14 A., his result would be in agreement with our formula. More accurate measurements with X-rays of short wave-lengths as well as with γ-rays are desirable for the test of the present theory.

Y. NISHINA.

Universitetets Institut for teoretisk Fysik,
Blegdamsvej, 15, Copenhagen,
Sept. 29.

Natural Pyramids on a Beach in the New Hebrides.

WHILE engaged recently in biological research in the New Hebrides (in the Pacific Ocean) under the Percy Sladen Trust, I came across a curious geological phenomenon on the black sandy beach to the east of the mouth of the R. Yoro in Big Bay, Espiritu Santo. I have never heard of anything resembling it in any part of the world. Possibly there are readers of NATURE who can explain it.

All the way along the beach for three or four miles there extends a row of piles of pebbles. Most of these piles are a couple of feet high in the middle and a dozen paces across. They are covered at high tide and wholly or nearly wholly exposed at low tide. The constituent pebbles, of black volcanic rock, are mostly oval in shape, somewhat flattened, and perhaps three or four inches long. Between each pile of pebbles and

the next there is in most cases an expanse of sand several paces across, which is almost bare of pebbles. There is a tendency for the piles to assume a definite shape (see Fig. 1), namely, the shape of a very low

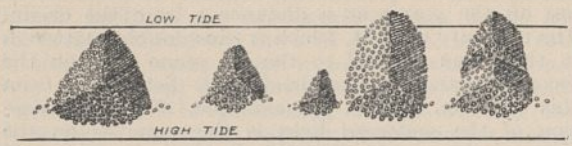

FIG. 1.—Plan.

three-sided pyramid, inclined on the beach in such a way that the landward side of the pyramid is almost level (Fig. 2). In some cases a second, smaller

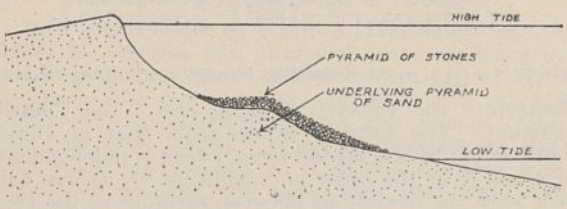

FIG. 2.—Vertical section.

pyramid has been plastered on, as it were, to the seaward side of a larger one (see right-hand side of Fig. 1). Each pile of pebbles rests on a similarly shaped accumulation of sand; and where there are no pebbles, the sand alone continues the succession of pyramids.

I erected sticks to mark the position of two adjacent well-formed pyramids, to see whether they would shift their position at all. Next day one of them was as before, while the other had shifted slightly, and a small one had arisen between them. Two days later again the two marked pyramids had *disappeared*, one completely, the other so nearly completely that I should not have guessed of its previous existence had I not marked it before.

It is perhaps significant I noticed a strong current running in a westerly direction parallel to the shore.

This curious row of low pyramids extends along the beach to the west of the mouth of the river also; but here the phenomenon is less clearly defined, for the stones are much more numerous and the pyramids are not separated by bare areas. At Tasiriki, near the south-west corner of the same island, there is a somewhat similar row of piles of pebbles.

JOHN R. BAKER.

University Museum,
Oxford.

Manuscript Herbals.

APROPOS of the article in NATURE of Oct. 27, p. 655, on "Manuscript Herbals," Dr. Singer and others interested in the subject may like to have their attention directed to the existence in the Banksian Library (MSS. No. 63), now in the Botanical Department of the British Museum (Natural History), of a volume of water-colour drawings copied from the Codex Anicia Juliana. The interesting point about this collection is that the drawings must have been made before the transference of the Codex to Vienna, since drawings imperfect or missing from the Codex are included and complete in this series.

A full description is given in the "Catalogue of Books . . . in the British Museum (Natural History)," vol. 6, p. 271.

B. B. WOODWARD.

4 Longfield Road,
Ealing, W.5.

I AM much interested in Mr. Woodward's reference to a copy of the "Juliana Anicia" Codex at the British Museum (Natural History) at South Kensington. The volume was unknown to me.

There are, however, quite a number of early copies of this magnificent Codex in existence. One such copy was described by Prof. Penzig of Genoa in 1904, in his "Contribuzione alla storia della botanica." There is another in the Cambridge University Library (Press mark Ee. 5. 7.). On this latter I was consulted some years ago by the late Prof. E. G. Browne. I convinced him of its true nature, and he catalogued it as an Oriental MS. of Dioscorides (Browne, 1385).

Another interesting copy, dating, perhaps, from about the year 1500, I found eighteen months ago in a miscellaneous volume of Greek texts at the Communal Library in Bologna. It contains figures derived unquestionably from the "Juliana Anicia," but so fantastically treated as to make them caricatures.

Yet another derivative of the "Juliana Anicia" is at the Bibliothèque Nationale at Paris (Gr. 2091). It is of the fifteenth century. I have directed attention to it in my article on ancient herbals in the *Journal of Hellenic Studies* (vol. 47).

The early history of the "Juliana Anicia" is unfortunately lost, but there is, I think, sufficient evidence that it was attracting the occasional attention of herbal illustrators throughout the ages. It is an extraordinary fact that the very elements of the art of independent plant representation should have entirely disappeared during the earlier Middle Ages, for at that period the interest in plants for herbal purposes was intense. Science was then, however, at its lowest ebb, and we have here, as I believe, an example of the penalty mankind must pay, in the end, in all its faculties, for the suppression or neglect of any one faculty.

CHARLES SINGER.

London, N.6.

Modulation of Light Waves by High Frequency Oscillations.

THE modulation of light trains by high frequency oscillations acting on a Kerr cell has been experimentally verified by Rupp (*Zeit. für Phy.*, Bd. 47) for the thallium resonance line. The results found by him seemed to agree well with the supposition that the wave form of frequency ν could be represented by an infinite wave train which would be split up into three wave trains of frequency $\nu + T$, ν, and $\nu - T$, where T is the frequency of the high frequency oscillations. However, results found by me and described below indicate that the modulations may depend on the form of the light impulse.

In these experiments, light from an iron arc was sent through a Kerr cell with plane parallel plates containing water, and the spectra of the light after passing through the cell was photographed with a quartz spectrograph. Photographs were taken both when the Kerr cell was attached to the high frequency oscillator (of approximately one metre wave-length) and when it was disconnected. In the region of the spectrum from 2385 A. to 2400 A., which was studied in detail with a densitometer, it was found that two of the lines were shifted towards the long wave-length side by 0·1 A. when the oscillator was acting on the Kerr cell, while the other eight lines which were measured in this region showed no difference in the two cases.

If we consider a light pulse of the form

$$y = Ae^{-|\alpha x|}\cos\frac{2\pi x}{\lambda}$$

at the time $t = 0$ which is propagated without change of form with the velocity of light, then we should expect, if the damping coefficient a of the pulse was simply related to the frequency of the oscillations present in the Kerr cell, that the wave train would be modified by the high frequency oscillations, causing the frequency of the light pulse with this damping coefficient to be changed.

ARTHUR BRAMLEY.

Bartol Research Foundation,
Franklin Institute, Philadelphia.

Action of Light on Coloured Bakelite.

A VERY interesting question is raised by Lord Rayleigh's letter on "Action of Light on Celluloid stained with Malachite Green," in NATURE of Oct. 27, p. 645.

Mr. A. Munro, the manufacturer of the 'Research' fountain pen, in a letter to me dated Oct. 3, 1928, discussing the colour of his pens made of bakelite, said: "The blue I gave up making . . . as in six months or less it spontaneously changed to green, and not a nice green either." Referring to another supply of bakelite, Mr. Munro said: "The colours it may change to are not yet known." In regard to a German brand of bakelite, he said: "Large quantities were sent to China a few years ago to make their images of, and it seemed an ideal substance, but now the Chinese will not have it, as the amber changed to red and blue to green, and the gods could evidently not be relied upon. A Research pen, green originally, came back from India a beautiful ruby and quite transparent."

For the information of those not acquainted with the substance, it may be mentioned that bakelite is a well-known synthetic resin made by combining carbolic acid and formaldehyde. Evidently nitrocellulose is not the only causative agent of this curious colour change. Bakelite at first is liquid, and can be obtained as a liquid varnish, which can no doubt be stained to any desired colour. Baking at a suitable temperature polymerises it, and it becomes completely insoluble in water and nearly all other reagents.

Apparently further investigation will be necessary to determine the cause of this change of colour.

DONALD MURRAY.

Villa Waitemata,
Monte Carlo.

Low Buoyancy of Surf.

MANY reasons have been advanced for the drowning of the crew of the Rye lifeboat, but there is one which I have not seen referred to, and which, I think, must be to a great extent responsible. The first time I realised the importance of this was when standing on the rocks overhanging the rapids below Niagara. I noticed that the water was mixed to a great depth with air bubbles, and this seemed to me to throw light upon the failure of swimmers to survive the passage of these rapids.

The human body has a density approximately the same as water, and a swimmer finding himself in water containing large numbers of air bubbles is in the same position as if attempting to swim in a liquid of a much lower density than water. Suppose, for example, the water contains 10 per cent of its volume of air bubbles, the effect upon a man attempting to swim in this would be the same as if in ordinary water he tried to carry more than a stone weight upon his back.

When the sea is very rough, with a wind blowing on shore, there is usually a surf, or a number of waves breaking simultaneously as they approach the shore, and this churns up the water so that for some depth it contains a considerable amount of air in the form of bubbles. This is the cause of the white appearance of such a surf. I do not think that people fully realise the danger of attempting to swim in such aerated water; the effect is perfectly obvious when once it is pointed out, but I have not found that this danger is realised at all, and a warning as to its existence may not be out of place.

J. S. OWENS.

A Lunar Eclipse Legend.

THE legends of primitive peoples connected with astronomical events are of interest to students of the history of culture, ethnography, etc. A story of this kind explaining the eclipse of the moon was heard by me last August in Karačaj—a region to the west from Elborus (Caucasus). The Karačaïans believe that on the moon there is a handsome girl guarded by two dogs. The evil spirit Žemilaùz, whose mouth is so large that when opened the lower lip lies on the earth and the upper on the sky (žemìl = large, aùz = mouth), wants to devour her; but he can do this only when the girl and the dogs are asleep. He watches this moment to swallow the moon with the girl and dogs. Thus begins the eclipse. The Karačaïans help the girl to be saved by means of shooting, shouting, and prayers. All this noise, they believe, must awaken the dogs, which, on their part, will wake up the girl. The girl being awakened, she is beyond the power of Žemilaùz, who is then obliged to discharge the moon.

N. IVANOV.

Astronomical Observatory,
Moscow.

Preparation of Tantalum Pentabromide.

DURING the course of preliminary investigations which are now in progress with the view of re-determining the atomic weight of tantalum, it has been found that tantalum pentabromide can readily be prepared in an atmosphere of nitrogen or argon by distilling bromine on to powdered tantalum heated to 260° to 300°. Heating the metal to red heat, as done by Moissan (*Comptes rendus*, **134**, 211; 1902) and subsequent workers, has been found unnecessary. It is hoped later to present in a paper details of the experimental procedure adopted, together with the results of analytical determinations.

K. R. KRISHNASWAMI.

University College,
Gower Street, W.C.1.

What is a Hybrid?

EVERY year, when discussing questions of genetics with my classes, I am compelled to explain that the text-book uses the word hybrid in a very loose way, including heterozygous individuals of all kinds. According to this common usage, the world is full of hybrids, and all human beings are hybrids. I suggest that it would be more convenient to restrict the name hybrid to crosses between species. Crosses between variations or mutants are mongrels, but it may be better to use a more technical or international word, and I suggest 'heterogene.'

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
Oct. 26.

The Ritchey-Chrétien Reflecting Telescope.

THE reflecting telescope possesses one obvious advantage over the refractor, in that the position of the focus is independent of the colour of the light used. But as an offset to this all types of reflectors which have been used by astronomers suffer from the fact that the field of good definition is comparatively small. It is true that, provided the mirrors be correctly figured, rays of light parallel to the principal axis of a Newtonian or Cassegrain reflector converge accurately to a focus, but a beam of parallel rays coming in in any other direction does not do this, and appreciable coma sets in at a comparatively small distance from the centre of the field of view.

It is in consequence of this defect that reflectors have so far not been used extensively for accurate positional work involving the precise measurement of good images, although they have been invaluable in colour photometry. As an exception to this general rule, however, it should be remarked that Dr. van Maanen has used the 60-inch reflector at Mount Wilson for the purpose of the photographic determination of stellar parallax—a research involving the most delicate and careful measures of position. Dr. van Maanen has usually chosen his comparison stars at a distance not exceeding eight minutes of arc from the centre of the field, and we have it on the authority of Prof. Ritchey that with this instrument really accurate measurements cannot be made at a distance greater than fifteen minutes from the centre.

The development of large reflectors, culminating thus far in the 100-inch mirror at Mount Wilson, has brought the astronomer up against another difficulty. The mirror is figured on a single large disc of glass, and for the largest mirrors the figure is apt to be spoilt by the flexure of the disc and by distortions introduced by temperature changes. In the case of the 100-inch the mirror had to be cast in three pourings, with the result that the bottom layer has, through de-vitrification, lost its rigidity, thereby impairing the general strength of the composite disc. In recent years Prof. G. W. Ritchey, with the co-operation of Prof. H. Chrétien, has devoted himself to the overcoming of the present defects in large mirrors and of the mechanical difficulties which threaten to bar the road to further progress. An account of these researches and of the designs to which they have led has been given by Prof. Ritchey himself in recent numbers of *L'Astronomie*, and also in a series of articles at present appearing in the *Journal of the Royal Astronomical Society of Canada*.

In 1905, Schwarzchild had shown by detailed calculation that it was possible to design a reflector which would give a large field of good definition. His plan consisted of allowing the light after reflection at the large concave mirror to impinge on a smaller concave mirror placed *inside* the focus of the large one. The beam then came to focus at a point on the optical axis *between* the two mirrors. The curves of the mirrors were not paraboloidal and ellipsoidal but departed from these forms, and Schwarzchild showed that they could be figured so as to secure good images at large angular distances from the centre of the field without at the same time spoiling the axial images. With such an arrangement, ratios of focal length to aperture as low as 2·5 to 1 could be secured. Schwarzchild probably regarded his design as giving a special type of telescope for a special purpose—a small focal ratio with a large field of view—but it could not be generally useful on account of certain defects. As designed, the diameter of the small mirror was half that of the large one, thereby cutting off a large proportion of the incident light. The photographic plate had to be situated between the two mirrors, thereby cutting off more light apart from the obvious awkwardness of such a position. Furthermore, the tube had to be inordinately long and consequently unwieldy.

Prof. Chrétien has continued the mathematical investigations thus begun by Schwarzchild, and has designed a telescope in which the usual Cassegrain form is adhered to, that is, in which the light after reflection at the large concave mirror is again reflected by a small *convex* mirror, placed inside the focus of the large one, and then passes through a hole in the centre of the large mirror and comes to a focus beyond. Following Schwarzchild's lead, the mirrors are not figured exactly to the paraboloidal and hyperboloidal forms, but are designed so as to give a wide field of good definition. One such design gives a focal ratio of 6·8 to 1, and the instrument as designed is compact and workable. The field is slightly curved, and in order to make the best use of it a spherically curved photographic plate is necessary. Alternatively, a correcting lens can be placed nearly in contact with a flat photographic plate.

Turning to the actual construction of mirrors, Prof. Ritchey has carried out careful researches in this direction. It will be remembered that he was intimately connected with the making of the 60-inch and 100-inch mirrors at Mount Wilson, and his experience of the various difficulties attending their construction and use has led him to concentrate his talent on new and improved designs. He has now designed a type of mirror in which, instead of figuring a single disc of glass, the mirror is a honeycomb structure composed of *cells* built up from thin plates of glass with their edges ground and cemented together. A thin spherical shell of plate glass is fitted on to the upper surface of the cellular structure to which it is then cemented, and a sheet of plane glass is similarly cemented to the lower surface. The upper surface is then figured to the required form.

The cellular mirrors constructed in this way are very light in comparison with other mirrors of the same aperture, and Prof. Ritchey anticipates that it will be quite practicable to construct a mirror of 10 metres aperture. Furthermore, they can be ventilated by circulating air through the cells, and in this way distortions arising from temperature inequalities can, it is claimed, be eliminated.

It must be emphasised at this point that the designs for the new telescope with a wide field of good definition, and for the new cellular type of mirror do not merely exist on paper. Prof. Ritchey has constructed in the optical laboratory of the Paris Observatory the mirrors for a model of this kind. Such instruments are to be known as Ritchey-Chrétien reflectors. In the model which has been constructed the aperture is 19·9 inches and the focal length of the combination 136 inches. The two mirrors are 41·73 inches apart, the convex being of 4·9 inches aperture. The focus is situated at a point 6·3 inches behind the vertex of the optical surface of the large mirror. The mirrors are of the cellular type described above, and are figured according to Prof. Chrétien's designs. The field is spherical and is concave towards the incident light, with a radius of 23·62 inches. Spherically-concave photographic plates have been constructed for use with the model. These are easily moulded to the required curvature. But it may be remarked here that, so far as astronomy of position is concerned, the precise measurement of images on a curved plate will present a difficulty to be overcome.

Optical tests with an artificial star have been carried out with this model, and also with a Newtonian model of the same aperture and focal length. These tests make interesting reading. Even at a distance of $2\frac{1}{2}$ minutes of arc from the centre of the field the images of the Newtonian reflector are distorted by appreciable coma. It is otherwise with the Ritchey-Chrétien model. Up to 20 minutes of arc from the centre of the field, the image is a diffraction disc of about 0·28 seconds of arc in diameter. Beyond this and up to 60 minutes from the centre they are approximately circular, the diameter of the image at 60 minutes being eight seconds of arc.

