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Superannuation of University Teachers.

AN inquiry is being made by the Council of the Federated Superannuation System for Universities as to "what capital sums would be involved to place senior members of the staffs of university institutions in receipt of Treasury grants in a position comparable with that they would have enjoyed had the federated scheme been in operation during the tenure of their university appointments." This inquiry has been authorised by the Treasury through the University Grants Committee. It may not be generally known, however, that the suggestion arose in the Council of the Federated Superannuation System, and the authorisation simply means that the Treasury is paying the expenses involved in the inquiry. No doubt by this time the staffs of the various university institutions have received copies of the relative form of inquiry with a request to fill in certain particulars, and most of them will not require to be told that the simplicity of the questions has no obvious relation to the difficulty of answering them.

We fear that the services of the psycho-analyst will have to be requisitioned if retrospective particulars regarding salaries are to be given with any degree of accuracy. In point of fact, we seriously doubt whether these particulars can be given with the necessary degree of accuracy; if some other principle is not adopted, the inquiry might easily develop into a farce. Apart from this, however, two facts emerge—(1) the ambiguity in the use of the term *senior*, and (2) the restricted use of the term *service*. If we are to suppose that one section of university teachers is to be considered in respect of retrospective benefits, and another not, it is perfectly clear to anyone who really understands the temper of university teachers that the University Grants Committee and the Treasury are asking for trouble. Where is the line to be drawn? Why, indeed, should it be drawn? If retrospective benefits are to be given to one, they should be given to another. The School Teachers (Superannuation) Act makes no such distinction in respect of its beneficiaries. The framers of that Act had no desire to bring a hornet's nest about their ears! To draw any such line between one set of university teachers and another, or to limit the retrospective benefits to a certain number of years or to those in receipt of salaries above a certain figure, would be manifestly unjust, and will inevitably lead to criticism and provoke discontent.

Serious as this point is, however, it is not so serious as the question of service. The inquiry is being directed to ascertain the amount of service in universities, constituent colleges of universities, and university colleges, the implication being that no service outside such institutions is to count for retrospective benefits. If this is what is meant, and it is difficult to interpret the inquiry in any other sense, a grave injustice will be done to a not inconsiderable number of university teachers at the present moment, and a distinct injury will be inflicted upon the universities in the future. According to this interpretation, a university teacher who has at some time or other of his career seen service in a school—elementary or secondary—or in a college of non-university rank, will not be allowed to calculate such service as pensionable in respect of retrospective benefits. Surely this is a very absurd position of affairs. As for the future, if the same principle operates, one of the bridges, and a very important one, connecting the schools with the universities will be broken down. If, for example, a teacher spends the whole of his career in a school, or the whole of it in a university, he will receive full pension benefits; but if he is so unfortunate as to spend part of his career in a school or technical college of non-university rank before becoming a university teacher, he is to be mulcted of some portion of his pension benefits. This being so, a barrier is set up, and not only the schools suffer, but also the universities.

The position is quite indefensible. The Council of the Federated Superannuation System, the primary function of which should be the conservation and the extension of pension benefits to university teachers, ought to recognise this. If our understanding of the position is correct, the council may rest assured that university teachers will not be content to remain passive under such an anomalous scheme. We may remind our readers that the conference of representatives of universities and colleges which waited upon the Chancellor of the Exchequer on June 17 last presented the following resolution to him: "That this conference is of opinion that the interests of English and Welsh education as a whole demand the institution of a scheme of superannuation for university teachers and administrative officials conferring benefits not inferior to those granted under the School Teachers (Superannuation) Act, 1918, and of a like retrospective character." This, we understand, is the absolute minimum which university teachers demand; if anything beyond this is granted, they are willing to pay for the additional benefits. They believe that their services, to say the least, are no less valuable to the State than the services of those who benefit under the Act, and that they should receive treatment no whit inferior. Their treatment under existing conditions is enough to rouse the righteous indignation of every just citizen. We had before us recently the case of a university professor who was compelled to retire on account of ill-health, after having taught for more than thirty years. All that he can receive from the Federated Superannuation System is a lump sum of 780*l.*, whereas had he been a teacher eligible for a grant under the Superannuation Act he would be entitled to a superannuation allowance of five-eighths of his average salary for the last five years of service, which would amount to a pension of 240*l.* per annum, and in addition he would have a gratuity of 640*l.* This is a typical case, and it would be easy to give many similar examples of manifest injustice to university teachers.

