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## Pestalozzi and the Teaching of Science.

JOHANN HEINRICH PESTALOZZI died at Brugg, Switzerland, on Feb. 17, 1827; and in the hundred years which have passed since then, a great change has taken place in educational thought and practice. Especially is this so in the province of school science, a growth almost entirely of the latter part of the nineteenth century. But as with all growths, we must search for the roots in the history of a far earlier period than this; and then we discover what science teachers owe to the pioneers of old, one of whom, Pestalozzi, will always hold an honoured place.

During the Middle Ages, when Aristotelian doctrines dominated intellectual thought and the grammar schools in England were precluded by their statutes from teaching any but grammatical subjects, there were already many people alive to the fact that a knowledge of science would be of advantage to the rising generation. They were not, however, thinking of science as we understand it to-day; all they advocated was a study of the scientific works of the classical authors, and by the middle of the seventeenth century a few, but very few, schoolmasters endeavoured to emphasise books of this nature.

Following the rise of modern science, and about the time of the foundation of the Royal Society (1662), a few pioneers urged a reform of the school curriculum in the direction of science teaching. But whether it was Comenius in his wide embracing encyclopædic fashion urging complete reform, or Milton and Cowley advocating a closer study of scientific Latin and Greek books, or Hartlib and Petty emphasising the need of school science of a practical nature, little success attended their labours. Their schemes were all premature; the English grammar schools were not allowed by law to teach science until 1840.

A hundred years after the beginning of the scientific movement came Rousseau, with his vigorous revolutionary doctrines, bent on making his Émile a model youth. The old order was to be swept away and Émile's education was to proceed on novel lines. Amongst other things he must learn science, not book science, but practical, everyday science. No pedant was to teach him, he must teach himself: "Let him not be taught science, let him discover it." No book for Émile but that of the world, for books "only teach us to talk about things we know nothing about." Wordiness in education must disappear, and in its place come things, a first-hand acquaintance with things, so bringing into use the boy's powers of observation, reasoning, and invention.

At the time, in 1762, when "Émile" was published, Pestalozzi was a student at the University of Zurich. He was enraptured with the book, and became ensnared in the revolutionary ideas of his hero Abandoning in turn his course of study for the ministry and for the law, he turned to farming, where his idealism was rewarded with bankruptcy. He then became schoolmaster, a profession he was to follow until his death in 1827.

In this short article we are not concerned with his general views on teaching or with the methods he devised or adopted. It is enough to say that he believed that the true basis of knowledge was sensory experience, and that education should be based on personal, first-hand observation. Out of this grew the familiar object lessons of the nineteenth century, and these are of great significance in the history of science teaching. For during them much scientific information was imparted to the children, since Pestalozzi and his numerous followers took for the subject matter familiar and interesting objects. The pupils learnt to look at things more closely, to examine plants, animals, and inanimate objects. Pestalozzi, it may be recalled, had had experience in farming, and it seems highly probable that in the lessons he himself gave, agricultural topics would frequently be mentioned. Occasionally excursions were made into the surrounding districts, when, under the supervision of the teacher, many interesting titbits of natural history were learnt. But unfortunately this science, if such it can be termed, was taught generally without plan and was of a haphazard nature. It was largely of the demonstrative type, where the attention of the child was directed to some particular part or property of the object, the name of which, when given by the teacher, was repeated aloud and memorised. Such lessons had for their chief function the teaching of words, not science.

In addition, however, to the smattering of scientific information which he gave in this manner, Pestalozzi included physics and chemistry in the curriculum of the school at Munchunbuchsee, and, in the "Report to Parents," special mention was made of science teaching, thus:

"We are also trying at the same time to organise the teaching of experimental science. So far we have demonstrated to the boys the principal facts concerning Electricity and Magnetism and the behaviour of certain gases. We are, in this connection, trying to establish a satisfactory course of instruction in the language of physical science. A local doctor gives weekly lessons in this direction to the older children with the aid of excellent apparatus in his possession."

Natural history was also taught, for, as he pointed out, almost every child is sure to be familiar with "half a dozen mammals, and as many birds, fishes, insects, amphibians, and worms." In short, he endeavoured to connect the course with the things the boys could see around them, such as the behaviour and structure of the common animals and plants.

All this Pestalozzi was doing, whilst in England and most other countries little, if any, attention was being paid to science in the schools. It is rather significant that many schools, when first introducing science, did so in a similar manner. For example, Dr. Arnold, of Rugby, persuaded the boys to collect specimens of rock, etc., from their neighbourhood to form a science museum, and his successor, Dr. Tait, invited a local physician to give lessons similar to these suggested by Pestalozzi.

The latter had no misgivings on how science should be taught, as the following extract from "How Gertrude Teaches Her Children" shows:

"All science teaching that is dictated, explained, analysed by men who have not learnt to think and speak in accordance with the laws of Nature, all science teaching of which the definitions are forced, as if by magic, into the minds of children, like a *Deus ex machina*, or rather are blown into their ears by a stage prompter, so far as it does, this must necessarily sink into a miserable burlesque of education."

Pestalozzi's influence on science teaching rests, however, on his object lessons, for they were widely imitated in England, largely owing to Dr. Mayo and his sister. After Dr. Mayo's return from visiting Pestalozzi he opened a school at Epsom and later at Cheam, and in time the Home and Colonial Infant School Society's training college resulted. Here intending teachers were trained to give these object lessons. Further, the two Mayos published books on methods of teaching, the most important for our present purpose being Miss Mayo's "Lessons on Objects." In it were given typical object lessons on numerous scientific subjects, and these served as models to numerous teachers. Lessons of this type became very common in England, especially in the elementary schools, and for many years, in fact until the introduction of Lowe's Revised Code in 1861, they were the only means by which children at such schools were brought into touch with science. But the lessons departed from the model of Pestalozzi, and readers of Dickens will recall the type of lesson Bitzer of " Hard Times " had to endure with his " Quadruped, graminivorous forty teeth, etc.," or the one Nicholas Nickleby caught Squeers giving.

Pestalozzi's influence was not confined to the elementary schools, however, and many secondary schools taught object lessons often with the idea of giving scientific information. Thus, from its foundation in 1832, University College School, London, made use of Miss Mayo's book on " Lessons on Objects," but not for long, since it was found, as Dickens saw later, that these lessons tended to degenerate into a mere explanation of hard words, and hence they were soon discontinued at this school.

Yet though Pestalozzi did little to establish modern school science—the science of his day was not sufficiently organised to serve as a school subject, whilst he himself was chiefly interested in young children—his name must be revered by science teachers because of his patient research into better methods of teaching.

## The Industrial Revolution.

*Health, Wealth and Population in the Early Days of the Industrial Revolution.* By M. C. Buer. Pp. xl+290. (London: G. Routledge and Sons, Ltd., 1926.) 10*s*. 6*d*. net.

THE author of this book is lecturer on economics in the University of Reading. The work is one which, in our opinion, is of first-class importance, written in a most interesting style, and we heartily commend it to all our readers. It is difficult within the compass of a review to give an adequate idea of the value of its contents. It deals with a subject which has caused acute controversy, and still awakens intense emotion in the minds of many of our countrymen—namely, the so-called industrial revolution. Although the author approves of the use of this term, and indeed states that the industrial revolution was of such magnitude as to dwarf all political revolutions, yet we think that the word revolution is misapplied in this case. This word has always been held to denote a violent upheaval and overturning of the social order by insurgence from within; but the industrial revolution was merely an extremely rapid evolution due to purely natural causes, as the author convincingly shows; and it had declared itself, shown all its characteristic features, and accomplished much of its course before any political change took place at all.

The popular conception of this change, which still figures largely in Socialist literature (we remember hearing it expounded with great vehemence by the late Mr. Hyndman in 1890), was that it involved the seizing of the common land of the poorer people by the landlords, whilst the dispossessed were then transformed from freeholders into tenants-at-will or driven into the towns, where they were ' exploited ' at starvation pay by greedy manufacturers. It was, so far as we can recollect, Dean Inge who first forced on public attention the fact that this change was accompanied by an enormous and rapid increase in our population. The Dean's estimate was that the population of England had increased by 30 per cent. between 1700 and 1800, and by 300 per cent. between 1800 and 1900; it is with the causes and time of beginning of this increase that our author first sets herself to deal.

The first census of England was made in 1801, but various sources of information exist from which fairly trustworthy estimates of the population at earlier dates can be made. The author weighs the evidence, and comes to the conclusion that at the beginning of the eighteenth century the population of England was 5½ millions; that it decreased during the first decade and then began to rise, and that it showed a net increase of one million by 1750, but that between 1750 and 1820 the population doubled itself. The rapid increase therefore began long before the invention of the steam engine, and before the expansion of manufacturing industries. It must obviously have been due either to immigration, or to an increase in the fertility of marriage, or to a fall in the death-rate. The author proves that the last was the real cause, and that it was not an increase on the longevity of adults which took place, *but a fall in the infantile death-rate*. She goes on to show that amongst primitive peoples population is regulated by an appalling wastage of child life. Persia, for example, is a country without motors, railways, or manufactures; there is widespread peasant proprietorship and few large towns — yet in some districts 85 per cent. of the children die before attaining the age of ten years, and in other districts only one child in ten attains maturity. In this, man resembles the lower animals, for the greater part of ' natural selection ' takes place at the expense of the young.

Now in the sixteenth, seventeenth, and eighteenth centuries, but especially during the first two, England was ravaged by diseases formerly supposed to be tropical. The exact nature of some of these was obscure, because distinct diseases were confounded together under the name of plague, but bubonic plague, typhus, typhoid, dysentery, malaria (ague), and above all, smallpox, were rampant. Smallpox attacked chiefly the young, and few children escaped it. About the middle of the eighteenth century, inoculation as a remedy was introduced, to be followed soon afterwards by vaccination. The author shows that inoculation was in most cases an effective and not very dangerous remedy, since it was performed with an attenuated virus, and in one respect it excelled vaccination, because it was never necessary to repeat it.

Thus the main reason for the increase was the gradual improvement of medical science, but this was coupled with the better development of agriculture and a regular and more nutritious supply of food. Food began to be grown for trading with other districts, not merely for the support of a particular district; this was rendered possible by the development of better roads. The author throws scorn on the idea that the medieval peasant proprietor lived under idyllic conditions. He was miserably housed, and he worked for unthinkable hours for a pittance. When the harvest failed there was no means of bringing food from elsewhere, and the peasant starved, or died from diseases which attacked him owing to his weakened condition brought on by eating rotten grain. One of the diseases which decimated the population was scurvy. Since there was no means of feeding cattle during the winter, the majority were slaughtered every autumn and their flesh salted. The stringency of the game laws is said to have been due to the determination of the feudal lords to avert scurvy by having fresh meat during the winter, so they alone were allowed to hunt game and to keep pigeons. But in the middle of the eighteenth century root crops were introduced from Holland, and thereafter cattle were kept alive during the winter.

The common on which the peasant had grazing rights and from which he collected firewood was unenclosed waste. The author gives a vivid picture of how incredibly large and unproductive this waste was when enclosure began. Agriculture could only be improved by bringing a large part of it under cultivation, and there is no evidence to show that this enclosure was detrimental to the peasant. For when really productive farming began there was regular employment for more men, and a comparison of villages in districts with and without enclosure shows that the population increased faster in the former than in the latter. What the peasant hated was a change in his habits; he preferred to starve under old conditions to which he was accustomed rather than to prosper under the new ones.

The author emphasises the fact that during the eighteenth century, though there was little political liberty as embodied in the right to vote, there was abundant personal and intellectual liberty. To the freedom of initiative, to the prevalence of the doctrine of laissez-faire—in a word, to private enterprise—she attributes the major part of the influences which produced modern England.

At the beginning of the century Northumberland was as wild and unenclosed as the backwoods of Canada, and the enterprising farmers who settled in its valleys, cleared the timber, and brought the ground under cultivation were as truly adventurous pioneers as the merchant adventurers of Queen Elizabeth.

Of course, as the steam engine came into use our manufacturing capacity increased enormously, and there was a steady drift into the towns which has continued ever since. A favourite theory has been that the peasants were lured from their healthy homes in the country into the slums of the towns, where they rotted and died. Now the author shows that the medieval city was in reality a festering sore. To contemporary writers cities were known as devourers of population. Our cathedrals, so beloved by the medievally-minded amongst us, arose in the midst of narrow, unspeakably dirty lanes from which air and light were shut out by overhanging upper stories, with no sewers except an open drain in the middle of the street, into which all rubbish, including human excreta, was flung from the windows. Herds of pigs wandered about fattening on this garbage, and proposals of the rich to pave the streets and remove the rubbish were resented by the poor as an invasion of their privileges. Truly the medieval circle of ideas which the reactionaries would restore if they could, was one of dirt and primitive superstition. But in the eighteenth century, when the drift to the towns began, advancing medical science had begun to discover the necessity for a better water supply; the streets were wider and better paved, and the garbage was removed. Far from perfect as the habitations of the work-people undoubtedly were, they were better than the dwellings they left behind in the country, and population grew in the towns by increase of births over deaths.

The myth that the workmen were 'exploited' by the payment of scandalously low wages is also exploded by the author. As she says, there never was a time when native talent and initiative amongst the workmen had greater opportunities. Early machinery was costly, wasteful, and constantly breaking down, and workmen with skill, common sense, and adaptability could practically demand their own price. Those who got the minimum wage and deserved no more were those who were only fit for routine operations. Just as daring private enterprise built up our agriculture, so it founded our manufactures. On it all England's greatness is founded, and by it, though sorely hampered and embarrassed, we still are borne.

The perusal of this book leaves us with some curious reflections. This unspeakably filthy medieval society from which we have slowly emerged succeeded to a Roman civilisation—a civilisation with paved roads carved with superb engineering across hill and dale; with properly constructed sewers, and with a plentiful supply of pure water carried on wonderful aqueducts. Houses were provided with 'central heating' on much the same plan as that now to be adopted in Liverpool Cathedral, and above all, with properly constructed baths. This civilisation can be traced through Rome to Greece and back to Crete, and possibly eventually to Egypt.

Yet this age-long civilisation, which must have appeared to its contemporaries as securely founded and permanent as the orbit of Nature itself, succumbed to the attacks of northern barbarians, and not until the middle of the nineteenth century did we reach the same level as that achieved by Rome. Washing was eschewed in the Middle Ages as a heathen luxury. So late as 1801 a London doctor stated that his patients amongst 'ladies and gentlemen' washed their hands every day, but did not wash their bodies from year to year. The Anglo-Saxon St. Dunstan is said to have given proof of his holiness by the fact that when he shook his sleeves as he sat at board, 'maggots' escaped from them.

The Mediterranean civilisation once penetrated to the south of Africa. Like the Roman civilisation in Britain, it was overwhelmed by barbarians, and its remains, overbuilt by the kraals of Kaffirs, are to be seen until this day. Our twentieth-century civilisation, if the private enterprise which upholds it is undermined, might suffer a like fate.

E. W. M.

## The Empty Quarter.

*In Unknown Arabia.* By Major R. E. Cheesman. Pp. xx + 447 + 32 plates. (London: Macmillan and Co., Ltd., 1926.) 25*s.* net.

OF the excellence of Major Cheesman's journey into the deserts of eastern Arabia there can be no question. He travelled down the Persian Gulf from Basra to Bahrain, and from there to the little port of Oqair, on the Arabian coast; there he met camels, sent down for him by the ruler of eastern Arabia, Abdul Aziz ibn Saud, whom he had already met, and to whom he carried a personal letter from Sir Percy Cox. The camels took him, his baggage, and his Baghdadi servant to Hufuf, an oasis which has already been visited by several European travellers. The purpose of the expedition was to collect mammals and birds, and, where necessary, to fix the position of places astronomically, and to make compass traverses when passing over unmapped routes; the traveller's purpose was to work his way south from Hufuf towards the empty quarter of Arabia, unvisited by Europeans, unknown to most Arabs, and only recently brought under the suzerainty of the conquering ibn Saud, leader of the Wahhabis.

Cheesman was delayed nearly three months in Hufuf in mid-winter; he occupied his time collecting the fauna and making a map as unobtrusively as possible, but he was handicapped by the season, for the resident birds were not breeding, and there was no through migration; the insects were presumably hibernating, if we may judge from his scanty collection and from what we know of their behaviour at the same season in Mesopotamia.

At length, on February 8, he left Hufuf and travelled 150 miles south over unknown country, most of it hard desert of an extreme type, until he reached the wells of Jabrin. He is the first European to see the Al Murra Arabs at home; he has brought back a route map, and established the position of the Wadi Sahba, which is now dry at all seasons, but formerly carried water from the highlands of western Arabia right across the peninsula to the Persian Gulf. He has also brought home a good collection of birds and mammals, and of observations on their habits, and a number of specimens of insects, plants, and rocks.

So much for the journey, already described in the *Geographical Journal.* The present book is delightful when it describes the author's observations on bird, beast, or man, and the conclusions which follow immediately from them. There is, for example, an excellent chapter on the water supplies of desert animals, though we think that the author is too much inclined to look for actual water in the form of dew, and that he does not realise the high proportion of water which is held in fragments of dry vegetation. There are also some most interesting notes on gerbilles of the genus Meriones, which prove to be diurnal, and not nocturnal like other gerbilles. We think that the author could have written a book of more permanent value had he included a general account of Nature in Mesopotamia and the islands of the Persian Gulf; he knows more about these countries than any other field naturalist, and he has wandered over them in all directions and at all seasons, collecting and observing. The raw materials for such a study are available in a long series of systematic papers by various specialists in the *Jour. Bombay Nat. Hist. Society*. The present book contains no reference to any of the author's previous travels, except a reprint of an account of a journey along the shores of the Gulf from Oqair to Salwa, and for this reason is a little unsatisfying. So far as the last journey is concerned, the unknown country covered was between Hufuf and Jabrin, and that journey only occupied a fortnight; the same featureless track was covered twice, and a general account of it would be easier to read than the transcript of diary which is given. But even as it stands the book is full of life and vigour and observation, and it makes delightful reading.

When the author gets away from his own observations, however, his zoology becomes surprisingly 'loose.' One may quote his own italicised sentence: "*I think the development of a colour as evidenced most clearly in a subspecies is the result of an influence which I will call subspecific desire, operating through generations of that subspecies, for that particular tone.*" It is clear from the context that he does, in fact, attribute the colour of animals to volition, and that the exercise of the will is thought to be most potent when the bird is nesting, except that predatory species do their 'wishing' when they are stalking their prey.

With regard to protective coloration, the author is strictly orthodox, so much so that he brings forward no fresh arguments in favour of the theory; instead of doing so he talks in general about willow grouse, and mallard, and desert birds, and trout, and lizards, and nightjars (which almost shut their eyes, because they know how conspicuous the eye would otherwise be!). Every one admits that the majority of desert animals, in the widest sense of the word, are coloured so that they resemble the soil on which they are found; in some cases the degree of resemblance is very high, in many much less so; but the theory that this similarity of colour is *protective* is not generally accepted nowadays, because it does not appear to cover more than a fraction of the facts. It is difficult to apply it to the strictly nocturnal animals, and still more difficult to fit it to the subterranean pocket gophers of California and Arizona, and other subterranean mammals and reptiles, many of which exhibit a high degree of resemblance to the soil in which they live. Moreover, if the facts are faced without prejudice, it will be found that a proportion of diurnal desert creatures are black, and this is true in the Old World, America, and Australia; examples occur in birds, and grasshoppers, beetles, flies, and other creatures.

The devout believer in protective coloration will tell us that none of these black creatures needs protection, and that explanation is enough for him; but those who are inquisitive, perhaps agnostic, may reasonably ask why all the creatures which do not need 'protection' should agree to wear black. Even among the facts recorded by Cheesman himself, one can find examples of animals to which the theory of protective coloration cannot be applied. In Arabia, and in many parts of the Old and New World deserts, the bats are much more sand-coloured than their relatives in other climates; moreover, this tendency, which is observable in the less extreme deserts—for example, Mesopotamia—is increased in the intense climate of Hufuf and other similar places. It appears that nothing but an act of faith could carry the true believer over such an obstacle as this, for we can scarcely suppose that a pale bat is protected from a (hypothetical) owl, or that its paleness assists it in pursuing moths (also 'protected') by moonlight.

We understand that the author left for Abyssinia before the book passed through the press, but that does not explain the multitude of inaccuracies which it contains. He was probably wise to adopt a simple system of transliteration from Arabic, suited to the general reader, but his use of it is quite inconsistent. For example, he writes *suq* and *booma*, though both have the same long *u* in the original tongue; on the other hand, he writes *suq* and *burr*, using the same English vowel to represent different sounds. He commonly transliterates the Arabic letter *Khe* by *Kh*, consistently with general usage, but he also uses *k* in 'Jebel Akdhar,' and *h* in 'Hashm.' "The ibn Shaikh" is an unnatural mongrel between the English "The

Shaikh's Son," and the Arabic "Ibn esh Shaikh." One gathers that when Cheesman bade farewell to the Amir at Jabrin, both were so much overcome that they forgot their grammar; one said "we am so pleased you came," and the other chorussed, "I are so pleased to have met you." Neither 'Brinjal' nor 'Jird' are words known to the educated English reader, and as one is Hindustani and the other Persian, there seems no justification for their use here, particularly as English equivalents of both are available.

The illustrations from the author's photographs are admirable, and they serve to show what excellent results may be obtained with a minimum of apparatus and trouble. They were all obtained with a quarter-plate Kodak, and the films were developed four months after they were taken, in England. The scientific results of the expedition have been dealt with by specialists, and their accounts are all reprinted as appendices; the result is that all that is known of the fauna of this part of the world is contained in this one volume. There is an adequate index and an excellent map, reprinted from the *Geographical Journal*.

Patrick A. Buxton.

## British Optical Science and Industry.

(1) *Proceedings of the Optical Convention, 1926.* Part 1. Pp. x + 491 + v + 26 plates. Part 2. Pp. viii + 493-1051 + v + 23 plates. (London: The Optical Convention, 1 Lowther Gardens, 1926.) 2 vols., 60*s*. net.

(2) *The Optical Convention, 1926. Catalogue of Optical and General Scientific Instruments.* Pp. x + 326. (London: The Optical Convention, 1 Lowther Gardens, 1926.) 6*s*. net.

(1) TWENTY-TWO years ago the first Optical Convention, defined as a conference of opticians "to discuss questions of interest and to promote the general welfare of the Trade," was held in London under the presidency of Sir Richard Glazebrook. It amply fulfilled the expectations of those members of the Optical Society whose prescient minds foresaw the advantages that might accrue to the science and practice of optics.

Seven years later, Prof. Silvanus P. Thompson, the president of the second Convention, held in 1912, in his address to the members declared: "We are met here to exchange views, to deliberate, to discuss, to learn from one another and from the material objects we have been able to bring together in an Optical Exhibition, anything and everything which can stimulate our thoughts, widen our information, or concentrate or harmonise our activities in matters optical."

After a further lapse of fourteen years the third Convention, presided over by Sir Frank Dyson, has recently been held. During that period of fourteen years the optical industry has experienced an extraordinary expansion followed by prolonged post-War depression. But however subdued the present state of the industry may be, there is no apparent abatement of the interest in optics. This is manifested by the two large volumes which embody the proceedings of the Convention. Containing as they do more than ninety papers, some of them miniature treatises, dealing with every aspect, they constitute the largest and most comprehensive addition to the literature of practical and theoretical optics that has ever been made at one time.

Surveying, and particularly that latest development, aerial surveying, forms the subject of fourteen papers. There are ten devoted to visual optics and eleven to photometry. Optical computation takes a prominent place, but only the geometrical aspects of the question have received much attention: practical trigonometrical methods such as are used by the manufacturer still receive little consideration from the mathematicians. For the first time there are included several excellent historical papers.

Since the date of the second Convention the foundations of optics have been overturned and the builders still lack some necessary material for their reconstruction. Only one paper on this basic subject is included. There is also only one paper—fortunately an authoritative one—which deals with that one-time popular instrument, the microscope.

So large a number of papers delivered in so short a time has resulted in a discussion of unduly limited extent; it amounts to about 13 per cent. of the material. In 1905 there was a 22 per cent. discussion, and in 1912, 18 per cent.

The index is scarcely adequate. The illustrations are generally good, but the cover is unattractive. In this respect it would be well in future to depart from the bad example of the 1905 *Proceedings*.

(2) This catalogue is no mere enumeration of the instruments of British origin exhibited at the Optical Convention of 1926. It records the important advancement that has been made by the optical industry since the date of the last Convention; it is a record of advancement that is remarkable when it is realised that all products of purely war character have been excluded. It also

serves as an index to which future progress will be referred.

More than sixty British firms who participated in the exhibition have contributed descriptions of the instruments and optical materials produced or supplied by them. These descriptions are devoid of salesmanship claims and are of special interest, as they express the essentially practical opinions of the manufacturers themselves.

Instruments are well classified under seventeen groups, of which by far the most extensive is that devoted to the microscope, which receives so little attention in the *Proceedings* of the Convention. Ophthalmic apparatus and surveying instruments occupy second and third place respectively. Of the five additional sections, one is devoted to experiment and research, and another to an account of the very valuable collection of historical instruments and books.

The catalogue is well produced, and should be studied by all engaged or interested in the optical industry.

J. W. F.

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## Organic Chemistry.

*A Text-Book of Organic Chemistry.* By Prof. Dr. Julius Schmidt. English edition by Dr. H. Gordon Rule. Pp. xxiv + 798. (London and Edinburgh: Gurney and Jackson, 1926.) 25*s*. net.

We learn from the preface that this translation of Schmidt's "Kurzes Lehrbuch der organischen Chemie" arises from the encouraging results that attended the adoption of the German original as a text-book for the advanced students in the University of Edinburgh, and indeed the translator has done his work so admirably and produced so readable a book that there can be no question that it also will find a similar welcome in other English-speaking universities. It is the type of book that the teacher can recommend with confidence to the more ambitious second-year and pass students in organic chemistry, and, in so far as any single text-book can meet the ever-growing requirements of the honours students of a university, this book will prove both helpful and useful.