This much has been accomplished, and it is clear that the accomplishment represents something of the nature of a revolution in the design and construction of reflectors. There seems no reason why instruments of moderate size of the Ritchey-Chrétien type should not be constructed, and astronomers would welcome their obvious advantages. No doubt the constructional technique would develop in a normal manner and larger instruments would appear in the course of time.

Prof. Ritchey has, however, determined to go immediately to instruments of the largest kind, and he has already designed telescopes up to ten metres aperture. Space forbids a detailed description of his plans, but one such design provides for a fixed vertical telescope with cœlostat. The aperture is to be 10 metres and there are to be interchangeable mirrors, so that five combinations of focal ratios ranging from 2·75 to 20 will be available.

Prof. Ritchey has announced his intention of constructing such an instrument. Whilst sympathising with his desire for rapid progress, many astronomers will feel that it would perhaps be more desirable to consolidate the ground already occupied and to erect an instrument of moderate dimensions under practical working conditions in an observatory. At the same time, if Prof. Ritchey's great adventure is successful, they will be the first to rejoice with him : in the meanwhile they will wish him good luck. W. M. H. G.

The States of Aggregation of Condensed Helium.[1]

By Prof. W. H. KEESOM, University of Leyden.

IN virtue of the very low value of its interatomic forces, helium—discovered in the solar chromosphere in 1868 and obtained from terrestrial sources by Ramsay in 1895—represents the ideal gas more nearly than any other known substance, and is the thermometric gas *par excellence*, while its extremely low critical temperature and boiling-point furnish the means of descending the scale of temperature to the immediate neighbourhood of the absolute zero.

The first experimenters to attempt the liquefaction of helium were Dewar and Olszewski. The method they used—cooling the gas in liquid hydrogen and then allowing it to expand—proved ineffectual, but success attended the efforts of Kamerlingh Onnes, who, in 1908, resorted to the procedure employed ten years earlier by Dewar for the liquefaction of hydrogen. Fig. 1 shows diagrammatically the arrangement of the apparatus. The helium from the storage cylinders was compressed into the liquefying vessel, in which it was cooled, by means first of hydrogen vapour and afterwards of liquid hydrogen boiling under reduced pressure, to −258° C. The cooled helium then passed into the spiral regenerator and through the expansion valve, part undergoing liquefaction in virtue of the Joule-Kelvin phenomenon. The lower part of the liquefaction vessel has been since modified to allow of the transference of the liquid to a cryostat, in which it can be subjected to physical measurement. In a later experiment for obtaining the lowest possible temperature, Onnes made use of a battery of Langmuir mercury condensation pumps in conjunction with a preliminary series of powerful mechanical pumps. To judge whether helium at those extremely low temperatures would solidify, he introduced into the Dewar vessel containing the liquid helium a small metallic cylinder suspended from a rod and capable of being moved upwards or downwards.

The results of these experiments showed that, whereas hydrogen boils at 20° abs. and the temperature 10° is attainable by bringing the solid hydrogen under diminished pressure, a temperature little above 0·8° is brought within reach by the similar use of liquid helium, with boiling-point 4·2° abs. At this temperature, however, the helium, under its own very low saturated vapour pressure, retained its liquid state.

[1] From a lecture before the Fifth International Congress on Refrigeration, at Rome, delivered on April 13.

My experiments, which resulted in the solidification of helium, demonstrate clearly that such solidification requires not only a temperature at which the interatomic forces overcome the thermal

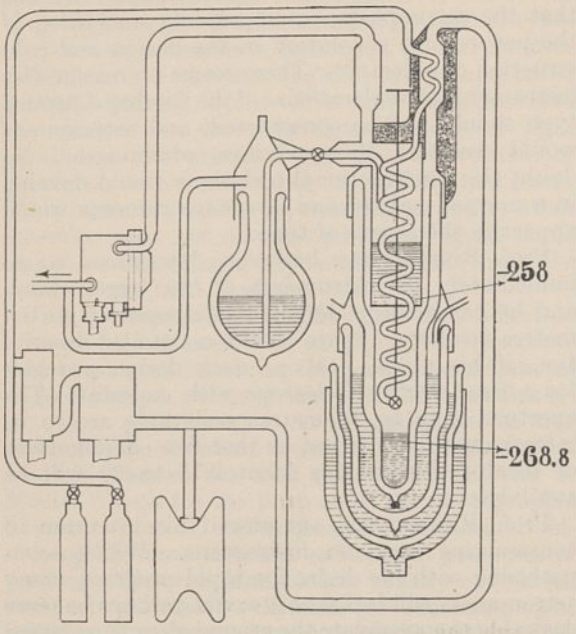

FIG. 1.

motion to such an extent that the atoms may be fixed in a crystalline lattice, but also the application of an external pressure sufficiently high to permit of free play for the interatomic forces. In the absence of such pressure the helium remains liquid at the lowest temperature yet realised, although at a certain temperature it may pass suddenly into a new liquid state of aggregation.

The apparatus used is shown diagrammatically in Fig. 2. The lower parts of two metallic tubes, B_1 and B_3, connected by a narrower tube, are immersed in liquid helium, and into these tubes helium is compressed by means of a small hydraulic pump charged with glycerine. When the plunger P of the pump is withdrawn, the mercury which half fills the two steel cylinders C, rises in the right-hand cylinder and draws helium from the supply vessel through the tap K_1 into the left-hand cylinder. The tap K_1 being then closed and K_3 opened, forward movement of the plunger P forces the helium into the system of tubes. In order to detect solidification of the helium, these tubes communicate with the branches of a differential manometer, consisting of a steel tube D passing into a steel chamber E partially filled with mercury. If a block of solid helium forms in the lower portion of the tubes and the tap K_2 is opened for an instant, a certain amount of gaseous helium escapes, and, the tap K_4 connecting the tubes being closed, the pressure in the right-hand tube becomes lower than that in the left and the mercury in the steel tube of the differential manometer rises. This tube contains a thin platinum wire forming part of one of the arms of a Wheatstone bridge; the mercury rising causes deflection of the galvanometer needle.

Another device, introduced later, and due originally to Kuenen, consists of a stirrer of soft iron H—capable of being raised and lowered magnetically—enclosed in the glass tube F communicating with the helium tubes through a metal tube; this glass tube is actually placed within the helium cryostat, although shown outside for the sake of clearness.

By adjusting the temperature of the helium bath by variation of the pressure exerted thereon, and ascertaining the corresponding pressure in the helium tubes necessary to produce blocking, the fusion curve of helium was followed for pressures ranging from 25 to about 140 atmospheres, the corresponding range of melting-point being about 1·2°–4·2° abs. At its lower end the fusion curve becomes more and more nearly parallel to the temperature axis and exhibits no tendency to meet the vapour pressure curve in a triple point, so that co-existence of gas and solid, and hence sublimation, appear impossible (below the critical temperature of helium).

Experiments made with the glass tube revealed neither change of volume nor change of state, nor a surface of demarcation between either gas and liquid or solid and liquid. Nevertheless, the solidification of helium was demonstrated in this experiment also, for a block of solid helium could be hammered. It is evident that, at the pressures used (about 90 atmospheres), the densities and the refractive indices are nearly identical for the three phases.

In the course of a series of measurements of the dielectric constant of liquid helium, carried

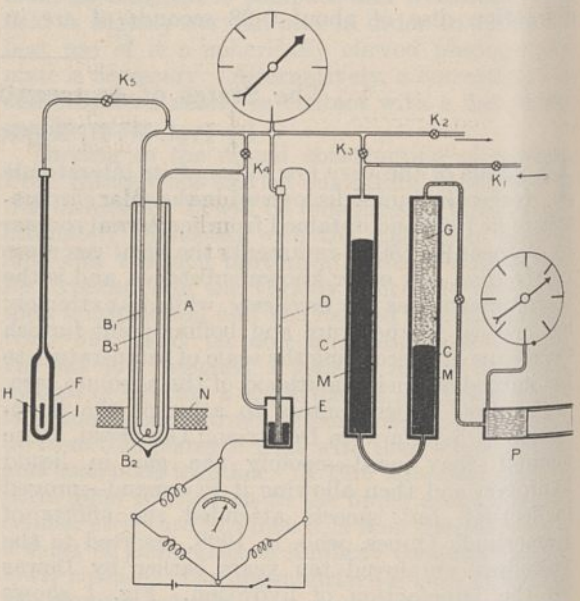

FIG. 2.

out with the collaboration of Prof. Wolfke of Warsaw, it was noticed that this constant undergoes a sudden or, at any rate, a very rapid change in magnitude at about 2·3° abs., which coincides sensibly with the temperature at which Onnes and Boks observed a maximum value for the density of the liquid. It appears that helium exists in

two liquid modifications, liquid helium I being stable above 2·3° and liquid helium II at lower temperatures; the density of the former is about 0·1 per cent higher than that of the latter.

Measurements of the specific heat of liquid helium were made by Dana and Onnes, who did not, however, publish the relatively high values obtained at temperatures near 2·3°, as these were not considered to be in accord with the other results. The apparent discordance is evidently due to the heat of transformation of helium I into helium II, which is calculated to be −0·13 cal. per gram. The heat of evaporation of helium appears to show a sudden variation, the value for helium II being the greater, while the surface tension of helium I exceeds that of helium II by about 3 per cent. It is remarkable that this transformation occurs at a temperature which corresponds, in the sense of the van der Waals' law of corresponding states, with the temperatures at which other substances melt.

Helium has, then, a triple point: liquid helium I—liquid helium II—vapour. Up to the present, such a point has been observed only for certain substances of complicated composition exhibiting a mesomorphic state (crystalline liquid), but further investigation is necessary before it can be ascertained if this is the case with helium. Fig. 3 is the characteristic diagram of the different states of helium, and shows the curve of saturated vapour pressure, the triple point, and the melting-point curve. Between liquid helium I and liquid helium

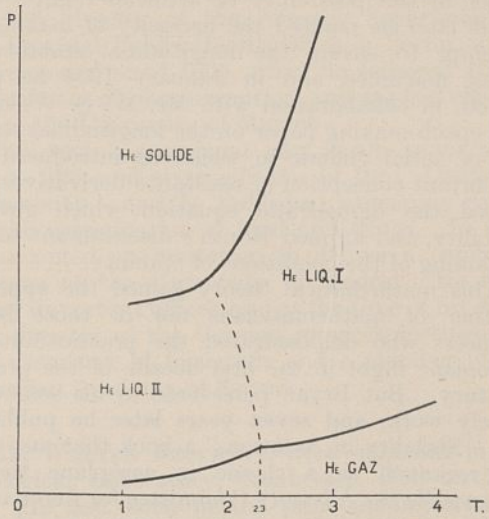

FIG. 3.

II there must be a transformation curve, but it is not yet known if this curve meets the melting-point curve, as shown in the diagram, or if it bends towards the axis of pressure.

Obituary.

PROF. G. H. BRYAN, F.R.S.

THE death of Prof. George Hartley Bryan on Oct. 13 removed one of the most interesting personalities among British mathematicians. His influence was felt in several directions, but it is in the mathematical theory of aeroplane flight that his work has made the greatest and most lasting impression.

Bryan was born at Cambridge on Mar. 1, 1864, the only child of Robert Purdie Bryan of Clare College. He lost his father at a very early age. His mother lived to a good old age, and Bryan always spoke of her with the greatest affection. He was brought up by his mother and his grandparents. He was the idol of the household, and being supposed to be delicate he was never allowed to go to school. Even when he went to Peterhouse as an undergraduate he was not given the opportunity of becoming self-reliant, for he still lived at home. The result of such an upbringing, in which discipline was totally absent, was a rather noticeable eccentricity, which did not, however, cover up a remarkable simplicity, honesty, and kindliness of character. Much of Bryan's early life was spent in Italy, France, and Germany. His excellent knowledge of the languages of these countries influenced both his scientific work and his literary style.

Bryan was fifth wrangler in the Mathematical Tripos of 1886 and second Smith's prizeman. He was a fellow of Peterhouse from 1889 until 1895. He succeeded the late Dr. G. B. Mathews as professor of pure and applied mathematics in the University College of North Wales, Bangor, in 1896, and held the chair until his retirement in 1926.

Hydrodynamical problems occupied Bryan's attention during the whole of his mathematical career. Inspired by the work of G. H. Darwin, he wrote important papers on the waves on, and the stability of, a rotating liquid spheroid, in 1888 and 1890. He soon became interested in the motion of solids through liquids, and in 1900 he produced a mathematical theory of the action of bilge keels in extinguishing the oscillations of a ship. This work was recognised by the award of the gold medal of the Institution of Naval Architects in 1901. He returned to the theory of discontinuous fluid motion as applied to a bent plate, in collaboration with Mr. R. Jones, in 1914, but meanwhile the fundamental work of Levi-Cività had introduced new methods for dealing with curved barriers, and the work of Lanchester, Joukowski, and Kutta was leading to the development of the powerful Prandtl theory. Later on Bryan wrote on the motion of an elastic fluid past a barrier.

The Cardiff meeting of the British Association in 1891 was the occasion of Bryan's important report on thermodynamics. He also wrote several independent researches based on kinetic theory, and when the "Encyklopädie der mathematischen Wissenschaften" was planned, Bryan was invited to contribute the section on thermodynamics. This appeared in 1903.

Bryan became interested in aviation very early,

long before actual flight in an aeroplane had become possible. So early as 1901 he delivered a lecture at the Royal Institution in which he affirmed his belief in the possibility of artificial flight. Two years later he realised the necessity of making an attempt to ensure the longitudinal stability of flying machines, and in January 1904 he published, in collaboration with Mr. W. S. Williams, the epoch-making paper on the longitudinal stability of aerial gliders, in which he introduced the important conception of resistance derivatives, deduced the biquadratic equation which governs stability, and applied Routh's discriminant to the obtaining of the conditions of stability.

This mathematical theory gained the approval neither of mathematicians nor of those brave pioneers who demonstrated the practicability of aeroplane flight in the first decade of the present century. But Bryan persevered in his somewhat lonely work, and seven years later he published his "Stability in Aviation," a book that may now be reckoned as a classic in aeroplane theory. Meanwhile the Advisory Committee for Aeronautics had been established, and a department of aeronautics set up at the National Physical Laboratory. Bairstow developed practical methods for finding the numerical values of the resistance derivatives by means of the aerodynamic balance and wind channel, and very soon Bryan's theory of stability became an integral part of all aeroplane design. His triumph was complete when in 1914 he was awarded the gold medal of the (now) Royal Aeronautical Society. It is difficult to over-estimate the service thus rendered to aviation by the theoretical mathematician.

Bryan continued to interest himself in the rigid dynamics of aviation, and inspired the researches of many workers. From 1917 until 1920 he worked with the advantage of a special grant, which enabled him to set himself free from teaching duties for a part of the time. He spent several months at Bristol in collaboration with the present writer and Mr. D. Williams, elaborating the theory of canonical forms for dealing with the general motion of an aeroplane.

In addition to the honours already indicated, Bryan obtained the fellowship of the Royal Society in 1895, and was elected honorary fellow of Peterhouse in 1915. He served as president of the Mathematical Association and of the Institution of Aeronautical Engineers. He was an honorary member of the Calcutta Mathematical Society. Reference must also be made to the series of text-books written by Bryan on mathematics, mechanics, and astronomy for the University Tutorial Press.

Bryan married Miss Mabel Williams in 1906. Mrs. Bryan is now living at the villa near Bordighera in Italy, where Prof. and Mrs. Bryan made their home on Bryan's retirement in 1926. Their only daughter is now a student at Cambridge. A fortnight before his death, Bryan met many friends at the International Mathematical Congress at Bologna.

In the words of an old friend of Prof. Bryan, Dr. F. J. Allen of Cambridge, Bryan was distinguished by "straightforwardness of character and generosity; by an ardent love of the beautiful in landscape, and for living things such as plants and insects which are so bound up therewith; by his great love of music, and the large part of his mind which it occupied." Bryan devoted much thought and experiment to the working of 'player' pianos, and invented an apparatus for accentuating any particular note or melodic passage. His two years of retirement at Bordighera were made happy by friendly intercourse with the Italian peasants, whose language he spoke so well, and 'Il Professore' was known and loved in many a mountain village far off the beaten track of the ordinary tourist.

S. BRODETSKY.

SIR ALEXANDER KENNEDY, F.R.S.

A NOTABLE figure in the engineering and scientific world is removed by the death of Sir Alexander B. W. Kennedy, F.R.S., in his eighty-second year. Born in London in 1847, the son of the Rev. John Kennedy, D.D., and Helen Stodart, sister of Prof. John Stuart Blackie, Kennedy received his early education at the City of London School and the School of Mines, Jermyn Street. In those early days there were no means of further education in his chosen profession of engineering, except by its actual practice, and for the next few years Kennedy was laying the foundations of his ultimate eminence as an engineer in the workshops and drawing offices of well-known firms of marine engineers in London and the north. In a surprisingly short time he was a leading draughtsman and an authority on the design and construction of the machinery of ships, and evincing thus early the keen judgment and sagacity in practical affairs which were so marked a feature of his character.

At the early age of twenty-seven, a turning-point in Kennedy's career was reached when he applied for, and obtained, the professorship of engineering at University College, London. It was a momentous step for the electors and himself, which was amply justified by events, for Kennedy proved to be an ideal professor as well as a notable pioneer in education and applied science. His outstanding educational achievement was his invention of the engineering laboratory as an essential part of a university course, a system which has spread all over the world and has proved so potent an influence for good in engineering education.

In his scientific work Kennedy was much attracted by the kinematic analysis of Realeaux, which he brought into prominence here by his lectures and his well-known text-book on "The Mechanics of Machinery." On the experimental side he became an authority in many branches of applied science, such as the scientific testing of boilers and steam engines, and also by researches on the properties of engineering materials and structures, for which he designed an autographic stress-strain recorder of great sensitiveness. As time went on, his advice and assistance on engineering matters were so much sought after that the strain became too great and he resigned his professorship in 1889 and went into practice as a

consulting engineer, although he remained in intimate touch with University College to the end of his life, and his name is permanently associated with his old chair there.