The suggestion that by receiving equal benefits they will put the yoke of State control round their necks is unworthy of the acumen of the Chancellor of the Exchequer. Already the universities receive an annual grant of 1,500,000*l.* (the total Education Vote this year is about 52,000,000*l.*), and yet they are not State-controlled. Is it conceivable that a Government for an addition of one-twentieth of the university grant—for this is approximately the annual amount that would be required to give university teachers similar benefits to those under the Teachers (Superannuation) Act—will demand State control of the universities? Why has the Government not demanded it up to now? Simply because it has the prescience to recognise that State control of the universities would be fatal to the highest development—intellectual, social, and industrial—of the community. The Chancellor of the Exchequer himself in his remarks to the conference expresses a doubt as to whether "it is an exaggeration to say that what did as much for the ruining of Germany as anything was the lack of independence and the lack of independent power of speech and thought by the teachers of the youth of Germany through all the branches." Is it likely that the Government, as a *quid pro quo* for a comparatively small addition to the annual grant, would propose to deprive the universities of their freedom when highly placed statesmen speak such language? Most unlikely! Is it likely, indeed, that the universities would submit to State control? In our opinion, the bogey of State control of universities as conjured up by Mr. Chamberlain is unthinkable. We begin to wonder what other argument will be adduced to support an absolutely untenable position.

One other fact remains to be stated. The Association of University Teachers, comprising some fifteen hundred full-time teachers in the universities and institutions of university rank in England and Wales, co-operated in the conference referred to above, and supported it in its demand. As a result of the failure of the deputation to the Chancellor of the Exchequer, it immediately instituted a postcard vote amongst its members, setting forth three alternative proposals. Seventy per cent. of the voters declared in favour of the extension of the School Teachers (Superannuation) Act to university teachers, and in consequence the executive has decided to adopt this as its superannuation policy. Here we have a significant fact. If the Council of the Federated Superannuation System, the University Grants Committee, and the Treasury are wise, they will ponder carefully over this indication of the direction in which the university teachers are moving.

Biology of Endogamy and Exogamy.

Inbreeding and Outbreeding: Their Genetic and Sociological Significance. By Dr. E. M. East and Dr. D. F. Jones. (Monographs on Experimental Biology.) Pp. 285. (Philadelphia and London: J. B. Lippincott Co., 1919.) Price 10*s*. 6*d*. net.

IT has been shown that close inbreeding of good stock, if associated with the usual common-sense elimination of wasters, may be persisted in for several generations without any undesirable consequences. Many fine breeds of animals and races of plants have had very close inbreeding at their beginnings. It is said that there is habitual endogamy among bees and ants, and we know that in some formicaries the females are inseminated without an outside excursion. It seems then that "inbreeding is not in itself harmful." This is the first conclusion that the authors of this excellent monograph reach.

One can go further, however, and maintain that close mating is positively advantageous. It fixes desirable characters and leads towards the establishment of a uniform and stable herd. But it is well known that this is only half the truth; there is sometimes an advance, but there is often a disappointing regression—a reduction of vigour, resisting power, fecundity, and even size. Thus the authors tell us that in the case of grain there is a reduction of productivity to perhaps half of what it was, while in the case of maize there is a marked reduction in size and rate of growth. The problem then is to explain the deterioration that sometimes sets in, and to discover whether it is due to the consanguinity as such or to something else.

Drs. East and Jones point out that if there are, to begin with, in the inheritance of the herd, say, four distinct hereditary factors relative to a particular character, such as the colour of the pellage, the automatic effect of the inbreeding will be to isolate four types, each pure as regards the particular character. But some of the characters which are thus segregated may be undesirable "recessives," seldom seen in ordinary circumstances, because they are hidden by their "dominant" allelomorphs. "These recessives are the 'corrupt fruit' which give a bad name to inbreeding, for they are often—very often—undesirable characteristics." "Inbreeding tore aside the mask, and the undesirable characters were shown up in all their weakness, to stand or fall on their own merits." This is an interesting theoretical interpretation, and it immediately suggests a practical application. For if the inbreeding brings to the surface certain characters which were in the general inheritance of the stock, but were kept out of sight by more favourable characters which dominated them, it is open to the breeder to practise stern elimination, to get rid of the "isolated" types with undesirable characters, leaving the stock all the better for its purgation. It need scarcely be said that the authors back up their conclusion with a wealth of experimental data, and that they give it the fit and proper technical formulation.