Following a general introduction of 68 pages, the book treats of the chemistry of the carbon compounds in 687 pages under the three sections (1) the aliphatic or fatty compounds, (2) the carbocyclic compounds, and (3) the heterocyclic compounds. It is obvious that in so limited a space the treatment of so vast a subject could not be wholly adequate, and in this respect the general introduction is perhaps the weakest part of the book; the description of the methods of qualitative and quantitative analysis, for example, is condensed into seven pages and unrelieved by any diagrams. In the three main sections, the chemistry of the hydrocarbons and their derivatives is discussed under their respective headings in the usual order, and one of the most valuable features of the book is the introduction of numerous sub-sections dealing with special groups of compounds—of natural or synthetic origin—as they fall within the category of the compounds under discussion. Some of these are of special interest, as for example those dealing with the polypeptides, with rubber, with the depsides, with the tannins, and with the vegetable alkaloids; the last forms a valuable monograph on the chemistry of these important compounds.

Judging from the numerous references to recent literature, the book has been carefully brought up-to-date, and it is surprising, therefore, to find no reference to the replacement of 'benzine' as a dry cleaning solvent by the chlorinated derivatives for acetylene; no mention of the preparation of synthetic methyl alcohol from water gas; no reference to the now extensive use of thionyl chloride in the preparation of acid chlorides; and no mention of the iodonium bases. In the preface the author states that "although the greater number of references to German literature contained in the original have been retained, some progress has been made towards the inclusion of representative English and American work"; it is therefore to be hoped that when further progress in this direction has been made, many of the unfortunate omissions from the present edition may be rectified, as for example Werner's work on the chemistry of urea, and Armstrong's and Wynne's classical researches on the chloro-derivatives of naphthalene.

Whilst the text is singularly free from errors, the following have been noted: p. 99, line 6 (from bottom), for "arsenite" read "arsinate"; p. 118, line 14, the equation should read $PhONa + (CH_3)_2SO_4 = PhOMe + NaMeSO_4$; p. 122, line 11 (from bottom), for $\beta\beta$ read $\beta\beta'$; p. 131, line 8, for "monobromoacetamide" read "acetbromamide"; p. 199, line 22, the middle formula is faulty; p. 476, line 12, for "boiling" read "melting"; p. 142, the formation of "aldehyde resin" is characteristic of acetaldehyde only. Finally, the reviewer would like to register a mild protest against the printing in formal text-books of laboratory slang terms as "to combust," even if, on its first appearance, the offender be shielded by apologetic inverted commas.

M. A. W.

## Our Bookshelf.

*Forest, Steppe and Tundra: Studies in Animal Environment.* By Maud D. Haviland (Mrs. H. H. Brindley). Pp. viii + 218 + 8 plates. (Cambridge: At the University Press, 1926.) 12*s.* 6*d.* net.

Within the last dozen years the author has seen the tundra and coniferous forests of the Yenisei, the steppes of south-east Russia, and the luxuriant tropical forests of Guiana. From her observations she has put together a picture of animal life in these widely different environments; the different parts of the book are introduced and co-ordinated by a general account of the adaptation of living things to their environment.

The purpose of the book is to show the fauna, as a whole, in relation to the floral and physical environment, and it is interesting to contrast the account of the forest of Guiana with the books of Waterston, Bates, Belt, and the other 'naturalists.' They observed and described: the modern ecologist co-ordinates a greater body of fact, and has been trained in experimental methods, which form a mental background even if experiments cannot be carried out. We suppose that the ecologist of the present day will soon give place to students who use the experimental method more and more. One important result may be expected: nearly every ecologist believes in adaptation; will the next generation of ecologists be able to furnish experimental proofs of it?

With regard to the coloration of animals, the author takes a moderate view. She thinks that belief in protective coloration is often based on a study of colour without study of habit; the sandy lark betrays itself by twittering from the top of a stone. On the other hand, she accepts mimicry as the explanation of the shapes and habits of some membracid bugs of Guiana.

We are becoming familiar with books on ecology written, or so it seems, with a blue pencil, scissors, and a paste pot, the whole cemented to a framework of new terminology. The book under review spares us from that; it is written in plain English, which seems sufficient. We are inclined to criticise the use of English names for a variety of animals from many parts of the world. Only those who pursue zoology that they may solve cross-word puzzles could give an account of the suslik, the Tatar lark, the huanaco, barbet, and bobolink. "Jumping rabbit" is a cruel misnomer for Alactaga, which is near of kin to the jerboa.

The photographs of different types of country are beautiful; there should be more of them.

Patrick A. Buxton.

*The Theory of Electricity.* By Prof. G. H. Livens. Second edition. Pp. vi + 427. (Cambridge: At the University Press, 1926.) 16*s.* net.

The first edition of Prof. Livens' "Theory of Electricity," published in 1918, was reviewed in Nature in 1919 (vol. 103, p. 142), and therefore the present notice need only take account of the changes introduced in the new edition. In its present form the book has been very much curtailed—from about 700 large octavo pages to rather more than 400 crown octavo pages—but the clear print characteristic of the series of the Cambridge University Press has been retained. A considerable amount of matter, relating principally to the detailed treatment of a considerable number of special problems, has been omitted in all cases where a full account is given in other books, but we are glad to note that the very careful and full discussions of fundamental principles and points of difficulty, so characteristic of the first edition of the book, have been retained in their entirety. Consequently, the work can be as highly recommended as before as an introduction to the theoretical side of electromagnetism, and in conjunction with such a detailed text-book as that of Jeans, gives as full an account of the theory in all its aspects as is to be found in any language.

In one point Prof. Livens has introduced a decided innovation on the usual treatment. He uses the term *magnetic force* for what is usually termed the *magnetic induction*, **B**, reserving the term *magnetic induction* for the vector **H**, which he regards as the derived vector. The main effect of this innovation appears in Chapter v., on the dynamics of the magnetic field, where the potential energy density of a distribution of magnetic polarisation of intensity **I** is written as $-(\mathbf{IB})$, in place of the usual $-(\mathbf{IH})$. Thus a *negative* potential energy density is obtained instead of the usual positive value; when this is interpreted as *positive* kinetic energy of hidden motions, according to the usual method of Lagrangian dynamics, a result is obtained which is certainly more consonant with theories of the ultimate origin of magnetism than the usual result of the classical theory. To us it seems that the whole question is a very debatable one, and may very well be left to the future for its ultimate decision.

*Potash: a Review, Estimate and Forecast.* By Dr. J. W. Turrentine. (The Wiley Agricultural Series.) Pp. ix + 188. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 15*s.* net.

Fifteen years ago, America's entire dependence upon imported potash led her to initiate a survey of possible home sources of this essential substance, which was scarcely completed when the breaking out of the War emphasised the importance of developing domestic resources. In pre-War days, Germany practically held the monopoly of the world's potash supply, but afterwards, when France obtained possession of the Alsatian mines, an agreement was made whereby Germany dealt with 62·5 per cent. and France with 37·5 per cent. of American and other demands for potash. In 1922 the world consumption was 1,600,000 tons of potash salts, far below the limit of producing capacity of Germany alone. At present the price is below pre-War rates, and this has caused in America an almost entire deflation of the development of the potash industries which had arisen during the War period. America's need is to push the domestic production of potash to such a point as to secure the possibility of the production of full home supplies in case of war.

Kelp is a valuable asset, as iodine and potash can be obtained as by-products from the manufacture of kelpchar, a very active decolorising carbon. Other sources of supply which can be exploited successfully are surface lakes, subterranean deposits, silicates, industrial wastes (both organic and inorganic), and cement-mill flue dust, the last being a very important potential source. Ninety per cent. of the potash entering American markets goes to agriculture, but the ten per cent. is of equal importance in that it is required for many industries. The feasibility of the recovery of sufficient potash from available home resources has been demonstrated, and the immediate problem is that of perfecting the methods employed and rendering the recovery process an economic proposition.

*Mono-Alu Folklore (Bougainville Strait, Western Solomon Islands).* By G. C. Wheeler. Thesis approved for the Degree of Doctor of Science (Economics) in the University of London. Pp. xv + 396. (London: George Routledge and Sons, Ltd., 1926.) 21*s*. net.

The collection of tales and song-texts given in this volume was made during a stay of ten months in Alu and Mono, Bougainville Strait, in 1908–9. The author has given the texts as taken down from the dictation of a Mono-Alu man, son of a late chief, and the Mono text is given in all but eight cases. Although traces of the old Alu speech are to be found in the tales, that language has practically disappeared and Mono has taken its place, owing to the conquest of Alu by the Mono people some sixty years ago. In these islands, therefore, Mono-Alu-Faura now form a unit area. The tales as presented by Dr. Wheeler provide much valuable material for linguistic study, but more important in some respects is the light they throw on the culture of the people. The tales, indeed, enshrine much that has already passed away. Dr. Wheeler himself points out, for example, that the incident of wrapping blood in a leaf which occurs in one of the most interesting and bizarre of the stories, in the actual practice is a feature of a rite analogous to the motive. In another story bones renew their life, a motive which stands in relation to the burning rites for a dead body in the Mono area. Similar analogies and references could be quoted time after time. Dr. Wheeler's scholarly volume will well repay careful study.

*The Aspergilli.* By Charles Thom and Margaret B. Church. Photomicrographs by G. L. Keenan. Pp. ix + 272 + 4 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 22*s*. 6*d*. net.

While this work is primarily and confessedly taxonomic, the authors have brought together most of the scattered information on the Aspergilli, and have given a comprehensive survey of the genus from a few different points of view. Part I. deals with such different aspects as culture methods, morphology, and special physiology of these forms. A very interesting chapter is devoted to enzymatic activities, and their economic significance in the production of acids, *sake*, taka diastase, etc., while their pathogenic importance in reference to man, birds, and insects is treated in another.

Part 2 of the book is devoted to a taxonomic revision of the whole genus based on the examination of large numbers of forms from natural substrates, and the 350 strains which the authors have grown in pure cultures in their own laboratory. While the sixty-six odd accepted species of Aspergilli have been considerably multiplied, an attempt has been made by the authors to indicate real relationships in the presentation of their various groups, and the diagnostic scheme in their keys has been so arranged as to bring together closely allied forms. A fairly exhaustive bibliography is appended to the work, which forms a welcome addition to current mycological literature.

*Maori Symbolism: being an Account of the Origin, Migration, and Culture of the New Zealand Maori, as recorded in certain Sacred Legends.* Report made by Ettie A. Rout, from the evidence of Hohepa Te Rake (an Arawa Noble). Pp. xxxii + 322 + 32 plates. (London: Kegan Paul and Co., Ltd., 1926.) 21*s*. net.

In this book Mrs. Rout reports the sacred lore of the Maori as faithfully transmitted to her by a Maori noble, Hohepa Te Rake, and solemn declarations to that effect by both participants in the production form part of the contents. It is, however, difficult to accept these statements at their face value, as the lore is not given in its original form, but as interpreted in the light of a theory of the origin and migrations of the Maori, based upon identifications which trace them back to Assyria and suggest identity of culture in Egypt, America, and elsewhere. The illustrations, which are exceptionally well reproduced and in another context would be both interesting and suggestive, have been carefully selected with this end in view. In spite of this defect the book does, however, contain a very full account of the customs and practices of the Maori which conduced to sound sanitation, personal cleanliness, and good health.

*Practical Colloid Chemistry.* By Prof. Wolfgang Ostwald, with the Collaboration of Dr. P. Wolski and Dr. A. Kuhn. Translated by Dr. I. Newton Kugelmass and Dr. Theodore K. Cleveland. Pp. xvi + 191. (London: Methuen and Co., Ltd., 1926.) 7*s*. 6*d*. net.

This laboratory manual has been well known to workers in colloid chemistry since the first German edition appeared in 1920, and in the variety and completeness of the course provided it reflects the versatility and enthusiasm of the chief author. He has, however, been badly served by his translators, whose frequent misrepresentations need to be seen to be believed, and to be compared with the German to be understood. P. C. L. T.

## 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 Band Spectrum of Mercury from the Excited Vapour.

I WISH to bring forward one or two additional results on this subject in supplement to my letter published in NATURE of Nov. 27, 1926.

In the first place, I found that the green visual band, extinguished by heat, recovers to some extent as the excited vapour moves on to a cold part of the tube. This effect has been satisfactorily photographed.

As emphasised in published papers, the main part of the band spectrum covers the whole region on the less refrangible side of the resonance line λ2537, at which point it abruptly begins.

I now find that the 'forbidden' line λ2270 is present on the plate, and that a separate stretch of band spectrum reaches from this point to the band λ2345. In the region of wave-length less than λ2270, and also in the region between λ2345 and λ2537, the background of the spectrum is quite dark.

Prof. Takamine has suspected that the band λ2345 was associated in some way with the 'forbidden' line, and he suggested to me some time ago to look for this line in the excited vapour. It was not to be seen on the negative then available. My present negative has been made with an improved technique, and exposed for as much as 100 hours. I do not think it has been suspected before that a stretch of continuous spectrum begins at λ2270, and connects up with λ2345 and the associated bands of intermediate wave-length.

RAYLEIGH.

Terling Place,
Chelmsford, Essex, Mar. 1.

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### Some Comments on Current Science.

THE COURSE OF COSMIC EVOLUTION.

MANY, like myself, will be interested in Dr. Jeans's letter in NATURE of Feb. 26, p. 315, and will wish to congratulate him on the confirmation, or rather the realisation, of his calculated states. The question will be asked, however, whether he is led to think that the universe ever was in that uniformly distributed initial state, or whether its proved instability is an argument that that condition never actually occurred.

One view of evolution is that the general appearance of things on the whole was not very different from what it is now, and that the various processes have gone on concurrently in different regions. I am wondering, and I expect others will be, whether it is his view that the universe evolved, so to speak, as a whole, with an initial state entirely different from its present state. In a gas of density $10^{-31}$ I reckon the molecules about 5 metres apart on the average—a curious state of things, of philosophical importance, if it ever really happened. There can scarcely have been a beginning for time! Though I suppose that, as there is a beginning for a solar system, there may have been a beginning for the universe as a 100-inch telescope sees it. But it is not an easy idea: or rather perhaps it is too easy to be satisfying; unless the universe is really infinite, when even the scope of the 100-inch would be but a unit.

THE DOWSING OR DIVINING ROD.

I have not myself studied the particular activity of the subconscious mind that is apparently operative in the detection of things hidden from the normal senses, but I have discussed it from time to time with the late Sir William Barrett, and I feel justified in saying that he would have appreciated and welcomed the review by Dr. H. R. Mill in NATURE of Feb. 26, p. 310. That we have as yet no satisfactory explanation of the phenomenon is true enough; but then that is equally true of many other obscure human and animal faculties, which react to the environment in a surprising manner. My own view is that we shall not begin to understand these things so long as we attend to our material environment alone. There is an etherial environment too; and it may be that that is the home of the subconscious, in the same sense as matter is the home of the conscious part of our minds. Probably everything psychic has a physical concomitant, which can some day be tracked down; but the adjective 'physical' is not limited to matter, else light and electric waves would be excluded. Already our instruments respond to non-material though truly physical disturbances; and it may be that some unrecognised parts of our bodily mechanism, or unconscious brain centres, are capable of response too.

I am myself inclined to think that we shall find ourselves more directly or immediately concerned or connected with the ether than we are with matter, in spite of the fact that matter looms so large to our familiar senses. We can only gradually confirm or negative a guess of that kind by following such clues as are available. I heartily re-echo the concluding words of the review, to the effect that those who only attend to the subject with a determination to prove that the whole thing is humbug will discover nothing.

PATHOLOGY OF LAMP FILAMENTS.

It sometimes happens that the facts of one science can be suggestive of ideas and possible fruitful inquiry in another quite different science, provided the devotees of that other science are made acquainted with the relevant or suggestive facts; but admittedly the disciples of the first branch of knowledge must be cautious how they obtrude, lest they seem presumptuous and interfering in matters beyond their ken. In the heading of this letter I venture to use the non-physical term 'pathology' in order to direct the attention of real pathologists to a recently observed and explained trouble encountered by manufacturers of electric lamps and vacuum valves, the filaments of which are sometimes subject to what may be called an inorganic, non-microbic, and purely chemico-physical disease.

At a recent meeting of the Royal Society of Arts on Feb. 16, an interesting paper, accompanied by experimental demonstrations, was read by Mr. C. C. Paterson, director of the Research Laboratories of the General Electric Company at Wembley: and from this paper I want to make a few extracts in order to attract wider attention to some of the results obtained by the brilliant staff at work there under exceptionally favourable conditions. The thorough knowledge necessary before trustworthy pieces of apparatus can be manufactured and turned out by the million is obvious, and the experience gained in the organisation of such mass-production is often of scientific importance. Here, then, is one of the side-issues of lamp and valve manufacture.

It is found that in gas-filled lamps, the filaments of which are made of tungsten, it is essential to reduce the residue of water vapour down to the lowest minimum possible; for water vapour has, on the coiled filaments of such lamps, a specific and recognised action that gradually and sometimes rapidly weakens and destroys the ignited filament, by thinning it down at one place and thickening it in another; the action, once begun, tending to go on more and more rapidly, since the thinner part gets automatically more heated and the thicker part more cooled. The action is described by Mr. Paterson as follows:

"Molecules of water vapour left in the bulb are decomposed into hydrogen and oxygen in contact with the hot parts of the filament. The oxygen immediately combines with some of the tungsten atoms at the hottest spots with the formation of tungsten oxide. This tungsten oxide is deposited on to a neighbouring cooler part of the filament where reduction of oxide can take place, [since] the cast-off hydrogen atoms can again claim their oxygen from the tungsten oxide. The tungsten atoms thus left coalesce with the filament at its cool point, with consequent thickening of the filament. Meanwhile the molecule of water vapour, now re-formed, is free to attack again the hotter part of the filament. This point becomes continuously hotter by virtue of its diminishing diameter. Thus the molecules of water vapour act much as ants, carrying particles of tungsten from one place and building them up in another, and become available over and over again as the carriers of tungsten atoms. Hence the potency of water vapour as a destructive agent. The quantity must be reduced to vanishing proportions if it is not to cause wastage and growth in this way during the long high-temperature life of a gas-filled lamp."

That water should act as a catalytic poison, in this way, is rather in accordance with the pronouncements of Prof. H. E. Armstrong about the influence of water and of traces of impurity in chemical reactions generally; for under other conditions traces of other substances may be acting in a similarly unstable or top-heavy way. In fact, Mr. Paterson elsewhere says that "in gas-filled lamps, and before gas-filling takes place, every possible trace must be removed of water vapour, because this acts in relation to the gas-filled lamp filament as cancer does in the animal body, and causes alternate local growths and wastage." He further points out that at the high temperature of a lamp "chemical reactions are extraordinarily vigorous, and many of them unexpected—water vapour is not the only vapour or gas which must be guarded against."

Whether there is likely to be any impurity in the blood or tissues that under vital conditions might act in a catalytic manner and build up local growths at the expense of tissue elsewhere, even in the absence of any microbe or customary disease agent, it is for biologists to decide. The idea may have occurred to them; but an actual instance occurring in the physical laboratory may cause them to pursue the idea further. I will only say this: The activity of an electrolyte capable of dissociation in a liquid—as in many saline solutions—is known not to be very different from the activity of the free molecules of a gas.

Oliver Lodge.

Normanton House,
Lake, Salisbury.

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### Hereditary Choice of Food-plants in the Lepidoptera and its Evolutionary Significance.

The problem of the practical differentiation of species in Nature stands so much in need of experimental work, that the recently published paper by Dr. J. W. Heslop Harrison on an apparently successful attempt to influence the hereditary instincts of a sawfly (*Proc. Roy. Soc.*, Series B, vol. 101, pp. 115-126) will be read with interest, and I am induced to offer one or two critical remarks.

This sawfly, *Pontania salicis*, is stated to feed on many species of Salix, but in any given locality to restrict itself habitually to some one (not the same) species, although several others may be equally plentiful. I do not dispute the statement, but in the whole of the Lepidoptera I have never heard of a similar instance. Salix, in particular, supports a large number of Lepidoptera, but in general the only discrimination made is between the rough- and smooth-leaved species (probably influenced by touch rather than taste), and again the choice of *S. repens* by certain species seems due rather to the superior shelter afforded by the dwarf habit. Also the Pontania is a gall-maker; and the case of gall-producers, where complicated reactions ensue between insect and plant, may be specially difficult to understand. In the experiments the change was produced immediately, and was completely established in three years; there must be some quite unusual element here.

From this single and quite exceptional case, however, Dr. Harrison proceeds to deduce what he calls a new principle of evolution, which I understand to be that in phytophagous insects (for example) pairs of allied species are produced by the accidental transference of larvæ from the usual food-plant to an adjacent allied plant, or even to one usually associated with it but not allied. Several pairs of species of Lepidoptera are instanced as suitably associated "in Britain," as, for example, *Cerura bicuspis* and *C. furcula*, but this argument is wholly fallacious, involving the assumption that one of the species originated here; both range over the whole of northern and central Europe and Asia, and the circumstances of their origin are entirely problematical. But is there anything new in the principle? All lepidopterists are aware that not merely pairs, but also whole groups of species, tend strongly to feed on allied and associated plants, and this would appear to be probable on any theory of the mechanism of evolution; and microlepidopterists in particular have long ago suggested that the closely similar species in such genera as Phthorimæa and Lithocolletis, each attached to its own food-plant, originated as phytophagic races.

The trouble is that no one has yet evolved a new species by this means; and I shall be very much surprised if, when this is accomplished, it proves to require only three generations of the insect. But even this achievement will not go very far to explain the formation of species in the Lepidoptera. A very large proportion of these (such as most of the very common British Caradrinidæ) have larvæ which feed either on grasses generally or on miscellaneous low plants almost indiscriminately, and without any variation resulting except perhaps of size; and a further large class feed on dead wood and dry vegetable refuse. The same influences which have resulted in the multiplication of species in these groups must be supposed equally efficient in the groups which are more specialised in their tastes; and, subtracting their effect, not much will remain for that of the food-plant. I have even recorded ("Exotic Microlepidoptera," vol. 2, p. 521) the case of two Indian species of Bactra, separable with difficulty, known only from series reared together from larvæ feeding on the same individual plants in the same way at the same time.

Edward Meyrick.

Thornhanger, Marlborough,
Feb. 19.

## Rotation of Bodies with Dielectric Surfaces in Electrostatic Fields.

REFERRING to Dr. S. W. Richardson's letter in NATURE of Feb. 12 on the rotation of dielectric bodies in electrostatic fields shown by Mr. L. G. Vedy and Mr. G. Gowlland, at the recent exhibition of the Physical Society, it may be of interest to point out that at the Exhibition in 1896 I showed two experiments which seem to bear on the subject. The first was with a *highly dried* dielectric liquid. If a spherical electrode is fixed some 5 mm. or 6 mm. above the surface and charged from one pole of a Wimshurst, the other pole being earthed, the liquid quietly rises up in a conical form, attaches itself to the electrode, and remains suspended while the field is maintained.

If this same liquid is then exposed to the atmosphere or otherwise absorbs a small percentage of moisture, on repeating the experiment—while there is still a tendency to lift the liquid—there is an even stronger one to depress it in places resulting in great turbulence, hollows, and sometimes whirling motions, all of which vanish if the liquid is again dried.

In a letter in NATURE for April 5, 1924, I showed that the properties called 'absorption' in dielectrics at ordinary frequencies are also due to small percentages of moisture and can be greatly altered by varying this. It would, therefore, appear that with dielectric liquids these effects are also due to 'absorption'.

If a short bar of a good dielectric, but showing some absorption, is placed between two electrodes, but with air-gaps, and a fairly strong field is maintained in a dried atmosphere for some time and it is then, with insulating tongs, brought near an electroscope, the two ends show opposite charges, and these take time to die out. This action is separate from the opposite induced polarity of the mass of the molecules of the dielectric, which is instantaneous, and disappears instantaneously when the field is removed. This latter action appears to take no part in the rotations which are due to interaction between the field and moisture in the dielectric, or to its 'absorption'.

In the letter referred to I mentioned that to produce the absorptive effects it was not enough to assume the dielectric constant of water as 80, but that the only conclusion was that when small percentages of moisture are occluded in dielectrics, much, at any rate, must exist in an ionised form, when the reaction of the separated ions with an outside field would be much more powerful.

From observation of the experiments I gathered that rotation only occurs when brush discharges of sufficient magnitude pass between the electrodes and the rotating body.

If a sheet of a good dielectric is held near such a charged electrode, and is then brought to an electroscope, the surface of the dielectric shows a charge, but it is *of the same polarity* as the electrode producing it, instead of having the opposite induced polarity which it would have had if the dielectric had been held at a greater distance.

Now when a dielectric having in it ionised moisture is placed in an electrical field, the negative ions are strongly attracted towards the positive electrode, and vice versa, and these ions tend to be drawn through the dielectric and to accumulate under the opposite surfaces. Primarily this would produce opposite induced polarity; but if the field is sufficiently strong there is evidence that some of the opposite ions are actually pulled out of the dielectric and drawn to the electrode. This leaves the dielectric opposite the electrode with a free charge, *but of the same sign* as the electrode, causing strong repulsion.

To start the rotations there must be initial movement of the dielectric or some want of symmetry. The rotation takes place either clockwise, or counter-clockwise, depending on the direction of the initial impulse.

Thus if a block of dielectric is placed in a strong field the electrodes extract opposite ions from the two opposed surfaces and leave each with a strong charge of the same sign as the opposite electrode. When the dielectric is given a slight movement one way or the other, these charges are repelled by the electrodes and both unite in turning the dielectric in the same direction. Now these charges in the dielectric, if the dielectric is what is called 'good,' or has a sufficiently high resistance, take some time to die away. They are continually renewed as fresh surfaces of the dielectric pass the electrodes, and, on the other hand, as the rotation carries each charge round towards the next electrode the charge will be of opposite sign and therefore will be attracted until it gets under the electrode. As it comes under the second electrode the attraction will draw the ions of opposite polarity out of the dielectric and again leave it with a charge of the same sign, again producing repulsion, all the actions thus uniting to produce motion in the same direction.