It may seem somewhat surprising that Kennedy's activities soon took a new turn into electrical engineering, for which there seemed to be no warrant from his previous training and experience, but possibly this can be explained by the fact that this branch was in its infancy and that what it then needed more than anything else was the mechanical engineering ability which Kennedy possessed in so remarkable a degree, for the major difficulties of that period were not so much electrical as mechanical.

It would take too long to enumerate the great electrical engineering enterprises with which Kennedy was associated: railways, tramways, power houses, and the like. There was one common feature in all this work, that Kennedy's advice was always of the best and his undertakings successful. Naturally, his share of honours was great. He became a fellow of the Royal Society in 1887, president of the Institution of Mechanical Engineers in 1894, and president of the Institution of Civil Engineers in 1906, a year after receiving the honour of knighthood for eminent services in naval matters connected with boilers and machinery. He was also the recipient of many honorary degrees and distinctions.

All this, however, does not really give an adequate idea of Kennedy's many-sided character, for he possessed by heredity and training that love of knowledge, culture, and adventure which led him into many fields: music, archæology, photography, and mountain climbing were some of his recreations, and he excelled in a knowledge of them all. He will be much missed by a large circle of friends, among whom will be numbered all his old students, who derived so much inspiration from his teaching and example.

DR. THEODOR PAUL.

WE are indebted to the *Chemiker-Zeitung* for the following details of the life of Prof. Theodor Paul, of Munich, one of the best known authorities on pharmaceutical chemistry, who died on Sept. 30, after a long illness.

Born in 1862 at Lorenzkirch on the Elbe, Paul took up the study of pharmacy on leaving school, and after some years' experience as an assistant he entered the University of Leipzig. After obtaining a qualification in pharmacy he took up the study of chemistry under Prof. E. Beckmann, and graduated in 1891. After graduation Paul came under the influence of Prof. Wilhelm Ostwald, who aroused in him a keen interest in physical chemistry, the effects of which were noticeable in all his later work. After serving as assistant to Ostwald for six years he was appointed assistant to Beckmann in the newly established laboratory of applied chemistry, and in 1898 he followed Buchner as extra-ordinary professor of analytical and pharmaceutical chemistry at the University of Tübingen. Meanwhile he had commenced the study of medicine, and while still at Tübingen he graduated a second time at Leipzig, this time in the faculty of medicine. In 1902 he was appointed director of the research department of the Imperial Public Health Office in Berlin, where he remained until 1905, when he followed Hilger as professor of pharmaceutical and applied chemistry at the University of Munich.

Paul took a prominent part in the preparation of the fifth and sixth editions of the "Deutsches Arzneibuch," and he published numerous papers on the investigation of food and drugs. In 1921 he accepted an invitation to deliver a course of lectures at the University of Madrid. He filled many important offices, and at the time of his death was director of the German research institute for the chemistry of foodstuffs and a member of the Bavarian Academy of Science.

MR. WALTER BROCKETT, head assistant in the Zoological Laboratory, Cambridge, died on Nov. 11. He had been in the same employment for forty-eight years, at first as a boy under F. M. Balfour and later under Adam Sedgwick and the present writer. He was an expert at section cutting, at first single sections and then as an operator of the original ribbon machines, which by his criticisms he helped to perfect. A part of his business was to mark off students at lectures and practicals, and a rough calculation shows that more than 7000 names are recorded in his books; he seldom forgot the name of anyone therein, and he generally would recall their peculiarities and athletic distinctions. A photograph of the annual laboratory cricket match, 'Assistants *v.* Staff,' shows him as captain seated alongside Dr. Gaskell, who had Sir Michael Foster, Sir Francis Darwin, Dr. W. Bateson, Sir Morley Fletcher, Prof. Barclay Smith, Mr. Brindley, Mr. Warburton, and the writer in his team. He regarded Cambridge as *his* University, the Laboratory as *his* department, and its graduates as *his* students, and he was proud of them. He was noted in Cambridge for his successful management and training of laboratory assistants, most of whom migrated to other universities. His affectionate and loyal relations with professor and staff makes their sense of loss very deep and personal. He leaves a fine example of whole-hearted loyalty and devotion. J. S. G.

WE regret to announce the following deaths:

Dr. John A. Bownocker, chairman of the department of geology at the Ohio State University since 1916 and State geologist of Ohio since 1906, who was interested chiefly in the economic geology of the region, on Oct. 20, aged sixty-three years.

Sir Hector Cameron, C.B.E., emeritus professor of clinical surgery in the University of Glasgow, a pupil and assistant of Lister, on Nov. 25, aged eighty-five years.

Dr. E. A. Schwarz, of the Bureau of Entomology of the U.S. Department of Agriculture, who was distinguished particularly for his knowledge of the Coleoptera, on Oct. 15, aged eighty-four years.

News and Views.

RESEARCH work in matters pertaining to forestry science has received a great impetus as a result of the War. In the case of forestry in the British Empire, the reasons are more apparent perhaps than in that of Europe. The countries overseas had, during the great struggle, to be self-supporting in several directions where the raw products of the industries concerned came from the forest. The armies in the East and Middle-East were dependent upon the semi-tropical and tropical forests for the supplies required to carry on their operations. Timbers of many kinds were made use of which had not previously found a place upon the markets; and not timbers alone, for other forest produce became marketable on the grand scale, which had only previously been tapped in a tentative manner. That the importance of research work in forestry in the tropical and semi-tropical forest regions came to receive recognition is not therefore surprising. In Europe the need of research work was not so widely accepted before the War. Although scientific forest management had been practised for a long period in several of the European States, yet it was not before 1891 that some effective recognition of the importance of research work was given by the founding, at a meeting held at Badenweiler, of an international union or association termed the 'International Union of Forest Research Stations.'

As its name implies, the object of the International Union of Forest Research Stations was to have periodical meetings between those engaged in forestry research, with the object of exchanging ideas and, so far as possible, introducing standard methods between the countries for carrying out certain classes of investigation work. The last meeting of the Union so founded, which was the sixth, took place in 1910 in Brussels. The succeeding meeting was fixed for 1914, to take place in Hungary. The War intervened, and no meeting has since been held. As an outcome of the War and the rising demands for timber in Europe, several of the States have realised that, by intensive management, a larger return should be obtainable from the forest areas, and that to obtain such returns demands careful investigation and research work. A revival of the research union came under consideration. During the International Forestry Congress at Rome, held in May 1926, the matter was discussed between a number of the delegates who had the cause of research work at heart. It then transpired that a small meeting of a few Continental experts had been held at Zurich shortly before, with the idea of resuscitating the International Union; and that the Swedish representative had been elected president and commissioned to endeavour to summon a congress in Stockholm in 1928 or 1929. At Rome the project matured, and an invitation to attend a congress, to be held at Stockholm in July 1929, has now been issued by Prof. Henrick Hesselman, chief of the Swedish Institute of Experimental Forestry.

A LARGE *Ichthyosaurus*, at least 30 ft. long, has been discovered at the works of Greaves, Bull, and Lakin at Harbury, near Leamington, Warwickshire. The specimen is interesting for its large size and good preservation. All the paddles are present, and the skull appears to be complete, though the individual bones are somewhat displaced. Most Lias ichthyosaurs lie crushed on limestone surfaces; but these remains lie in hardened shale, and it should be possible so to develop them that the skeleton can be mounted 'solid,' like the reptiles from the Oxford Clay. The species is almost certainly *I. platyodon* Conybeare. The specimen was found at a higher horizon of the Lias than the plesiosaur which occurred in the same quarry in the *angulatus*-beds and was acquired by the British Museum a year ago. It is hoped that associated ammonites will enable the exact age of the present specimen to be fixed. Messrs. Greaves, Bull, and Lakin have most generously placed the specimen at the disposal of the Trustees of the British Museum, and it should prove a valuable addition to the remarkable series of ichthyosaurs already in the collection.

THE name and personality of Sir Paul Rycaut, F.R.S., traveller, author, and diplomatist, born in the autumn of 1628—three hundred years ago—at the Friary, Aylesford, Kent, is worthy of remembrance. Rycaut's connexion with the Royal Society began on Dec. 5, 1666, when at a meeting he was proposed a candidate by Henry Howard, afterwards sixth duke of Norfolk, who, by the way, had been himself elected in the previous month. "It being intimated (we read) that the said Mr. Rycaut was to go into Turky, and offered his services to the society in inquiring into philosophical matters, it was ordered that the secretaries should get ready, both a copy of the general inquiries for all countries, and of such particular ones as were proper for Turky; which last were recommended to the consideration of Mr. Hoskyns and Mr. Oldenburg." Rycaut [was] elected at the ensuing weekly meeting, and admitted as well.

HOWARD'S interest in Rycaut is further exemplified by the following minute: "There were produced by Mr. Howard's servants several pictures of Turkish habits (to the number of sixteen single and eight double ones) as well as those of the grand signor and the empress, as of those of their officers and servants. He desired that they might be put into the library of Arundel House." Rycaut as an envoy from England was a marked success; also, he became a skilled narrator. His chief work (amongst many) was "The Present State of the Ottoman Empire . . . illustrated with divers pieces of sculpture, representing the variety of habits among the Turks." London, 1668. Rycaut returned to England for good in 1679; six years afterwards he again took office as secretary to the Earl of Clarendon, and was knighted. To the *Philosophical Transactions* he communicated a paper in April 1699, entitled, "A Relation of the small creatures called Sable-Mice." . . . A fine portrait of Rycaut, by Lely, may be seen in the National Portrait Gallery. It was engraved by R. White, and forms a

frontispiece to the "Turkish History." Rycaut was buried near his father and mother in the south chancel of Aylesford Church.

THE condition of the Bear River Marshes, Utah, has in recent years caused much concern to sportsmen as well as naturalists. Owing to scanty rainfall and to the diversion of water for irrigation purposes from Bear River and tributary streams, the shallow waters in many parts of the marshes become concentrated solutions of alkali during the summer and autumn of each year. The marshes are a gathering place for millions of wild duck and geese during the spring and autumn migrations, and it has been estimated that in the course of the past few years not fewer than 7,000,000 ducks alone have died owing to alkali poisoning. So serious had the problem become that the Federal Government took the matter in hand, and after sundry delays in Congress during the past two years a Bear River Migratory Bird Refuge Bill has at length been signed by President Coolidge. It grants authorisation for expenditure of 350,000 dollars to be used by the Secretary of Agriculture in the construction of such dykes, ditches, spillways, sluices, etc., as may be necessary for establishing a suitable refuge and feeding- and breeding-ground for migratory wild fowl. This is a most important step in wild-bird conservation, which will result in economic as well as æsthetic advantages, for it is predicted, we learn from *California Fish and Game*, that the food value of the birds that can be saved in a single season will exceed the cost of the proposed improvements.

AT a conference of the Superintendents of the National Parks of the United States of America, held on Feb. 17, 1928, Dr. Joseph Grinnell read a paper upon the balance of life in national parks, which bears on the question of the proper maintenance of animal preserves in any country. He discusses the troublesome problem of the artificial regulation of the balance of life so that no dominant animal may attain too great a share of the preserve at the expense of any other, and in particular that of beasts of prey which live upon the other inhabitants of the reserve. In this matter his conclusion is that "animal life in the national parks should simply be let alone. It can be encouraged in amount and variety most practically by desisting from any avoidable interference with the full range of natural conditions of food and shelter. Here is a case where a *do-nothing* policy is the soundest policy." It seems doubtful if such a negative policy, however well suited it may be for the enormous ranges of the parks of the United States, is suited for the limited areas available for preserves in Great Britain. The relatively tiny Nature reserves in Britain are surrounded by cultivated land from which the surplus of dominant species tends to overflow into the reserve to the detriment of the rarer species which require encouragement. We doubt also whether the wardens of the great preserves in Africa would feel justified in adopting the *laissez-faire* policy, in view of the tendency of certain species, particularly of the larger mammals, to multiply unduly in the absence of a sufficient check from natural enemies.

WITH another of Dr. Grinnell's conclusions every naturalist will be in agreement. "First and foremost," he says, "any and all *non*-native animals must rigidly be denied admission. . . . No addition in the way of bird or mammal, reptile or amphibian, should be made to the complement of animal life in a National Park, to that which belongs there. . . . Such introductions should be guarded against like the plague." We commend these wise words to the notice of the authorities and the game warden of Kenya, which is threatened with the setting free, on a deliberate policy, of Scottish red deer and Indian black buck. Dr. Grinnell is opposed to the creation of any sort of zoo in a National Park, for where an animal may be seen in freedom no one would choose to see it in the unnatural conditions of captivity; but he thinks that a museum may serve a useful purpose if it is "conducted subserviently to the function of nature guiding," so that it directs visitors to the living animals out-of-doors, and helps them to understand and appreciate what they see in the wilds.

A COMMITTEE appointed by the Radio Manufacturers' Association of the United States recommends that all radiovision pictures at present being broadcast be standardised, so that one radiovision receiver with one scanning disc will be able to receive any of them. The committee adopts as standard the system used by C. F. Jenkins in Washington. The method recommended uses 48 lines with 15 separate pictures (frames) every second. The pictures therefore will not show much detail, being decidedly inferior in this respect to the pictures which J. L. Baird can broadcast from his laboratory. It is expected that all the television broadcast stations in the United States will adopt this standard, so that one receiver with one scanning disc will be able to receive any of them.

THE progress of electric railway work in Great Britain since the War has been disappointingly slow. On the Continent and in America, progress has been much more rapid. We learn, for example, that the Pennsylvanian Railway Company has decided to spend twenty million pounds in electrifying its entire train service between New York and Wilmington, Delaware. The 'wait and see' policy adopted by several railway companies in Britain since the late Sir Alexander Kennedy's Committee issued its report in 1921 has done very little to advance matters. We therefore welcome the report of Sir John Pringle's Committee which has just been published (London: H.M.S.O.) Most of its members have a thorough knowledge of the practical problems which now face the railway companies, and during the past few years many of them have seen how these problems have been attacked overseas. It is now suggested that the direct current system should be standardised, the pressures chosen being 750 and 1500 volts respectively.

IT appears that in March 1928 there were in Great Britain 1257 miles of track operated on the direct current (d.c.) low tension system and 77 on the d.c. high tension system. There were only 151 miles operated on the alternating current (a.c.) system and

this number is diminishing. On the higher voltage d.c. system it is suggested that the current be collected from overhead wires with an uninsulated return. On the lower voltage d.c. system the current will be collected by a shoe pressing on the third rail. To permit of interrunning between the various railway systems it can easily be arranged that every train can run on either the high voltage or low voltage network. The recommendations of the earlier commission about standardising the track are endorsed. We hope that rapid progress will now be made. Past experience has shown that the prevention of the railway currents from interfering with the Post Office work either by electromagnetic or electrostatic induction is not a difficult problem.

THE seventh annual report of the British Cast Iron Research Association, covering 1927–28, records developments in the work of the Association, especially in the direction of making its results more readily available to its members. Melting plant has been set up, and experiments on a working scale are also being undertaken in foundries belonging to members. This is a good sign, as indicating willingness to co-operate in research. Cast iron containing nickel and copper has been found to have properties which make it useful in situations exposed to corrosion, but no iron which is resistant under all conditions has yet been discovered. Special attention has been given to the effects of varying composition in the manufacture of malleable castings, and similar studies have been made with reference to iron for light castings. In the main, the work of the Association has dealt with foundry problems, and it is to be hoped that in future increased support from the industry will make it possible to undertake more fundamental research. During the past year the most important work in this direction has been that of Dr. Norbury on the influence of manganese, which reconciles some of the conflicting opinions held on this subject, and consitutes a distinct addition to knowledge.

DURING the past ten years considerable progress has been made in developing the use of X-rays. Not only has their use been extended in medical and surgical practice, but there has been a notable development in their application to the examination of problems which arise in scientific and industrial work. The present range of X-ray equipment extends from the diminutive dental outfit to the apparatus required for the examination of various materials and the inspection of finished articles. The most recent achievement was the penetration of steel to a depth of $4\frac{1}{2}$ inches by radiations from the powerful set in the radiological research department at Woolwich. In a paper read to the Institution of Electrical Engineers by L. G. H. Larsfield, on Nov. 22, the question of the standardisation of the electrical equipment of X-ray apparatus was discussed. The subjects included were induction coils, voltage transformers, filament heating transformers, rectification and switchgear, and control fittings. The Coolidge tube has now largely displaced the gas tube for X-ray work. In the former a hot cathode governs the tube current by supplying a steady stream of electrons, the impact of which upon the anode causes X-rays to be generated. Induction coils are now seldom used, having been displaced by transformers. In the author's opinion, however, for the highest voltage work there will in the future be a reversion to some improved type of induction coil. Of special interest was the description of a very small set (10 in. × 7 in. × 6 in.), weighing only 26 lb., patented by Coolidge. The tube is only 4 in. long, and operates at 56,000 volts and 10 microamperes. As the whole of the high voltage system is enclosed in an earthed metal case, there is no danger of electric shock and no external electric field. Objects under examination also can be brought very near to the tube. Other equipments were also described which are used for army requirements, such as examining the materials used in aeroplane construction, etc.