It is often useful to stand back, as it were, from the realm of organisms and the age-long process of organic evolution, and ask ourselves what the great steps or trends have been. We mean such steps as getting out of the water, substituting sexual for asexual reproduction, and establishing viviparity. Another great trend is the securing of cross-fertilisation, though the range of the cross varies within wide limits. Parthenogenesis has been tried, and it seems to work well enough among Rotifers; autogamy or self-fertilisation has been tried, and it seems to work well enough in the liver-fluke; but the broad fact is that some form of cross-fertilisation is the rule. And if we ask for the deep reason justifying this, the probable answer is that the survival value of cross-fertilisation lies largely in the fact that it promotes variability. It brings about a greater variety of raw material on which selective agencies can operate. Now the authors bring forward experimental evidence to show that the wider ranges of cross-fertilisation which are called outbreeding are valuable in promoting variability, and they have an interesting discussion of the limits of profitable crossing. The strains crossed may easily be too unlike.

But there is another advantage in outbreeding, that it promotes the mysterious quality called "vigour." Darwin was strongly of opinion that the gain in constitution derived from an occasional crossing was a more important biological fact than the loss that sometimes follows close inbreeding; the authors confirm this shrewd judgment. What is the meaning of this "hybrid vigour," which may be associated with increase in resisting power, in size, and in other good qualities? It has been suggested that some physiological stimulus comes to the offspring because of the unlikeness or apartness of the parents, but that is not the authors' view. They think that the reason for "hybrid vigour" is to be found in the pooling of diverse hereditary resources of good quality. The crossing makes it more likely that a *minus* on one side may be made good by a *plus* on the other, or that desirable dominants may corroborate one another.

Sterility is such a puzzling phenomenon that any suggestion from competent biologists is very welcome. The authors point out the striking fact that both inbreeding and outbreeding may land the organism in sterility, and they suggest that there may be two quite different kinds of diverse origin. Inbreeding tends to sort out homogeneous pure strains in a stock, and in this sifting the ability to reproduce may be lost. On the other hand, outbreeding may bring together two germ-cells too incompatible in their chromosomal complex to allow of the continuance of the germ-cell lineage. Thus it may be that the number of chromosomes in horse and ass is too discrepant to allow of fertile progeny.

We have to thank the authors for a valuable monograph, embodying the results of many personal experiments and a critical utilisation of material previously available in the work of others. The book is marked at once by independence and by scholarship. Of great interest to many will be the application of the biological results to the particular case of man. There is a carefully selected bibliography, which might have included perhaps a useful work by Reibmayr, "Inzucht und Vermischung beim Menschen" (1897).

Einstein's Exposition of Relativity.

Relativity: The Special and the General Theory. A Popular Exposition. By Prof. Albert Einstein. Authorised translation by Dr. Robert W. Lawson. Pp. xiii+138. (London: Methuen and Co., Ltd., 1920.) Price 5*s*. net.

A POPULAR exposition of the doctrine of Relativity and what it implies: for this the world has been crying since the astronomers announced that the stars had proved it true. Here is an excellent translation of Einstein's own book; we hasten to it to know the whole truth and nothing but the truth. The reviewer on this occasion should be the man in the street, the man who, with thousands, has been asking, "What is Relativity?" "What is the matter with Euclid and with Newton?" "What is this message from the stars?" Whether it is possible for the prophet to make his message clear to the multitude, only history can prove. He must needs speak largely in parables, in incomplete similes; and he is subject, therefore, to inevitable misunderstanding.