Surface moisture will also give rise to the same actions if the film is sufficiently thin. If, however, the film forms a layer of low enough resistance, surface conduction will neutralise the opposite charges on the dielectric and thus reduce or stop the rotation. This was observable in some of the experiments. For example, a metal cylinder wrapped with paper would not rotate until the paper was dried, and the same inability to rotate occurred with a glass beaker before it was surface dried.

Speaking generally, this seems to be the explanation of these interesting demonstrations.

I have been investigating actions of this character during the last two years under conditions calculated to show their causes more clearly; the results, it is hoped, will be published shortly.

G. L. ADDENBROOKE.

35 Holland Villas Road,
Kensington, W., Feb. 21.

## The Effect of Intense Light on the Energy Levels of Atoms.

IN 1923, Bohr (*Z. f. Phys.*, 13, p. 117; 1923) directed attention to the fact that the usual formulæ of the older quantum theory might not be strictly applicable to atoms which are subjected to intense radiation fields of high frequency, such as those of ordinary light. Schrödinger (see particularly equation 16, *Ann. d. Phys.*, 81, p. 109; 1926) has formulated the differential equation for the $\psi$-function of an atom exposed to a harmonic electric force, and from this the allowed values of the quantity $E$ appearing in the equation may be determined. In such a case, however, the physical interpretation of $E$ is doubtful, though it seems highly probable that it represents the (average) energy of the disturbed atom. Thus we cannot be certain that the equation $E_1 E_2 = h\nu$ is correct for calculating the frequencies emitted by such an atom. Whatever be the final formulation of the theory, it seems reasonable to suppose that the energy levels of atoms in sources at very high temperatures may be modified by the electric and magnetic fields of the radiation from the source itself.

Mr. W. Kuhn (*Z. f. Phys.*, 38, p. 440; 1926) devised an interesting experiment for detecting changes in the energy levels of sodium atoms illuminated with wave-lengths near the D lines, and performed it in collaboration with Mr. R. de L. Kronig. By analogy with the classical theory of dispersion, such wave-lengths should be capable of producing disturbances quite large compared with those produced by wave-lengths much farther from the resonance lines. Briefly, the experiment consisted in studying the D line absorption of sodium vapour illuminated by a suitable continuous background, (1) when it was also illuminated by the broadly reversed D lines from a very intense sodium source, and (2) without this intense illumination. The temperature of the absorption vessel was so regulated that wave-lengths extending about 0·03 Å.U. on either side of the centre of a D line were absorbed and the temperature of the intense source was such that the reversal was about 0·06 Å.U. wide. The effective radiations lay mainly at a distance between 0·03 and 0·06 Å.U. from the centres of the D lines, so that the total range of wave-lengths utilised in the neighbourhood of either D line was about 0·06 Å.U. Kuhn states that an approximate computation indicates the possibility of a shift of 0·15 Å.U. for the D lines in absorption, due to the alteration of the energy levels of the sodium atom. He gives no details of his calculations. Therefore no statement can be made here as to the way in which the phase differences of the monochromatic constituents of the incident light were taken into account. But leaving aside all theoretical questions, the experimental result was that no such broadening or shift could be detected.

It is the purpose of this note to point out that if such an effect exists, it should be readily possible to detect it in the solar spectrum, or better, in the spectra of very hot stars. To show this we note that the intensity of the yellow sodium light used by Kuhn corresponds to an energy density in the light beam of $400 \times 900/c$ ergs per c.c. For an atom at the surface of the sun we may suppose as a rough approximation that the effective energy density corresponds to about five-sixths of the energy density of isotropic black body radiation. That is, if we consider a unit cube in which the atom is placed, we see that black body radiation of the temperature appropriate to the sun streams in through five sides of this cube, since about one-half of the total solid angle is subtended by the sun at this position. Calculating from Planck's formula, the energy density of black body radiation carried in a wave-length interval of 0·06 Å.U. units at the position of the D lines, we find the value $3{\cdot}4 \times 10^6/c$ ergs per c.c. This must be doubled to take account of radiations in the neighbourhood of both D lines. The result, $6{\cdot}8 \times 10^6/c$ ergs per c.c., is twenty times as large as the figure given by Kuhn.

Kuhn's calculation of the change in energy levels depended upon the assumption that the atoms are subjected to an electric force $E$ obtained from the equation

$$\text{Energy density} = E^2/4\pi.$$

This is open to considerable question. In calculating the actual electric force acting upon an atom, it may be necessary to take the microscopic structure of the wave front into account. Looking at the question from the point of view of the theory of uni-directional quanta (simply for the sake of convenience), it seems reasonable to suppose that many of the absorbing atoms may not be affected at the moment of absorption by any quantum belonging to the intense beam. This objection may also be applied to speculations on the possibility that atoms are oriented by the electric and magnetic fields of incident radiation, an idea which is sometimes invoked to explain the polarisation of resonance radiation in cases which do not yield to the usual theories. Arguments based on analogy with Huyghens' principle in classical optics could no doubt be given to show that the detailed structure of the wave fronts may be neglected; but the attitude adopted here consists essentially in questioning the validity of such evidence.

Further, it should be remembered that in Kuhn's experiment (uni-directional illumination) only half the energy density is effective in producing a polarisation of the atoms parallel to a given direction in a plane normal to the beam. A similar factor must be applied for atoms in celestial sources, but since we are interested only in the order of magnitude of the effects, we shall not discuss the matter further.

It may be that an effect of this kind exerts a detectable influence on wave-lengths in celestial sources. Whatever the verdict may be, the question can only be settled by those familiar with the complexities of astrophysical spectroscopy. Such an effect cannot be easily disentangled from those due to other physical disturbances. The question should certainly be considered in future discussions of the Einstein red shift and of peculiar motions in the line of sight.

ARTHUR E. RUARK.
Yale University,
New Haven, Conn., U.S.A., Jan. 24.

### The Behaviour of Polyploids.

MR. HUSKINS' description (NATURE, Jan. 8, p. 49) of the strict correlation he has observed between abnormal chromosome behaviour and abnormal breeding results in fatuoid oats encourages me to put forward suggestions based partly on analogous observations of my own.

The basic chromosome number throughout the genus Prunus appears to be 8. *P. cerasus*, *P. acida*, and *P. fruticosa* are tetraploid relatives of the diploid *P. avium*; *P. domestica* and *P. insititia* hexaploid relatives of the tetraploid *P. spinosa* and the diploid *P. cerasifera* and *P. triflora*. In both the sour cherries and the plums I have found in particular individuals at one reduction division complete pairing, at another the formation of a trivalent and a univalent instead of two of the pairs, or of two trivalents and two univalents instead of four pairs. This occurrence in an orthoploid is analogous with what Mr. Huskins has observed. Furthermore, in these cherries secondary association of bivalents may occur, and in some cases the chromosomes are associated in eight groups of four. The segregation of the parts of these quadrivalents must be, from their form, if not haphazard, at least not predetermined.

There is, however, a further significance in this variable pairing which is perhaps better shown by another example. In 1914 Mr. Crane, at Merton, crossed *P. cerasifera* on *P. domestica*; the single seedling resulting from 750 indoor pollinations has now been examined. Behaviour at the reduction division is not distinguishable from that in tetraploids such as the sour cherries, and irregularity is of the same degree. We have thus shown, what has not yet been proved in the hexaploid cereals, that the three sets of the gametophyte complement of the plum are all homologous with one another, or with the one set of a related diploid species.

If, on hybridisation, chromosomes of any one set in the plum are capable of pairing with their respective homologues of any of the other five sets, we must not assume that this freedom is effective within the species itself, yet it is possible that choice of mate is less restricted than in a simple diploid. The importance of this is indicated by a calculation of the number of chromosome-types in the offspring that may be produced by selfing a diploid with 48 chromosomes, in which every one of the chromosomes is distinct from its homologue, and a similar individual in which complete freedom of pairing prevails — a functional hexaploid. In the first case the number is $1\cdot4 \times 10^{14}$ and in the second $3\cdot6 \times 10^{33}$; this disproportionate increase no more than corresponds with the unparalleled diversity which Crane (1921) has actually discovered in the selfed offspring of certain plums.

This analysis of a polyploid brings us, I think, to the same conclusion as the synthetic method that has been successful in Nicotiana, *Primula kewensis*, and the Brassica-Raphanus cross and accidentally, as it were, in *Primula sinensis* and Fuchsia—the conclusion that polyploids have often arisen as the immediate or eventual result of hybridisation between diploid species and that, although the varying affinities between their parents are reproduced in the varying affinities between their constituent chromosome sets, their constitution is hybrid in all those respects in which their diploid parents differed. It is noteworthy in this respect to recall that the most successful experiments in the study of hybrid vigour have been carried out with diploids.

Now so long as a polyploid pure line is selfed its intrinsic hybridism remains latent, but on crossing with a related species possibilities of *secondary segregation* must be considered. Supposing, for example, speaking crudely for the sake of brevity, we imagine the tetraploid species *Triticum durum* made up of two species $A$ and $B$ and *T. polonicum* of two others $C$ and $D$, how will pairing take place in an $F_1$ between these two? It has been assumed always that pairing is only possible between $A$ and $B$ chromosomes on one hand and those of $C$ and $D$ on the other. My observations and the whole probability with regard to the relations of the original species incline me to conjecture that, while this may be true of most of the members of each set, others are likely to be less fixed in their association, and others again possibly pair $A$ with $B$ and $C$ with $D$. Characters in which the parents differed, determined in these last chromosomes, would then never be fully recovered from the progeny of the cross. Further, new characters would be discovered sometimes even exaggerating the peculiarities of one parent, and expected new combinations would fail to occur. These phenomena are exactly what Backhouse (1917) observed, ascribing them to "zygotic inhibition," and Engledow (1920) ascribing them to "shift"; although it has always been clear that these were not the inevitable concomitants of interspecific hybridisation (Belling, 1915). Gates (1915) has described a similar occurrence in forms not polyploid but possibly aneuploid, ascribing it tentatively to "gametic contamination," but offering the still adequate alternative of a cytoplasmic influence.

I venture to conclude, therefore:

1. That the possibilities of segregation in a functional polyploid are enormously enhanced as compared with those in a comparable diploid.

2. That a pure line of a polyploid species may retain the heterosis of an interspecific $F_1$ when selfed.

3. That crossing such a line with a related species exposes the latent heterosis, causing

(a) Appearance of new and extreme forms (Backhouse);

(b) Failure to recover the parental form (Engledow and Vavilov).

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London, S.W.19, Jan. 12.

### Prothetely in Insects.

IN the hemimetabolic insects, the nymphs at a very early stage of development possess rudiments of almost all the organs of the adult, for example, wings, compound eyes, etc., whereas in the holometabolic forms the appearance of these organs is postponed to a definite later stage, namely, the pupal instar. Numerous cases, however, are on record in which the larvæ of the holometabolic insects also showed wing pads, etc. The first communication on this subject was made so long ago as 1813 by Majoli, who observed that certain silkworms after the fourth moult developed directly into moths without spinning a cocoon or passing through a pupal stage. It was in 1896, however, that Heymons definitely described the phenomenon in mealworms (*Tenebrio molitor*). Kolbe in 1903 reviewed all the cases known at that date, and concluded that the appearance of these organs is premature and is due to accelerated development; he therefore gave the name 'prothetelie,' or prothetely, to the phenomenon. Since 1903 numerous cases of prothetely have been reported, and thus the phenomenon is now recognised to be of fairly common occurrence amongst insects, especially in the orders Coleoptera and Lepidoptera.

In view of the important bearing of prothetely on the metamorphosis, phylogeny and evolution of the higher orders of insects, numerous theories have been propounded, all based on the assumption of Kolbe that the phenomenon was a case of accelerated development. Unfortunately, nobody tried to verify the assumption by experiment or otherwise.

In 1924, while breeding *Tenebrio molitor*, the species which had afforded the classic example of prothetely, I observed in a culture which was being kept at about 28° C. that although most of the larvæ pupated normally, some remained, which, as time progressed, grew more and more inert, ceased active feeding, and began to show wing-pads and other characters usually associated with prothetely. The larvæ thus affected, if they moulted at all, did so with great difficulty. Only a few of them ultimately pupated, but the pupæ were abnormal in appearance. The affected larvæ, when put in a lower temperature, became active and lively.

These observations suggested that the prothetelic changes in mealworms were not obviously the result of the accelerated development on account of which the phenomenon is designated prothetely, but rather of inhibited metamorphosis.

This hypothesis was investigated by means of a long series of experiments, which conclusively showed that wing pads and several other imaginal organs, including the proliferation of testes, appeared in those larvæ only which were kept at a temperature too high or too low, and consequently could not pupate, although controls of the same brood kept at optimum temperature had in the meantime pupated. Thus under the influence of unsuitable temperature the metamorphosis of the individuals had been inhibited and, in spite of this, there had been a tendency for their imaginal organs to appear at the proper time.

These experiments were reported in the *Jour. Camb. Phil. Soc.*, 1924, when it was also shown that in almost all the previously recorded cases where details were known, the pupal organs had most probably appeared only in those individuals whose larval life had been excessively prolonged. In view of this the writer suggested that all the cases of prothetely were really 'neoteny,' and that the name 'prothetely' for the phenomenon was not only superfluous but also misleading.

These conclusions, diametrically opposed to those hitherto held, naturally required confirmation. This has come from quite an independent source. Recently (*Jour. Exp. Zool.*, 1926) Chapman, apparently unaware of my work (he does not make any reference to it), has studied the phenomenon in *Tribolium confusum* Duval, and has also come to the conclusion that wing-pads, etc., appear in those larvæ alone whose metamorphosis has been inhibited. It is interesting to point out that in his experiments the inhibiting factor was not unsuitable temperature, but a peculiar gas given out by the beetles.

There is therefore no doubt that the name 'prothetely' for this phenomenon should be dropped, and along with it should go the numerous theories based on the assumption that the phenomenon is a case of accelerated development.

Incidentally, the above facts raise several questions as to the origin and mode of metamorphosis. A discussion of those must be reserved for a future communication.

HEM SINGH PRUTHI.

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Zoological Survey of India,
Calcutta, Jan. 20.

### The Occurrence of Branched Lint Hairs in Egyptian Cotton.

DURING the past three months I have been engaged on measurements of ribbon width of cotton hairs for the determination of 'fineness' as described by Harland (*Journal of the Textile Institute*, vol. 15, No. 1; 1924). In one sample of Sakellaridis of good quality a branched hair was noticed and photographed. Fig. 1 shows the hair as originally observed in a

FIG. 1. (×700.)

small bunch of some thousand hairs. In this instance the camera was focussed on to the lumen of the hair and distinctly shows the fibrillar structure on the inner surface of the secondary thickening as described by Balls (*Proc. Roy. Soc.*, B, vol. 93; 1922).

The small lateral branch was difficult to focus owing to its being crossed by other hairs which show as dark shadows in the photograph. An attempt was then made to disentangle this branched hair and remount it so as to obtain a better view of the lateral branch. This trying operation was successfully accomplished, but not without mutilation, and a photograph taken (Fig. 2).

Further examination of this sample of cotton has revealed the existence of what might be more correctly described as lateral protuberances rather than

FIG. 2. (×500.)

branches. One of these is shown in Fig. 3. Investigations are being continued to ascertain the

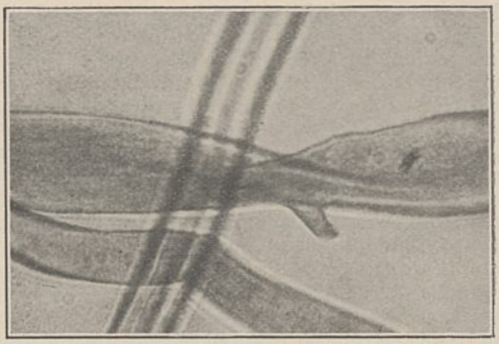

FIG. 3. (×500.)

extent of the occurrence of this structure and its probable influence on the spinning properties of the cotton.

N. W. BARRITT.

Botanical and Plant Breeding Section,
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Jan. 18.

### The Formation of Twin Metallic Crystals.

THE reply of Messrs. Carpenter and Tamura appended to my remarks (NATURE, 119, 120-121, Jan. 22) on their description of twin boundaries in metal crystals makes it clear how what I must continue to view as their misconception of the problem has arisen.

They fix attention upon an arbitrary unit of structure—in the case most discussed, a face-centred cube—and do not consider as a permissible twinning plane any plane which does not pass through the centre of this unit. This amounts to ascribing *physical significance* to the position in space of a set of lines and planes which are merely *mathematical conveniences*.

A better way of proceeding is to consider the whole array of atom-centres on one side of a twinning plane as derivable from the corresponding array on the other side by reflection therein, or by rotation about a suitable line. If, however, a unit of structure bisected by the twinning plane is desired, it can easily be found. In the case of the face-centred cubic arrangement such a unit of structure is—if my description is the correct one—a cube with atom-centres at $(0, 0, a/2)$, $(0, a/2, 0)$, $(a/2, 0, 0)$, $(a/2, a/2, a/2)$ and at points derived from the first three of these by translations of amount $a$ parallel to the cubic axes. Atom-centres therefore lie at the centre of this cube and at the mid-points of its twelve edges.

Contrary to the most recent statement of Messrs. Carpenter and Tamura, reflection in an octahedral—[111]—plane through atom-centres involves in the diamond structure the same abnormally small distance between atom-centres—two-thirds the normal distance—as does reflection in the octahedral plane they first considered.

In this connexion it is interesting to observe that in the diamond-like structure of silicon it is possible to choose a position for an octahedral twinning plane which involves no change in least inter-atomic distance. Such planes cut orthogonally the cube-diagonal *in the usually chosen unit of structure* at points distant $a\sqrt{3}/8$, $11a\sqrt{3}/24$, $19a\sqrt{3}/24$ from a corner of the cube. One cube which is bisected by such a twinning plane has atom-centres at the points
$(a/8, a/8, a/8)$, $(a/8, 5a/8, 5a/8)$, $(3a/8, 3a/8, 7a/8)$, $(3a/8, 7a/8, 3a/8)$, $(5a/8, a/8, 5a/8)$, $(5a/8, 5a/8, a/8)$, $(7a/8, 3a/8, 3a/8)$, $(7a/8, 7a/8, 7a/8)$.
In this case the twinning plane passes through no atom-centres.

No general rule can be stated as to whether the twinning plane for least lattice distortion contains atom-centres or not, since, as seen above, this depends upon the lattice. L. W. MCKEEHAN.

Bell Telephone Laboratories, Inc.,
New York, N.Y., Feb. 4.

### The Origin of Humic Matter.

THE origin of the humic matter of coal, peat, and the soil has been the subject of controversy for many years. At present an increasing amount of support is being given to the hypothesis of Fischer and Schrader, who regard lignins as the parent substances of humic matter. The older view, according to which carbohydrates (notably cellulose) are primarily concerned in the production of humic matter, finds less support than formerly. Waksman has suggested that the humic matter of soils is a mixture of unchanged lignins with the organic substances derived from the life processes of micro-organisms.

For some time past this question has been under investigation in the chemical department of this Station. On the whole, the results so far obtained are in favour of the origin of humic matter from lignins. There is a marked resemblance between the general properties of lignins and humic acids. We are now studying the action of aqueous sulphur dioxide under pressure on a variety of humic acids prepared from natural sources and artificially. We have found that this treatment effects a true fractionation of humic and hymatomelanic acids of natural origin, and that the substances brought into solution show close analogies with the lignosulphonic acids obtained in the bisulphite treatment of wood pulp. Salts of organic bases with the 'sulphonic acids' from one variety of humic acid have been made, and found to show distinct double refraction, indicating a tendency towards crystallisation. The proportion of insoluble residue from sulphur dioxide treatment varies markedly with different preparations of humic acid, and its nitrogen content is not appreciably different from that of the original material.

These results suggest strongly that there is a close relationship between natural humic acids and lignins. It is, however, not yet possible to say whether this is due merely to the presence of unchanged lignins in natural humic acid preparations, or whether humic acids themselves are actually chemically related to lignins. Further work is in progress with the aim of deciding this question, together with the closely related question of the state of the nitrogen in natural humic acids. C. E. MARSHALL.
H. J. PAGE.

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### Intensity Distribution in the Fine Structure of the Balmer Lines.

IN the course of an investigation of the fine structure of the Balmer lines, at present being undertaken in this Laboratory, certain preliminary results of an apparently novel character have been obtained which seem to be of considerable interest. These refer to the dependence of the relative intensities of the two components $\lambda'$ and $\lambda''$ of $H_\alpha[\lambda' < \lambda'']$, referred to in a recent letter in NATURE (Jan. 29, p. 163), upon the conditions of the discharge and in particular upon the diameter of the tube in which the discharge takes place.

Three discharge tubes were used. In the first the average diameter of the capillary was 0·16 cm. The intensity ratio of $\lambda''$ to $\lambda'$, about 3 : 1 in this tube, was not appreciably dependent on either pressure or current density. The average diameter of the second tube was 0·6 cm. In this case the intensity ratio, now approximately unity, was, in agreement with Hansen's results (*Ann. d. Phys.*, 78, p. 558; 1925–26), primarily dependent upon the gas pressure and to a less degree upon the current density.

In an attempt to elucidate the striking difference between the results obtained in the above cases, an apparatus consisting of a tube of average diameter 0·6 cm. fixed axially with a second of about 0·9 cm. diameter was constructed. The apparatus was arranged so that independent discharges could be sent through the axial tube and through the space between it and the outer one (about 1 mm.), the pressure being the same in both. In the former, the intensity ratio was again dependent upon the gas pressure and current density, as it was in the second tube; in the latter, the intensity ratio was practically constant, and of the same magnitude as it was in the first tube. G. E. HARRISON.

Physical Laboratory,
University of Birmingham, Feb. 7.

### Electro-deposition of Rubber.

IN the description of the process of electro-deposition of rubber given in NATURE of Jan. 22, pp. 129 and 130, there occurs one statement which might be misleading to those not actually acquainted with the process. After reference to certain operating conditions it is said, "Against these advantages must be set the fact that, since rubber is a non-conductor, it is possible to obtain only comparatively thin sheets of rubber product, though further investigation will doubtless remove this limitation."

Although, of course, rubber is a non-conductor, the deposit of latex rubber particles, with or without other filling material, forms a spongy gel which is still permeated by the intermicellar liquid, which, of course, is an electrolytic conductor. Consequently the electro-deposited rubber is not actually an insulator, but is perfectly analogous to a porous diaphragm electrolytically connected with a metallic anode. Such limitations as exist in regard to the thickness of coating depend mainly on other conditions, therefore, than the formation of an insulating layer.
S. E. SHEPPARD.

Eastman Kodak Company,
Rochester, N.Y., Feb. 5.

# The Survey of the Stars.[1]

By J. H. JEANS, Sec. R.S.

AT the dawn of civilisation, when man awoke from his long intellectual slumber, nine muses were appointed to preside over his various activities. Only one muse was allotted to science, and that one was allotted to astronomy. Perhaps the high gods of Olympus who arrange these things had heard of no science beyond astronomy, or perhaps they thought it the only one worth encouragement; we do not know. But it is said that since then the claims of other sciences have been admitted, and a vast crowd of junior muses have been appointed to look after them. When they all meet in conclave, many of the latter report quite extraordinary rates of progress in their particular sciences, and it has sometimes been thought that astronomy, which started first in the race, has at times shown some tendency to lag behind.

To this Urania has always had a ready answer. She can point first to the immensity of her task; sciences such as geography, geodesy, and geology, whose field of action is limited to the surface of one tiny planet, can no doubt claim to be well on towards the completion of their tasks, but the exploration of an entire universe offers a task of a different order of magnitude. She can point also to the extraordinary difficulty of this task; after once the first obvious steps have been taken, the astronomer can get nothing of value except with instruments of almost incredible precision. Moreover, instead of being able to investigate phenomena when he pleases, he has to wait on Nature, and Nature moves very slowly in comparison with human life—the whole age of astronomy, as a science, bears the same relation to the ages of the stars that it studies, as does the last tick of the clock in the dying century to the century itself. Finally, she has often been heard to remark, with a mixture of pride and sorrow in her voice, that her science presents problems of such enthralling interest that only too few astronomers can be found to do their fair share of the fundamental work on which all progress must ultimately be based. We can rest assured that she is well satisfied when, as on the present occasion, our Society signals out for its highest honour one who has done not only a fair share, but also a lion's share, of most valuable fundamental work.

To the ancients the intrinsic difficulties of astronomical science did not loom large. The age of the universe meant much the same thing to them as the age of the human race, and the size of the universe was believed to be of the same order of magnitude as the size of the earth. The moon, they agreed, was about the size of the Peloponnese; the sun, as any one could see at an eclipse, was rather bigger. Aristarchus of Samos had, it is true, calculated that it must be eighteen or twenty times bigger, and had maintained that the fixed stars must be very remote indeed. But he was far in advance of his time, even believing that the earth moved round the sun. The majority of the early astronomers held that the spheres of the moon, sun, planets, and fixed stars were all packed fairly closely together. For the most part they believed firmly in the principle they described as 'the economy of Nature,' which prohibited the leaving of any unnecessary unoccupied space between the heavenly bodies—surely no scientific belief has ever been so utterly unwarranted by the facts! With this supposed principle firmly rooted in their minds, they naturally felt confident that it was a simple matter to determine the distances of the various heavenly spheres with fair accuracy. Later, when the determination did not prove so easy as had been anticipated, it began to be felt that the impossibility of discovering any parallactic motion whatever—any apparent change, that is, in the positions of the nearer stars as the earth performed its journey round the sun—presented an objection of real force against the Copernican system of astronomy.