DR. E. D. ADRIAN delivered two lectures on "The Mechanism of the Nerves" at the Royal Institution on Nov. 22 and 29. The messages which are sent from the sense organs to the brain and from the brain to the muscles, are composed of a series of brief impulses —waves of chemical change which spread rapidly down the nerve fibre, leaving in their wake a refractory state from which the fibre must recover before a second impulse can pass. Impulses of the same general type may be produced in non-living systems, and the iron wire model of R. S. Lillie copies the behaviour of a nerve fibre with surprising accuracy. The impulse is accompanied by a change of electric potential, and the recent development of the valve amplifier has made it possible to record these changes with much greater certainty. Whenever a sense organ is stimulated, *e.g.* by touching the skin, it is found that a series of impulses pass up the sensory nerve fibres at a frequency which varies from 5 to 150 a second, and depends upon the strength of the stimulus. This message is somehow translated into consciousness, giving a sensation which rises or falls in intensity according to the frequency of the incoming impulses. In the same way, when a movement is to be carried out, the motor nerve fibres transmit a series of impulses to the muscles, and here, too, the frequency is varied over the same range to produce contractions of different intensity. A further means of gradation is provided by changes in the number of fibres in action. Communication between the different groups of nerve cells within the brain is probably carried out by impulse messages of the same kind, though disturbances which arise and subside more slowly must occur in certain regions. The complex reactions of the nervous system depend in the main on these more lasting changes.

IN his recent presidential address to the Surveyors' Institution, Mr. C. B. Fisher dealt with a number of points of agricultural interest. Since 1920, upwards of fifty Acts have been passed in the House of Commons which affect the land in some way or other: in consequence, the agriculturist is often uncertain as to his actual position. Changes are proceeding so rapidly that there is a danger of old records being lost; many of them cease to have present application

but their historical value is considerable. Mr. Fisher appealed particularly for the preservation of documents describing the enclosure of open fields, the growth and break up of large estates, fluctuations in size of farms and rents; these should be handed over to the custody of public libraries or local historical societies. He discussed also the disparity in price paid by the consumer to the middleman, and by the middleman to the farmer, and pointed out that the United Dairies' last balance sheet showed profits of more than £500,000, while "any addition to price to assist in meeting the cost of production is grudgingly given and passed on to the consumer." It is notorious that the payment to the farmer is so low that he can barely make both ends meet, even with the minimum agricultural wage of 30s. to 31*s.* per week.

RECENT acquisitions in the Department of Zoology of the British Museum (Natural History) include a mounted specimen of a baby sloth-bear, or Aswal (*Melursus ursinus*), from Oudh, India, presented by the Rowland Ward Trustees. This specimen measures little more than 18 inches in total length, whereas the adult bear will measure from 5 to 6 feet in length; the animal is restricted in its distribution to India and Ceylon. Rear-Admiral H. Lynes has presented a collection of birds and eggs from Africa, including 964 examples of different kinds of small fan-tailed warblers of the genus *Cisticola*. These small birds have a very intricate summer and winter plumage, which it was impossible to work out without this additional material. A specimen of the king cheetah (*Acinonyx rex*) has been acquired. Unlike the common cheetah, the markings on the skin are not in the form of spots so much as longitudinal stripes and blotches, giving the animal a very handsome and gaudy appearance. The king cheetah is found in Southern Rhodesia, and it is surprising that such men as Selous, who hunted this district for many years, never obtained a specimen or made any record of its existence. Interesting acquisitions reported by the Department of Geology include a specimen, 3½ feet long, of a fossil angel- or monk-fish (*Squatina*) from the Upper Jurassic lithographic stone of Bavaria. This fossil scarcely differs from the recent form found living in temperate and tropical coastal waters, and is intermediate between the sharks and the skates. Additions to the Mineral Collection include further examples of fluorescent minerals from the zinc mines at Franklin Furnace, New Jersey, and the Trustees have agreed to the purchase for the Department of Botany of a valuable series of 870 plants collected in Mexico by Ynes Mexia of the University of California, and a further instalment of 1237 specimens from Frère Sennen's collections of Spanish plants.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include five assistant conservators of forests: Mr. R. G. McK. Willan and Mr. R. D. Catterall to Nigeria, Mr. E. W. March to Ceylon, Mr. C. Swabey to Trinidad, and Mr. C. Cairns to the Federated Malay States. There have been three appointments of veterinary officers, Mr. F. W. Aston and Mr. D. F. Macpherson to Kenya, and Mr. H. M. Salusbury to Tanganyika Territory. Mr. G. F. Clay, who has for some time been geneticist at the Amani Institute, has been appointed senior agricultural officer, Uganda. Messrs. D. Thornton, F. E. Buckley, and K. D. R. Davis have been appointed superintendents to the Agricultural Department, Nigeria. Mr. T. H. Nicol has been appointed agricultural instructor at Sultan Idris College, Federated Malay States; Mr. H. A. Pieris, divisional agricultural officer, Ceylon; Mr. J. L. Greig, assistant agriculturist, Federated Malay States; and Mr. E. J. H. Corner, assistant director of Gardens, Straits Settlements. Messrs. Buckley, Nicol, Greig, and Pieris were holders of Colonial agricultural scholarships.

AT the annual meeting of the American Optical Society, held on Nov. 1–3, the first award was made of the Frederic Ives Medal, to Mr. Frederic Eugene Ives, a pioneer in the invention of the half-tone process used for the reproduction of photographs, etc., for book and newspaper illustrations. The medal, which was founded recently by Dr. H. E. Ives, son of Mr. F. E. Ives, will be awarded biennially "for distinguished work in optics."

THE International Society of Experimental Phonetics has acquired *Vox* (Prof. Calzia, Hamburg) as its monthly organ of publication. Copies are sent free of charge to the members. The Society will also publish a yearly volume entitled *Psychologische Beiträge* (herausgegeben von Prof. Dr. E. W. Scripture, Wien).

"THE Royal Natural History," which was edited by Richard Lydekker, is probably the most comprehensive of popular systematic works on the animals of the world in the English language. A re-issue of this standard work, which contains 63 coloured plates, more than 2000 engravings, and nearly 3500 pages, is being published by Messrs. Warne in 18 fortnightly parts, at a price of 2*s.* 6*d.* each. Since it was first completed in 1896 this has been a standard work of reference, and its accuracy, its detailed descriptions, and the particular attention which it pays to the habits of animals, must assure it a place on the shelves of every well-equipped naturalist.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in mechanical engineering in the department of mechanical engineering of the University of Sheffield.—The Registrar, The University, Sheffield (Dec. 7). A demonstrator in physics in the University of Leeds—The Registrar, The University, Leeds (Dec. 10). Two assistant lecturers in chemistry at the Battersea Polytechnic, one to conduct classes in analysis of foods and drugs and the microscopical examination of food and drugs—The Principal, Battersea Polytechnic, S.W.11 (Dec. 10). A senior demonstrator in anatomy in the University of Sheffield—The Registrar, The University, Sheffield (Dec. 11). A chemist at the Royal Naval Cordite Factory,

Holton Heath—The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 15). A technical assistant at a naval establishment at Portsmouth, with a sound knowledge of high frequency electrical testing methods—The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 15). A pathologist in the General Infirmary, Salisbury—The House Governor and Secretary, General Infirmary, Salisbury (Dec. 17). A professor of mathematics in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, W.C.2 (Dec. 18). A public analyst for the County of Cornwall—The Clerk of the County Council, County Hall, Truro (Dec. 22). A professor of mechanical engineering at the College of Engineering, Guindy, Madras—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Dec. 31). A lecturer in geography in the Huguenot University College, University of South Africa—The Registrar, Huguenot University College, Wellington, Cape Province (Jan. 1). An officer-in-charge of the Wood Preservation Section of the Forest Research Station, Dehra Dun, India—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 19). A director of the Tea Research Institute of Ceylon—The Director, Royal Botanic Gardens, Kew (Jan. 30). A principal of the Technological Institute, Cawnpore—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31). The John Lucas Walker Studentship in the pathological laboratory of the University of Cambridge—Prof. H. R. Dean, Cambridge (Feb. 19). An assistant science master with good qualifications in physics, at King Edward's School, Birmingham—The Headmaster, King Edward's School, Birmingham. An assistant in physiology in the Medical School of Dalhousie University, Halifax, Nova Scotia—Prof. A. V. Hill, University College, Gower Street, W.C.1. Junior technical officers at the Royal Aircraft Establishment for, respectively, tests and experimental work on strength of materials and aircraft components, and work in the engine experimental department—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A temporary science mistress at the Central Foundation Girls' School, Spital Square—The Head Mistress, Central Foundation Girls' School, Spital Square, E.1. An assistant master in the physics department of the Leeds Central High School—The Director of Education, Education Department, Calverley Street, Leeds. Teachers of woodwork and metalwork under the West Riding Education Committee—The Education Department (Elementary Branch), County Hall, Wakefield.

Our Astronomical Column.

NEW COMET.—The third cometary discovery of the year was made on Nov. 19 by Mr. Forbes, an amateur astronomer of Cape Town. It was a fairly easy telescopic object, being then estimated as of the sixth magnitude, but no tail was seen. The following observations, of which the first was noted as being only approximate, have been distributed by the I.A.U. Bureau at Copenhagen :

U.T.	R.A. 1928·0.	S.Decl. 1928·0.	Observatory.
Nov. 21·08333	12h 8m 30s	21° 42′ 0″	Johannesburg.
„ 24·21465	12 17 2·6	23 58 53	Algiers.
„ 24·57167	12 17 59·7	24 13 32	Lick.

The estimated magnitudes at Algiers and Lick were 10 and 7. The discordance illustrates the large personality that exists in these determinations. The Lick observer was Mr. Berman.

These observations are not well spaced for orbit determination, the second and third being only 8 hours apart. An attempt (not yet completed) indicates that the motion is direct and that the distance from the earth at the middle observation was about one unit ; perihelion appears to be already past, the distances from both earth and sun increasing. When this note appears, the comet will be inconveniently low in England, but may possibly be seen just before dawn in the south-east.

THE LEONID METEORS OF 1928.—The display this year, writes Mr. W. F. Denning, appears to have given evidence of increased activity and to have furnished some brilliant objects, if the shower was not strikingly abundant. On the morning of Nov. 16, from 2 to 3 A.M., Mr. A. King, of Ashby, Lincolnshire, found the horary rate of appearance for Leonids was 30, and he noticed several as brilliant as Jupiter. On the following morning there was a decline in activity, but at 2h 47m A.M. he observed a brilliant Leonid fireball falling from Ursa Major through Hercules. There was an explosion at the end of its flight, and the sky was illuminated in the region where it occurred, for the object was several times brighter than Venus.

From Blackheath, London, S.E., on the night following Nov. 15, several brilliant meteors with long paths and luminous trails were casually observed. One appeared at about 11h 30m P.M., ascending some 50° in the eastern sky from the 'Sickle of Leo,' and other large and conspicuous meteors were remarked near midnight. It is evident from the descriptions of their flights that they were Leonids. It is probable that this system of meteors will exhibit more abundance in the next few years, as the ensuing maximum and the return of its parent comet (Tempel, 1866 I) are due in 1933.

DETERMINATIONS OF RADIAL VELOCITIES AT THE CAPE.—*Annals of the Cape Observatory*, vol. 10, part 8, contains radial velocity determinations not previously given in the Cape publications. The first section contains a new determination of the constant of aberration and the solar parallax from the radial velocities of stars. Using Hayford's value, 6378·388 km., for the earth's equatorial radius, and Michelson's 1926 value of the velocity of light, 299800 km./sec., then the solar parallax is given as 8·803″ and the constant of aberration 20·475″. The probable errors are 0·004″ and 0·010″ respectively. It is satisfactory to note how narrow the range of different determinations of the solar parallax has become ; it scarcely exceeds one-hundredth of a second.

The orbits of 13 spectroscopic binaries are determined, and the radial velocities of 434 stars. There are several different values found for the solar motion. When the *K*-term is taken as zero, the apex is found to be R.A. 263·6°, N. Decl. 28·8°, velocity 20·5 km./sec. An erratum on p. 11 may be noted ; the period of Sirius should be 50, not 40 years.

Research Items.

THE CARRYING OF YOUNG BY MAMMALS.—In discussing the life history of the woodland deer mouse (*Peromyscus leucopus noveboracensis*) E. Raymond Hall makes a side observation of interest (*Jour. Mammalogy*, August). In a hunting cabin in Kansas he disturbed a female mouse with four young, which in her haste to seek shelter she scattered upon the floor. Within thirty seconds the mother reappeared and picked up with her teeth one of the young, and so on until she had carried all to safe places. In each case she deliberately turned the young belly up, grasped it on the under side with her incisors, and, adjusting it slightly with her fore feet, scampered away. Recalling that squirrels and some other rodents are known to carry their young belly up, rather than by the back of the neck, as cats and dogs do theirs, the author suggests that it may be a universal, or at least general, habit of rodents to carry their young belly up, and of carnivores to carry their young back up. The point is a curious one, and the experience of readers of NATURE might help to solve the question.

THE FAUNA OF HOT SPRINGS.—In the course of an investigation extending over several years, Charles T. Brues has examined the faunas of hot springs in the Yellowstone National Park, and in 1927 visited 34 hot springs or groups of springs in New Mexico, Nevada, California, and Utah (*Proc. Amer. Acad. Arts and Sci.*, vol. 63; 1928). His paper, containing careful records of the temperature, specific gravity, and *p*H of the waters, with a detailed list of the organisms found living in them, and references to other work of a similar kind, is a valuable contribution to knowledge. Of vertebrate animals he found only a cyprinoid fish (*Notropis lutrensis*) at 39·5° C., and a frog (*Hyla regilla*) at 35·8° C. Molluscs were occasionally found, but the vast majority of the population was composed of insects, of which aquatic coleoptera formed by far the most numerous section. The author discusses the nature of heat susceptibility, body temperature, the brackish water fauna in relation to that of thermal waters, and the temperature range of individual species. Unfortunately, none of the springs was suitable for following the changes in the composition of the thermal fauna over a considerable range of temperature in water from a single source, but the interesting discoveries of Blanchard and Seurat at the springs of Meskhoutine in northern Africa are quoted to illustrate the temperature stages at which fresh creatures invade the fauna.

VARIATION AND ITS ASSOCIATION WITH HABIT.—The American Fox-sparrow (*Passer iliaca*), though a bird of restricted habitat, has apparently developed a sensitiveness to environmental influences, for although in any one locality variation is slight, geographical variation is common, so that the species is split into sixteen races. A very thorough study of the variations which occur in these races has been made by Jean M. Linsdale (*Univ. California Pub. Zoo.*, vol. 30, p. 251; 1928). It is impossible to follow her into her analysis of the details of 465 specimens, but, in general, she found that significant geographic variation occurs in every part of the skeleton that was examined. Evidence was not forthcoming to show that the variations in every case were of any biological advantage. For example, races in which enlarged bills and skulls occurred were not found to use food different from their smaller-headed neighbours. One character, however, length of sternum, appeared to have a real functional value. The subspecies *iliaca* has the longest sternum in the species, and this is the race which in general breeds farthest north and migrates farthest south. Indeed, it may be said that the amount by which this race is set off from the others in respect of its sternum is roughly paralleled by the distance by which its migration route exceeds theirs. With this length of sternum goes, but to lesser extent, similar elongation of the limb bones associated with the sternum. In the other races similar behaviour of these characters can be correlated with the length of their respective migration routes. In short, every part of the skeleton used considerably in flight has been developed to a high degree as an accompaniment to a lengthened line of migration flight.

CAUSE OF HONEY FERMENTATION.—Spoilage of honey, due to fermentative changes, causes some loss to the bee-keeper and tradesman. Messrs. Fabian and Quinet investigating the subject (*Technical Bull.*, No. 92; Agricultural Experiment Station, Michigan State College of Agriculture, East Lansing, Michigan, U.S.A.), find that bacteria, yeasts, and moulds are present in many samples of spoiled honey. A number of these organisms were isolated and re-inoculated into honey to test their effects. Only the yeasts were found capable of causing honey fermentation; good honey frequently, perhaps always, contains yeasts, yet only some honey ferments. It is suggested in explanation of this anomaly that honey is capable of absorbing moisture—up to 30 per cent of its weight—and that when the moisture content rises to about 21 per cent and above the yeasts, the growth of which is inhibited in ordinary honey, are able to develop in the diluted honey.

FOREST NURSERY WORK IN GREAT BRITAIN.—In *Bulletin No. 11*, recently issued by the Forestry Commission, Mr. H. M. Steven discusses, under "Nursery Investigations," work upon which he and others have been engaged during the last few years in connexion with raising young stocks of trees for subsequent planting out to form woods. The investigations deal mainly with the chief coniferous species at present in use in Great Britain. The forest nursery has gradually increased in importance in British forestry since the beginning of the eighteenth century. But it is not pointed out that this factor is due mainly to the woods of the country having been privately owned; that continental practices were unknown; and, finally, that for the private owner wishing to grow coniferous plantations on comparatively short rotations, the nursery and artificial formation of woods by planting may be the best method at present available. Mr. Steven writes: "The purpose of this Act"—the allusion is to the Forestry Act of 1919—"was to increase the forest area by the creation of new forests. This could only be done by planting or direct sowing. To date, the percentage afforested by direct sowing has been less than five, and it will be contrary to the present tendency in European practice if direct sowing becomes the principal method of establishment." This allusion is to the afforestation work of the Forestry Commission. But the author is mistaken in his contention that "the present tendency in European practice" is against direct sowing. Some of the most important post-War mountain afforestation work with conifers is being undertaken by direct sowing over considerable areas in France. Even though netting against rabbits would not be necessary, as in Great Britain, the expense of raising plants in nurseries and afterwards planting them out is regarded as prohibitive, and is only resorted to in special circumstances. The Forestry Commission might consider the advisability of carrying out, over a series of years,

investigations into methods of raising coniferous woods by direct sowing.