The plain fact is that Einstein asks the world to give up preconceptions, and to change its point of view. Men jump at suggestions of the fourth dimension, which promise some amusement, and room for a play of fancy. But the fourth dimension does not call for a very high flight of imagination; it is not taken very seriously; it is even recognised as a commonplace and somewhat old-fashioned intellectual pastime. A much more serious trouble comes in with the simple concrete instance. A passenger sitting in a train finds himself hurrying towards the other side of the carriage. He remarks that the brakes have been put on and the train is stopping. We are told that he may also interpret his experience thus: "The carriage remains permanently at rest . . . during the period of application of the brakes, the railway embankment, together with the earth, moves non-uniformly in such a manner that their original velocity in the backwards direction is continuously reduced." This seems to upset all the mechanics we had ever learned. For while we had always been carefully taught that the real explanation of the phenomenon lies in the stopping of the train while we ourselves move on uniformly, it is now held to be indifferent whether we adopt this attitude or think of the pressure of the driver's hand on the brake lever as imparting a change of motion to the whole earth and to ourselves—to everything, in fact, except the train. But the plain man feels there is a very real difference, and the ardent mathematician must indeed be living in an abstract world if he does not feel it too.

Here, indeed, is the great virtue of mathematics, that in it one may escape from the tyranny of gross perception. As Prof. Eddington puts it, the mathematician is never so happy as when he does not know what he is talking about. The engine-driver applying the brake does not know what happens either to the train or to the earth; he does know that he has some control over their relative motion. The mathematician does not know, and does not wish to know, what happens to this or that individual thing. He takes that for granted. He asks only what are the relations between events, or rather what can the mind know about them. Here only the genius can make progress. An unshackled imagination and a keen logical sense must combine in the adventure. The human mind has dared to look upon all history in space and time as laid out before it, and having thus overstepped the limits of mortality, it must go back and ask how much of this vision it may, as mortal, know.

At this moment rain is falling, leaves are rustling, a motor hurries along the road, the clouds are drifting. All is change and motion. It seems that all history is change, and all is hurrying by us as we stand. But is it not a truer view, certainly a less egoistic one, to see history as one eternal whole, and ourselves as voyagers through it, our vision of it ever changing? All our experiments, our measurings and comparisons are themselves part of the great web; we ourselves are part and parcel of it, and must acknowledge our incapacity to put ourselves outside. All our pictures and conceptions of the universe in time and space are but pictures, and the painters are many. There are strange differences between their records of what they have perceived—more, indeed, of difference than of similarity. We go to a picture-gallery; there is so much of difference that at first there seems little in common. Yet gradually we become conscious that the pictures are all drawn from a common life. We begin to be able to analyse the painters, and see what kind of a mind is looking out upon it, to detect a point of view. In so doing we grow more clear as to the one reality behind all the pictures.

This is a true parable of the great change that has been consummated in physical thought by Einstein's work. It is the recognition of the relativity of our space-and-time pictures that has clarified our understanding of the universal phenomena. Gravitation has not been explained. The mystery of it is ten times greater than before. To Newton it was one among many properties of that fundamental mystery "matter." It is almost true now to reverse the order and say that matter is one of the manifestations of the fundamental mystery of gravitation.

The reader of Einstein's exposition will need to ponder hard if he is to get to the heart of the matter. For it is a spiritual adventure upon which he has to embark. The very clarity and simplicity of the book may hide this from the over-confident. The parable may be understood and its meaning lost. But to those who have the vision the world of physics will take on a new and wonderful life. The commonest phenomena become organic parts of the great plan. The rationality of the universe becomes an exciting romance, not a cold dogma. The thrill of a comprehensive understanding runs through us, and yet we find ourselves on the shores of the unknown. For this new doctrine, after all, is but a touchstone of truth. We must submit all our theories to the test of it; we must allow our deepest thoughts to be gauged by it. The metaphysician and he who speculates over the meaning of life cannot be indifferent.

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The Cambridge British Flora.

The Cambridge British Flora. By Prof. C. E. Moss, assisted by specialists in certain genera. Illustrated from drawings by E. W. Hunnybun. Vol. iii. Portulacaceæ to Fumariaceæ. Text: Pp. xvi+200. Plates: Pp. vi+191. (Cambridge: At the University Press, 1920.) Price, two parts, 6*l.* 15*s.* net; two parts in one volume, 7*l.* net.