It was on the absence of parallactic motion that Ptolemy had based his argument that the earth was the unmoving centre of all the celestial spheres, and as century after century rolled by and no trace of parallactic motion was forthcoming, it almost began to look as though Ptolemy had been right after all. Hooke, Römer, and Bradley, realising the fundamental importance of the question, attempted in turn to detect parallactic displacements of the stars, and all their efforts ended in failure, although we must remember that Bradley's failure immediately resolved itself into a triumph—the discovery of aberration. This provided convincing evidence of the earth's orbital motion, but threw no light on the question of the distances of the stars.

Early in the seventeenth century, Kepler had maintained that the stars were probably of the nature of suns, and that our sun was similar to the other stars. The observation that the brightest of the stars appear, in modern terminology, some 25 magnitudes ($10^{10}$ times) fainter than our sun, might well have suggested that the nearest of the stars must be some 100,000 times as distant as our sun, and so must have a parallax of the order of, at most, two seconds of arc. But, so far as I know, this type of argument scarcely appeared until Newton advanced it in his "System of the World." From the observed size of Saturn's disc he calculated that the sun must emit in all $2{\cdot}1 \times 10^9$ times as much light as falls on Saturn. Although Saturn cannot re-emit all the light it receives, it appears rather brighter than a first magnitude star. Thus if the first magnitude stars are as luminous as the sun, they must be more than $\sqrt{(2{\cdot}1 \times 10^9)}$ as distant as Saturn. Newton conjectured their distance to be about 100,000 times that of Saturn, representing a parallax of $0''{\cdot}21$—that is to say, he estimated that the first magnitude stars would

[1] From an address delivered to the Royal Astronomical Society on Feb. 11, referring to the award of the Gold Medal of the Society to Prof. Frank Schlesinger for his work on stellar parallax and astronomical photography.

appear to swing through an angle of only 0·42 seconds of arc in the sky as the earth moved from one end of its orbit to the other.

Almost at the same time the converse of this argument began to appear. Although Bradley had not succeeded in obtaining a definite parallax for any star, he had proved in 1727 that that of γ Draconis could not exceed one second of arc. Assuming this result to be generally true for all stars, astronomers began to compute lower limits to the luminosities of the brighter stars and found that they were commensurate with that of the sun, as Kepler had maintained. In 1800 Herschel used this supposition to compute hypothetical parallaxes both for bright and for faint stars.

The year 1838 saw the whole situation suddenly transformed. For in that year Bessel, Struve, and Henderson independently found definite and distinctly different parallaxes for the three stars 61 Cygni, α Lyræ, and α Centauri, and it first became possible to assert, on incontrovertible evidence, that the stars were not all at the same distance from the earth. It was now for the first time conclusively proved that the system of the stars formed a three-dimensional and not a two-dimensional structure. A workable method had been found for sounding the depths of space, and the universe lay open for exploration.

The general feeling of astronomers at the time is well shown in the address delivered by Sir John Herschel when, eighty-six years ago, he handed our gold medal to Bessel. He said: "I congratulate you and myself that we have lived to see the great and hitherto impassable barrier to our excursion into the sidereal universe, that barrier against which we have chafed so long and so vainly—*aestuantes angusto limite mundi*—almost simultaneously overleaped at three different points. It is the greatest and most glorious triumph which practical astronomy has ever witnessed. . . . Let us trust that, as the barrier has begun to yield, it will speedily be effectually prostrated."

The difficulties of the problem were so great as to put out of the question any such speedy prostration of the barrier as my predecessor of eighty-six years back appears to have hoped for. Although astronomical ability of the highest order was brought to bear, progress was slow. In 1901 Newcomb compiled a catalogue of stars of known parallaxes; their total number is only 72, of which 15 are designated as being "subject to more doubt than usual," while one is damned with four little dots which, we are told, means that it is "entirely unreliable." Even including the unreliable parallaxes, astronomy had been exploring the universe thrown open to it sixty-three years earlier at the rate of only about one star a year. The appearance of Newcomb's table, however, marked the darkest hour before the dawn.

Within two years Schlesinger begun publishing photographic determinations of parallax, which showed a far higher level of accuracy than had hitherto been either attained or thought possible. Other astronomers speedily adopted photographic methods, and in due course a scheme of co-operation was arranged between the seven observatories of Allegheny, Dearborn, Greenwich, McCormick, Mount Wilson, Sproul, and Yerkes. The results of this scheme of work up to the year 1924 are contained in Schlesinger's "General Catalogue of Parallaxes." This contains the parallaxes of 1870 stars to a very high degree of accuracy, and forms one of the most useful and valuable publications the working astronomer has ever seen. A comparison of this catalogue of 1870 parallaxes with Newcomb's 1901 Catalogue of 72 parallaxes gives a vivid picture of the work done in twenty-three years. While Newcomb's parallaxes show an average error of nearly a twentieth of a second, those in the Schlesinger catalogue seldom show a probable error of more than a hundredth of a second—the angle subtended by a pin-head at a distance of twenty miles! The gain in accuracy is the greater part of a decimal place, while the Schlesinger Catalogue contains twenty-six times as many stars as the earlier list.

Let us turn from this record of work achieved, to contemplate the realms which remain to be conquered. In measuring the distances of the stars, the natural unit of length is the 'parsec,' the distance of 19,100,000 million miles, at which a star has a parallax of one second of arc. There is no known star within one parsec of the sun. The number of known stars within spheres of radii 2, 3, 4 parsecs, drawn round the sun as centre, is 3, 6, 18 respectively. In this count binary systems are treated as single stars, although Proxima Centauri is deemed to be distinct from α Centauri, and the sun is not counted since its presence is a prerequisite to our making the calculation at all. Now if the stars in the neighbourhood of the sun were scattered at random, and were all known, the number of stars observed to lie in different spheres would be proportional to the cubes of their radii; if they were not all known, there would of course be a falling off from this law for the spheres of greatest radii, since distant stars are more likely to remain unknown than near stars. In particular, if the 18 known stars were the total inside a sphere of 4 parsecs radius, the numbers to be expected inside the three spheres of radii 2, 3, and 4 parsecs would be 2·2, 7·6, and 18 respectively. These are near enough to the actual numbers of 3, 6, and 18 to justify the hope that the great majority of the stars within 4 parsecs are known. But 4 parsecs is the greatest distance for which such a hope can be entertained. With 18 stars lying within 4 parsecs of the sun, there ought to be a further 17 lying at distances between 4 and 5 parsecs: only 6 such stars are known. There ought to be about 280 within 10 parsecs: Schlesinger's Catalogue contains only 86.

Thus even now our survey of the universe is tolerably complete only to a distance of about 4 parsecs; beyond this the number of known stars increases nothing like so rapidly as the cube of the distance. With present-day accuracy, trigonometrical parallaxes can be estimated to a probable error of, let us say, 0″·008, so that the parallaxes of stars within 100 parsecs may be said to have a real physical significance. Of such stars there ought to be about 281,250, and at the present rate of progress the determination of their parallaxes would occupy astronomy for fully 1000 years to come.

Just now we compared astronomy's past 3000 years of existence to the last tick of the clock in a dying century; we may with equal justice compare the 3000 years next to come to the first tick in a new century—such is the proportion it bears to the total time our present stars may be expected to last. Looked at on this scale there may be thought to be plenty of time for a really exhaustive survey of the universe, and past progress may be accounted amazingly rapid. In one tick of the clock astronomy has come to birth, has developed the most difficult and accurate technique known to science, and has surveyed the universe, accurately and completely to 4 parsecs, and sketchily and imperfectly beyond. The next tick of the clock should see the accurate survey extended to well beyond 100 parsecs, and astronomy has a whole century of life before it. I fear there may be a fallacy involved in the adoption of this point of view; it is that we do not know how long the human race will endure. At the very longest estimate, man has only existed for a hundred ticks of our clock, civilised man for only two or three, so that our race and civilisation would alike seem to be at the very beginning of their existence. Yet he would be a bold extrapolator who would assert with confidence that man is good for another three thousand million ticks of our clock on the ground that, if nothing unforeseen happens, the present stars will still be in existence at the end of that time. When we take a time-scale in terms of individual lives, we may still feel gratified at past progress, yet we cannot but feel awed by the magnitude of the task that remains.

## On Rejuvenation.

FEW human beings will view the approach of old age with philosophic calm, so that any method by which the period of maturity may be prolonged and the onset of senility delayed will always arouse widespread interest and discussion. Within the last few years a considerable amount of attention has been directed to the subject of rejuvenation, following certain somewhat sensational operations on human beings and the higher apes. Although there is no doubt that the internal secretions of the genital glands exert a pronounced effect upon the rest of the body, yet it is by no means certain that old age can be attributed solely to their degeneration: in fact, the cells of the body as a whole suffer decay, so that it is probable that an operation affecting only one of the organs of the body, only one, moreover, of the number which influence the activities of the other cells throughout life, would have no more than a temporary effect at best.

Although removal of the genital glands has a profound influence upon the mentality and bodily structure of the subject, yet evidence as to its effects upon strength and endurance has been conflicting. M. D. Sumulong, in a recent paper (*Philippine Jour. Sci.*, Mar. 1926, p. 327), from experiments on guinea-pigs, concludes that castration is without definite influence upon their pulling power or endurance. Yet one of the characteristic results of a rejuvenating operation has been the increased physical vigour of the subject, suggesting again that decay of the genital glands is not the sole factor in old age. Finally, in discussing the results of human experiments, it is difficult to know how far the element of suggestion must be taken into consideration.

Various operations have been proposed for rejuvenating purposes; thus transplantation of the gland from another individual of the same, or a closely allied, species has been effective, especially in the female. In the male, the ligation of the efferent duct from the testicular gland has been advocated as a much simpler, withal as effective, a procedure. It is of interest to note that the flatworm Planaria can be rejuvenated by starvation. It shrinks to one-quarter its adult size and becomes young again: if fed, it grows up: the process can be repeated indefinitely and the organism's life may be prolonged to twenty times the ordinary length (F. A. E. Crew, *Nineteenth Century*, Feb. 1927, p. 225). The infinitely more complex structure of the higher animals, however, prevents the recourse to such a simple expedient.

The justification for the operation of ligature of the efferent duct of the testes, or *vasoligation* as it is called, depends on the assumption that this procedure causes degeneration of the sex cells proper, thus permitting the interstitial cells to hypertrophy, with a consequent increase in the amount of the internal secretion produced by them. It might not even be necessary for them to hypertrophy: with degeneration of the sex cells the nutriment supplied to the whole gland by the blood stream might be sufficient for the full activity of the internal secretory cells, whereas with the sex cells present the former might fail to obtain all the food they required owing to the competition of the latter. In the period of full maturity both types of cells are probably sufficiently supplied by an efficient circulation.

Oslund has stated that vasoligation does not lead to degeneration of the sex cells unless the testis moves from its usual position in the scrotum into the abdomen. Y. Tamura and F. A. E. Crew, in experiments on the mouse (*Proc. Roy. Soc. Edin.*, 1926, vol. 46, p. 283), find that this operation is followed by degeneration of the sex cells, provided sufficient time has elapsed before the testis is examined. If the epididymis is removed, degeneration occurs much earlier. On the other hand, in neither case was the degeneration complete. The evidence, however, favours the assumption on which the operation of vasoligation is based.

From what has been said above, it is clear that the two functions of the testis are to a certain extent independent. Thus an individual may be rejuvenated, without at the same time becoming capable of begetting offspring. This would naturally occur if vasoligation was performed on both sides. The unilateral operation, or gland transplantation, on the other hand, might lead to renewed activity in the individual's own glands, with the production of spermatozoa and a further period of fertility.

In the female, apart from gland transplantation, which may lead to renewed activity in the individual's own ovaries, the sex cells may be destroyed by irradiation with the X-rays; in the latter case rejuvenation, due to increased activity of the interstitial cells of the ovary, is of course accompanied by sterility.

One other possible method of the future may be mentioned, and that is rejuvenation by the administration of potent extracts from the sex-glands. In the case of the female, the hormone which produces 'heat can be extracted in a, probably crude, condition from the ovaries of a number of animals and is effective on subcutaneous injection. No such active extract has yet been obtained from the testis. At any rate, the effect of the former upon the general bodily condition has not yet been studied.

By some one of these methods, used in time, it may become possible to prolong the span of life. In the case of the rat, death has been postponed for a period equal to one-fourth its average length of life. No information is available in the case of man, but it is claimed, as Crew points out, that senility in a rejuvenated individual is sudden, and death, when this phase of life is reached, soon supervenes.

## Obituary.

### Colonel C. H. T. Marshall.

Col. Charles Henry Tilson Marshall died in London on Jan. 20 in his eighty-sixth year. He was born on July 8, 1841, and was the eldest son of W. Knox Marshall of Hereford. He entered the Indian Army in 1859, and on arrival in India was attached to the 35th Royal Sussex Regiment. On leaving this regiment he joined the 3rd Sikhs, Punjab Frontier Force, but saw little military service, being appointed in 1865 to the Punjab Commission. After filling various appointments with exceptional ability, he was finally made Assistant Commissioner of Lahore, retiring in 1896.

Col. Marshall was best known to Indian and other ornithologists not so much as a scientific worker but as a field naturalist. Wherever he was posted, and his districts were many, he made copious observations and notes on the local birds, and it was his extensive knowledge of game birds and his high reputation as a small-game shot that induced Hume to obtain his collaboration in the "Game Birds of India" in 1879. The three volumes composing this work are full of Marshall's field notes, and the business portion of the work, such as arrangement of plates, etc., also fell to his share. Marshall was, however, never fond of publishing his vast stores of bird lore, and never brought out any book in his own name alone for the benefit of his brother workers. At the same time, "Stray Feathers," Hume's journal of ornithology, which ran through eleven volumes, contains many of his notes, which also appeared from time to time in other Indian papers and journals. In 1877 his brother, then Capt. G. F. L. Marshall, R.E., brought out a book entitled "Bird Nesting in India," and in this volume much of the valuable information compiled was obtained from Col. Marshall. They were also associated in bringing out "The Monograph of the Capitonidæ or Scansorial Barbets," 1870. Their name has since been given to one of the most beautiful of Indian barbets, *Megalæma marshallorum*.

After his retirement in 1896 Col. Marshall returned to England, and since that date, with the exception of a few articles in English papers, he ceased to write upon ornithology. His brother, General Marshall, who survives him, is, of course, well known to ornithologists and botanists not only in India but also elsewhere. His son, Dr. G. A. K. Marshall, is now Director of the Imperial Bureau of Entomology.

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We regret to record the death on Feb. 18, at Oxford, in his seventy-fifth year, of Mr. Frederick Eden Pargiter, the well-known oriental scholar. Mr. Pargiter was educated at Taunton Grammar School and Exeter College, Oxford, where he took a first class in both Moderations and the final schools. He was also Boden Sanskrit scholar. He entered the Indian Civil Service in 1876 and served as district and sessions judge and was a judge of the Calcutta High Court, retiring in 1906. He was an active member of the Asiatic Society of Bengal, of which he was successively secretary and president. On his retirement, he became closely associated with the work of the Royal Asiatic Society, serving for some years on its council and later becoming one of its vice-presidents. In his oriental studies he showed great originality. His "Dynasties of the Kali Age," published in 1913, was a work which initiated the critical study of the semi-historical, semi-legendary Puranas. This study he carried further in his annotated translation of the Markandeya Purana and "Ancient Historic Indian Tradition." He was a frequent contributor to *Epigraphia Indica* and prepared for the press the centenary volume of the Royal Asiatic Society issued in 1923.

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We regret to announce the following deaths:

Dr. A. W. Crossley, F.R.S., who had just resigned the post of Director of the British Cotton Industry Research Association, on Mar. 5, aged fifty-eight years.

Dr. Ira Remsen, president emeritus of Johns Hopkins University, Baltimore, who was largely responsible for the organisation of chemical teaching and research in the United States, and was also the author of well-known text-books on chemistry, aged eighty-one years.

## News and Views.

The Trustees of the British Museum have appointed Mr. Charles Tate Regan to be Director of the Natural History Departments of the British Museum in succession to Sir Sidney F. Harmer, who retired from office on Mar. 9. Mr. Regan was born in 1878 and was educated at Derby School and at Queens' College, Cambridge. He graduated with a first class in Part I. of the Natural Sciences Tripos in 1900 and obtained a second class in Part 2 in 1901. He joined the staff of the Natural History Museum in 1901 as assistant in the Department of Zoology and was placed in charge of the collection of fishes. The care of this unrivalled collection opened before him an extensive opportunity for research, of which he took full advantage, and he soon established himself as one of the leading ichthyologists of the day. He has written many memoirs on fishes—as well as reports on the fishes of Central America and the Antarctic—and is the author of a book on "British Freshwater Fishes." He was elected a fellow of the Royal Society in 1917. He was president of Section D at the Southampton meeting of the British Association in 1925, and selected "Organic Evolution" as the subject of his address. He was exempted from military service during the War on account of the important work which he was doing on the Fresh-water Fish Committee. At the time when he entered the Museum, the other members of the Zoological Department were much senior to him in years, and as many of them had no desire to undertake administrative work, he secured early promotion. In 1919, on the retirement of Mr. W. R. Ogilvie-Grant, he was appointed Assistant Keeper (or Deputy Keeper, as the office is now styled), and in 1921, when Sir Sidney Harmer became Director, he succeeded him as Keeper of Zoology. He now succeeds him in the highest office of the Museum, and to him falls the task of advising the Trustees on the work of the Museum and on the course that may provide the best solution of the difficulties arising from the present congestion in the buildings at South Kensington.

With the announcement of the appointment of Mr. Tate Regan as Director of the Natural History Museum comes that of the promotion of Dr. William Thomas Calman to succeed him as Keeper of Zoology. Dr. Calman was born in 1871, and was educated at Dundee High School and at University College, Dundee, in the University of St. Andrews. He graduated B.Sc. in 1895 and D.Sc. in 1900. From 1895 until 1903 he was assistant lecturer and demonstrator in zoology at University College, Dundee, and in 1904 he was appointed assistant in charge of Crustacea in the Natural History Museum. On this subject he is a recognised authority, and is the author of many books, memoirs, and articles dealing with it: for his researches he was elected a fellow of the Royal Society in 1921. He was appointed Deputy Keeper of Zoology in 1921. He is zoological secretary of the Linnean Society and secretary of the Ray Society. Dr. Calman is a man of culture and has a wide knowledge of zoology; he may therefore be expected to stimulate the multifarious work of his Department.

Great interest has been aroused in the celebrations arranged by the Yorkshire Branch of the Mathematical Association in connexion with the two hundredth anniversary celebrations on Mar. 18-20 of the death of Sir Isaac Newton, and a large number of representative mathematicians and others have intimated their intention to participate. Close on two hundred visitors will go to Grantham for the scientific bi-centenary meeting to be held at the Old School, King's School, Grantham, on Saturday morning, March 19. This is the room in which Newton studied as a schoolboy. The meeting will be presided over by Dr. J. H. Jeans, and will be addressed by the Master of Trinity, the Astronomer Royal, Prof. G. H. Hardy, and Dr. Horace Lamb. After lunch the company will visit Woolsthorpe Manor House where Newton was born, and will be entertained to tea at Stoke Rochford by Mr. Christopher Turnor. The celebration dinner in the evening will be attended by many local people; the Master of Trinity will preside, and Prof. Whittaker, the Bishops of Birmingham and Lincoln, the Master of the Mint, and others will deliver addresses. It is expected that several interesting speeches referring to Newton's life and work will be made at the dinner. The mayor of Grantham is inviting all the visitors to a civic reception at the Guildhall, Grantham, on Friday evening, Mar. 18. The mayor and other civic officials will join the visitors in a procession from the Guildhall to the Grantham Parish Church on the Sunday morning, Mar. 20, for the special bicentenary service at which the Bishop of Birmingham will preach, and the Bishop of Lincoln will also be present.

The Judicial Committee of the Privy Council has delivered judgment in the boundary dispute between Canada and Newfoundland. This involved several thousand square miles in the interior of Labrador. The dispute centred round the meaning to be attached to the expression "coast of Labrador," which in the eighteenth century was granted by proclamation and royal commission to Newfoundland. Canada contended that it referred merely to a coastal strip of sufficient depth inland to meet the needs of the fishing population, and proposed one mile from deep water as the limit. Newfoundland interpreted it as meaning all the territory drained by westward-flowing rivers. The importance of this inland elevated area lies in its timber resources and reported iron-ore deposits. Judgment has been given in favour of Newfoundland, and the boundary is defined as a line drawn due north from "Blanc Sablon Bay to the 52nd parallel of north latitude, thence westward along that parallel to the Romaine River, then northward along the left bank of that river and its head waters to their source and from thence due north to the west of the water-shed or height of land there, and from thence westward and northward along the west of the watershed of the rivers flowing into the Atlantic Ocean until it reaches Cape Chidley." Thus the whole Hamilton River system, with its floating ways for timber and its great water-power resources, is added to Labrador. The judgment is, in effect, a recognition of the principle that a coast region cannot be economically separated from its hinterland.

PROF. H. E. ARMSTRONG delivered the Horace Brown Memorial Lecture before the members of the Institute of Brewing on Feb. 25, and was presented with the memorial medal shown in the accompanying illustration (Fig. 1). In the course of his lecture, Prof. Armstrong gave an outline of Horace Brown's life and scientific career. The feature in his early career was his devotion to the study of scientific subjects in his out-of-school time. He entered the College of Chemistry in Oxford Street, London, then under the celebrated Hofmann, in the spring of 1865. Prof. Armstrong joined the school at the same time and the two students became fast friends for life. After only six months professional training, when scarcely 17½ years old, Horace Brown entered as junior brewer into Worthington's Brewery at Burton. In 1875 he was made manager of the manufacturing department and held this post until 1889, when he became a managing director. He retired in 1893, but only to devote himself to consulting work and original inquiry. Horace Brown gradually introduced scientific methods into brewery practice and was a pioneer in making brewing subject to scientific control. His scientific researches led to his election into the Royal Society in 1899. He was awarded the Longstaff medal of the Chemical Society in 1894, a Royal medal of the Royal Society in 1903, and finally the Copley medal of that Society in 1920—the highest scientific distinction in Great Britain. He died on Feb. 5, 1925. Horace Brown's early work was built largely upon the foundation laid by the great Pasteur. An industry, the lecturer said, which has had within its fold men of such nobility of outlook and penetrative power, has reason to be proud and to take pride in its potential status among the comity of professions. The industry is one affording special opportunities of studying the life process. In instituting the lectureship, the Institute of Brewing representatives of the brewing industry have held out the right hand of fellowship to the scientific fraternity, especially to physiological inquiry.

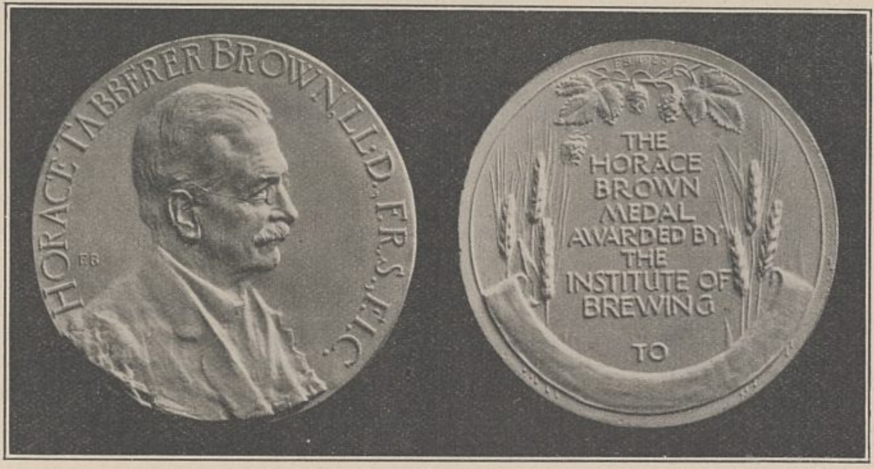


FIG. 1.—Horace Brown Memorial Medal (natural size). Upon the medal presented on Feb. 25 were inscribed the words: "Henry Edward Armstrong, LL.D., F.R.S."

THE subject of Prof. A. S. Eddington's eighth Gifford Lecture in the University of Edinburgh on Friday, Mar. 4, was 'World-building.' After a consideration of modern views of this subject he gave an account of some of the ideas underlying the 'new quantum theory' which could necessarily involve changes not yet formulated in the scheme of world-building. He said the conflict between quantum theory and classical theory becomes most severe in the problem of the propagation of light. Here it becomes in effect a conflict between corpuscular theory and wave theory. There is no serious doubt as to the ultimate source of the conflict; the classical (including the relativity) view of space and time is inappropriate in dealing with a single quantum. A single quantum has not travelled 50 billion miles to us from Sirius; it has not travelled for eight years. To apply these phrases to *one* quantum is like reading the Riot Act to one man. Somehow, when enough quanta are present to form a quorum, we shall be able to find among their statistical properties the genesis of the conceptions of distance and duration. But at present we are unable to make a start with such a reconstruction. As a condition for treating the subject in space and time, it seems necessary to allow that wave properties and particle properties are not inconsistent. Thus we find that in the new developments, not only do the waves of light seem to have corpuscular properties, but also reciprocally the corpuscles of matter are found to have wave properties. Long ago phenomena of diffraction of light were observed which ruled out a purely corpuscular theory of light; and it seems that, to-day, phenomena of diffraction of matter are being observed which rule out a purely corpuscular theory of matter.