YARN STRENGTH AND YARN EXTENSION.—*Bulletin No. 12* from the Indian Central Cotton Committee Technological Laboratory contains a survey by the Director, A. J. Turner, of the very intricate problem of relating yarn strength to the strength of the component fibres. The pioneer work of Bowman and Monie, which is freely quoted in the report, led to the conclusion that only about 10 per cent of the fibre strength is utilised in the yarn. This value is apparently too low on account of insufficient determinations of fibre strength, and corresponding data obtained for Indian cottons by Turner show that the percentage of fibre strength utilised in yarns of various kinds varied from 26·5 to 46·5 per cent (lea test). Such gross inefficiency in yarn structure gave rise to the impression that yarns must break by slippage rather than rupture of the constituent fibres. Turner has disagreed with this opinion in previous papers, and his views are adequately summarised in the present report, which includes photographs to demonstrate that while slippage does undoubtedly occur in the case of loosely twisted yarns, hard-twisted yarns break by fibre rupture. This position has been substantiated by the work of Miss Clegg, who, by employing Bright's technique, was able to determine the proportion of fibres broken when yarns of various kinds were fractured. But if yarn breakage occurs by fibre rupture as well as by slippage, it becomes even more important to explain the inefficiency in yarn strength. This is discussed in terms of ten factors, the most important of which are the transmission of tension by the component fibres; the boundary effect, *i.e.* the progressive decrease in compressional forces from the axis to the surface of the yarn; the effects of group testing; and imperfections of yarn structure such as irregular thickness and twist. The value of the analysis is diminished by the recent appearance of Dr. Lawrence Balls' more fundamental treatise, "Studies of Quality in Cotton."

FORMATION OF RAINFALL.—A recent paper by D. Brunt and C. K. M. Douglas (*Mem. Royal Met. Soc.*, vol. 3, No. 22) opens up a line of investigation which should help to explain the mode of formation of that large proportion of our rainfall which is not due to simple elevation of moist air currents by the interposition in their path of hills or mountains. It puts into mathematical form a relationship, hitherto only vaguely realised, between rainfall and change of barometric pressure. The work of Shaw and Gold on the relation between barometric gradient and wind force established many years ago the important fact that above the first few hundred feet in the atmosphere the motion of the air is such that there is balance between the accelerations brought into play by the motion of the air and the pressure gradient on occasions when the distribution of pressure is steady, and that a close approximation to this balance exists in a very large proportion of actual situations. In the paper under discussion, the difficult task of dealing mathematically with the case of a changing pressure distribution has been attempted, through a realisation of the fact that without a departure from 'balanced' motion convergence of air cannot take place, and consequently an upward current of air such as would give rise to steady rainfall cannot be maintained. An equation of motion is arrived at in which the effects of changing pressure gradient, curvature of the air's path and its acceleration, appear separately. Reasons are found for supposing that in certain cases the effect of changing pressure gradient is greater than that of the other terms. The wind is then made up of the geostrophic wind blowing along the isobars and a component blowing from rising towards falling pressure, this component being proportional to the gradient of barometric change. It is considered that the general tendency for rain to occur in regions of maximum fall, and for fine weather to occur in regions of maximum rise of pressure, may be attributed to convergence and divergence respectively of the 'unbalanced' component of the wind, that is to say, of the deviations from the 'geostrophic' wind. Observational evidence in support of this view is given.

NEW GEOLOGICAL MAP OF SOUTH AUSTRALIA.—The *Annual Report* of the Director of Mines and Government Geologist of South Australia for 1927 contains an account of the new geological map which has been issued by the Survey, together with a useful summary of the distribution and chief characters of the geological formations and references to the leading literature. The map has been printed in colours by photo-lithography, and is on the scale of 32 miles to an inch. Fossiliferous Cambrian rocks are now separated from the generalised Lower Palæozoic, and the oldest tillites have been grouped with Upper pre-Cambrian. The glacial deposits of Permo-Carboniferous age are now shown over a far wider area than was formerly possible. The age of the Leigh Creek coal measures is changed from Jurassic to Triassic as a consequence of recent palæobotanical work. The Cretaceous is divided into two divisions, a Lower marine series and an Upper freshwater series. More prominence is given to the mantle of Recent or Pleistocene material than formerly, mainly for economic reasons. Subterranean structure, however, is indicated by columns of figures showing in various places the downward succession of formations. A greatly reduced copy of the map in black and white patterns accompanies the *Report*, which, together with the colour-printed map, is obtainable from the office of the Geological Survey, Adelaide.

ORIGIN OF THE METAL IN METEORITES.—The peculiar and significant relations between the metallic and silicate portions of stony meteorites have been discussed by most investigators of these remarkable bodies. G. P. Merrill returns to the subject in a paper in which he reviews the divergent opinions of others, and gives the deductions which he has drawn from his own observations (*Proc. U.S. Nat. Museum*, vol. 73, Art. 21, 1928). By means of a series of cogent illustrations it is shewn that in the examples selected the metal was the *last* constituent to congeal and was probably wholly of secondary origin. Reduction of a ferriferous silicate by means of carbon or hydrogen is ruled out of consideration by the complete absence of residual products. Of all the other known constituents the ferrous chloride, lawrencite, seems best to meet the requirements of the case. In a hydrogen atmosphere it is reduced at temperatures not exceeding 400° C. Stony meteorites are certainly volcanic products, and it is possible to conceive the original chloride as one of the volcanic emanations. In terrestrial volcanoes the iron is oxidised almost at once, but in an atmosphere of reducing gases the iron would appear in metallic form. It is noteworthy that Sorby long ago suggested that the metallic constituents of meteorites were introduced into the interstices of the silicates in a state of vapour.

ATOMIC MAGNETISM.—In the September issue of the *Science Reports of the University of Sendai*, Prof. K. Honda gives an account of his theory of the origin of magnetism. He takes the atom to consist of a number of orbital electrons equal to the atomic

number of the element and a nucleus which contains additional electrons in number equal to the difference between the atomic weight and the atomic number, revolving with a high velocity. Just outside these electrons are a number of protons revolving in the opposite direction to the electrons. The outer electrons cannot be magnetised by an external field, but the processional motion produced gives rise to the diamagnetism of the atom. In ferromagnetic atoms the magnetic moment of the nuclear electrons and protons nearly cancel each other and the atom is easily turned by an external field. In paramagnetic atoms neutralisation is less complete and the external field has less effect. In diamagnetic atoms the magnetic moment is large and the field produces no effect on it, the diamagnetism being due to the outer electrons. The author shows that this theory explains many facts not covered by previous theories.

'RESIDUAL HEAT' OF METALS.—Two years ago Prof. Q. Majorana announced that iron, steel, lead, and copper placed, after a previous heating, in a thermostat at the temperature of the air, would retain for weeks a temperature about 0·01° C. higher than that of the thermostat. In the issue of the *Physikalische Zeitschrift* for Sept. 15, Miss M. A. Schirmann, of Vienna, gives an account of her measurements of this effect. Two similar specimens of the metal were used, one heated to redness before polishing, and the other unheated. They were placed in Dewar vacuum vessels immersed side by side in a water bath. The specimen previously heated showed a temperature 0·1° C. higher than the other, but the difference gradually decreased, and after several weeks disappeared. She ascribes the effect to the absorption and adsorption of air by the specimen previously heated, the effect of the heating having been to drive off the gases which the material contains in its normal state. She supports this opinion by showing that during the process of re-absorption the electrical resistance of the specimen increases. She points out that her explanation involves the disappearance of the effect when the metals are placed *in vacuo*.

WIND PRESSURE ON WIRES.—Many researches have been made on the connexion between wind pressure and the velocity of the wind. The construction of the English grid of overhead electric wires has brought the question prominently to the front, and the B.E.R.A. (British Electrical Research Association) have had many researches made in connexion with this subject at the National Physical Laboratory. In a paper read to the Institution of Electrical Engineers on Nov. 8, W. B. Woodhouse gave an interesting account of the work and the definite results that have been obtained. So far as smooth cylinders are concerned, it is now possible to predict with certainty the pressures corresponding to any wind velocities likely to be met with in practice. From theoretical considerations it was known that the ratio of the pressure on the cylinder to the product of the wind speed and the projected area should be a constant, provided that the product of the wind speed and the diameter of the wire remain the same. This has been directly verified by experiment. It has been found that if the diameter of the wire or the velocity of the wind vary, this ratio alters in a definite way. If the pressure is in pounds per square foot and the velocity of the wind in miles per hour, then for large wires the ratio is 0·003, and this is the number generally taken hitherto by engineers. For smaller wires, however, this ratio may be so small as 0·00246, and for very minute wires it may be 0·00360. Experiment shows that this law does not apply to stranded cables, the law derived from dynamic similarity being no longer applicable. Tests made on wooden poles disclosed that the usual design could be greatly improved by suitably modifying it. It has been found that the wind pressure on a strut of circular cross section can be considerably reduced by the addition of a similar strut in its wake. At certain speeds the pressure on a sphere can be reduced by roughening its surface. It has also been shown that the wind pressures on two struts of equal mechanical strength may be in the ratio of 6 to 1, depending on the shape of their sections.

MICRO-IDENTIFICATION OF ISOMERS.—A recent number (vol. 3, No. 8) of the *Bulletin of the Chemical Society of Japan* contains a paper by M. Migita on the micro-identification of the three isomeric xylenes in their mixture. Xylene is present in most samples of petroleum and wood-spirit and it is an important constituent of solvent naphtha, but the identification of *o*-, *m*- and *p*-xylenes in small quantities is a matter of considerable difficulty. From this paper it appears that traces of *m*- and *p*-xylene can be identified by the colour reactions given by their trinitro-derivatives in alcohol or acetone solution on the addition of alkali, while *o*-xylene can be detected as the sodium sulphonate by microscopic examination of the crystals.

REACTION BETWEEN ZINC AND CARBON MONOXIDE.—The *Journal of the American Chemical Society* for October contains a note by R. W. Millar on the reaction between liquid and gaseous zinc and carbon monoxide. From thermodynamical considerations it appears that, except at very low partial pressures, zinc vapour and carbon monoxide should react to give zinc oxide and carbon at about 700°, which is the temperature of the condenser used in zinc smelting. Experiments were carried out in order to ascertain whether the rate of direct reduction of carbon monoxide by zinc was appreciable, but the results indicated that, in the absence of a catalyst, the reaction $CO + Zn = ZnO + C$ is very slow at 600°-700°. It was found, however, that zinc reduces carbon dioxide rapidly at this temperature. The production of zinc oxide in the condenser seems to be due, therefore, to the oxidation of the zinc by carbon dioxide or by water vapour, both of which are present in considerable quantities during the smelting operations. Zinc may be safely distilled in carbon monoxide provided that the apparatus is free from iron.

ACCELERATED TESTS OF ORGANIC PROTECTIVE COATINGS.—The *Bureau of Standards of the U.S.A.* has recently issued Research Paper No. 1, which consists of an account by P. H. Walker and E. F. Hickson of the accelerated tests applied by the Bureau to paints, varnishes, lacquers, etc. The most important causes of the decay of such protective coatings are light, moisture, and temperature changes. An enclosed carbon arc is used as the source of light for test purposes in preference to a mercury arc, since the latter emits a considerable amount of radiation not present in sunlight. Test panels are also exposed to a spray of warm water, to low temperatures, and to various gases such as ozonised air. The extent of disintegration is determined by measuring the permeability to air and water vapour, and by testing the insulating properties of the film. The apparatus used for these purposes is also described. So far as can be judged by visual observation, the nature of the breakdown of a coating by artificial means is similar to that of a breakdown caused by weathering, but it is not easy to know the time of weathering equivalent to given standard tests owing to the variations of the weather.

The Kimberley Meeting of the South African Association for the Advancement of Science.

THE twenty-sixth annual meeting of the South African Association for the Advancement of Science was held at Kimberley on June 29–July 4, 1928, under the presidency of Sir J. Carruthers Beattie. The meeting was well attended, and eighty-six papers were read. Joint meetings of several sections were held. The South Africa medal and grant were presented to Dr. H. H. Green at the conclusion of the presidential address. A popular, illustrated lecture was given by Prof. P. Kirby on "Primitive and Exotic Music." There was a reception by the Mayor and city councillors in the City Hall, and visits to various places of scientific interest in Kimberley and the neighbourhood.

The president, Sir Carruthers Beattie, took as the subject of his address "Some Possible Extensions of the Activities of the Association." He gave an account of the first magnetic survey of South Africa, and emphasised the necessity of repeating a magnetic survey at not too long intervals. A re-survey has recently been begun in South Africa and its importance was indicated, particularly in regard to aviation and to the location of minerals and oil. The study of the problems of African peoples was indicated as a field for further work. Much research had been done in practically every field, but more was needed. The effect of present and prospective African industrialism on European and other industries might be investigated. As a body the Association might undertake the co-ordination and dissemination of the knowledge already available. The question of the extent to which the Bantu was capable of development affected not only South Africa, but also the world. The presence and determination of the European to remain in certain parts of Africa created the native question from the European point of view and the European question from the native point of view. The possibility of persistence of the white in South Africa, as occurred in other continents, needed investigation. Whites and natives both so far flourished, but how these non-homogeneous elements were to continue needed research. The possibilities were racial amalgamation resulting in a new race, or domination of one race by another, or development of the races on their own lines. The domination policy was considered as never succeeding permanently. The Bantu were assimilating European ideals and culture rapidly. Guidance in the science of government would be necessary. The possibility of development of the Bantu to a degree comparable with our own, and the assumption that the white knew best what was good for natives, needed consideration. The problems of population and food supply in parts of South Africa, of the second Oriental generation in Africa, and the effect of the native in European industry, also were indicated for research. "By research, discussion, and publication we can make a contribution of value towards the solution of Africa's greatest problem."

The presidential address to Section A was given by Dr. J. S. van der Lingen, his subject being "Garnets." Garnets as associates of diamonds were noted. The classification as aluminous and non-aluminous garnets was shown as applying to 'ideal' garnets, those found being isomorphous mixtures. The spectroscopic examination of garnets was described in detail. From numerous examinations it was concluded that yttriferous garnets are not rare in South Africa. The name proposed for this type of garnet, namely, a spessartine containing yttrium, is emildine, the limitation being that molecules of uvarovite must be absent and the molecule of pyrope either absent or a trace. In another type of garnet from other localities the molecule of pyrope was conspicuous. Magnesium and chromium were the determining elements in garnets derived from kimberlite. Yet another type of garnet, designated erinadine, contained both pyrope and uvarovite; but unlike the pipe garnets, they also contained yttrium. The absorption spectra of garnets were discussed and the application of these methods of examination of garnets to the detection of the presence of kimberlite pipes was indicated.

"The Liquid Fuel Problem" was the subject of Prof. J. Smeath Thomas's address to Section B. Adequate and continuous supply of liquid fuel was essential for national welfare. The general tendency to use oil instead of coal was shown by ship construction and mechanised transport. The possible exhaustion of the world's oil deposits was discussed, and it was concluded that there was no immediate danger. In non-oil producing countries fears in this direction were really due to political and strategic considerations. The oil position in the United States is such that control of the world's petrol reserves must pass from it, just as control of the coal market has passed from Great Britain. Petroleum substitutes and admixtures were considered. Alcohol mixed with petrol and benzene provided an excellent motor spirit. The production of fuel alcohol from home-grown materials was of special importance in South Africa, where large quantities of waste vegetable products and rank grasses were available. Sawdust and wood waste, ethylene and acetylene also were considered. The production of liquid fuel from oil shale and other carbonaceous rocks by destructive distillation was considered, and the value of by-products such as ammonium sulphate, in addition to the oil, was considerable. Coal as the source of future supplies of liquid fuel was of the greatest importance, and South Africa had abundance of suitable coal. The various methods of producing liquid fuel from coal—by low temperature carbonisation, the Bergius process, conversion into water gas, and synthesis of alcohols and hydrocarbons from this by catalysts—were discussed. The establishment of a Fuel Research Institute was urged.

In his presidential address to Section C, Mr. J. S. Henkel dealt with "The Relation of Vegetation to Water Supply in Southern Rhodesia." In Rhodesia summer rainfall prevails. Grassland and woodland are the principal types of vegetation, the latter being either close types (high forest) or savannah. About 60 per cent of the Colony is woodland. Most of the savannah trees are deciduous. Where human influence is not conspicuous, crowded trees of large dimensions and tall growth occur in high forest, small trees in savannah. Native shifting cultivation has caused much deforestation, but scrub is largely scanty regrowth of savannah. The heaviest rainfalls are along the eastern boundary, and rainfall distribution and vegetation maps do not coincide. Five groups of grasslands are differentiated. Extensive level areas occur on the main plateau, which become waterlogged in summer. Grass is the climax type. When drainage occurs, trees take possession. The second group occurs on ridges or narrow plateaux where excessive water supply in the growing season excludes trees. The third group has soil sufficient for grass but not for trees. The fourth is where neither excessive water supply nor shallow soil is present. The fifth group is along the eastern border mountains, the grassland being of an ancient type. Indigenous forest encroaches on grassland if not disturbed by man. Close

type or high forest is confined to areas of abundant rainfall and high elevation. They are not extensive and are mostly evergreen. Streambank forests of evergreens occur at all elevations where there is permanent water. Lists of the trees in the various sites were given. The western high veld showed *Baikiæa plurijuga* and *Copaifera coleospermia* were dominants, but in parts invasion by *Brachystegia* and *Berlinia* was occurring. Ridges at heads of valleys with eastern and southern aspects had *Uapaca* as the dominant. It formed abundant humus, hence deforestation by natives occurred. The mountain Acacia group was described and the *Brachystegia-Berlinia* savannah association. In the low veld, *Copaifera mopane* is the dominant tree. The type species of savannah forest change with elevation and therefore with water supply. The study of vegetation and its trend may indicate whether the climate is becoming wetter or drier, an important problem to South Africa.

The president of Section D, Prof. P. J. du Toit, spoke of "The Significance of Zoology in Veterinary Science" in his address. The early history of veterinary science dated to 4000 years ago, but modern science began in the eighteenth century. Outstanding discoveries of the late nineteenth century were those of the trypanosome causing surra, and of the Babesia responsible for redwater in cattle. These illustrated how veterinarians seeking the cause of disease had to focus their attention on the microscopic and invertebrate world. The study slowly emerged from empiricism and gradually began to embrace biology as a whole. The Protozoa as disease excitants had led to intensive study of the group, accompanied at first by the creation of numerous species, now reclassified under relatively few names, the rest being synonyms. The characters of these standard forms and their synonyms were given. The Piroplasms were similarly considered. Among the Metazoa, the veterinarian and zoologist have common ground in the study of the Cestoda of domestic stock and in the search for intermediate hosts of other parasitic worms. For the determination of such life histories a good knowledge of zoology is essential. A necessary part of the equipment of every veterinarian is a knowledge of the systematics, anatomy, and biology of insects, mites, and ticks. In no group was the common interest of veterinarian and zoologist more clear than in the vertebrates. Anatomy, physiology, and embryology all demanded the comparative method of study for the best results. Many species of mammals were carriers of organisms pathogenic to domestic animals. The diseases of birds are assuming greater importance yearly, as are those of fish. In veterinary education in South Africa an attempt has been made to break away from the more stereotyped course of the older schools and to give to the students the broad scientific bases necessary. Special courses in protozoology, entomology, and helminthology have been instituted. It is hoped that adequate recognition of the value of zoology will enable the younger generation of veterinarians to maintain a leading position for South Africa in veterinary science.

"The Study of Social Structure" was the subject of the address by Prof. T. T. Barnard to Section E. South Africa was a great field for the study of cultural anthropology, and there was urgent need for sympathetic knowledge of the social forms of the Southern Bantu. The study of man's socialised behaviour overlapped with other branches of anthropology. The main divisions of anthropology are ethnography, ethnology, and social anthropology. The methodology of ethnography was discussed, and need for both field work and theoretical treatment by the same investigator emphasised. Both ethnology and social anthropology take their subject matter from ethnographical records. The ethnology of the Southern Bantu was the historical analysis of their distribution, development, history, evidence for possible external influences, and transmission of cultural traits from group to group, of which illustrations were given. In social anthropology there was the search for general principles underlying the varieties of cultural form. Historical reconstruction of the prehistoric past is the legitimate aim of ethnology, but the principles of cultural development could only be demonstrated by inductive study of social change. The method of studying cultural variation and development must be inductive. Social anthropology is mainly concerned with the standards of social behaviour, and their analysis is one that will explain the forms as expressions of the needs of the society in which they occur. The study of social groupings is fundamental for the discussion of adjuncts of group differentiation. The three main problems are the actual distinctions existing between individual members of society, the operation of some criterion of similarity for the formation of social groups and the expression of group membership in the behaviour of its constituent members by the observance of group obligations. As examples, problems of kindred differentiation were considered and, in particular, the four methods of incest extension among the Bantu-speaking peoples of Southern Africa.

The presidential address to Section F was delivered by Dr. M. Boehmke, who dealt with "Some Social Implications of the Poor White Problem." It was pointed out that in South Africa there was a group of persons known as 'poor whites,' who were becoming an ever-increasing burden to the population. The poor white problem was considered to be due to remediable economic and social causes, such as the mental attitude towards manual labour, the presence of a coloured race at a lower level of civilisation, inheritance laws, exploitation by landowners, geographical and social isolation, laziness, misfortunes such as droughts, and, above all, ignorance. The solving of the problem of the poor white was essential. Early marriage and intermarriage had produced much feeble-mindedness. The non-intelligent ballot must be considered. The social whole must assume responsibility. The mental survey was of much use, but the social survey, organised along proper lines, was considered to be the best mode of attack. Such a survey must be local, definite, and public. Every house, family, and organisation must be included. Co-ordination and intensification of all uplifting efforts would eliminate the poor white problem in a generation, it is believed. The positive force for good would be appreciable when the poor white was brought to a normal position in life and he should become an asset to the country.

A few remarks may be made on the subjects discussed in the various sections:

In Section A, mathematical and engineering problems were to the fore, the maximum and minimum values of a function determined by the method of undetermined multipliers, the elastic impact of a sphere on a plane fixed surface and graphical solutions of electrical engineering problems being discussed.

In Section B an apparatus for observing changes in electrical conductivity in immersed paint films was described, a useful account of the medicinal springs of South Africa was given, the geological problems connected with the occurrence of kimberlite, and with the formation of red soil and of black vlei soil from dolerite in Rhodesia were discussed.

In Section C several papers of veterinary interest were taken at a joint meeting with Section D. These dealt with the poisonous plants, *Bowiea volubilis* and

Cucumis myriocarpus, rapid agglutination tests in calf paratyphoid, and *Salmonella* infections in canaries. Mycological papers were given on various new South African fungi, South African *Salicornia* and some natural hybrids were described, valuable practical notes on the reclamation of drift sands were given, very interesting accounts of plant indicators and of the forest types in the Knysna region were presented, and pharmocologists found much interest in an account of South African medicinal and poisonous plants.

A wide range of subjects was discussed in Section D. Many topics of interest to veterinarians and pathologists, as well as to zoologists, were considered, among these being the experimental induction of infection with *Trypanosoma vivax* in sheep and goats, gross invasion of the liver of lambs by cysticerci, fat necrosis, fatty infiltration of the liver, and bent-leg in sheep. East Coast fever and immunity therein was also considered, and some interesting facts regarding longevity of the brown tick without feeding were given, the latter having some significance in explaining sporadic outbreaks of disease. The adhesion reaction in trypanosomiasis and new methods in diphtheria prevention were also considered, and the culture of *Crithidia melophagia* from the blood of South African sheep described. The Protozoa found in South African soils, wherein a series of comparisons of the protozoal fauna of soils from the Knysna Forests was made, and an account of some new plant-inhabiting Herpetomonads were of much interest. A case of human infestation by *Armillifer armillatus*, showing southernward extension of the range of the Porocephalid parasite, was described. A series of papers dealt with crimps and quality estimations of grease wool, the standardisation of quality numbers and fibre variation in the merino. Some valuable observations on the formation of non-nucleated blastospheres in the eggs of a spider were detailed. The natural history of the 'Loerie' (*Turacus*) in the Knysna Forests and its rôle in seed dispersal were described. Some physiological papers dealt with the chromatic function in *Xenopus*, excitement pallor in chameleons, the relation of electrolytes to cardiac rhythm in *Octopus* and *Palinurus*, the hydrogen-ion concentration of the waters around the Cape Peninsula. A study of the zoogeographical relationships of certain insect groups was of much interest.

In Section E, stone implements and their significance were to the fore, the stone culture of Victoria West, implements from Howieson's Poort and stone bracelets being described. The Middle Stone Age in South Africa was defined and an account given of the implements in Sir Langham Dale's collection. Strand-looper excavations at Knysna were also described. The political organisation of the Bechwana, the religion of the Bapedi, and the magic medicine of the Hottentots also evoked interest.

In Section F, philosophy and economics were the chief topics. The philosophers discussed some aspects of the approach of philosophy and science, the social significance of art, the psychology of advertising, the nature of perception, and there was a joint meeting with Section D for a paper on industrial psychology. Other papers dealt with the Stanford revision vocabulary test, the first results of the Porteus maze test to native school children. Much interest was aroused by notes on some native budgets collected in Durban.

The next annual meeting of the Association, under the presidency of the Hon. J. H. Hofmeyr, will be held in July 1929, when the South African Association for the Advancement of Science will merge with the British Association, members of which will meet in South Africa as guests of the South African Association.

H. B. F.

The Evolution of Human Races.

THE Huxley Memorial Lecture of the Royal Anthropological Institute was delivered by Sir Arthur Keith in the lecture hall of the Royal Society on Tuesday, Nov. 27, at 8.30 p.m., when Prof. J. L. Myres, president of the Institute, took the chair. Sir Arthur Keith took for his subject "The Evolution of Human Races." He traced Huxley's career as an anthropologist, and said that in his opinion, his final conclusion that the chief types or races of existing mankind can be reduced to four, is still the most acceptable working hypothesis. Huxley's four chief types are represented by the fair people of Europe (his Xanthochroi), the negro of Africa, the Mongol of Asia, and the aborigine of Australia. The less differentiated types or races Huxley regarded as intermediate in characterisation to his main types, and was disposed to look upon them as having arisen by various degrees of miscegenation of the main types.

That peoples have arisen by the mixing of diverse races cannot be denied, but the chief problem which has to be solved is the origin of the chief types, which cannot be explained by any theory of hybridisation. The only valid explanation is Darwin's, which requires restatement in the light of modern knowledge. The theory of the evolution of races as thus restated includes the co-operation of a triple mechanism: (1) physiological processes which regulate the growth of the human body and determine its racial characterisation; (2) an isolating or segregating mechanism, which tends to preserve a local people in its purity, and thus permits physiological processes to work undisturbed through many generations; this isolating mechanism is found to be mainly physiological, but physical barriers also isolate; (3) a selective mechanism represented by changing environment and also by inter-racial competition. If these evolutionary means are sufficient to produce the four chief racial types, they could also have given rise to all secondary and intermediate races. The conclusion was reached that hybridity has played only a subsidiary rôle in the evolution of differentiated races.

If evolution is true, we ought to find human races in every stage of differentiation. This is what anthropological investigation is now revealing. There are not only Huxley's main or completely differentiated racial types, but there are also nationalities and peoples which represent every stage in the process of differentiation from a zero-point upwards. To races in which every individual is differentiated and can be recognised at sight by physical appearances, Sir Arthur applies the term pandiacritic. If 80 per cent and upwards of the individuals are recognisable, he proposes the name macrodiacritic; if more than 30 but less than 80 per cent, he suggests the name mesodiacritic; if less than 30 per cent, he names them microdiacritic races.

In conclusion, Sir Arthur applied this more plastic conception of race to the national and racial problems of Europe, in particular to those of the British Isles. Huxley rightly regarded the English, Welsh, Scottish, and Irish nationalities as mixtures of the same two racial stocks—the Nordic and Mediterranean of Europe—and they, from a zoologist's point of view, he held have no claim to racial status. In a lecture given in 1870 he stated: "If what I have to say in a matter of science weighs with any man who has political power, I ask him to believe that the arguments about the difference between

Anglo-Saxon and Celts are a mere sham and delusion."

A truer conception of the manner in which human races are evolved must lead to a reversal of Huxley's verdict. A nation must be regarded as an incipient race; it was only when this biological conception is applied that national behaviour can be explained. The men who settled in Britain at various periods of time, although representing different branches of European humanity, had in their bodies and brains the same ancient machinery of evolution. When diverse racial elements are assembled on new territory —provided the diversity be not too great—the race-building machinery at once comes into operation. The new assemblage starts from zero-point and works unconsciously towards complete racial differentiation. The conditions of modern civilisation make the smooth working of the ancient machinery of racial evolution an impossibility.

At the close of the lecture Prof. J. L. Myres presented the Huxley Memorial Medal for 1928 to Sir Arthur Keith.

University and Educational Intelligence.

CAMBRIDGE.—Mr. J. F. Cameron, bursar and formerly senior tutor and lecturer in mathematics at Gonville and Caius College, has been elected Master of the College in succession to Sir Hugh Anderson, who died in Nov. 2.

LONDON.—Mr. R. G. H. Clements has been appointed as from Dec. 1 to the Maybury chair of highway engineering tenable at the Imperial College—City and Guilds College. Mr. Clements studied at Heriot-Watt Engineering College, Edinburgh, where he obtained the diploma in civil engineering in 1904, and at University College, Southampton. He has worked as an engineer on public bodies and has held various appointments in the Roads Department of the Ministry of Transport.

The title of emeritus professor in the University has been conferred on: Prof. J. Norman Collie, on his retirement from the University chair of organic chemistry tenable at University College; Prof. L. W. Lyde, on his retirement from the University chair of economic geography tenable at University College; Prof. A. W. Porter, on his retirement from the University chair of physics tenable at University College. The title of emeritus professor of philosophy at University College has been conferred on Prof. G. Dawes Hicks, on his retirement from the chair of philosophy at that College.

SIR DUGALD CLERK will distribute the awards and give an address at the annual prize distribution of the Northampton Polytechnic Institute, London, E.C.1, on Friday, Dec. 7, at 7.30 p.m.

THE tenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, N.Y. In 33 articles, schools of medicine and institutes and departments of medical studies in all parts of the world are described, and their courses of instruction outlined. As in previous studies, the text is lavishly illustrated with plans and reproductions of photographs of the buildings and laboratories. An article entitled "How to Use a Medical Library" gives valuable advice as to the sources the investigator should consult to obtain the literature of his subject. The articles are not copyright and may be utilised in any way.

THE Martell Scholarship (£130 per ann.), the Fairfield Scholarship (£150 ann.), per and the Denny Scholarship (£75 per ann.), all in naval architecture, and the Parsons Scholarship (£150 per ann.) in marine engineering, will be offered for competition in 1929 by the Institution of Naval Architects. The Denny Scholarship is open to boys less than nineteen years of age (British subjects) who have not yet begun their apprenticeship; the other scholarships are open to British apprentices or students between the ages of eighteen and twenty-three who have not yet entered upon a university course. Particulars can be obtained from the Secretary, Institution of Naval Architects, 2 Adam Street, Adelphi Terrace, London, W.C.2.

THE New Education Fellowship, an international organisation of educationists, teachers, and parents in all parts of the world, is holding its fifth International Conference at Elsinore, near Copenhagen, on Aug. 8–21, 1929, on the subject of "The New Psychology and the Curriculum." At the Fellowship's last Conference, held at Locarno, more than 1200 members were present from 42 different countries. Examinations will form the subject of concentrated study at the Conference, and three public meetings will be held, at which representatives from various countries will bring forward the results of their investigations in this field. A special study will be made of the Danish Folk School. Further details of the Conference can be obtained from the headquarters of the New Education Fellowship, 11 Tavistock Square, London, W.C.1.

THE Science Masters' Association will hold its annual meeting at Cambridge on Jan. 2–5; the president, Prof. A. C. Seward, is to deliver his address on the evening of Jan. 2. The programme includes lectures by Prof. A. S. Eddington on the interior of a star, by Prof. T. M. Lowry on the arrest and promotion of chemical change, by Mr. J. T. Saunders on raising animals in cultures and their use, by Prof. E. V. Appleton on large scale optical experiments, by Sir William Pope on colour photography, and by Prof. J. Barcroft on hæmoglobin. There will be facilities for visiting the University laboratories, the Cambridge University Press, and also a sugar beet factory at Ely, and a trade exhibition of books and apparatus will be open throughout the meeting. Particulars as to accommodation, etc., can be obtained from the honorary secretary, Mr. I. M. Bankes-Williams, Lincoln House, London Road, Harrow.

THE annual conference of the Geographical Association will be held on Jan. 3–7, at the London School of Economics, Houghton Street, W.C.2, under the presidency of Sir Henry Lyons, who will deliver his presidential address, entitled "The Geographer and his Material," on Jan. 4. The programme includes lectures of Prof. J. Sölch of Heidelberg, on geomorphological problems of the Eastern Alps, by Dr. P. W. Bryan, of University College, Leicester, on natural environment related to human activity in the corn belt of North America, by Prof. C. B. Fawcett on the balance of urban and rural populations, and by Dr. Vaughan Cornish on linguistic frontiers in Central Europe. There will also be discussions on sketch maps for senior and central schools and on educational reorganisation and the teaching of geography, to be opened respectively by Miss E. G. R. Taylor and Mr. E. J. Orford, both of Birkbeck College, London. A reception will be given by Dr. Henry S. Wellcome at the Wellcome Historical Medical Museum, Wigmore Street, W.1, on Jan. 5. A publisher's exhibition of books and maps will be open during the meeting. Programmes of the meeting can be obtained from the Association, 11 Marine Terrace, Aberystwyth.

Calendar of Customs and Festivals.

December 6.

ST. NICHOLAS.—Born at Patara, a city of Lycia, and, though a layman, for his piety made bishop of Myra. He died in A.D. 343. The cult of St. Nicholas is specially connected with children and young people, hence many observances connected with his festival were transferred, some to Holy Innocents (Dec. 28) and some to Christmas. Various legends were current to account for this connexion. It is related that the innate piety of St. Nicholas was such that from the time of his birth he abstained from his mother's breast more than once on Wednesdays and Fridays.

More familiar is the story of the two youths who came to visit St. Nicholas at Myra while on their way to be educated at Athens, and were murdered by an innkeeper. The dismembered bodies were salted and placed in a pickling tub with some pork. On the saint, who had been informed of this event in a vision, upbraiding the innkeeper with his infamy, he repented, and the youths, miraculously made whole and brought to life at the intercession of the saint, stepped from the tub and prostrated themselves before him. Other versions make the scholars three in number. Hence originated the emblem of St. Nicholas—the naked children and the tub—and hence all schoolboys came to regard him as their patron. When a boy was hard pressed in a game and wished to cease play for a short period for any reason, the cry of 'Nic'las' secured him a brief respite, a survival of a medieval form of appeal to an overlord which still obtains in the Channel Islands, where the right of the *Clameur* or *Cri de Haro* is traditionally said to have been conferred upon the inhabitants by Rollo or Rou, Duke of Normandy. Under this privilege, anyone who considers himself wrongfully treated can secure immediate cessation of the act, pending investigation, by kneeling in the presence of two witnesses and crying 'Haro! (Ha Rou) Haro! à mon aide, Mon Prince, on me fait mal.'

A further manifestation of St. Nicholas's interest in children was the custom of making gifts to them on the morning of the saint's festival. These were said to come from St. Nicholas. This custom has now been transferred to Christmas. It has its legendary explanation in a story that St. Nicholas cast purses of money by night through the bedchamber window of a poor citizen to serve as portions for his three daughters and save them from prostitution. Hence also his patronage of virgins.