In continuation of the series of lectures being delivered at Bedford College, London, Prof. H. H. Turner spoke on Mar. 1 on "Conceptions of the Cosmos in the Galilean and Newtonian Period." The period with which Prof. Turner dealt was characterised by a complete breakaway from old ideas. The beginning of the secession was evident in the work of Galileo (1564–1642) and Kepler (1571–1630), but Newton (1642–1727) crowned it by making a new orthodox system to account for the motions of the earth and the heavenly bodies. Galileo is chiefly remembered in connexion with the telescope, but he also made two great discoveries. By observation of the hanging lamp in Pisa Cathedral he found that the time of swing of a pendulum is approximately independent of the angle through which it swings. By experiments from the Leaning Tower of Pisa he found that a heavy and a light body dropped at the same instant from the same height will reach the ground almost simultaneously. This was directly contrary to the generally accepted theory, due to Aristotle, that the time of fall varies inversely as the weight of a body, and brought Galileo into conflict with the Church and the philosophers of his time. Kepler, assisted by the extraordinarily accurate observations of Tycho Brahe, contributed his three laws of planetary motion, but it was left to Newton to account for all these phenomena by his universal law of gravitation. He first proved in 1665 that Kepler's third law (on the periodic times of the planets) fitted in with the assumption of an attraction according to the inverse square law. He then proved that a heavenly body attracted in this way by the sun, will move in an ellipse with the sun at one focus. His great difficulty then was the problem of the attraction of a sphere on a body just outside it, assuming that every particle of matter attracts every other particle according to the inverse square law. It was not until 1685 that he proved, very elegantly, that a sphere attracts like a particle at its centre, and thus accounted to his satisfaction for the falling apple. The "Principia" was published in 1687 at Halley's expense, and it is largely due to his encouragement that the world was able to learn of Newton's discoveries.

A memorial tablet to the late Sir Patrick Manson, who has been aptly termed "The Father of Tropical Medicine," will be unveiled by the Minister of Health, the Right Hon. Mr. Neville Chamberlain, on Mar. 15, at 3.30 P.M., at the Royal Albert Dock Hospital. This tablet has been erected by the Seamen's Hospital Society to commemorate the great services of Sir Patrick Manson to that Society as well as to the cause of science. Sir Patrick was elected physician to the Society in 1892, and laboured almost continuously in its service for twenty years until he retired in 1912. It is a most appropriate position for this memorial in the spacious ward of the Albert Dock Hospital now known by his name, where Manson conducted his clinical teaching and where a great many of his well-known researches were carried out. It was in the Royal Albert Dock Hospital, in fact, after some seven years' intensive labour, that the London School of Tropical Medicine was founded, with the active aid and encouragement of Mr. Joseph Chamberlain; and it was the association of these two great men that has made tropical medicine stand for what it does to-day in the British Empire. It is therefore appropriate that his son, Mr. Neville Chamberlain, should unveil this memorial in the wards of the Seamen's Hospital under the auspices of that great Society which has done so much to encourage and foster the teaching of tropical medicine in Great Britain.

Some account of Manson's life and work appeared in our columns shortly after his death (May 6, 1922, p. 587). The portrait medallion in the memorial tablet is the work of Mr. T. R. Pinches, of Albert Embankment, London, and is the original plaque from which the Manson medal, now the property of the Royal Society of Tropical Medicine and Hygiene, has been struck. The original idea of a memorial medallion emanated from a committee which assembled shortly before Manson's death (April 9, 1922) to raise subscriptions from Manson's old friends and fellow-workers for a presentation portrait. After defraying expenses, the surplus of the fund was devoted to the execution of this medallion. The portrait was obtained by the artist shortly before Manson's death and is considered a specially good likeness, portraying, as it does, in a pleasing manner, the rugged but kindly face of this great teacher and investigator. It is well, now that Manson's school has been moved to the centre of London and is about to expand beyond his most ambitious dreams, that this Manson memorial should rest, where he first founded it, in the charge of the Seamen's Hospital Society at the Royal Albert Dock.

An interesting association of science with literature was approved a few days ago, when the West Sussex County Council accepted the sum of £500 as a Shelley Memorial Trust. The income from this fund is to be used for prizes to pupils in schools in the county who have been most successful in the study of science subjects, "special preference being given to boys and girls who express themselves with literary ability." Shelley was born at Field Place, near Horsham, Sussex, on Aug. 4, 1792, and the centenary of his birth was celebrated in the county in 1892. Mr. J. J. Robinson and Mr. J. Stanley Little, the trustees of the fund then raised, have now handed over the residue to the County Council for the purpose stated. It was a happy thought to establish school prizes for literary style combined with knowledge of Nature; and it is most appropriate that Shelley's name should be associated with them. His "Queen Mab," for example, and his notes upon this and other poems, reveal a knowledge of astronomy unusual in poets and of beauty in expressing it, while "The Cloud" is a perfect picture of a natural theme. Since his time, our conceptions of the universe, and of the constitution of the radiant orbs in it, have been greatly extended, but there is only one poet to-day—Mr. Alfred Noyes—who has found in it a source of inspiration. We welcome, therefore, the encouragement to be given to young people in Sussex to think of truth and beauty together instead of things apart.

Sir Herbert Jackson delivered the Friday evening discourse at the Royal Institution on Mar. 4, when he discussed some colouring agents in glasses and glazes. Out of a large number of colouring agents for glasses and glazes, copper and iron were chosen as illustrations. Metallic copper dispersed through a glass in an extremely fine state of division gives a clear transparent red glass. With progressively larger particles a semi-transparent red glass can be obtained or a glass which is blue to look through and red-brown by reflected light. With still larger particles the glass in thin layers is of a grey neutral by transmitted light and a pronounced brown-red by reflected light. Cuprous oxide was used by the Egyptians to produce a brilliant scarlet glass, the colour of which is due to comparatively large crystals of cuprous oxide. Specimens of early glass, presumably of Saxon origin and of an orange-yellow colour, also owe their colour to cuprous oxide, but in its yellow form. Only recently has it been possible to reproduce these glasses on a laboratory scale. The colours produced by cupric oxide are transparent blues and greens, the precise colour being determined by the amount of cupric oxide present, the composition of the glass, and the temperature at which it is made. Ferric oxide gives yellows, browns, and brownish reds, which are attributed to various concentrations and states of dispersion of this oxide. Ferrous oxide as a colouring agent produces blues and greens according to the composition of the glass, and to it can be attributed the beautiful tints found in certain Chinese glazes. Ferroso-ferric oxide (magnetic oxide of iron) gives neutral tints of various depths, and with high concentrations a black glass can be obtained. If the concentration of the oxide be high enough, some of the oxide will come out in cooling so as to be dispersed through the glass in very minute aggregations, which are, however, presumably crystalline, since the resulting glass is appreciably magnetic.

Mr. T. L. Eckersley, who has for several years been experimenting on short-waves for the Marconi Co., read an important paper on short-wave radio telegraphy to the Institution of Electrical Engineers (Wireless Section) on Mar. 2. As the paper is both theoretical and experimental, it will prove of interest to many. The agreement between practice and the ordinary theory is far from satisfactory. Some propose to use aerials which radiate their energy upwards so as to take advantage of the conducting layer. The Marconi Co. radiates its beam horizontally with a vertical polarisation. Some Americans prefer to use a horizontal polarisation. The author's experiments seem to indicate that low-angle transmission, that is, almost horizontal radiation, is the best. Cases have been known where the ray comes right round the world and affects a receiver relatively close to the transmitter. The ray which has gone round the world causes an echo which is heard about a seventh of a second behind the main signal. Experiments with very short wave-lengths prove that an aerial 7 metres in height is much less efficient than aerials of 35 metres and 70 metres height respectively. With low wave-lengths the author finds that the range increases very definitely with the square of the frequency, provided the wave-length is greater than 10 metres. At this wave-length, signals projected at a fairly high angle in Great Britain have little if any effect on a receiver at Buenos Ayres. They seem to leave the earth altogether. There is little doubt that the daylight range is a minimum for waves 200 metres in length. He concludes that in long-distance transmission the ray trajectory has a shallow angle of elevation of about 15° and follows the great circle path. His theory is essentially a modified form of the conducting layer theory.

The British Museum (Natural History), to use the awkward official title, has issued the first number of a *Natural History Magazine*, designed to further natural knowledge by descriptions of important additions to the collections and of notable possessions in the galleries and cabinets. It is a welcome sign, taken with the creation of popular exhibits, the institution of popular demonstrations, and the issue of a wonderful series of picture post-cards, of the will of the Trustees to make special appeal to the intelligent but non-scientific public whose moneys support the institution. The first number contains a variety of articles dealing with particular items in the departments of zoology, entomology, geology, and botany—"Two Important Additions to the Collections of Beetles," "Tektites," "Rafflesia: the largest known Flower," "Sirens in Fancy and in Fact," to mention the first four. The articles are short and informative; they are severely limited in scope and are largely descriptive, so descriptive as to suggest occasionally the flavour of the text-book. The success of the magazine depends, we take it, upon the support of the public, and the public, greedy as it is nowadays of natural history information, demands the general as well as the particular, and above all likes the light touch. We suggest that at least one article in each number be reserved for a general theme, such as the exhibits are well fitted to illustrate, heredity, protective, sexual, or seasonal coloration, migration of fishes, or a score of others, and that too narrow a view should not be taken of the way in which the collections and the work of the staff can be best advertised. There could be no better model of a successful, attractive, and purposeful museum magazine than the parallel publication, *Natural History*, issued by the American Museum of Natural History.

Conflicting reports as to the extent of the earthquake which occurred in Japan on Monday, Mar. 7, at 6.28 p.m., have been received. It seems that a severe shock lasting about three minutes was felt in Nagoya, Kyoto, Osaka, and Kobe. In Osaka and Kobe, fires broke out and sea waves following the earthquake added to the disaster. A number of smaller towns have been destroyed. The seat of the disturbance appears to have been in the provinces of Tajima and Tango on the north side of the main island, Honshiu, some two hundred miles west of Tokyo and about fifty miles north of Kobe.

Prof. H. H. Turner, Savilian professor of astronomy at the University of Oxford, has been awarded the Bruce Gold Medal of the Astronomical Society of the Pacific, "for distinguished services to astronomy."

The Secretary of State has appointed the following as members of a joint committee for the management of the proposed Dairy Research Institute in Scotland: Sir Donald MacAlister (chairman); Prof. Robert Muir and Prof. D. Noël Paton, representing the University of Glasgow; Mr. C. Lindsay, Mr. John Speir, and Principal W. G. R. Paterson, representing the West of Scotland Agricultural College; the Right Hon. Lord Weir; and Mrs. Houison Craufurd.

Dr. W. Lawrence Balls has been appointed Director of the Botanical Section of the Egyptian Ministry of Agriculture. Meanwhile Dr. Balls is paying a short preliminary visit to Egypt, at the invitation of the Royal Agricultural Society, to advise that body on a proposed cotton research institute. It is of interest to recall that both these developments are the outcome of Dr. Ball's activities in the years 1904–14.

In an article in *Scientia* of January last on the dawn of modern biology, the tercentenary is commemorated of the birth of the illustrious and observant Italian biologist Francesco Redi. The long prevalent view that flies were generated in putrefying flesh was demolished by a few simple but fundamental experiments of Redi, who proved for the first time that the maggots in putrefying flesh were the product of eggs laid thereon by flies which visited it—a notable beginning of the long attack on the doctrine of spontaneous generation.

The managing director of the Amalgamated Wireless (Australasia) Ltd., telegraphs to the Marconi Co. that during the past three weeks the beam wireless station has been readjusted and now gives most satisfactory results. During two days, beam signals have been heard in Australia throughout the 24 hours. Two-way communication also at high speeds has been established daily for several hours on end, the maximum speeds equalling those obtained over the relatively short distance between England and Canada. During a continuous test of seven days, the average traffic capacity exceeded 60,000 words per day in each direction. As soon as the British official tests are completed, the service will be open for public traffic. The transmitting and receiving stations in England are at Grimsby and Skegness respectively; the Australian stations are near Melbourne.

The Prize Thesis submitted to the University of Edinburgh no less than sixty-seven years ago by Prof. W. Carmichael McIntosh has been reprinted (by Messrs. Paul and Matthew, Dundee, 1926). It is entitled "Observations and Experiments on Carcinus mænas," and it includes some most interesting notes on the natural history of this familiar crab. It contains also an account of the anatomy of the central nervous system, with observations on the effects of operative interference with the parts of these organs. A most curious description of the action of a number of narcotic and other poisonous substances on the living animal follows. There are four lithographic plates, which were drawn on the stone by the author. We congratulate Prof. McIntosh on this remarkable piece of research. There must be few scientific workers, still actively employed, who can look back on substantial investigation carried out so many years ago.

A discussion on the problem of the humane slaughtering of animals was held on Feb. 25 at King's College, London, under the auspices of the newly formed University of London Animal Welfare Society. Prof. Julian Huxley, who presided, contrasted the up-to-date public abattoir in which he had had occasion to work at Heidelberg with the old-fashioned little private slaughter-houses of Oxford, and Profs. J. M'Cunn and A. R. Smythe, of the Royal Veterinary College, while differing on minor points, agreed in recommending the use of the captive-bolt pistol as more humane than the old-fashioned methods employed in the case of 90 per cent. of the animals slaughtered in Great Britain. That view was vigorously opposed by a representative of the meat trades, but a resolution was passed calling upon the Government to appoint a commission of inquiry into the whole question.

At the forty-ninth annual general meeting of the Institute of Chemistry, held at 30 Russell Square, Prof. G. G. Henderson, president of the Institute, remarked that there appeared to be some abatement of the enthusiasm for chemistry as a career which was noted immediately after the War, although the roll of membership had increased by 242 during the past year, to a total of more than 5200. At present the supply of chemists in Great Britain exceeds the demand. In October next the Institute will celebrate its jubilee, and a medal and prize have been established in honour of the first president, Sir Edward Frankland, who held office from 1877 until 1880; the award will be made to a registered student of the Institute for the best essay on a set subject of professional, as opposed to technical or purely chemical, importance. The subject for the first essay will be "The Importance of Chemistry to the Welfare of the People." Prof. Arthur Smithells has been elected president of the Institute for the period 1927–28.

At a meeting of the Newcomen Society on Feb. 22, held at the Institution of Mechanical Engineers, papers were read by two French members, MM. Seguin and Achard, one dealing with "British Railways of 1825 as seen by Marc Seguin," and the other with "The First British Locomotives of the St. Etienne-Lyon Railway." Marc Seguin (1786–1875), nephew of Montgolfier, was one of the best-known engineers of the day, and papers and notebooks of his preserved at the family seat at Varagnes, near

Annonay, contain an interesting account of a visit he made to England in 1825, the year of the opening of the Stockton and Darlington Railway. Seguin met Brunel, Maudslay, Babbage, Stephenson, and Brewster, and travelled to Leeds, Newcastle, Edinburgh, and Liverpool. He himself was concerned at that time with a project for steam navigation on the Rhone, and the main object of his visit was to obtain engines. He saw, however, a good deal of the early mine railroads of England, while his account of the Stockton and Darlington railway is of great historical value. Sequin was connected with the St. Etienne-Lyon Railway and was an independent inventor of the tubular boiler.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for technical records work at the Building Research Station of the Department of Scientific and Industrial Research—The Director, Building Research Station, Garston, near Watford, Herts (Mar. 21). A laboratory assistant at the Chemical Research Laboratory, Teddington—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Mar. 21). A lecturer in the chemical and metallurgical department of the Wolverhampton and Staffordshire Technical College, and a lecturer in engineering subjects at the same institution—The Clerk to the Governors, North Street, Wolverhampton (Mar. 25). Lecturers in the spinning and weaving departments of Keighley Technical College—The Secretary, Education Offices, Keighley (Mar. 26). An assistant curator of the Leeds City Museum—The Town Clerk, 26 Great George Street, Leeds (Mar. 28). Professors of mathematics, and education and psychology at Raffles College, Singapore—The Secretary, Board of Education, Whitehall, S.W.1 (Mar. 28). An assistant in the department of archæology, Free Public Museums, Liverpool—Dr. J. J. Simpson, Free Public Museums, Liverpool (April 2). A woman professor of physiology at the Lady Hardinge Medical College, Delhi—The Honorary Secretary, U.K. Branch Dufferin Fund, c/o Major-General J. B. Smith, India Office, Whitehall, S.W.1 (April 19). A graduate for engineering subjects and mathematics at the Workington County Technical and Secondary School—The Principal.

## Our Astronomical Column.

RETURN OF THE COMET PONS-WINNECKE.—This comet was detected by Prof. G. von Biesbroeck at Yerkes on Mar. $3^d\ 10^h\ 19{\cdot}5^m$ U.T., in R.A. $14^h\ 12^m\ 20{\cdot}4^s$, N. Decl. 25° 45′ 24″ (1927·0), magnitude 16·0. With the aid of this observation, and using the following elements, which are those of Mr. C. J. Merfield slightly modified, Dr. A. C. D. Crommelin has calculated the following ephemeris :

$$T = 1927 \text{ June } 21{\cdot}1564 \text{ U.T.}$$
$$\left.\begin{array}{l}\omega = 170°\ 22'\ 50''\\ \Omega = 98\ \ 10\ \ 0\\ i = 18\ \ 57\ \ 0\end{array}\right\} 1927{\cdot}0$$
$$\log q = 0{\cdot}016840$$
$$e = 0{\cdot}685516$$
$$\text{Period} = 6{\cdot}00983 \text{ years}$$

EPHEMERIS FOR $0^h$ U.T.

| | R.A. | N. Decl. | log r. | log Δ. |
|---|---|---|---|---|
| Mar. 13. | $14^h\ 23^m\ 23^s$ | 29° 5′ | | 9·9410 |
| 17. | 14 27 37 | 30 36 | 0·2106 | 9·9173 |
| 21. | 14 31 34 | 32 11 | | 9·8938 |
| 25. | 14 35 23 | 33 49 | 0·1914 | 9·8703 |
| 29. | 14 38 47 | 35 30 | | 9·8467 |

T is 0·6 days later than Mr. Merfield's prediction.

The comet will make a very close approach to the earth in June, being at its nearest (3·6 million miles) about $0^h$ on June 27. Its parallax will then be 227″, and it will be well placed for observation, being on the meridian at $3^h$ A.M. in North Decl. 6°. Its daily motion will then be 11°·7, which is just equal to that of the moon in apogee. It should be readily visible to the naked eye, but may be rather difficult to observe for position in the telescope, as it will fill most of the field. The presence of a stellar nucleus is not very probable, but if there should be one, the occasion should be utilised for deducing the solar parallax.

THE FIREBALL OF FEB. 25.—Mr. W. F. Denning writes: "The observations of this brilliant object, though for the most part incomplete in scientific details, yet include some excellent descriptions and enable the real path to be determined with satisfactory accuracy. Seventy-four accounts were received, ranging from Leicester in the north of England, Sandwich on the east, Portland in the south, and Plymouth and Penzance on the south-east. That the object detonated rests on the testimony of about half of the observers.

"The radiant point was in Leo at 144° + 6° and the height of the meteor was 65 to 27 miles, path 54 miles, velocity 18 miles per second. These results are slightly different from those derived from the preliminary investigation.—The path was over Devon from about Kingsbridge to north of Dawlish. This shower from near *o* Leonis is visible from November until February. At any rate radiation is maintained from apparently the same point.

"The fireball was chiefly remarkable for the vividness of its intensely white light and for its double outburst. Many large meteors display very long paths from radiants near the horizon, but this object was comparatively near to its point of emanation."

THE ORBIT OF 61 CYGNI.—This double star has always excited great interest, since it was the first to have its parallax determined by Bessel. The duplicity was discovered by Bradley in 1753, and measures were obtained by Ch. Mayer, Sir W. Herschel, and later by Bessel. The latter ventured to assign the period of 460 years, but in the course of time it became clear that this period was considerably too short. Not a few astronomers (among them C. Flammarion and Burnham) questioned the orbital nature of the motion, and considered that it could be represented by a straight line. But Mr. T. Lewis, in his memoir on the Struve double stars, gave a large diagram which made the curvature palpable and obvious. P. Baize contributes an interesting article to *L'Astronomie* for January, into which he brings Mr. Lewis's diagram, with the addition of twenty more years of observations which have still further established the curvature. He makes a re-determination of the orbit, reaching results quite close to those given by Peters in 1883; the periods found are, Peters 783 years, Baize 756 years, so we may perhaps consider it as known within a century or so. Baize's other elements are: Periastron A.D. 1978, inclination 45°, eccentricity 0·013, semi-major axis 32″·8. Taking the parallax as 0″·28, the mean distance is 117 units, which would give a period of 1266 years if the joint mass was equal to that of the sun. The period 756 years, therefore, indicates a joint mass considerably in excess of that of the sun.

## Research Items.

A Bronze Age Tumulus at Dunstable.—*Man* for February contains a report of the opening of one of the barrows (No. 5) of the " Five Knolls Tumuli " at Dunstable by the University College and Hospital Anthropological Society of London. This is the most northerly of the mounds. It is regular in shape, with a diameter of 50 ft. and a height of 5 ft. The remains of thirteen individuals were discovered. With one exception, those skeletons which showed no sign of disturbance were buried in the extended position with the head raised. The one exception was that of a female of Mediterranean type which lay in a crouched position in an oval cist cut into the chalk, the sole furniture being a flint knife. The skull showed a remarkable advanced symmetrical thinning. This feature is discussed by Prof. Elliot Smith in a note, in which he points out that this peculiarity is rare in Europe but common in the aristocracy of ancient Egypt from the third to the nineteenth dynasties. The only features common to the other skeletons from the barrow are presented by the limb bones. The cranial forms vary, though within narrow limits, being all mesaticephalic. In the lower limbs the femurs are all platymeric. Remains of two cremation burials were found, one accompanied by a cinerary urn of late bronze age type, which it may be assumed is of later date than the burial by inhumation near which it was found.

Rock Paintings from the Central Sahara.—Dr. P. Durand and M. L. Lavauden describe in Vol. 36, No. 5-6, of *L'Anthropologie* some hitherto unpublished rock paintings in the cave of In-Ezzan, Central Sahara, a little to the north of the Tropic of Cancer. This cave, situated in a circle of rocks from which issues a subterranean stream, is about 1700 kilometres south-east of the Straits of Gibraltar. It has been a halting-place for the nomads of the region from times immemorial. The paintings are executed in white and red, while certain missing details may once have been shown in a black which has now disappeared owing to the perishable nature of the charcoal or other form of black pigment used. The paintings are obviously of very different ages. The question of their date and affinities are discussed in an appended note by the Abbé Breuil, who classifies the pictures and inscriptions into ten categories. Of these the oldest are nude human figures, male and female, accompanied by tree or palmlike forms ; one man carries a bow, and with him seem to be associated figures of oryx in white and red. A man clothed and bulls closely resemble figures of the Spanish paintings of Cogul. In another class are human forms, clothed, more schematic in design than the human figure last mentioned but with the same type of clothing, part of which is a kilt recalling the early Egyptian costume. These figures are accompanied by hounds of Asiatic type. Paintings in both white and red show Arab horsemen, hunting scenes, and a man mounted and armed with a long lance. The style, especially of the horses, suggests Sassanid art, and is evidently comparatively modern, as also are the inscriptions in Arabic. Apart from the groups which are evidently modern, the paintings present a great diversity of style and date, and morphologically recall now the art of the Bushman, now that of eastern Spain, and now that of predynastic Egypt.

Brewing in Babylon and Egypt.—The Society of History and Bibliography of Brewing of Berlin has recently published the results of the first of a series of investigations on beer and brewing by the peoples of ancient civilisations (" Bier und Bierbereitung bei den Völkern der Urzeit," 1. Babylonien und Ägyptien. Berlin, 1926). The art of brewing has now been traced back to 7000 B.C., when brewing was a common household occupation of the peoples of the valleys of the Tigris and Euphrates. Dr. E. Huber shows that the beer of the day also played an important part in the social and religious life of this period. Definite rations of beer were allotted to each class of workman, and it was also used as an offering to the gods and as a diluent in medicine. The evidence in support of the cultivation and use in brewing at this time of Emmer wheat and of barley is of particular interest in view of the recent correspondence in Nature. By 5000 B.C. brewing businesses existed, often on a large scale. It is uncertain whether hops were used in Egyptian times, though there is evidence of the use of other flavouring herbs such as rue and safflower. The publication is profusely illustrated with photographs of Babylonian seal cylinders, chiefly of the time of Hamurabi, and of inscriptions and bas-reliefs from Egyptian tombs. A number of the latter are pieced together to form twenty-three scenes describing the complete brewing process. Dr. M. Phillipe contributes discussions of the brewing technique of these periods.

Scottish Sea Trout.—In a paper on the sea trout of the River Ailort and Loch Eilt (*Fisheries, Scotland, Salmon Fish.*, 1926, 3 (June 1, 1926)) Mr. G. H. Nall summarises the results deduced from figures and tables contained in an unpublished report. 1692 sets of scales, mostly between April and October 1925, were taken from fish varying in weight from a few ounces to 12 lb., and in age from $2\frac{1}{4}$ years to $12\frac{1}{4}$ years. Two fish, each of 12 lb., were in their thirteenth year, having both had 3 years of parr life, 2 years in the sea without spawning, and then spawned in seven successive winters. An interesting feature was the big run of heavy fish very early in the season in fat condition, with remarkably strong growth in the opening months of the year. An examination of the scales for 'slow growth' and 'rapid growth' zones indicated that these fish started rapid growth in December or January ; growth ceased on entering fresh water, although the period of heavy feeding and rapid growth for the majority of fish was between spring and mid-August. There were indications that fish of the same smolt age tend to descend to salt water in company and remain together in homogeneous shoals during early sea life. Interesting comparisons are made between these sea trout and those from other districts in Scotland, which point to the fact that the farther north the district the longer the parr life and the later the approach of maturity. In the Ailort district, two-thirds of the smolts migrated after 3 years of river life, and there was a tendency for the older smolts after migration to mature earlier in life than the younger smolts.