The saint's patronage of scholars was extended to all clerks, and thus he became the patron saint of parish clerks. Thieves also, as coming under his protection, were known as 'St. Nicholas's Clerks.'

In his connexion with the sea, and his protection of sailors, St. Nicholas has assumed the function Poseidon or Neptune. A chapel in Minorca dedicated to St. Nicholas was hung with votive pictures by sailors who had suffered shipwreck, in gratitude for their escape. The custom was general throughout the Roman Catholic world and recalls the *votiva tabella* to which Horace refers (*Odes* i. 5). Churches dedicated to St. Nicholas generally stood within sight of the sea. The corposant or St. Elmo's light which appears on the sails and masts of ships in stormy weather is in the Eastern Mediterranean also considered a mark of St. Nicholas's protection.

THE BOY BISHOP.—The observation of Dec. 6 as a festival in honour of St. Nicholas among schoolboys was signalised by the election of one of their number as a 'bishop.' This seems to have been especially a custom of the grammar schools. Sports took place in which, so early as Edward I., it was necessary to prohibit the inclusion of tournaments. According to a record of Wye School, it was customary for an offering of pence and a cock to be made to the master on St. Nicholas's day. The custom of electing a boy bishop was sometimes connected with the memory of Gregory the Great, also a patron of scholars. In addition to the sports, processions headed by the boy bishop took place. In Franconia, where the deacons as well as the bishops were elected from among the boys, subsidies were demanded, not begged, in the name of the bishop in a house-to-house visitation. Processions of a similar kind took place in England, the boys receiving presents for their singing, and the blessing of the bishop. The processions through the streets were forbidden in London by proclamation in 1541.

These observances among schoolboys were a survival of what had originally been a purely ecclesiastical practice. It was the custom for the cathedral choir boys to elect one of themselves as bishop to hold office until Holy Innocents' Day. The Boy Bishop, dressed in full pontifical robes with mitre and pastoral staff, often at very great expense, as is shown by the accounts, conducted a service in the Cathedral, and preached a sermon, which had been written for him. The choir boys occupied the stalls of the Church dignitaries, who fulfilled menial offices and occupied the lowest seats. During his tenure of office the Boy Bishop was supposed to bestow any preferments which became available—sometimes on the Continent his privileges included the appointment of civil officers and police—and if he should die within the period, he was buried with the full honours of a bishop. That the ceremony sometimes degenerated into buffoonery is suggested by records which show that a fool in the usual costume with inflated bladder was included in his train. In the proclamation of Henry VIII. forbidding the procession in London, reference is made to the personation of women, and in some nunneries little girls seem to have performed the offices.

Evidences of the election of the Boy Bishop in medieval times on the Continent and in England are numerous. Salisbury provides the most detail in the "Processionale ad usum . . . Eccles. Sarum," 1566, in which an elaborate service set to music gives the whole ritual to be observed by the Boy Bishop on the eve of Holy Innocents. This was at one time thought to be the only instance in England, but the custom has been traced in a number of the cathedral cities, collegiate churches, and larger towns. It is not improbable that it was even more widely spread, and may, as has been stated by some writers, have once been celebrated in every parish. If this was really the case, it was probably in origin a popular festival taken over by the church. This would account for the wearing of vizards alluded to by some writers, and for the inclusion of women and girls in an institution essentially masculine. Apparently so early as the Synod of Constantinople in 867 there existed a practice at the courts of princes of decking out a layman as a bishop, and an attempt was then made to suppress the custom. Probably, like the Scottish 'Abbot of Unreason,' this bishop was a Lord of Misrule such as was elected at certain seasons, but especially at Christmas—a form of the more popular masquerade or carnival, when all authority was abrogated, as in the Roman saturnalia, and ultimately to be traced to the periodical observances found among primitive peoples when all taboos and regulations, particularly those affecting sexual relations, are deliberately ignored.

Societies and Academies.

LONDON.

Royal Society, Nov. 15.[1]—F. A. Jenkins and H. de Laszlo: Structure of the violet bands of silicon nitride. The analysis shows a marked isotope effect for $Si^{28}N$, $Si^{29}N$, and $Si^{30}N$.—R. A. Fisher: The general sampling distribution of the multiple correlation coefficient.—F. W. Carter: On the stability of running locomotives. The inherent riding qualities of locomotives are discussed from the point of view of their natural tendencies, whether to seek the centre of the track or to deviate therefrom. The locomotive of one truck or axle group is generally unstable. In the locomotive of two trucks, these have regions of stability, limited by running speed and by the forces between main and auxiliary trucks.—A. C. Menzies: Ground terms in the spectrum of nickel II and proposed standard wave-length in the Schumann region. The method already described of obtaining spectrograms with exposures of the order of 1/100 second in the Schumann region (by fusing wires) is particularly well suited to the investigation of ground-terms, and has been applied to elucidate those of nickel II.—J. M. Whittaker: On the principle of least action in wave-mechanics. The connexion between Dirac's wave equations and the equations suggested by the author in a recent paper are discussed.—H. Dingle: The spectrum of doubly ionised fluorine (F III). Comparison of the spectrum with that of singly ionised oxygen shows close correspondence, with a few exceptions.—J. A. V. Butler: The equilibrium of heterogeneous systems, including electrolytes (Part 3). An equation is deduced for the variation of the adsorption of a substance dissolved in a more polar medium with the electric field at the interface.—G. R. Goldsbrough: The tides in oceans on a rotating globe (Part 2). The method of Part I of this paper is applied to two types of flat rotating sea; a semicircular basin, deepest in centre and shelving towards circumferential edge, and a flat semicircular basin of uniform depth.—T. Bradshaw and G. H. Livens: The formula for the optical rotatory dispersion of quartz.—H. T. Flint: The new metric of Einstein and the wave equation.—A. Robertson: The strength of tubular struts.—G. S. Adair: A theory of partial osmotic pressures and membrane equilibria, with special reference to the application of Dalton's law to hæmoglobin solutions in the presence of salts. The osmotic pressures of hæmoglobin solutions in equilibrium with solutions of diffusible salts have been measured and correlated with determinations of the membrane potentials, and the distribution of diffusible ions. Within certain ranges of hydrion, salt and protein concentrations, a modified form of Dalton's law of partial pressures is applicable for analysing the observed osmotic pressures in terms of the diffusible ion pressure difference, and the partial osmotic pressure of the protein ions. The value 67,000 obtained for the molecular weight hæmoglobin in physiological salt solutions agrees with that previously determined for hæmoglobin in distilled water.—A. T. Waterman: The effect of electric fields on the emission of electrons from conductors. An examination of the Schottky effect from the point of view of the Sommerfeld electron theory of metals. Accurate experimental data on the Schottky effect should therefore distinguish between the Sommerfeld theory and the classical.—W. Mandell: (1) The change in elastic properties on replacing the potassium atom of Rochelle salt by the ammonium group. The two substances are isomorphous. Their densities differ considerably, whilst smaller changes take place in the optical rotation, the refractive indices, and the size of the space-lattices and of the interfacial angles. The ammonium salt is less elastic than the potassium salt, the deformation magnitudes being fairly uniformly increased in all directions. Comparison of the elastic curves shows that the inter-atomic forces in both are very similar and that the potassium atom is a sort of 'key' atom in the molecule. (2) The determination of the piezo-electric moduli of ammonium seignette salt.—A. M. Tyndall, L. H. Starr, and C. F. Powell: The mobility of ions in air. Part 4. Investigations by two new methods. At long ages, the positive ions have mobilities distributed over a small range with a mean value of about 1·25, which is independent of the humidity of the air. There is no evidence of initial positive ions in very dry air or in pure nitrogen. If any are formed, they nearly all transform in less than 1/100 sec. The mobility of both the negative and positive ions in air containing alcohol vapour is independent of the age of the ions from 1/25 to 2/3 sec.—A. M. Tyndall, G. C. Grindley, and P. A. Sheppard: The mobility of ions in air. Part 5. The transformation of the positive ions of short ages. An air blast method was used. A small quantity of ozone produces a marked increase in the rate of transformation; this effect may explain the different results obtained by various observers using different methods. The rate of transformation is greatly retarded if, before entering the air blast, the ions are formed in an atmosphere containing the vapour of certain alcohols of the aliphatic series.—L. J. Freeman: The spectrum of doubly ionised nitrogen (N III).—W. R. Dean: Fluid motion in a curved channel. The motion of fluid forced under pressure round the space between concentric circular cylinders may become unstable for a symmetrical disturbance. In certain cases the disturbance may be that which actually ensues when steady motion breaks down. It cannot persist in a straight channel. This effect of curvature may explain why there is not in a curved pipe a sudden increase in loss of head in the neighbourhood of the critical velocity.—H. E. Watson and A. S. Menon: The electrical conductivity of thin oil films. Part 1.—W. Kapucinski and J. G. Eymers: Intensity measurements in the secondary spectrum of hydrogen.—E. Rudberg: Some remarks concerning the production and absorption of soft X-rays and secondary electrons. The number of photoelectrons produced for one quantum of radiation absorbed is of the order unity. This result, with efficiency measurements on soft X-ray production using the photoelectric method, shows that the yield of such radiation when metals are bombarded with electrons of a few hundred volts' energy is extremely small. A very much larger portion of the energy of the bombarding electrons reappears in smaller units as energy of secondary electrons, a great part of which are probably initially free conduction electrons of the substance.—B. Swirles: The internal conversion of gamma-rays. Part 2.—R. S. Bartlett: The increase in thermionic currents from tungsten in strong electric fields. Experimental results for the increase of thermionic currents with applied electric field at constant temperature show only general agreement with theory. Surface impurities in the cathode exert a marked effect.—L. H. Thomas: On the rate at which particles take up random velocities from encounters according to the inverse square law.

Physical Society, Oct. 26.—Allan Ferguson and Jas. P. Andrews: An experimental study of the anticlastic bending of rectangular bars of different cross-sections. A method is described for the survey of the

[1] Continued from p. 829.

surface of a beam bent by couples, with special reference to the study of the curvatures in and perpendicular to the plane of bending.—**B. S. Smith** and **F. D. Smith**: An instrument for the production of known small high-frequency alternating electromotive forces. A portable instrument for the production of known electromotive forces, variable in frequency from 10 to 50 kilocycles and in magnitude from 0·0076 to 15,000 microvolts, is described. It is intended for the calibration of amplifiers and the measurement of the strength of wireless signals of long wave-length.

Mineralogical Society, Nov. 6.—**F. A. Bannister**: The so-called 'thermokalite,' and the existence of sodium bicarbonate as a mineral. The composition of a large collection of saline incrustations collected by Dr. Johnston-Lavis about 1889, has been investigated. He labelled them 'thermokalite,' but they are found to be a mixture of trona, thermonatrite, thenardite, and free sodium bicarbonate; no potassium salts are present. The name nahcolite is proposed for naturally occurring sodium bicarbonate. These incrustations were found lining the walls of a cuniculus near the Stufe di Nerone, Baia, Naples, Italy; their mode of occurrence is discussed from a physical-chemical point of view.—**W. A. Wooster**: The piezo-electric effect of diamond. The effect has been investigated by a delicate method using magnetic attraction to apply pressure to the diamond. The result shows that the effect, if it exists, is less than $\frac{1}{200}$ of the effect observed in quartz cut perpendicular to the electric axis.

CAMBRIDGE.

Philosophical Society, Oct. 29.—**P. A. M. Dirac**: The basis of statistical quantum mechanics. Neumann's method of describing a Gibbs' ensemble of systems in quantum mechanics by a matrix is very closely analogous to the classical description. The matrix may be regarded as a function of the co-ordinates and momenta and is then the analogue of the classical density of distribution of representative points in phase space. An equation of motion for the quantum density is obtained, of the same form as the classical one, and a justification is provided for the usual assumptions of *a priori* probability in quantum theory.—**L. H. Gray**: The absorption of penetrating radiation. When an electroscope is shielded from all local radiations, and its natural activity has been allowed for, there remains a small residual ionisation which increases with altitude. One hypothesis attributes this ionisation to ultra-gamma radiation. Assuming a homogeneous isotropic radiation at the top of the earth's atmosphere, an approximate calculation is made of the ionisation to be expected at different heights and the relative contributions to the ionisation of the radiation of longer wave-length produced by the Compton scattering process from the primary radiation. As the altitude increases, the apparent absorption coefficient at first increases and then decreases.—**N. A. de Bruyne**: Note on the effect of temperature on the auto-electronic discharge. The auto emission is independent of temperature up to approximately 2000° and the apparently contradictory experimental results of Millikan are explained.—**J. Hargreaves**: The dispersion electrons of lithium. An attempt is made to estimate the number of electrons of dispersion (+) for the lines of the principal series of lithium, and the value of df/dv for the continuous spectrum, using a 'self-consistent' field, and Hartree's method of integration. Owing to polarisation effects the 'self-consistent' field does not, however, give the correct term-values. General normalised solutions of the wave-equation with continuous *eigenwerte* are given, and the normalised solution for the zero *eigenwert* is deduced by a limiting process.—**E. E. Watson**: Current measurement with a Compton quadrant electrometer. By using the rate of deflection method with a Compton quadrant electrometer, a current of 10^{+14} amp. can be measured in a minute. The rate of deflection of the electrometer spot is proportional to the current right up to the fastest measurable speed, 5 cm. per sec.

PARIS.

Academy of Sciences, Oct. 8.—**Ch. Depéret** and **J. Viret**: The discovery of the fauna of Burdigalian mammals of the Orléanais sands in Haut-Armagnac. Excavations near the village of La Romieu have given the more or less complete debris of 16 species of mammals, a list of which is given.—**Georges Claude**: The extraction of krypton and xenon from air and from gases dissolved in water. The aim of the work described was to obtain xenon and krypton, not from air specially treated for the purpose, but as a by-product from a commercial process. Special rectifying apparatus designed to prevent mechanical losses of krypton and xenon has given a continuous stream of gas containing 0·1 per cent of xenon, and krypton at about one-half of the amount present in the air treated. Removal of oxygen by combustion in hydrogen raised the proportion of the two rare gases to 2 per cent. This mixture is further concentrated by means of silica cooled in liquid oxygen. About 10 litres of krypton and 800 c.c. of xenon per day can be thus prepared.—**Léon Guillet** and **Ballay**: The influence of the composition and cold hardening on corrosion and the increase of the size of the grain in aluminium. The influence of cold hardening is more marked in 98·81 per cent aluminium than with pure aluminium (99·87 per cent).—**Maurice Fréchet**: The existence of an index of desirability of indirect benefits.—**Bertrand Gambier**: Remarkable configurations of four right tangents to certain curves.—**Georges Bouligand**: The order of measurement of a closed ensemble.—**A. Buhl**: The function $E(y)$ of Mittag-Leffler and developments in series intervening in mathematical physics.—**P. Myrberg**: Discontinuous groups of biuniform transformations.—**J. Guéron**: The electro-chemical study of the action of acids on the solutions of some salts of zinc.—**Mme. and M. M. Lemarchands**: The quantitative separation of barium and calcium. The increase of solubility caused by the presence of hydrochloric acid is emphasised.—**V. Auger** and **Al. Yakimach**: The phosphates and arsenates of quadrivalent manganese. The preparation and properties of some crystallised compounds of tetravalent manganese are described, including $((NH_4)H \cdot PO_4)_2\ MnO$, $Mn(H_2AsO_4)_4$, and $((NH_4)HAsO_4)_2MnO$. All these compounds contain active oxygen, and with hydrogen peroxide in acid solution evolve oxygen.—**Lespieau**: 1·12-Dodecanediol. Pentamethylene bromide, reacting with magnesium, gives not only the normal $(CH_2)_5(MgBr)_2$, but also a series of condensation products of the general formula $(CH_2)_{5n}(MgBr)_2$. The glycol $CH_2(OH) \cdot (CH_2)_{10} \cdot CH_2OH$ has been prepared from one of the latter products.—**Mlle. L. Remy**: Mutation in mosaic.—**M. Bridel** and **Mlle. S. Grillon**: The glucoside from *Gaultheria procumbens*, giving rise to methyl salicylate, is monotropitoside. The identity of this glucoside with monotropitoside from *Monotropa Hypopitys*, *Betula lenta* and other species is definitely proved.—**Mlle. M. L. Verrier**: The peculiarities of the mitochondrial apparatus of some cecidia.—**Motoi Sakurai**: The tracheal gland of some insects.—**Mme. N. Dobrovolskaïa-Zavadskaïa**: A strain of mice presenting an unusual mutability of the tail.—**Et. Burnet**: Biochemical modifications impressed on cultures of *B. abortus* with the view of using it in giving immunity against Maltese fever.

VIENNA.

Academy of Sciences, July 5.—**E. Hartmann** and **J. Zellner**: The chemistry of the higher fungi. (19) *Polyporus pinicola*. An ally of the larch fungus containing a dozen different compounds.—**N. Fröschl** and **J. Zellner**: The chemistry of the higher fungi. (20) *Omphalia Campanella, Marasmius Scorodonius, Boletus cavipes, Calocera viscosa*.—**J. Zellner**: Contributions to the comparative chemistry of plants. (21) Chemistry of plants with latex.—**J. Pollak** and **F. v. Meissner**: The constitution of the disulpho-acids of meta-xylol.—**J. Pollak** and **E. Riess**: Oxy-thiophenols.—**E. Riess**: The oxidation products of 4, 4-dichlor-2, 2-dinitro-diphenyl-sulphide and disulphide.—**K. Brunner**: Determination of the constitution of β-resorci-dicarboxylic acid.—**A. Kohaut**: Thermo-electric forces in wires partially covered with another metal.—**F. Bartl**: The compressibility of liquids. A formula is proposed which seems to connect the molecular weight, the density and the number of atoms in the molecule with the compressibility; also a table showing observed and calculated results for 25 different liquids, including mercury, ether, alcohol, and water.—**F. Raaz**: The electric conductivity of lithium silicates in the solid state. In contrast to other silicates, the lithium silicates show a marked conductivity at higher temperatures, and the orthosilicate a greater conductivity than the metasilicate.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1151 (Ae. 317): The Characteristics of a Karman Vortex Street in a Channel of Finite Breadth. By H. Glauert. (T. 2573.) Pp. 14+1 plate. (London: H.M. Stationery Office.) 9*d*. net.