Marine Biology in the Pacific.—In publications on " Marine Zoology of the Tropical Central Pacific " (Bernice P. Bishop Museum, Bulletin 26 and 27. *Tanager* Expedition Publications Nos. 1 and 2, 1925) results obtained on the *Tanager* Expedition of 1923–24 are given. This expedition was organised under the auspices of the U.S. Navy, the National Research Council, the U.S. Biological Survey, and the Bernice P. Bishop Museum. A survey was made of the thirteen islands of the Hawaiian group, extending north-east from Kauai to Ocean Island, and also of Johnston and Wake Islands. The work opens with an account by C. H. Edmondson of the Crustacea, in which 12 new species are described and figured and notes on distribution given, including a considerable number of new records for the North Pacific Ocean. W. K. Fisher deals with the sea stars, describing two new species and giving valuable information on the composition and distribution of the fauna. The remaining echinoderms are reported on by H. Lyman Clark. A short account of the polychætous annelids by A. L. Treadwell, with a description of two new species, is included; the specimens were, however, rather few owing to unsuitable methods of collection. This first publication concludes with a chapter by J. A. Cushman on the Foraminifera collected on the expedition. Photographic reproductions of some of the species described in the above articles are given. H. W. Fowler and J. C. Ball describe the fishes of Hawaii, Johnston Island, and Wake Island.

THE CILIATED CELLS OF THE GILL OF MYTILUS.—D. Bhatia has examined the structure of the latero-frontal cells of the gills of Mytilus (*Quar. Jour. Micr. Sci.*, vol. 70, Part 4, Dec. 1926). Between the corresponding cells of American species of Mya, Lampsilis, and Quadrula, Grave and Schmitt (1925) observed inter- and intra-cellular fibrils which they suggested represent paths for the conduction of stimuli from cell to cell and for co-ordination of the epithelium. Bhatia emphasises the importance of careful sectioning of the epithelium so as to display the whole extent of the cell and its intracellular fibrils. Each latero-frontal cell bears a pair of cilia which, as Carter showed, are loosely united. The exposed surface of the epithelium is covered with a continuous gelatinous cuticle with a wavy outline through which the cilia pass at the crests. Each cilium, which has a small microsome at its base where it enters the cytoplasm, *i.e.* immediately below the cuticle, divides into two rootlets, right and left ($r$, $l$, and $r'$, $l'$). The $r$, $r'$ and $l$, $l'$ rootlets gradually converge and near the nucleus fuse to form single fibrils which pass respectively right and left of the nucleus, unite in the base of the cell, and are firmly attached to the subepithelial layer. It is suggested that fibrils described by Grave and Schmitt as connecting adjacent pairs of microsomes are the inner edge of the cuticle. The author, while stating that his observations do not throw any new light on the function of the ciliary rootlets, thinks it is probable that the co-ordination of movement is effected by cell contact rather than by any specialised fibrillar mechanism.

FACTORS OF BIRD MIGRATION.—It has usually been assumed that either food or temperature, or a combination of both, released the migratory instinct; but a recent paper by Prof. William Rowan ("On Photoperiodism, Reproductive Periodicity, and the Annual Migrations of Birds and Certain Fishes," *Proceedings of the Boston Society of Natural History*, vol. 38, No. 6, pp. 147-189) points out that neither of these are of sufficiently regular recurrence to account for the extraordinary accuracy of arrival-date in a number of migrating species. The only environmental factor which would seem to fulfil the necessary conditions is length of daylight; and the bulk of the paper is devoted to a discussion of the possible influence of this. The author's case is of course strengthened by reference to the well-known and important discoveries concerning the influence of day-length upon plants, an influence first properly investigated by Garner and Allard in 1920. If such extraordinary effects upon rate of growth and time of flowering can be exerted by this agency in plants, there is every reason for suspecting that it may be operative in animals also. In birds it might operate directly, or indirectly through length of time available for feeding. In addition to a critical summary and discussion, Rowan refers to the results of his experimental investigations on the subject, of which a preliminary report appeared in NATURE (115, 494; 1925). He has definitely established that an increase of 'day' in autumn, produced by artificial illuminations after dark, will cause precocious growth of gonads (accompanied in the males by song) in the dead of a Canadian winter, in species which normally migrate southwards in early autumn. He has further established that control birds liberated in mid-winter when their gonads were at minimum size do not migrate southwards, while light-exposed birds whose gonads are beginning to enlarge, if liberated at the same time, disappear: one may, with the author, surmise that the light has so upset their normal endocrine equilibrium that they move northwards in spite of the arctic conditions. It therefore appears quite probable that relative length of day and light, acting via the gonads, determines the onset of migration.

LEAF STRUCTURES AND WOUND RESPONSE.—Although the healing of wounds in stems has provided a fruitful subject of investigation for numerous botanists, wound response in the leaf has so far received much less attention, and so it is of considerable interest to read the results of Prof. R. B. Wylie's experiments (*Science*, vol. 65, No. 473, Jan. 21, 1927). He considers that the thin structure of most leaves makes them well fitted morphologically for healing, on account of the comparatively small area of tissue exposed following lesion. Wounds made on leaves by removing circular areas with a punch are first of all closed up by a pseudocicatrice formed mainly from the collapsed thin-walled mesophyll cells damaged in punching. With the collapse of the interior cells, the upper and lower epidermal layers curve over and may even overlap, thus giving the wounded leaf a rounded edge. Certain secretions such as latex, gums, and resins may add efficiency to this preliminary barricade against water loss. One of the functions of the pseudocicatrice is considered by the author to be stimulation of the underlying tissues to the development of the cicatrice proper, which is formed by what corresponds to a phellogen layer developed by tangential divisions immediately behind the pseudocicatrice. Even the highly specialised epidermal layers respond by prompt mitosis, dividing by means of vertical walls only, a phenomenon one would scarcely expect in the very thick and heavily cutinised epidermal cells of sclerophyllous evergreen types. In brief, all cell layers of the leaf blade share in building up new protective tissue, and the cicatrice proper shows greater uniformity of cell size and content than the several cell elements which through mitosis have contributed to its formation. The cell walls in the cicatrice tissue are also usually modified chemically, and very early in its development the presence of lignin can be demonstrated behind the wounded margins. Wound healing may be complete in ten to twenty days, according to the particular species involved.

COMPASS VARIATION IN CANADA.—Bulletin 58 of the Topographical Survey of Canada (price 10 cents) is entitled "The March of the Compass in Canada, and Daily Variation Tables." The author, W. H. Herbert, gives a very interesting and well-written account of the secular change and daily variation of the compass declination, and their importance for all who make use of the compass in practical life. For nearly all the early land surveys in Canada the boundaries were defined in the deeds by compass bearings, and in order to re-trace and re-establish these old boundaries, and to link together old surveys, it is desirable to have trustworthy and accessible information as to the past and present secular variation of declination throughout Canada. The Bulletin, therefore, which is prepared primarily for compass users, gives tables of the declination at 126 well-distributed stations for every tenth year from 1750 onwards (when data are available) to 1900, and thereafter for every fifth year to 1925. At many of the stations the earliest data are for 1820 or 1880. These tables thus indicate the secular variation at the corresponding stations and the regions around them. Tables of the average diurnal variation of declination, which must be taken into account in accurate surveying by compass, are also given for 24 stations for the summer, winter, and equinoctial seasons. Detailed examples of the use of the tables are given. The Bulletin should interest and help all who, for duty or pleasure, have occasion to travel off the beaten track in Canada.

Gold Coast Survey.—The Report of the Survey Department of the Gold Coast for the year 1925–26 shows a record of continued progress in actual field work, in the training of surveyors and draughtsmen and the publication of further sheets of the topographical map. The surveys are now completed of the whole of the Gold Coast Colony, the greater part of Ashanti, and the eastern part of the Northern Territories. During the present year work is on hand in the Northern Territories, the western frontier of Ashanti, and the mandated territory of Togoland. It is of interest to note that the map sheets are now all printed in Accra instead of in Britain. The report includes a layer-coloured map of the southern part of the Gold Coast on a scale of 1 to 500,000, which shows the excellence of the local colour printing and technique.

Heats of Adsorption on Charcoal.—The heats of adsorption of oxygen, chlorine, carbon dioxide, ammonia, ether, chloropicrin, and water on charcoal at 0° have been measured by F. G. Keyes and M. J. Marshall. The ice calorimeter was employed, and the charcoal was contained in an evacuated quartz tube. In every case a large initial adsorption was noticed, which rapidly fell to a constant value with increasing concentration. Interesting conclusions are drawn from the detailed results, which appear in the *Journal of the American Chemical Society* for January 1927. The adsorbed vapour is considered to be in a special state, and only the first layer is directly influenced by the adsorbent. Because of this special state, the first layers form new adsorbing surfaces which adsorb molecules of the same kind. This special state becomes less pronounced with each succeeding layer, and finally a layer is reached in which the molecular arrangement corresponds to ordinary contact.

Propagation of Sound in Wide Pipes.—In the December number of the *Annales de Physique*, M. Th. Vautier describes a repetition of Regnault's classical researches on the propagation of sound in wide pipes. The pipe chosen for these experiments was a conduit intended for water. It was one metre in diameter, made of cast iron, and placed under the pavement of the Cours Gambetta, Lyons. A section of this conduit, of length 1640 metres, was available for the experiments. The ends of the section were closed with wooden planks, and a gap at one end of the section allowed the insertion of recording instruments. The latter consisted either of rubber membranes or suspended mirrors or microphones, which, owing to their inertia, could only be used to register the passage of the waves and not their form. Records of the form of the waves are promised in a later memoir dealing with records obtained by an interferometer method. The source of the sound impulse was a pistol or a powerful spark from an electrostatic machine. Vautier gives numerous oscillograms which indicate the response of the recording apparatus. Reduced to dry air at 0° C., the velocity of sound found in these experiments was $330 \cdot 54 \pm 0 \cdot 5$ metres per second. The value obtained by Regnault with a conduit 1·1 metre in diameter was 330·45 metres per second. The value obtained by Esclangon as the mean of a large number of experiments in the open air carried out during the War, was 330·9 metres per second.

Carbon Assimilation.—In *Scientia*, vol. 41, Feb. 1927, Prof. Walter Stiles gives a lucid and closely reasoned review of the present state of our knowledge and conceptions of the mechanism of carbon assimilation in plants. He considers the conclusions regarding the process of photosynthesis arrived at by various chemical investigators invalid, on the ground that they are based on experiments conducted *in vitro*, and form no criterion of the actual processes going on in the plant amid the complex of physiological factors found in the actual protoplasm itself. So long ago as 1861, Butlerow was able to produce a sugar-containing substance from a derivative of formaldehyde, and there seems no doubt that formaldehyde can be produced from carbon dioxide and water, and sugar from formaldehyde, without the aid of the living green plant, but this constitutes no evidence that the course of synthesis *in vivo* follows on the same lines. Even the theory of Willstätter and Stoll, based on physiological work with living plant material, assumes the formation of formaldehyde as an intermediate product in photosynthesis, though the evidence for the presence of that substance in plants is of a very slim kind. Some considerations are adduced for concluding that the complete photosynthetic process must comprise both a photochemical stage and a 'dark' chemical stage in which light is not involved. Willstätter and Stoll thought the chemical stage was controlled by some enzymatic factor, and there is considerable evidence supporting this hypothesis. The problem of changing radiant energy to chemical energy in the assimilating cell is closely bound up with the function of the four leaf pigments, chlorophyll-*a*, chlorophyll-*b*, carotin, and xanthophyll, but no completely convincing explanation of the rôles of all four pigments has yet been given. While a satisfactory understanding of the mechanism of carbon assimilation is so far non-existent, knowledge on the subject is becoming fuller and clearer, but a complete solution of the problem will require the co-operation of workers in the three fields of botany, chemistry, and physics.

Ultra-violet Therapy Apparatus. — Messrs. Watson and Sons (Electro-medical), Ltd., have issued a new edition of their booklet on "Artificial Sunlight" as Bulletin No. 80. The first 10 pages are devoted to a brief account of the nature of ultra-violet rays, their method of production, and their properties; the remaining 36 pages contain a detailed account of the various sources of artificial sunlight now available. The illustrations are very good, and show how quickly the various medical needs of a technical character are being met by manufacturers. There is scarcely a part of the body for which some special piece of apparatus has not been designed, for the administration of ultra-violet rays to it. The booklet includes also an account of devices for the measurement of the rays when used clinically. There is no unanimity yet as to the best method to be adopted for this purpose, but in the meantime medical men will be glad to know of the selection that does exist.

# Science in Japan.

By Prof. C. Coleridge Farr, Christchurch College, Canterbury, N.Z.

As a delegate from the New Zealand Institute I had the honour and great pleasure to visit Japan on the occasion of the third Pan-Pacific Scientific Congress which was held there in October and November last, and an account of that visit may be of interest. As a physicist, and from a scientific point of view, I confined my attention solely to physics, geophysics, and cognate branches of knowledge; and I must leave other delegates to make such remarks as they may think necessary on the branches of science which interested them. Before dealing with the main subject of this article, however, I desire to make several observations of a general character.

Organisation.—The organisation of the meeting was remarkable for its completeness and thoroughness, and is a great credit to those who had to do with its development. On entering Japanese waters at Nagasaki, a port at least 850 miles from the city of Tokyo, where the meeting was held, we were met by an emissary from the Conference, Dr. Oshima, and from then until the moment of sailing again from the same port four weeks later, we were not without the assistance of honorary guides, who were Japanese gentlemen who could speak English fluently. I believe similar guides met every party arriving from oversea at their port of arrival, and that each party was also 'shepherded' in the same way as we were throughout the tour. The amount of strenuous effort on the part of the guides must have been tremendous. They took control of all the baggage—and I did not hear of a single instance of loss—they made all the necessary arrangements regarding sleeping berths in the trains, they provided meals where the travelling was done in trains which had no dining-car—in fact they saw to all details, and seemed to leave nothing whatever to chance. The benefit of this in a land with a foreign and absolutely unknown language cannot be imagined, and only became apparent to us on those occasions when—breaking away from our guides—we attempted to make our own way about in some of the cities. Progress then, if not impossible, became exceedingly slow. The people one met were courtesy itself but could not understand what we wanted, nor could we understand their answers, and it was therefore necessary to light at length upon some person who did understand something of the language one was speaking.

In all other respects the organisation of the meeting was at an equally high level.

Japanese Courtesy.—Perhaps it may not be out of place to make a few observations upon this delightful feature of Japanese life which impressed itself upon so many of us upon numerous occasions. The Japanese seem—as was stated by a speaker at one of the functions that were held—to be a nation of gentlemen. They appear to be as courteous amongst themselves as they certainly were to us. One could notice the most polite meetings and partings of Japanese who did not know they were being observed. The school children that one met—and they were everywhere to be seen—were friendly and orderly amongst themselves, and prettily responsive to greetings from us. I heard of no unpleasant incident, but I myself had many examples of courtesy which would be exceptional in some other parts of the world. Not once or twice, but many times, have I asked my way to a place from a person who understood what I wanted but whose answer I was unable to comprehend. On every such occasion he would answer, "I will show you," and would go perhaps half a mile out of his way to do so. Or if a *rikisha* or motor-car was available he would call it and give directions to the man. Courtesy seems to be a natural and very pleasant trait in Japanese character.

Scientific Aspects of the Meeting.—If the Congress left anything at all to be desired it was more time for the reading and discussion of papers. In all, some four hundred papers were sent in, which had to be got through in ten days. This necessitated very strict time limits being imposed upon authors and speakers, and it was a very exceptional paper that could be given more than ten minutes. Though no doubt it would be well to have more time, yet such restriction is not so bad as it might seem. Fairly complete abstracts were available, and were often read in place of the paper. These abstracts were printed and distributed on the morning or afternoon that any particular paper came on, and it could thus be seen in advance what the paper was about, and as all the delegates were staying at the same hotel in Tokyo, there were many other opportunities for discussion. It was in the hotel that some of the most valuable discussions took place, between perhaps the author of a paper and others who were interested. It is often the case in scientific meetings such as this, that informal discussions arising out of papers read are more productive of good than the actual hearing of the papers. To appreciate fully the work described by an author in a written paper, it is necessary to read and study the paper, and in physical and mathematical papers it is frequently important to work out anew the author's mathematical reasoning. For this the publication of the paper is essential, and in the present case most, if not all, of the papers read will in due course be published. Thus although the number of papers offered was very large for the time available, yet I think all the delegates felt that this did not militate against the success of the meeting to the extent which it might have been expected to have done by those who were not present. In future meetings it may perhaps be well if a previous censorship of papers is instituted, so that only those of outstanding importance shall be read.

Constitution of the Congress.—Until the present meeting, I believe the meetings of the congress have been conducted without any very definite constitution or by-laws, much being left to the president, and to the discretion of those organising the next forthcoming meeting—that is to say, to the local organising committee at the place of meeting. At the Tokyo meeting, however, a definite constitution and by-laws were drawn up and received the approval of the conference as a whole. By this constitution the name of the conference is now "The Pacific Science Association," and its meetings are to be held at intervals of not less than two or more than five years. The constitution consists of fifteen clauses, of which Clause 4, relating to the constitution of the Council, is probably the most interesting and important from the point of view of the New Zealand Institute. The administrative work of the association is arranged to be carried on by a council of not more than fifteen members, the seats being allotted to 'Countries' of which eleven or twelve are named in the constitution, leaving three or four vacancies for countries that may at some future time desire to come in. The countries so far named are the United States of America, Canada, Australia, France, Great Britain, Hawaii, Japan, Netherlands, Netherlands East Indies, New Zealand, Philippine Islands, and Russia, and these countries are to be represented on the council each by one member, who is to be elected by its National Research Council, or by some other scientific organisation of recognised standing. The scientific bodies thus having electoral powers are named in the constitution, and in the absence at present of a National Research Council, the New Zealand Institute has been named for New Zealand.

Amongst the by-laws, which consist of fourteen articles, there is one (Art. 7) for which perhaps we may be grateful. It provides that the usual language of the congress shall be English.

Visits to Scientific Institutions.—This journey to Japan presented exceptional opportunities for visiting and obtaining information about the activities of any particular scientific institution there in the work of which one might be interested. In most cases visits of a large body of delegates to these institutions was a part of the programme of the Congress, but at such visits the greatness of the numbers present prevented many questions being asked, or much individual attention being given to any particular visitor. They were, however, most valuable, as they showed all who took part in them how much Japan is doing in the cause of science. One had, moreover, only to express a wish to see any particular institution and a more or less private inspection of it was most willingly and most courteously arranged. In this more complete way I was enabled to see some most interesting organisations, the work of some of which will now be referred to.

Aeronautical Research Institute, Tokyo.—This institute is, and always has been, a part of the Imperial University of Tokyo. The first of the ordinances which govern it states that the Aeronautical Research Institute shall be attached to the Tokyo Imperial University, though its present location is some miles from what is actually the Imperial University building. It concerns itself with the investigation of all subjects relating to aeronautics, a term which it wisely interprets in a very broad manner. It is a development of the Investigation Committee on Aeronautics which was founded under the chairmanship of Dr. A. Tanakadate in 1916. The Research Institute dates from 1918, and, like most other Tokyo institutions, was very seriously damaged by the 1923 earthquake. It is, however, rebuilt sufficiently to enable work to be carried on there pending the completion of a much larger and more complete institution at another part of the city. Much might be said about this institution, but here only a few of the points which were most interesting to myself can be referred to. The work of the institute is divided into twelve departments, which are as follows : Physics, chemistry, metallurgy, materials, wind tunnel, aero engines, aircraft, instruments, aeronautical psychology, central library, workshop, and office.

It will be seen that at the head of this list of departments, which is taken as it stands out of a report of the Institute, the fundamental sciences of physics and chemistry are recognised as of the first importance to progress. This is the case in all the Japanese research establishments of this nature, and there are very many of them. Without progress in the fundamental sciences, progress in the applications is impossible. The whole institution is under the general control of Baron Shiba. The liberal staffing of the various departments is worthy of more than passing notice. Thus the physical department has five chief investigators, nine senior assistants, seven junior assistants, and two laboratory attendants. The chemical department has seven chief members, one senior assistant, five junior assistants, and one laboratory attendant. The aero-engine department has eight chief investigators, twelve senior assistants, fifteen junior assistants, and twenty-two laboratory attendants, and so on throughout the whole of the Institute. The subjects under investigation at present are some nineteen in number in the physical department, nine in chemistry, five in metallurgy, two in materials, seven in the wind-tunnel department, thirty-three in the aero-engine department, eleven in the aircraft department, five in the instrument department, and seven in the aeronautical psychology department, making in all about a hundred different subjects which are under investigation in this one Institute of Aeronautical Research alone. Many researches have been completed and have led to results of great value, and one finds amongst these such subjects as the transverse vibrations of elliptic and rectangular plates, the content of helium and other constituents in the natural gases occurring in Japan, and many others. The bearing of the first of the subjects mentioned is of course in connexion with the vibrations of aeroplane wings, and that of the second with the inflation of dirigible balloons. One must visit Japan to realise what is being done in institutions like this ; institutions, that is to say, the whole object of which is research.

It is here and at similar places that every advance in scientific method is examined, and if possible some application of it is made to the practical problems under consideration. The remotely, or seemingly remotely, connected subject of piezo electricity finds a most valuable use in the investigation of the pressure of piston rings and the wearing of cylinder walls. Electric valves find an application here to the examination of the rate of dissemination of the gaseous charge to different parts of the cylinder, and it may be that some alteration in the design of the form of the cylinder from the old cylindrical shape to some other in which the charge is spread more quickly and more uniformly throughout it may result from this work. Very much more could be said about this interesting establishment at which, owing to the courtesy of Baron Shiba, I was able to spend an all too short morning, but it is, after all, only one of many other similar places, and I must refer to some of the others.

The Institute of Physical and Chemical Research.—Perhaps the best way to begin my remarks upon this will be to quote from a pamphlet which was published this year concerning it : " The Institute conducts investigations in the pure sciences of physics and chemistry, aiming at their industrial development, and at the same time engaging in applied research. No undertaking, whether it be in industry or agriculture, would be able to attain sound development unless it was based on physics and chemistry. Particularly in such a densely populated country as Japan, where industrial materials as well as other commodities are not ample, it is essential to aim at the development of industry by having recourse to science, thereby promoting national interests. The object of the institute is to perform this important mission.

" When any physico-chemical applied research is completed in the laboratory it is tested for its industrial applicability, and in case the test shows an appropriate result, arrangement for manufacture is carried out at the Institute ; or the manufacture may be entrusted to others ; or a new company may be established on the basis of a remunerative contract with the Institute, depending upon the nature of the work. At present there are several undertakings that have already existed as industries or are going to exist as such. As the fundamental cause of success in these applied researches lies in there being sound scientific investigations at the back of them, a part of any profit accruing to the Institute is allotted to the investigation expense of pure science and a further part is given as a reward to the inventor or discoverer."

The staff of this institute numbers 384, of whom 216 are directly engaged in the investigations; the number of distinct lines of research pursued is, this year, 171, whilst last year it was 154. The results of the researches are published, very often in the English language, but they do not appear, as a rule, in any of the more generally recognised scientific journals which we see, at any rate in New Zealand.

Glancing through a list of the investigations, one would scarcely realise that this Institute of Physical and Chemical Research is, like the Aeronautical Research Institute, utilitarian in its work. But the Japanese have realised that for the industries to attain a sound development it is an absolute essential that they should be based upon the fundamental sciences of physics and chemistry, and that any advance in these means a hundredfold corresponding advance in the industries and in agriculture. They therefore interpret the charter in the broadest possible spirit, and amongst the 171 distinct investigations in progress in the Institute there are to be found those relating (*a*) to the transmutation of mercury into gold; (*b*) the calculation of mutual and self inductance; (*c*) photo elasticity; (*d*) the manufacture of synthetic *sake*; (*e*) the by-products derivable from waste human hair, and 166 others. The greatest freedom is given to the investigators in their work; they are free to undertake or reject any proposed problem. They are experts in their work, and are treated as such, but they receive some benefit of a financial kind for any practical applications of their work. I had the benefit of spending an afternoon at this most interesting institution, and was most kindly shown round by Prof. Nagaoka, whose scientific reputation is very well known, and by Viscount Okochi, who is the superintendent and director of it.

The time available was of course much too short to appreciate all or nearly all that was going on, and very little of the work could really be seen; but what I did see showed how complete and efficient the methods of investigation were, and what a valuable stream of knowledge is issuing from it.

The Institute was founded only nine years ago and its income is derived from an endowment of more than £600,000, about one-sixth of which was an Imperial gift, a third was a government subsidy, and the other half consisted of contributions from official sources as well as from individuals. The income is now no doubt being augmented by its interest in the rights of some 140 patents which have been obtained as the result of investigations carried out at the establishment.

THE RESEARCH INSTITUTE FOR IRON, STEEL, AND OTHER METALS AT SENDAI.—It is a remarkable thing, and one to be noticed, that many of the 'practical' research institutions of Japan are connected with universities. The Iron and Steel Institute is a part of the Imperial University at Sendai, and the Aeronautical Institute is part of the Imperial University of Tokyo, whilst the Institute of Physical and Chemical Research is closely connected with the Imperial University at Tohoku. This fact becomes more and more impressive the more of these institutions one is able to obtain information about. The Iron and Steel Institute began in a somewhat small way in 1915 to deal with problems arising out of the War, but its scope has been rapidly enlarged, until in 1924 its staff was seemingly about 54 persons, namely, 22 experts and 32 assistants, with Prof. Honda, a man whose reputation has been recognised in Europe for many years, at their head. The research staff consists of twenty members, all of them men of distinction and learning.

Forty-one problems have been the subjects of investigation since September of last year, of which a few may be enumerated, though these are picked at random from the list: (*a*) The viscosity of molten metals and alloys; (*b*) comparative investigation of hardness testers; (*c*) investigation of magnetic sands; (*d*) the effect of sulphur on iron and steel. The Institute publishes its results—or at least some of them—in the *Science Reports* of the Tohoku Imperial University, in European languages, and has thus published in some accessible European language no less than 140 papers. The knowledge contained in these papers must be a very mine of information for those engaged in metallurgical questions, and it speaks most eloquently for the broadness of the view that the Japanese adopt, that they have published these papers in a European language, as indeed they do most of their papers in every institution. In the vast majority of cases the language used in recent years is English.