The Calendar of the Pharmaceutical Society of Great Britain 1928–1929. Pp. 242. (London.) 3*s*. 6*d*.

Madras Fisheries Department. Administration Report for the Year 1926–27. By Dr. B. Sundara Raj. (Report No. 1 of 1928, Madras Fisheries Bulletin, Vol. 22.) Pp. iii+99+3 plates. (Madras: Government Press.) 1 rupee.

New Zealand. Department of Lands and Survey: Scenery-Preservation. Report for the Year ended 31st March 1928, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 12+3 plates. (Wellington, N.Z.: W. A. G. Skinner.) 9*d*.

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 4, No. 1. Pp. 144. (Adelaide.) 10*s*. 6*d*.

Government of the Gold Coast. Report on the Survey Department for the Period April 1927–March 1928. Pp. 31+3 plates. (Accra: Colonial Secretariat; London: The Crown Agents for the Colonies.) 3*s*.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Fourteenth and Fifteenth Years) 1926 and 1927. Supplement 2. Pp. 171+29 plates. (East Malling: East Malling Research Station.) 5*s*. 6*d*.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 8: Methods for the Examination of Soils. By Prof. J. A. Prescott and C. S. Piper. Pp. 52. Bulletin No. 36: Kimberley Horse Disease (Walk-about Disease). By D. Murnane and Prof. A. J. Ewart. Pp. 61. (Melbourne: H. J. Green.)

The Royal Aeronautical Society, with which is incorporated the Institution of Aeronautical Engineers. List of Members. Pp. 55. (London.)

British Cast Iron Research Association. Seventh Annual Report for the Year ending June 30th, 1928. Pp. 24. (Birmingham.)

Empire Grown Sisal and its Importance to the Cordage Manufacturer: Memorandum prepared by the Imperial Institute with the co-operation of its Advisory Committee on Vegetable Fibres, and issued by the Empire Marketing Board. (E.M.B. 10.) Pp. 25. (London: H.M. Stationery Office.) 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 11: The Action of Aromatic Amines on Nitric Esters. By Dr. Hugh Ryan and Michael T. Casey. Pp. 101-111. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

FOREIGN.

Det Kongelige Departement for Handel, Sjøfart, Industri, Handverk og Fiskeri: Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard og Ishavet. Nr. 13: The Micromycetes of Svalbard. By J. Lind. Pp. 61+3 plates. 6.00 kr. Nr. 15: Geology of Bear Island, with special reference to the Coal Deposits, and with an Account of the History of the Island. By Gunnar Horn and Anders K. Orvin. Pp. xi+152+10 plates. 15.00 kr. Nr. 16: Déterminations astronomiques pour Norges Geografiske Opmaling. Par Hans S. Jelstrup. Pp. 28. 2.00 kr. Nr. 17: Beiträge zur Kenntnis der Kohle von Svalbard (Spitsbergen und der Bäreninsel). Von Gunnar Horn. Pp. 60+5 Tafeln. 5.50 kr. (Oslo: Jacob Dybwad.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. Agalines and Allies in North America, I. By Francis W. Pennell. Pp. 339-449. (Philadelphia, Pa.)

Hamburger Sternwarte in Bergedorf. Index der Sternörter 1900–1925. Herausgegeben von R. Schorr und W. Kruse. Band 1: Der nördliche Sternhimmel. Pp. ii+308. Band 2: Der südliche Sternhimmel. Pp. ii+291. (Bergedorf.)

Hamburger Sternwarte in Bergedorf. Erstes Bergedorfer Sternverzeichnis 1925·0 enthaltend die mittleren Örter von 4983 Sternen nach Beobachtungen am Repsoldschen 19 cm.-Meridiankreis in den Jahren 1913 bis 1926. Von Dr. Franz Dolberg. Pp. xxviii+108+2 Tafeln. (Bergedorf.)

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 6, No. 1. Pp. iv+69+37. Japanese Journal of Geology and Geography: Transactions and Abstracts. Vol. 6, Nos. 1-2. Pp. ii+62+7+12 plates. (Tokyo: National Research Council of Japan.)

Argeologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Eerste Stuk: Die Koningse Kultuur. 1: Die Koningse Industrie. Deur Dr. Ir. E. C. N. van Hoepen. Pp. 11+4 plates. (Bloemfontein.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 4, October. Pp. 487-684. 25 cents. Research Paper No. 18: Mutual Inductance of any Two Circles. By Chester Snow. Pp. 531-542. 5 cents. Research Paper No. 22: The International Temperature Scale. By George K. Burgess. Pp. 635-640. 5 cents. Research Paper No. 23: Tables of Theoretical Zeeman Effects. By C. C. Kiess and W. F. Meggers. Pp. 641-684. 15 cents. (Washington, D.C.: Government Printing Office.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 7, Part 3: Paleobotany of Porto Rico. By Arthur Hollick. Pp. ii+177-393+plates 51-88. (New York City.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 5, November. Pp. 685-866. (Washington, D.C.: Government Printing Office.) 25 cents.

Diary of Societies.

FRIDAY, NOVEMBER 30.

TEXTILE INSTITUTE (Manchester), at 1.15.—E. E. Canney: Rational Development in the Organisation of the Cotton Industry.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (Newcastle-upon-Tyne), at 2.30.—J. H. M. Cragg: Notes on an Electric Heading Machine.—*Papers open for discussion*:—Bore-holes and their Purposes, W. S. Armstrong; Diamond Boring applied to Tapping Drowned Areas Underground, F. E. Smyth.

ROYAL SOCIETY (Anniversary Meeting), at 4.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. Dalby: The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine (Thomas Lowe Gray Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. E. V. Telfer: Frictional Resistance and Ship Resistance Similarity.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Manchester), at 6.30.—J. F. Leeming: Civil Air Transport.

ROYAL SANITARY INSTITUTE (at Town Hall, Manchester), at 7.—Dr. G. S. Coleman: The Training of a Sanitary Inspector.—F. W. Platt: Some Aspects of the Housing Problem.

ENGINEERING AND SCIENTIFIC CLUB (Wolverhampton), at 7.—Prof. D. Smith: Cutting Tools, their Treatment and Performance.

TEXTILE INSTITUTE (jointly with Leigh Municipal College Textile Section) (at Leigh), at 7.15.—W. Bailey; Various Methods of Winding Artificial Silk Yarns.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—C. W. Harvey: The Manufacture of Decorative Metal Work.

INSTITUTION OF PRODUCTION ENGINEERS (at 83 Pall Mall), at 7.30.—Dr. G. H. Miles: Psychology as an Aid to Production.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates' Branch) (at 51 West Regent Street, Glasgow), at 8.—W. P. Kirkwood: Brakes.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—W. Lind-Jackson: Napier Aero Engines.

SATURDAY, DECEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: The Violin Sonatas of William Young (17th Century).

MONDAY, DECEMBER 3.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Sir James MacKenna: The Sugar Industry of India.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. T. A. Stephenson: Contribution to Actinian Morphology: the Genera *Phellia* and *Sagartia*.—Miss S. M. Manton: On Some Points in the Anatomy and Habits of the Lophogastrid Crustacea.—Prof. H. Graham Cannon and Miss S. M. Manton: On the Feeding Mechanism of the Syncarid Crustacea.—B. P. Wiesner and Prof. F. A. E. Crew: The Preparation of ρ Factors: their Physiological Action upon the Immature, Mature, and Senile Gonad.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr J. A. Fleming: Matter, Energy, Radiation, Life, and Mind.

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

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University, Birmingham), at 7.—F. H. Rosencrants: Practice and Progress in Combustion of Coal as applied to Steam Generation.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Leeds), at 7.15.—Dr. H. W. Davies and Prof. B. A. McSwiney: Poisoning and Disease in Industry. (1) Carbon Monoxide Poisoning.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—C. S. Lane-Roberts and A. McAlister: Discussion on The Artificial Termination of Pregnancy.

EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. H. Campbell, Dr. Ryle, and others: Discussion on Public Health and the C3's.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt. B. S. Thomas: The South-East Borderland of the Rub 'Al Khali.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—Dr. L. A. Jordan: Scientific Aspects of Paint Technology.

TUESDAY, DECEMBER 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (III.).

INSTITUTION OF CIVIL ENGINEERS, at 6.—H. V. C. Johnstone: The Gezira Irrigation Scheme: Canalisation of the Gezira.—J. R. Russell: Sluices and Machinery of the Gezira Irrigation Scheme: Blue Nile Dam and Canalisation.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Technical College, Leicester), at 6.45.—H. Cotton: Polyphase Commutator Motors and their Application.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. Basil: Portraiture.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. H. E. Merritt: Gear Transmission.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—A. G. Lobley: Electric Furnaces.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.

QUEKETT MICROSCOPICAL CLUB, at 7.30.

TELEVISION SOCIETY (at Engineers' Club), at 8.—Prof. Cheshire: Tuning Forks; how they talk and what they have to say. Lecture preceded by a demonstration of Television by Wireless.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—G. Perkins and others: Discussion on The Painful Shoulder.

WEDNESDAY, DECEMBER 5.

ALCHEMISTS' SOCIETY (in Chemical Lecture Theatre, Glasgow University), at 3.30.—Debate.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—R. H. Barfield and G. H. Munro: Attenuation of Wireless Waves over Towns (Effect of Towns, including Buildings, Tuned Aerials, etc., on Wave Damping).

WOMEN'S ENGINEERING SOCIETY (at 138 Piccadilly), at 6.15.—P. E. Rycroft: Modern Steam Plants.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—J. W. F. Gardner: The Renewal and Strengthening of Railway Bridges.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall, Westminster), at 7.—S. Hopkins: Constant Pressure Thermal Storage.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—R. M. Doidge: Refractories.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—H. A. Morham: Feed Water Heaters.

INSTITUTION OF AUTOMOBILE ENGINEERS (Derby Graduates' Branch) (jointly with Derby Society of Engineers) (at Technical College, Derby), at 7.30.—J. H. Dickenson: The Heat Treatment and Mechanical Properties of Alloy Steels.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 8.—S. B. Bratley: Dairy Chemistry.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—A. Scott Dodd: The Natural Occurrence of Boric Acid in Fruits.—J. Evans and A. O. Jones: Chemical Tests for Drunkenness.—C. A. Adams and J. R. Nicholls: The Analysis of Mixtures containing Acetone Ethyl Alcohol and Iso-propyl Alcohol.—J. R. Nicholls: The Specific Gravities and Immersion Refractometer Readings of Dilute Mixtures of Acetone and Water.—J. J. A. Wijs: The Wijs Method as the Standard for Iodine Absorption.

ROYAL SOCIETY OF ARTS, at 8.—Sir Eustace Tennyson d'Eyncourt: Fuel for Ships.

INSTITUTION OF MECHANICAL ENGINEERS (Liverpool Branch) (jointly with Liverpool Engineering Society).—W. A. Benton: Weighing Machinery.

INSTITUTION OF MECHANICAL ENGINEERS (Yorkshire Branch) (at Sheffield).—Prof. F. C. Lea: Chairman's Address.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—Prof. A. E. Boycott, C. Diver, S. Hardy, and F. M. Turner: The Inheritance of Sinistrality in *Limnæa peregra*.—R. H. Burne: A System of "Fine" Vessels associated with the Lymphatics in the Cod (*Gadus Morrhua*).—E. Hindle: Further Observations on Chinese Kala-Azar.—*Papers to be read in title only*:—E. Ponder: Hæmolysis by Brilliant Green and Serum.—Prof. A. V. Hill, Grace Eggleton, and P. Eggleton: The Coefficient of the Diffusion of Lactic Acid through Muscle.—C. H. Best: K. Furusawa and J. H. Ridout: The Respiratory Quotient of the Excess Metabolism of Exercise.—Prof. A. V. Hill and W. Hartree: The Energy liberated by an Isolated Muscle during the Performance of Work.—Prof. A. V. Hill: The Diffusion of Oxygen and Lactic Acid through Tissues. Parts I., II., III., and IV.—Dr. D. Keilin: Cytochrome and Respiratory Enzymes.—F. R. Miller and N. B. Laughton: Myograms yielded by Faradic Stimulation of the Cerebellar Nuclei.—D. Burk: The Free Energy of Glycogen-Lactic Acid Breakdown in Muscle.—F. C. Smith: The Ultra-Violet Absorption Spectra of Certain Aromatic Amino-Acids and of the Serum Proteins.

IMPERIAL COLLEGE CHEMICAL SOCIETY, at 5.—Dr. E. K. Rideal: Chemical Activation.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir Richard Paget, Bart.: Human Speech as a Method of Expression by Gesture (I.).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. E. Foster, P. G. Ledger, and Dr. A. Rosen: The Continuously Loaded Submarine Telegraph Cable.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Fuel Section) (at University, Bristol), at 7.30.—Dr. E. W. Smith and H. M. Spiers: Refractories in Industry.

CHEMICAL SOCIETY, at 8.—U. R. Evans: The Mechanism of Corrosion.—E. H. Farmer and W. D. Scott: Properties of Conjugated Compounds. Part VI. The Dibromination Products of Cyclic Butadienes.—E. V. Bell and G. M. Bennett: The Stereoisomerism of Disulphoxides and Related Substances. Part IV. Di- and Tri-sulphoxides of Trimethylene-trisulphide.—G. M. Bennett and G. H. Willis: The Structure of Organic Molecular Compounds.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.15.—Dr. H. H. Scott and Dr. H. B. Day: Clinical and Pathological Correlation in Typhoid and Allied Diseases.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (jointly with Institute of British Foundrymen—Scottish Branch) (at Glasgow).—Discussion on Steel Castings.

FRIDAY, DECEMBER 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—G. F. Jenkins, T. B. Layton, and E. D. Davis: Discussion on Meningitis.

INSTITUTION OF WATER ENGINEERS (at Geological Society), at 10.30 A.M.—J. Bowman: The Consumption and Waste of Water.—E. J. Rimmer: Legal Considerations relating to the Administration of Engineering Contracts.—A. W. Burtt: The Sandfields.—W. T. Halcrow, G. B. Brook, and R. Preston: The Corrosive Attack of Moorland Water on Concrete.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Atmospheric Ionisation. Chairman, Dr. G. C. Simpson. Discussion to be opened by Prof. J. Nolan, and continued by Dr. J. S. Owens, Prof. A. M. Tyndall, and R. E. Watson.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—C. H. Faris: The Application of Electro-deposited Metals to Engineering.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Prof. F. W. Thomas: Weak R in Central Asia.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women), at 5.30.—J. Littlejohns: The Appreciation of Pictures.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. H. E. Armstrong: Hurter Memorial Lecture.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.30.—K. O. Keller: Combustion and its Difficulties in Marine Oil Engines.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—H. Bairstow: Bromoil Transfer.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: The Future of Coal in relation to Industry (Presidential Address).

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

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institution of the Rubber Industry—Manchester Section) (at Geographical Hall, Manchester).—Dr. Aner: Colloid-Chemical Changes in Rubber and other Unsaturated Organic Compounds.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—Prof. C. James: Pollution of Rivers.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Sir E. Farquhar Buzzard: The Harvey Tercentenary Film.

SATURDAY, DECEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Bayes: The Gulf between Painter and Public (I.).

MINING INSTITUTE OF SCOTLAND (at Glasgow).

PUBLIC LECTURES.

SATURDAY, DECEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Bird Life.

MONDAY, DECEMBER 3.

UNIVERSITY COLLEGE, at 5.15.—Prof. W. E. Gibbs: Chemical Engineering Education and Research in Great Britain.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—J. Garton: Can Canadian Methods of Farming be adopted in this Country with Advantage?

TUESDAY, DECEMBER 4.

ROYAL SANITARY INSTITUTE, at 6.30.—H. C. Adams: The Drainage of Basements and Low-Lying Areas and the Prevention of Damp (Chadwick Lecture).

WEDNESDAY, DECEMBER 5.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. R. Fortescue Fox: Rheumatism in relation to Industry.

KING'S COLLEGE, at 5.30.—Prof. R. R. Gates: The Indebtedness of Industry to Pure Science: The Relation of Botany to the Grain, Rubber, and Cotton Industries.

UNIVERSITY COLLEGE, at 5.30.—Prof. A. E. Richardson: The Housing of Books.

FRIDAY, DECEMBER 7.

KING'S COLLEGE, at 5.30.—Sidney Smith: Babylonian Amulets.

SATURDAY, DECEMBER 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. Aitken: Life and Traditions in the Spanish Rioja.

CONFERENCE ON DRYING.

THURSDAY AND FRIDAY, DECEMBER 6 AND 7.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).

Thursday, Dec. 6, at 10.30.—S. T. C. Stillwell: The Seasoning or Drying of Timber.—A. T. Henly: Tunnel and Stove Drying.

At 2.30.—J. A. Reavell: Film and Spray Drying.—Prof. J. W. Hinchley: Drying by Pressure.

Friday, Dec. 7, at 10.30.—T. J. Horgan: Rotary Dryers.—G. W. Riley: Vacuum Drying.

At 2.30.—Dr. S. G. Barker: The Hygroscopic Nature of Textile Fibres.—B. J. Owen: The Drying of Agricultural Products.—A. C. Barnes: Some Drying Problems in Tropical Africa.