The regulations with regard to patent rights arising from work done in the Institute are well worthy of study, especially as similar questions will crop up in connexion with the Department of Industrial Research which is about to be established in New Zealand.

THE GEOPHYSICAL LABORATORY AT BEPPU.—This laboratory, which is a part of the Imperial University of Kyoto—though it is several hundred miles from it—has only been established recently. So far, no publications have issued from it, though a good deal of work is in hand. The laboratory is situated in one of the principal hot-spring regions of Japan. The work undertaken there consists of researches into changes of level, temperature, hydrogen and chlorine ion content, and electrical conductivity of the hot-spring waters. Micro-seismographs magnifying fifty thousand times are to be seen there, and the institution is undoubtedly being established at Beppu on a very broad and valuable basis. Indeed, it might form a better model upon which to establish our own proposed vulcanological station than the Hawaiian Vulcanological Observatory. The latter is, perhaps, more concerned with activities of a living volcano, whereas this Geophysical Laboratory is in a region not very unlike Rotorua, although perhaps of rather less activity than Rotorua. Dr. Shida, of the Geophysical Department of the Kyoto University, is in charge of the laboratory, and many of the instruments in use in it are of his own design.

RESEARCH IN JAPAN.—What I have said refers to the institutions that I was able—in the exceedingly short time available—to visit. I am afraid it gives a most imperfect idea of the work that is going on in them, and it certainly gives no idea of the amount of research in progress in Japan. Besides the work at institutions solely intended for research purposes—and to deal at all with these would need a volume rather than a short report—besides these an immense amount of first-class research work is done at the universities themselves. There are forty-five government or municipal research institutions in Japan. As well as these, there are twenty-five other institutions either privately endowed or maintained by business firms (one of these is the Institute of Physical and Chemical Research already referred to), and this number does not include observatories, of which there are many. The average number of research 'experts' employed in these institutions is about twenty, which number does not include those who are classed as 'assistants' and are very much more numerous, probably at least double as many.

The Imperial Universities.—There are six of these, namely, Tokyo, Kyoto, Tohoku (at Sendai), Kyushu at Fukuoka, Hokkaido, and Keijo. There are also other universities, known as private universities. The staffing of these universities is to a New Zealander exceedingly liberal, but it accounts for much that it would be otherwise impossible to explain. The Tokyo University, besides teaching its students, or rather perhaps as an aid to teaching its students, maintains the following institutions: (*a*) The Tokyo Astronomical Observatory; (*b*) the Earthquake Research Institute; (*c*) the Aeronautical Research Institute; (*d*) the Institute for Infectious Diseases; (*e*) the Seismological Institute; (*f*) the Botanic Garden; (*g*) the Marine Biological Station; as well (evidently) as some others.

The Kyoto University has associated with it: (*a*) The Astronomical Observatory; (*b*) the Kamigamo Seismological Station; (*c*) the Beppu Geophysical Laboratory; (*d*) the Seto Marine Station; and (*e*) the Otsu Hydro-Biological Station. These are, of course, in addition to the usual laboratories which are to be found in every modern university.

The general policy and mode of working of these universities can perhaps be seen from considering one department in one of them, and the one I naturally choose is that of physics at Kyoto. The Department of Physics is divided into three sub-departments, namely, (*a*) physics; (*b*) cosmical physics; and (*c*) geophysics. The sub-branch physics has in it four professors, three assistant professors, and two lecturers, and I was informed that there are less than 60 students taking the subject. The sub-branch cosmical physics has two professors and two lecturers. The sub-branch geophysics has three professors, two assistant professors, and nine lecturers. The liberal scale of staffing is thus apparent, and amounts in the sub-branch physics to less than seven students per teacher. The students enter the University at the average age of about twenty-two years. Such a system produces first-class men, and, moreover, so restricts the field of study of the professor or teacher that he is enabled to be really an expert in his branch, rather than a man who perhaps knows something of many branches and knows none of them well.

The cost is of course proportionally high, but that Japan finds that it pays is shown by the figures relating to the Kyoto University, which are taken from the Kyoto University Calendar for 1926. The University is a very modern institution, only boasting twenty-nine years of existence—it was founded in 1897. The cost of it during that year was approximately £5400, whereas during the year 1926 it was £500,000. As there are something a little under 4000 students at the University (in all grades), this cost is about £125 per student per annum at present. In the whole Department of Science in the University of Kyoto there are 85 teachers. To cover the same work in Canterbury College we have about ten teachers. The number of students in this Department in Kyoto is 250, which is probably about what it is in Canterbury College—indeed, it may be more at the latter place.

The same kind of thing holds in every department of all the six Imperial universities of Japan. Japan has realised that the thorough education—specialist education, of course, in every case—of a comparatively few is more the function of the university, and pays the nation better than the cheap sort of education of a great many. Perhaps I may quote from an Imperial ordinance governing universities which was promulgated in 1918. Art. 1 of that ordinance gives a concise statement of the functions of a university as conceived in Japan. It reads: "Universities shall have for their objects the teaching of such sciences, theoretical and practical, as are required for the purposes of the State, and the prosecution of original research in the said sciences; and consideration shall be given to refinement of character with an eye to fostering national ideas." A narrow view of the word "sciences" as used above is not taken, and Art. 2 specifies the departments which may be set up, of which "Literature" is one.

It is no doubt in the spirit of this ordinance that the universities of Japan are such centres of research. They have realised, as some one once put it, that "the function of a university is not to teach," but that it also has the further function of learning as well, and that by learning, teaching is best done. These universities have therefore established such places as the Aeronautical Research Institute and the Beppu Geophysical Laboratory, to which reference has already been made, as well as many other institutions of an analogous sort, and it is to these that the students are drafted as they become more proficient in their work, and they see the work done there as it is done in actual practice, and they advance knowledge at the same time.

In conclusion, I may perhaps refer to an opinion which was expressed to me by one of the Overseas delegates having special knowledge of the interaction of science and industry. He told me that he thought that the organisation of the co-operation of the two is more complete in Japan than in any other of the many countries he has visited (which included England, France, the United States, Czechoslovakia, and Germany), with the exception of one of them, which, so far as I remember, is Germany. Thus the work started in the 'seventies by Ewing and Ayrton and Perry has borne rich fruit for this progressive Empire.

## The Diffusion of Culture.

THE Frazer Lecture was delivered at Cambridge by Dr. R. R. Marett, reader in social anthropology in the University of Oxford, on Mar. 2. Dr. Marett, taking "The Diffusion of Culture" as his subject, dealt chiefly with the views of Prof. Elliot Smith, whether as expressed positively or as implied in the criticism of rival doctrines. Thus as a critic he stigmatised Tylor's animism as mere guess-work which defies the known facts. Again, he regards "The Golden Bough," however learned, as based on a fallacy and as amounting to nonsense because it does not follow the historical method. The reply to these criticisms seems to be that the whole virtue of scientific method consists in being "sufficient unto the day." To require that what may be proved now might just as well have been proved fifty years ago is to ignore the historical conditions that determine movement of thought. In view of the immense stimulus given to research, no less in the field than in the study, by the working hypotheses carefully formulated as such by Tylor and Frazer, it is absurd to accuse them of having laboured in vain. In short, the critic seems to be deficient in that historic sense which he desiderates in others.

Turning from the polemics to the positive tenets of the diffusionist school, Dr. Marett distinguished between the special question of whether Egypt could be shown to be the sole originator of civilisation and the general question whether a diffusionist method is capable of taking entire charge of cultural anthropology. The evidence for and against the claims of Egypt as the cradle-land of civilisation being too vast to consider briefly, Dr. Marett was content to examine a single specimen of the proofs on which Prof. Elliot Smith relies, namely, his contention that the earliest conception of a deity arose out of certain beliefs connecting the cowry shell with the female principle. Here 'earliest' can scarcely mean more than 'earliest known,' in view of the notorious imperfection of the historical record. Even so, it is possible to cite from palæolithic Europe only, a variety of practices of seemingly ceremonial intention suggesting that the idea of deity may have had many other sources than the one alleged. What Prof. Elliot Smith puts forward with assurance is thus at best a more or less plausible hypothesis which needs to be framed with all due reservations and precautions.

As to the all-sufficing efficacy of the diffusionist method, there is uncertainty at this point within the diffusionist school itself, seeing that Dr. Rivers was for assigning the last word in cultural anthropology to psychology, though only after the study of cultural diffusion had been more fully developed. But surely there is a present need of psychological analysis as applied to primitive culture as we meet with it under existing conditions. Diffusionism offers us merely an exterior history of culture, a number of particular events following one on the other without apparent rhyme or reason. Psychology alone can supply the general law or tendency that brings the particular facts into relation. It alone, therefore, can furnish the hypothetical bridge that leads to the discovery of fresh particulars of the same kind by enabling their real character to be recognised. Prof. Elliot Smith can be shown constantly to assume psychological principles in his account of the diffusion of culture; but since he is unconscious of so doing, his psychology is uncritical and, therefore, crude.

Stated temperately and with a due sense of the difficulties, Dr. Marett is of opinion that Prof. Elliot Smith's theory of Egyptian influence deserves the most careful attention. but the present dogmatic assertions of the diffusionist school are out of place.

## University and Educational Intelligence.

CAMBRIDGE.—Prof. J. A. Fleming, Prof. G. F. Stout, and Prof. A. E. H. Love have been elected honorary fellows of St. John's College.

Mr. A. Amos, Downing College, has been reappointed director of the University farm for five years. Various fresh lectureships in mathematics, agriculture, physics, engineering, and economics will be established. Some of these represent steps in completion of the changes from the old conditions to the present ones under the new Statutes.

The report of the Faculty Board of Archæology and Anthropology mentions considerable additions of interest to the collections in the Museum of Ethnology. These include a number of objects of the dolmen age from Portugal and Brittany, presented by Mr. L. C. G. Clarke, English pygmy implements from the Pennine region presented by Mr. F. Buckley, Baron von Hügel's Tongan collection, a magnificent Hindu Indian totem-pole, 45 feet high, and a Kwakintl Indian house-pole in the form of a grizzly bear, presented by Dr. Glaisher, and various bequests already mentioned in these columns.

LONDON.—The title of reader in geometry in the University has been conferred on Mr. J. L. S. Hatton in respect of the post he holds at East London College. Mr. Hatton studied at Hertford College, Oxford, and for two years was demonstrator at the Clarendon Laboratory, Oxford. Since 1896 he has been Principal of East London College and head of the Mathematical Department.

PROF. D. A. GILCHRIST, professor of agriculture at Armstrong College (University of Durham), Newcastle-on-Tyne, and Director of the Northumberland Agricultural Experiment Station at Cockle Park, having reached the age-limit, has resigned. Prof. Gilchrist is best known for his Cockle Park experiments on the use of phosphatic manures and wild white clover for grassland.

THE annual general meeting of the Association of Technical Institutions was held in the Goldsmiths' Hall, London, on Feb. 25-26. The incoming president, Lord Riddell, chose as the subject for a racy address "The Business Climate." He believed that the causes of good and bad trade are just as capable of scientific discovery as are the causes of climatic change; and, in the case of trade, he regarded education and organisation as the means of coming nearer to a state of affairs less charged with uncertainty and error. An important section of the Association's annual report showed that in most institutions there is available a very limited number of books of a technical nature, and, in some cases, what there are appear to be out of date and of no real value. Some six schools reported a provision of £200 per annum for additions and renewals, but in the great majority of institutions the average expenditure is £20-£30 per annum. In order to direct attention to such serious defects in the distribution of technical literature an analysis of questionnaire results was sent to the Association of Special Libraries and Information Bureaux which promoted the reading of a paper dealing with the matter at a recent meeting at Oxford. "The Technical Training of Students for the Worsted and Woollen Industry" (by Prof. E. Midgley); "The Value and Functions of Advisory Committees in Technical Education" (by Mr. G. F. O'Riordan); "The Technical Training of Students for the Cotton Trade" (by Mr. W. Wilkinson): these titles of some of the papers read during the conference will indicate the subjects round which valuable discussion centred. A paper by Mr. J. R. Riddell described excellent work in connexion with training for the printing industry, but was somewhat marred by a singularly imperfect conception of the complementary nature of the contributions to be made to education by industrialists and "well-intending but theoretical educationalists."

IN view of the growing importance of technical education, a paper by Principal J. F. S. Ross, read at the recent meeting of the Association of Technical Institutions, was especially valuable. Dealing with "Some Problems of the Smaller (Technical) Institution," he directed attention to the problem of an institution which has to be staffed by visiting teachers. The method certainly has the advantage of securing specialists who, during the day, are engaged in the trade or profession for which, in the evening, they prepare their students. There are, however, many disadvantages: efficiency and the corporate life of the school are handicapped not because the visiting teacher lacks quality, but because his work is restricted and limited by the essential conditions of his appointment. As part of the solution of the difficulty, Mr. Ross considered that every department of a technical institution which promotes a full-time senior grouped course covering three years should have at least one full-time teacher. The chief obstacle to such an arrangement lies in the present superannuation regulations; but Mr. Ross's paper showed clearly not only the equity of an alteration of these regulations, but also the enhancement of the value of technical education which would result.

## Calendar of Discovery and Invention.

March 13, 1759.—In 1757, Clairaut began his long calculations on Halley's Comet, in which he was afterwards assisted by Lalande. In Nov. 1758 he announced that the comet would reach perihelion on Apr. 13, 1759, though its arrival might differ from this date by so much as a month. The comet reached perihelion on Mar. 13, 1759, the accuracy of Clairaut's prediction being regarded as a brilliant triumph of Newton's theory.

March 13, 1781.—Herschel's great review of the heavens began in 1775 and was carried out mainly with telescopes constructed by himself. On Mar. 13, 1781, while examining some small stars, he discovered what he thought was a comet. Further observations and calculations by himself and others, however, proved the newly discovered body to be a planet to which the name Uranus was given by Bode.

March 14, 1794.—Cotton has been cultivated from the dawn of history. It is mentioned in the Rig Veda hymn, composed fifteen centuries before the Christian era, and the roller gin for cleaning cotton was evolved in India 300 B.C. Roller gins, however, are not suitable for cleaning the 'upland' cotton grown in America, where all cotton was cleaned by hand until the invention of Whitney's gin, patented on Mar. 14, 1794. In 1791, 189,500 pounds of cotton had been exported from the United States; nine years after Whitney's invention the amount exported had grown to 41,000,000 pounds.

March 15, 1816.—The national standard of length in Great Britain up to 1824 was the yard of Elizabeth, kept at the Exchequer, which, said Baily, was such that "a common kitchen poker filed at the ends by the most bungling workman would make as good a standard." Through a resolution of the House of Commons on Mar. 15, 1816, the Royal Society initiated experiments to find the length of a pendulum swinging seconds, one of the objects being to compare British and French standards, and these were the beginning of experiments spread over many years which gave us our present standards.

March 17, 1876.—Kelvin, writing to Andrews of Belfast on Mar. 17, 1876, said: "I have to-day been seeing an exquisite electrical experiment, quite a first-class discovery by Dr. John Kerr." What the discovery was Kerr explained to the British Association that year when he showed that when polarised light is reflected from the end of the core of an electro-magnet, the plane of polarisation is rotated under the influence of the magnet in a direction opposite to the conventional direction of the current. These experiments led to the fundamental researches on electro-optics and magneto-optics of later physicists.

March 18, 1700.—The inauguration of an Academy of Sciences at Berlin, after the plan of the Royal Society of London, was decided upon on Mar. 18, 1700. On July 11 the King, Frederick I., signed the letters patent which made it a State institution and Liebnitz was proclaimed president for life. The King, it is said, gave his consent to please his wife. In 1744 the Academy was re-organised by Frederick the Great, who attracted Euler, Lagrange, and other eminent foreigners to Berlin.

March 19, 1702.—In the *Post Man* of this date appeared an advertisement to the effect that Captain Savery's engine, which raises water by the "force of fire with less expense than any other forces of horses or hands" could be seen at his "Workhouse in Salisbury Court, London, against the old Playhouse." This 'Workhouse,' the first steam-engine factory in the world, was close to St. Bride's Church, Fleet Street.

E. C. S.

## Societies and Academies.

### London

**Royal Society**, Mar. 3.—W. L. Bragg and J. West: The structure of certain silicates. Each series of silicates classified together as a mineral species, although with wide variation in chemical composition, is regarded as based on a characteristic type of oxygen assemblage. A number of structures are based on cubic or hexagonal arrangements of closest packing of oxygen atoms, the metal and silicon atoms being inserted into this framework. The dimensions of the unit cell are related to the fundamental spacings of this simple background of oxygen atoms, on which the complex pattern formed by the other atoms is embroidered. Closest-packing is found for an extended series of compounds, ranging from BeO, $Al_2O_2$, $BeAl_2O_4$, and $MgAl_2O_4$ to cyanite $Al_2SiO_5$, olivine $(Mg, Fe)_2SiO_4$, monticellite $MgCaSiO_4$, and the chondrodite $[(MgOH)_2Mg_3(SiO_4)_2]$ group. The arrangement of oxygen atoms is in general more complex, closest-packing being an exceptionally simple case, but the packing of oxygen atoms seems to remain the predominant feature of the structure.

M. C. Johnson: Doppler effects and intensities of lines in the molecular spectrum of hydrogen positive rays. The luminosity of hydrogen positive rays was examined with apparatus capable of maintaining constant electrical and gas conditions over very long exposures. About 150 lines present in the positive ray spectrum are listed, and also about 100 strong lines conspicuous by their absence. Five lines with Doppler components not before recorded are found, including one displacement to the red. From measurement of the Doppler components in both atomic and molecular spectra, evidence as to the carriers of both is found. Certain lines are carried by $H_2$, and only one is probably carried by $H_3$. The displaced Balmer lines are due to free atoms, not to those newly dissociated. The Fulcher characteristics of the secondary spectrum weaken towards the violet, as also does the ratio of displaced to undisplaced intensities in the Balmer lines. The majority of the secondary lines are due either to radiation or to the impact of positive ions on stationary molecules which have not been recently ionised.

E. Mallett: A vector loci method of treating coupled circuits. If in the first of two coupled circuits an E.M.F. of constant amplitude and variable frequency is introduced, the currents in the primary and secondary respectively may be written $i_1 = e/Z'$ and $i_2 = e/Z''$, where $Z'$ and $Z''$ are complex impedance operators. The loci of these impedances, as $\omega$ is varied, have definite geometrical forms; $Z''$ is a parabola, $Z'$ a cissoid. Current loci are inverse of impedance loci. When the circuit condensers are varied instead of $\omega$, the loci degenerate into straight lines and circles.

H. S. Allen and I. Sandeman: Bands in the secondary spectrum of hydrogen. A band in the secondary spectrum of hydrogen at higher pressures, recently described, comprising a $P$, $Q$, and $R$ combination, was attributed to triatomic hydrogen. It has since been found to be one of a considerable system of bands which occur in groups, the bands of a group being spaced out at intervals of very nearly 92 wave-numbers, the spacing being in some cases approximately constant and in others conforming to a quadratic law. In some cases the lines of the groups are enhanced in the spectrum of the arc in hydrogen at higher pressures. The bands must originate in molecules with large moments of inertia, probably active or triatomic hydrogen.

C. G. Darwin and W. H. Watson: The constants of the magnetic dispersion of light. A review of various dispersion formulæ for the magnetic rotation of light shows the great practical advantage of Becquerel's, which determines an effective $e/m$ from a comparison of the rotation with the refractive index. This formula is applied to all transparent substances for which the rotation has been measured; it is shown that no other theoretically possible terms are needed to represent the rotation. For hydrogen gas the ratio is unity, for all other observed substances less, ranging for the most part between 40 and 80 per cent. The only exceptional substance is oxygen gas, which completely refuses to fit any reasonably probable formula.

Royal Microscopical Society, Jan. 19.—James A. Murray: Nuclear degenerations due to multipolar mitosis (Presidential address). Personal recollections were given of the late Prof. Theodor Boveri, on whose material of disperm echinoderm eggs the investigations were carried out. A number of characteristic nuclear degenerations occur at a later stage of development in echinoderm eggs which have been fertilised by two spermatozoa and in which the first segmentation division is tri- or quadri-polar. The commonest form of degeneration involves a separation of the chromatin and achromatic parts of the nucleus with progressive condensation of the chromatin. Rarer forms of degeneration similar to the formation of chromidia and to the synaptic figures of gematogenesis may be of theoretical importance. Some of the commoner forms of degeneration could be recognised in tumour-like proliferations of lymphoid tissue in the mouse.

Society of Public Analysts, Feb. 2.—T. Hedley Barry: Arsenic in printing ink. Most of the printing-ink pigments contain arsenic, and it is possible to classify them into three groups on the basis of the amounts of arsenic present. A limit of 1 part of arsenic in 50,000 of the ink pigment should satisfy the most stringent requirements of health authorities; but this mode of expression is unsatisfactory, and it would be preferable to fix a limit of arsenic per unit area of the printed paper or wrapping.—G. D. Elsdon and J. R. Stubbs: The immersion refractometer and its value in the analysis of milk. The refraction of a milk serum apparently changes with two factors—the percentage of solids-not-fat, and the acidity of the milk. The decreased refraction due to added water may be entirely masked by the souring of the milk; up to 10 per cent. of added water may be entirely overlooked in this way. The examination of about one thousand mixed milks with a Zeiss immersion refractometer shows that the average refraction for milk serum, when the copper sulphate method is used, is about 38·3 scale divisions in the case of commercially fresh milks. The method offers no advantage over the usual determinations.—Paul Haas and Barbara Russell-Wells: Irish moss mucilage and a method for its determination. Irish moss, or carrageen mucilage, consists of a mixture of two ethereal sulphates. These can be determined by precipitation with benzidine chloride and titration of the washed precipitate with standard sodium hydroxide solution. Free sulphates, if present, are first precipitated by adding excess of barium chloride. The method can be used in the presence of gelatin, gum arabic, agar-agar, and fruit pectins.

Optical Society, Feb. 10.—T. Smith: Some uncultivated optical fields (Presidential address): (1) A graphical method, by which the properties of an optical system over the whole image field may be explored rapidly and with useful accuracy, is developed. The method is recommended for the investigation of 'best form' spectacle lenses, and for the preliminary exploration of new forms of photographic lenses. (2) The use of the characteristic function in the design of optical systems is discussed, and it is shown that it is always possible to construct such functions for optical systems having surfaces of any given shape. The optics of the future is likely to depend essentially on the use of the characteristic function. (3) The balancing of aberrations is also discussed. (4) As a special application of these methods it should be possible to design optical systems by calculations on equivalent lenses which are 'thin' in the usual sense. For the actual construction the equivalent 'narrow' lenses, or lenses which are just thick enough to attain the required aperture and strong enough to withstand treatment in manufacture, would be used. The correlation of the properties of 'thin' and 'narrow' lenses should prove a fruitful field.

### DUBLIN.

Royal Irish Academy, Jan. 24.—G. H. Carpenter: Further records of Collembola from Spitsbergen. The paper comprises the results of the collecting and observational work done by members of the Merton College Expedition of 1923 and the Oxford University Arctic Expedition of 1924. The Collembola described were, for the most part, obtained from the far northern coast of the West Island and from the shores and islets of Hinlopen Strait between the West Island and North-east Land; the abundance of several species enduring the severe climate of this district is remarkable. *Isotoma olivacea* Tullb., found above the shore of Green Harbour, Icefjord, is an addition to the recorded Spitsbergen fauna, and a three-spined form of the common *Achorutes longispinus* Tullb. is noteworthy.

Feb. 14.—A. W. Stelfox: The Aculeate Hymenoptera of Ireland. The insects are grouped under the four super-families Apoidea, Sphecoidea, Vespoidea (including the Chrysididæ and Bethylidæ) and Formicoidea. A hundred and seventy-one species are definitely recorded as found in Ireland, and notes of their habits are given. Many of the commonest of British aculeates are absent from Ireland.

### PARIS.

Academy of Sciences, Jan. 31.—E. Fichot: The relation between the maximum velocity of the current and the amplitude of the tide.—Paul Pascal was elected a Correspondant of the Academy for the section of chemistry.—Bertrand Gambier: Surfaces which are not surfaces of revolution and have their geodesics closed.—Henri Labrouste: The analysis of the curves resulting from the superposition of sinusoids.—S. A. Janczewski: The theorems of oscillation of the regular problems of Sturm for ordinary linear differential equations of the fourth order.—Walter Saxer: Quasi-exceptional meromorph functions.—R. Gosse: W surfaces and surfaces of constant curvature.—Beniamino Segre: The integration of a certain system of differential equations.—Nikola Obrechkoff: The singular points of analytical functions.—Louis de Broglie: The atomic structure of matter and radiation and undulatory mechanics.—P. Dupont: The application of conjugated vortices to the aerodynamics of the circle and its profiles.—R. Wavre: The heterogeneous fluid mass in rotation and the internal movements of the planets.—P. Helbronner: The measurement of an arc of meridian of 8° amplitude, comprised between the north of the Jura and the south of Sardinia.—Mlle. M. Hanot: The enlargement of the Balmer lines by the intermolecular electric field. The widening of the lines is probably due to the Stark effect of the intermolecular field. According to the calculations of Holtomark, the width of the line should be proportional to $n^{\frac{2}{3}}$, $n$ being the density of the ions. Experimental confirmation of this is given, at least approximately.—A. Gargam de Moncetz: The chemical actions of radiations. Remarks on recent communications on this subject by H. Belliot and by P. Villard. Reference is made to results of experiments published by the author in 1908 and 1909.—L. Meunier and G. Rey: The determination of the isoelectric point of wool and silk. Applications.—M. Wilmet: The sensibility of some reagents to gaseous hydrogen sulphide.—Auguste Lumière and Félix Perrin: A new organometallic derivative of gold. A solution of sodium thiopropanolsulphonate is mixed with a concentrated auric chloride solution, when the new salt is precipitated. Its therapeutic application is suggested.—Emile Saillard: The coloration of products of the sugar factory.—Ph. Joyet-Lavergne: The action of osmic acid and the physico-chemical characters of the sexualisation of the cytoplasm.—Joseph Devaux: The existence and localisation of vertical ascending air currents in the neighbourhood of the Pic du Midi: their utilisation by vultures.—G. Ollivier: A Ceramium containing *bromuques*.—L. Mercier and J. Villeneuve: The controlling muscles of the lunule in *Eristalis tenax*. Sexual dimorphism.—P. Vignon: The ancestral origins of the dragon fly.—Mlle. S. Perle: The origin of the first genital outline in *Bufo vulgaris*.—G. Athanassopoulos: Certain migrations of eels in Greece.—S. Posternak: The phosphorus-containing nucleus of casein.

### Brussels.

Royal Academy of Belgium, July 3.—P. Bruylants and A. Dewael: Contribution to the study of the action of organo-magnesium compounds on nitriles. Glutaronitrile and magnesium-benzyl-chloride. This reaction differs from that between the same nitrile and magnesium-phenyl-bromide: the product would appear to be a cyclic amidine.—Edm. van Aubel: The calculation of the refractive indices of mixtures and the formulæ of Dieterici and Lichtenecker. These two formulæ are applied to published data on mixtures of acetone-water, and sulphuric acid-water, and the Dieterici formula is shown to agree better with the experimental results for these two mixtures.—P. Fourmarier: Observations on the age of the sedimentary strata of the Belgian Congo exterior to the Lualaba system.—Th. De Donder and Fr. H. van den Dungen: The quantification of relativistic systems.—A. Castille: The ultra-violet absorption spectra of some substances with two benzene nuclei.—G. Van Lerberghe: The velocity of physico-chemical transformations.—Lucien Godeaux: A double plane of genus zero and bigenus one.—L. Vuylsteke: Contribution to the study of the reaction between organo-magnesium compounds and nitriles. Dimethylcyanamide.—Désiré Tits: The action of amino-acids on the germination of *Phycomyces nitens*.

Aug. 7.—Edm. van Aubel: The thermoelectric power of alloys. Experimental study of bismuth-thallium, antimony-tin, and antimony-silver alloys, from the point of view of the variation of the thermo-electromotive force with the percentage composition of the alloy. The curve of the bismuth-thallium alloys shows one definite compound, $Bi_5Tl_3$. The antimony-tin curve shows two discontinuities, corresponding to definite compounds $Sb_2Sn_3$ and SbSn, and $Ag_3Sb$ is shown on the antimony-silver curves.—J. E. Verschaffelt: The variation of surface tension with temperature. The theoretical conclusions deduced by Van der Waals on the variations of the surface tension with temperature in the neighbourhood of the critical temperature are not in agreement with experiment. Van der Waals has assumed a perfect continuity of the equation of state in the neighbourhood of the critical point, and as this assumption is regarded as not legitimate, an alternative proof not assuming this continuity is given. The resulting equation is in fair agreement with experimental results.—Victor and Laure Willem: The influence of the respiratory movements on the cardiac pulsation in teleostean fishes.—R. Moens and H. Steffens: The thermionic phenomena in a magnetic field. The action of the magnetic field is shown by experiment to diminish the plate current and retard saturation.—G. Homès: Various energy balances of the Maxwell field plunged in a Minkowski field.—G. Balasse and O. Goche: The luminescence spectrum of cæsium produced in the discharge without electrodes.—A. Piccard and E. Stahel: The realisation of the Michelson experiment in a free balloon. The experimental error was of the same order as the positive results obtained, so that no definite conclusion can be drawn.

### Rome.

Royal Academy of the Lincei, Dec. 19.—E. Paternò: The transmutation of the elements.—S. Baglioni, L. Bracaloni, and A. Galamini: Investigations on the physiological action of alcohol: the alcohol content of the blood of a fasting man following ingestion of alcoholic liquors. The curve showing the relation between the proportion of alcohol in the blood and the tissue since the alcoholic drink was taken varies greatly in form according as the subject of the experiment is or is not a habitual drinker. With the latter the maximum amount of alcohol in the blood is always reached, and this alcohol is dispersed, more rapidly than is the case with an abstainer. The subjective phenomena (drowsiness, incipient drunkenness, etc.) are related directly to the concentration of the alcohol in circulation in any one individual, and inversely to the rapidity with which, in different individuals, the alcohol disappears from the blood.—E. Bortolotti: Conform representations, and a new physical interpretation of Levi-Civita's parallelism.—L. Fantappiè: The theory of analytical functions in the integration of linear equations with partial derivatives of any order.—A. Weinstein: The analytical representation of certain aperiodic movements.—G. Rossi: The scintillation of the stars. A historical résumé is given as a preface to a description of experimental work.—A. Carrelli: The paramagnetism of the elements between calcium and zinc. As with the rare elements, so also with the elements constituting the group between calcium and zinc, spectroscopic data indicate a double period of variation in the number of magnetons as a function of the atomic number.—G. Scagliarini: Additive compounds of salts of quadri- and bi-valent elements with organic bases: probable nature of the secondary valencies.—F. De Carli: Reactivity of manganese dioxide in the solid state. Mixtures of manganese dioxide with the alkaline earths undergo exothermic reactions, which begin at comparatively low temperatures, namely, 150-250°; the mixture with cuprous oxide commences at 380° and that with stannous oxide at 180°. The oxidation of the dioxide is influenced by lead peroxide and by various anhydridic metallic oxides.—M. Salfi: Biology of *Clavelina lepadiformis* (Müller).—E. Remotti: Phenomena accompanying the crisis of sexual maturation of Gambusia. As regards oxidation processes, sexually immature forms of Gambusia exhibit uniform behaviour, interrupted only by the advent of sexual maturation, which acts differently in the two sexes.

## Official Publications Received.

BRITISH.

The Ninety-third Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 5, Part 4, 1926. Pp. xliv-lviii+294-378+19+viii. (Falmouth.) 5s.

The South-Eastern Naturalist: being the Thirty-first volume of Transactions of the South-Eastern Union of Scientific Societies; including the Proceedings at the Thirty-first Annual Congress, held at Colchester, 1926. Edited by A. F. Ravenshear. Pp. ci+81. (London.) 5s. net.

Natural History Magazine. Vol. 1, No. 1, January. Pp. vi+32. (London: British Museum (Natural History).) 1s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 30: *Caninia cylindrica* Scouler and other large *Caninias* from the Carboniferous Limestone of Ireland. By Herbert P. Lewis. Pp. 373-382+2 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

Memorandum on Rivers Pollution submitted to the Right Hon. the Prime Minister by a Joint Committee of the British Waterworks Association and the Salmon and Trout Association (Supported by other Bodies). Appendix: Review of Recommendations of Royal Commissions, etc. Pp. 23. (London: British Waterworks Association.)

Proceedings of the National Laboratory of Psychical Research. Vol. 1, Part 1, January. Pp. 63+5 plates. (London.) 3s. 6d. net.

Proceedings of the Royal Society of Edinburgh, Session 1925-1926. Vol. 46, Part 4, No. 30: Experiments and Observations on Crustacea. Part vii: Some Structural and Physiological Features of the Valviferous Isopod Chiridotea. By Dr. John Tait. Pp. 334-348. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s. 3d.

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 5, January 31. Pp. 493-615. (Cambridge: At the University Press.) 7s. 6d. net.

Hampstead Scientific Society. Report of the Council and Proceedings, with a List of the Members, for the period October 1924 to September 1926. Pp. 62. (London.)

Records of the Survey of India, Vol. 21. 1: Air-Survey in the Irrawaddy Delta, 1923-24, by Major C. G. Lewis; 2: Reconnaissance Survey in Bhutan and South Tibet, 1922, by Captain H. R. C. Meade. (Published under the Direction of Col.-Comdt. E. A. Tandy, Surveyor-General of India.) Pp. iii+49+3 plates+2 maps. (Dehra Dun.) 1.8 rupees; 2s. 6d.

Report of the Seventeenth Meeting of the Australasian Association for the Advancement of Science, Australia and New Zealand, Adelaide Meeting, August 1924. Edited by L. Keith Ward. Pp. xliii+770. (Sydney, N.S.W.: Australasian Association; Adelaide: R. E. E. Rogers.)

Transactions of the Optical Society. Vol. 28, No. 1, 1926-27. Pp. ii+44. (London: Optical Society, Imperial College of Science.) 10s.

British Museum (Natural History), Cromwell Road, London, S.W.7. Summary Guide to the Exhibition Galleries. Third edition. Pp. 16. (London.) 3d.

Proceedings of the University of Durham Philosophical Society. Vol. 7, Part 3, 1925-1926. Pp. 107-163. (Durham.) 5s.

Agricultural Progress: the Journal of the Agricultural Education Association. Vol. 4, 1927. Pp. 136. (London: Ernest Benn, Ltd.) 5s. net.

List of the Officers and Fellows of the Chemical Society: Corrected to August 31st, 1925. Pp. 185. (London.)

Aeronautical Research Committee: Reports and Memoranda. No. 1048 (Ae.234): Slot and Aileron Control on a Wing of R.A.F. 31 Section with various Types of Ailerons. By F. B. Bradfield and A. S. Hartshorn. (A.2.a. Stability Calculations and Model Experiments, 113.—T. 2294.) Pp. 16+10 plates. 1s. net. No. 1052 (Ae.237): Full Scale and Model Measurements of Lift and Drag of Bristol Fighter with R.A.F. 30 Wings. Part i: Full Scale; Part ii: Model Experiments; Part iii: Comparison of Model and Full Scale Results. By A. E. Woodward Nutt, Dr. R. G. Harris and L. E. Caygill. (A.3.a. Aerofoils-General, 166.—T. 2322.) Pp. 6+9 plates. 6d. net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 31: Studies on Peat. Part ii: Distillation under Reduced Pressure of certain Constituents of Peat. By Dr. Joseph Reilly and Joan Sullivan. Pp. 383-388. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

The Journal of the Institution of Electrical Engineers. Vol. 65, No. 362, February. Pp. 185-296+xxviii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 17, 18, 19, February. 17: The Production of Essential Oils from Irish-grown Plants. Part ii: The Cultivation of *Mentha piperita*, and further Experiments on the Winning of Lavender Oil, by Dr. Joseph Reilly and Dr. Connell Boyle; 18: The Production of Essential Oils from Irish-grown Plants. Part iii: Oil of Peppermint. By Dr. Joseph Reilly and Dr. John Taylor; 19: The Production of Essential Oils from Irish-grown Plants. Part iv: Note on Oil of Camomile. By Dr. Joseph Reilly and Peter J. Drumm. Pp. 285-301. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

FOREIGN.

Publications of the National Academy of Sciences of the United States of America (1915-1926). Part i: Index to the First Ten Volumes of the Proceedings (1915-1924); Part ii: List of other Publications of the Academy from 1863-1926; Part iii: List of Publications of the National Research Council from 1916-1925. (Vol. 13, No. 1, Part 2, January 1927, Proceedings of the National Academy of Sciences.) Pp. 197. (Washington, D.C.) 1.50 dollars.

Carnegie Institution of Washington. Year Book No. 25, July 1, 1925, to June 30, 1926; with Administrative Reports through December 10, 1926. Pp. xix+451. (Washington, D.C.: Carnegie Institution.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 366: Isostatic Condition of the United States as indicated by Groups of Gravity Stations. By William Bowie. Pp. ii+11. (Washington, D.C.: Government Printing Office.) 5 cents.

New Dynamical Wave-Theory of the Tides: Discovery of the Physical Cause of the Variation of Latitude, with Calculation of the Period and Amplitude of the Polar Motion, from the observed Oscillations of the Unsymmetrically situated Ocean Hemisphere, including a revised Cotidal Map of the Oceans, now shown to be Oscillating in Synchronous World-Waves coperiodic with the Disturbing Forces, Laplace's Principle, together with an Investigation of other Laws of the Motion of the Sea hitherto unknown, and an Improved Method for Calculating the Rigidity of the Earth. (H.O. No. 207.) (Published and Sold by the Hydrographic Office under the Authority of the Secretary of the Navy.) Pp. iii+91. (Washington, D.C.: Government Printing Office.) 60 cents.

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1926. (Publication 2877.) Pp. vi+135. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 78, No. 3: The Classification and Distribution of the Pit River Indian Tribes of California. (E. H. Harriman Fund.) By Dr. C. Hart Merriam. (Publication 2874.) Pp. 52+27 plates. (Washington, D.C.: Smithsonian Institution.)

Annual Report of the Director, United States Coast and Geodetic Survey, to the Secretary of Commerce for the Fiscal Year ended June 30, 1926. Pp. iv+60+16 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, Vol. 23, Part 5: Trees and Shrubs of Mexico (Bignoniaceae-Asteraceae). By Paul C. Standley. Pp. ii+1313-1721. 50 cents. Bulletin 134: Material Culture of the People of South-eastern Panama, based on Specimens in the United States National Museum. By Herbert W. Krieger. Pp. v+141+37 plates. 40 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Fisheries. Document No. 968: Plankton of the Offshore Waters of the Gulf of Maine. By Henry B. Bigelow. Pp. 509+20 plates. (Washington, D.C.: Government Printing Office.)

State of Connecticut. Public Document No. 24: Forty-ninth Report of the Connecticut Agricultural Experiment Station, New Haven, Conn., for the year 1925. Pp. 721+26 plates+93T+xxxv. Public Document No. 47: State Geological and Natural History Survey. Volume 7, Bulletins 33-35, 1923-1925. Pp. 70+8 plates+807+20 plates+17. (Hartford, Conn.: State Library.)

## Diary of Societies.

*SATURDAY*, MARCH 12.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Bath), at 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. J. B. McEwen: Beethoven (3).

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (at Newcastle-upon-Tyne), at 3.—The following paper will be read:—W. Britton: Systems of Conveying.—The following papers will be open for further discussion:—Screening and Washing Plant at Deaf Hill Colliery, by L. F. H. Booth; Steam and Electric Locomotives for Colliery Purposes, by P. F. Hope; Winning Thin Seams of Great Britain, by W. Leebetter; Dry Cleaning of Coal, by J. S. Carson.

*MONDAY*, MARCH 14.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Prof. G. I. Taylor: An Experiment on the Stability of Superposed Streams of Fluid.—Dr. C. D. Ellis and W. A. Wooster: The Absolute Intensities of the $\gamma$-rays of Radium B and Radium C.—P. M. S. Blackett: The Limits of Classical Scattering.—J. A. Gaunt: The Stopping Powers of Hydrogen Atoms for $\alpha$ Particles according to the New Mechanics.—L. H. Martin: Absorption Coefficients for X-rays.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Sir Alfred Ewing: Exhibition of some of his Models illustrating the Molecular Process in Ferromagnetic Induction, which have been prepared for the Historical Collection in the South Kensington Museum.—Prof. J. H. Ashworth: The Distribution of Anopheline Mosquitoes in Scotland.—A. D. Hobson: Study of the Fertilisation Membrane in the Echinoderms.—*To be read by title*:—W. L. Calderwood: Note on the Salmon of the R. Grand Cascapedea, Canada.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Prof. W. E. Soothill: Chinese Cartography.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Peoples of the East: Past and Present (6). Evidence bearing on the Distribution of Racial Types in Southern and Western Asia in Past Times.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham and Wolverhampton Centres) (at Chamber of Commerce, Birmingham), at 7.—A. P. Young and L. Griffiths: The High-Tension Magneto, with especial reference to its Design, Manufacture, and Service.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Meeting) (at the College, Loughborough), at 7.—C. Legge: Modern Motor Cycle Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—F. H. Clough: The Stability of Large Power Systems.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—E. F. Cordell: Efficiency of the Repair Shop.

INSTITUTE OF METALS (Scottish Local Section) (Annual General Meeting) (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. W. Tyrrell: Moulding Sands.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. Robertson: Modern French Architecture.

ROYAL SOCIETY OF ARTS, at 8.—G. I. Finch: Some Industrial Applications of Electrothermics (Cantor Lectures) (1).

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Exeter).—R. B. Mitchell: Home Lighting.

MEDICAL SOCIETY OF LONDON.—Dr. J. Forestier: Demonstration of Lipiodol Injections.

*TUESDAY*, MARCH 15.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Prof. F. R. Fraser: Cardiac Dyspnœa (Goulstonian Lectures) (2).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. Shearer: X-rays and the Chemical Molecule (1).
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Sir Alfred Watson: National Health Insurance: a Statistical Review.
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
MINERALOGICAL SOCIETY, at 5.30.—C. E. Tilley: A Melilite-spurrite-$Ca_2SiO_4$ Assemblage from Larne (Antrim).—G. Greenwood: Rotating Crystal X-ray Photographs.—Dr. G. T. Prior: Alkaline Rocks from Nimrud Volcano, Armenia.
LONDON NATURAL HISTORY SOCIETY (at 40 Winchester House, E.C.), at 6.30.—Dr. E. J. Salisbury: Woodland Vegetation.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—R. N. Speaight: Home Portraiture in Many Lands.
INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Municipal College, Burnley), at 7.15.—A. Buck: The Mixing of Cast Iron, with special reference to Carbon, Silicon, Phosphorus, Manganese, and Sulphur.
ROYAL SOCIETY OF MEDICINE (Pathology Section) (Annual General Meeting), at 8.30.

*WEDNESDAY*, MARCH 16.

ROYAL IRISH ACADEMY, at 4.15.
ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. H. Carlill: The Simulation of Surgical Affections by Hysteria.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—Prof. J. C. Drummond: Bio-chemical Aspects of the Nature of Life.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30. — F. C. Jordan: Fire-Protection in Buildings, with special reference to Reinforced-Concrete Construction and Automatic Sprinklers.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (Wireless Sub-section Meeting) (at University, Birmingham), at 7.—C. Robinson: Characteristics of Audio-frequency Amplifiers used in Telephonic Repeaters.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Dr. W. H. Eccles: Address.
MERSEYSIDE AQUARIUM SOCIETY, at 7.30.—F. Jefferies: Aquatic Plants.
ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Prof. G. I. Taylor: Turbulence (G. J. Symons Memorial Lecture).
ROYAL SOCIETY OF ARTS, at 8.—Dr. R. E. M. Wheeler: History by Excavation.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Major R. W. G. Hingston: Protective Devices in Spiders' Snares.
FOLK-LORE SOCIETY (at University College), at 8.—Exhibits and Short Communications.
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB, at 8.15.—Prof. H. E. Armstrong: The Failure of our Universities and their Future.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Swansea Technical College).—E. A. Tyler: Further Notes on Pure Chemicals.
INSTITUTE OF CHEMISTRY (London Section).
SOCIETY OF GLASS TECHNOLOGY (at Birmingham).

*THURSDAY*, MARCH 17.

ROYAL SOCIETY, at 4.30.—Prof. W. L. Bragg and J. West: The Structure of Certain Silicates.—W. A. Wooster: The Analysis of Beams of Moving Charged Particles by a Magnetic Field.—J. F. Spencer and E. M. John: The Magnetic Susceptibility of some Binary Alloys.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Prof. F. R. Fraser: Cardiac Dyspnœa (Goulstonian Lectures) (3).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15. — J. Guild: Colour Measurement and Standardisation (1).
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. R. Rees: Completion of the Education of the Parent.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6. —Prof. W. M. Thornton: What is Electricity? (Faraday Lecture).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—M. A. Giblett: Line Squalls.
INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—C. E. Barrs: The Works Chemist.
CHEMICAL SOCIETY, at 8.—F. G. Mann: Tetrachloro-(triaminopropane γ-monohydrochloride) platinum, a New Type of Optically Active Complex Salt.
C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—A. S. E. Ackermann: Popular Fallacies connected with Birth Control.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at Royal Army Medical College), at 8.15.—Demonstrations by Drs. S. Adler, A. Balfour, Maj. J. S. K. Boyd, Maj. C. R. Chadwick, C. MacHattie, C. A. Hoare, Drs. Saiki, E. C. Smith, H. H. Scott, A. C. Stevenson, C. M. Wenyon, Prof. Warrington Yorke, and Dr. A. R. D. Adams.
SOCIETY OF GLASS TECHNOLOGY (at Birmingham).

*FRIDAY*, MARCH 18.

BIOCHEMICAL SOCIETY (Annual General Meeting) (at University College), at 4.30.—B. Holmes and E. Holmes: Carbohydrate Metabolism of the Brains of Normal and Diabetic Animals.—P. Eggleton and M. G. Eggleton: Phosphagen.—C. Rimington and H. D. Kay: The Phosphorus of Caseinogen.—Dr. R. K. Cannan and B. C. J. G. Knight: Observations on the Sulphydryl-disulphide System. — L. C. Baker and G. F. Marrian: Estimation of Adrenaline.—L. C. Baker, G. F. Marrian, and Prof. J. C. Drummond: Observations on the Adrenals of Rats with relation to Vitamin B.—S. Kon and Prof. J. C. Drummond: The Relation of Vitamin B Deficiency to Inanition in the Pigeon.—A. Hassan and Prof. J. C. Drummond: The Relation of certain Dietary Factors in Yeast to Growth on Diets rich in Protein.—H. J. Channon and A. C. Chibnall: The Presence of Calcium Salts of Glyceridephosphoric Acids in the Ether Extract of Cabbage Leaf Cytoplasm.—O. Rosenheim: Some Sterol Colour Reactions in their Relation to Vitamin A.—M. H. Roscoe: Some Observations on the Dual Nature of Vitamin B.—R. V. Stanford: (*a*) A Simple Automatic Apparatus for the Rapid, Quantitative Removal of Ammonia from Solutions; (*b*) The Pulsating Bubble: A Device for Preventing 'Bumping' in Boiling Liquids.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—R. St. Leger Brockman: The Toxæmia of Acute Intestinal Obstruction.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 6. — D. M. Shannon: Development of the Fiat Marine Oil Engine.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—F. E. Robinson: Some Aspects of Workshop Organisation.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group Meeting), at 7.—W. Thomas: Portraiture by Flashlight.
PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—Members' Evening.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Calderwood: An Investigation of Tortional Vibration, with particular reference to Aircraft Engines.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—E. Hatschek: Rigidity and other Anomalies in Colloidal Solutions.
INSTITUTION OF CHEMICAL ENGINEERS (jointly with Coventry Engineering Society, and Society of Chemical Industry, Chemical Engineering Group) (at Coventry).—Prof. J. W. Hinchley: The Importance of Chemistry to the Engineer.

*SATURDAY*, MARCH 19.

GEOLOGISTS' ASSOCIATION (in Department of Anatomy, University College), at 2.30.—Prof. G. Elliot Smith: Demonstration of Fossil Remains of Man.
ASSOCIATION OF MINING ELECTRICAL ENGINEERS (North of England Branch), at 3.—C. D. le Maistre: Standardisation of Colliery Electrical Requisites.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Alpha Rays and their Application to Atomic Structure.
PHYSIOLOGICAL SOCIETY (at University College).—Annual General Meeting.

## PUBLIC LECTURES.

*SATURDAY*, MARCH 12.

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

*SUNDAY*, MARCH 13.

GUILDHOUSE (Eccleston Square), at 3.30.—Major W. Tudor Pole: Universalism in Religion, with special reference to the Bahai Faith.

*MONDAY*, MARCH 14.

UNIVERSITY OF LEEDS, at 8.—Sir Bernard Pares: Present-Day Russia.
UNIVERSITY COLLEGE, at 8.30. — Sir Oliver Lodge: A Century's Progress in Physics (Centenary Address).

*THURSDAY*, MARCH 17.

KING'S COLLEGE, at 5.30.—Prof. L. T. Hobhouse: The Mind: Sociology.
UNIVERSITY COLLEGE, at 5.30.—Prof. J. Chevalier: Idéalisme et Réalisme. Le Français est-il Idéaliste? Est-il Réaliste?

*SATURDAY*, MARCH 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Animal Growth and Evolution.

## CELEBRATION.

MARCH 18 TO 20.

MATHEMATICAL ASSOCIATION (Yorkshire Branch) (at Grantham).—The Two-Hundredth Anniversary of the Death of Sir Isaac Newton.
*March* 18, at 8.—Civic Reception by the Mayor of Grantham at the Guildhall, Grantham.
*March* 19, at 10 A.M.—Bicentenary Scientific Meeting in the Old School, King's School, Grantham, with addresses by:—
Sir J. J. Thomson: Newton's Work in Physics.
Sir F. Dyson: Newton's Work in Astronomy.
Dr. H. Lamb: Newton's Work in Mechanics.
Prof. G. H. Hardy: Newton's Work in Pure Mathematics.
Dr. J. H. Jeans will preside and give an address on Isaac Newton.
At 2.—Pilgrimage to Woolsthorpe Manor House (Newton's birth-place) and visit to Stoke Rochford, where Mr. C. Turnor will speak on Newton's Countryside.—At 7.30.—Celebration Dinner at the George Hotel, Grantham. Chairman: Sir J. J. Thomson. Speakers: Prof. H. H. Turner, Prof. E. T. Whittaker, the Bishop of Birmingham, and the Bishop of Lincoln.
*March* 20, at 11.15 A.M.—Bicentenary Service at the Parish Church, Grantham. Preacher—The Bishop of Birmingham.

## CONGRESSES.

APRIL 20 TO 24.

JOURNÉES MÉDICALES MARSEILLAISES ET COLONIALES (at Marseilles).—Prof. Cantacuzène: The Rôle of the Streptococcus in the Etiology of Scarlet Fever.—Dr. Mayer: Recent Advances in the Treatment of Cancer.—Prof. Ottolenghi: Malaria.—Dr. N. Bernard: Beri-beri.—Prof. Imbert: Bone-grafting.

APRIL 25 TO 28.

GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).—Discussions on Psychotherapy, introduced by Gaupp and Fleischmann; Results of Recent Functional Investigations of the Stomach and Duodenum, introduced by G. Katsch.—A joint meeting with the German Röntgen Society will be held on April 28, with a discussion on the Significance of Röntgen-ray Examination of the Lungs and Mediastinum for Internal Medicine (excluding Tuberculosis), introduced by Dietlen, Assmann Haenisch and Lorey, and Fleischner.