THE previous volume of "The Cambridge British Flora" was reviewed in NATURE of August 6, 1914. Since this review was written many things have happened. Dr. Moss has been appointed professor of botany at the University College, Johannesburg, and has been unable to give personal attention to the volume during its passage through the press. The syndics of the University Press acknowledge valuable assistance given by Mr. A. J. Wilmott, of the botanical department of the British Museum, in correcting proofs and in dealing with questions which are normally settled by an editor. In July, 1918, Mr. E. W. Hunnybun died. A sympathetic note by Mr. Wilmott, at the beginning of the present volume, gives an interesting account of his method of work in preparing the illustrations, which makes clear both its advantages and limitations. The character of the illustrations has been much discussed among British botanists, but it became evident that Mr. Hunnybun could work only on his own lines, the accurate delineation of an individual specimen, and was also unable to supply the botanical details of structure of flower and fruit which, in the opinion of many, would have enhanced the value of the illustrations. As permanence is a consideration in a work of such importance as a standard British Flora, it is surprising to find the plates printed on a chalk-faced paper. Other events have tended to delay the appearance of the present volume, and to cause the serious increase in cost of production, which has necessitated raising the price to nearly three times that of the previous volume. The syndics of the Cambridge University Press must view this addition to their difficulties with grave anxiety, and it is to be feared that many students of our British flora who would wish to possess the book will be unable to meet the increased cost. The critical elaboration of a number of families will be of considerable value should the work fail of completion; but British botanists will feel deeply disappointed if it cannot be carried through satisfactorily.

The families included in vol. iii. are Portulacaceæ, Illecebraceæ, Dianthaceæ (more generally known as Caryophyllaceæ), Nymphæaceæ, Ceratophyllaceæ, Ranunculaceæ, Actæaceæ (comprising the single genus Actæa), Berberidaceæ, Pæoniaceæ (limited to Pæonia), Papaveraceæ, and Fumariaceæ. The genera Montia and Cerastium have been elaborated by Dr. G. C. Druce, several genera of Dianthaceæ by Prof. R. H. Compton, and the genus Fumaria by Mr. H. W. Pugsley. In view of unavoidable delay in publication, it would be an advantage if the dates of completion of the monographs of the various families and genera were given; this would avoid the necessity for explanation in such cases, for instance, as Mr. Pugsley's account of Fumaria, which is antedated in publication by his recent complete monograph of the genus in the Linnean Society's journal, but was probably completed before the more important work was undertaken.

Dr. Moss has intercalated in the text notes on systematic arrangement, limitations of orders and families, and discussions of points of nomenclature, many of which are of considerable interest, though sometimes difficult of appreciation by the ordinary student of British botany, who may, perhaps, consider the elevation of Actæa and Pæonia to the rank of distinct families as puzzling and unnecessary. On the other hand, the student of the British flora will welcome the careful and critical treatment of the genera, species, and varieties of his plants, and appreciate the notes on their respective distribution in Great Britain and Europe, and the discussions as to their indigenousness in doubtful cases. The outline maps indicating distribution are a useful feature, and the information conveyed therein may be supplemented should occasion arise.

It is to be regretted that personal matters should have been introduced into a work of this kind. "The Cambridge British Flora" will, presumably, take rank as a standard work, a presentation of the knowledge and views of eminent British botanists at a certain period in the history of botany, and to perpetuate the differences of opinion which have arisen on matters of very secondary importance detracts from the dignity which such a work should possess. The syndics of the Cambridge University Press would have been well advised if they had exercised a fatherly censorship on several paragraphs in the introduction to the present volume. In conclusion, we would express the hope that the two succeeding volumes, which will carry the work to the end of the family Rosaceæ, will be published with as little delay as possible.

A. B. R.

Man and Matter.

Religion and Science: From Galileo to Bergson. By J. C. Hardwick. Pp. ix+148. (London: S.P.C.K.; New York: The Macmillan Co., 1920.) Price 8s. net.

BECAUSE we wish to give a very favourable impression of this little book, we propose to state our criticisms at once, leaving no "but" to the end which might suggest a reservation on the part of the reviewer. Mr. Hardwick has written a very clear account of some of the chief movements of philosophic thought since the Renaissance, in so far as these bear on the concepts of science and of religion, though he modestly disclaims so large a plan. We doubt if the title is well chosen, in spite of its excellent simplicity. "Religion and Science" suggests apologetic, possibly ill-balanced and ignorant, and this the book emphatically is not. Further, the author's definition of science is unduly wide in scope. "Systematic and accurate knowledge about everything there is to be known" (p. 2) really covers the whole of philosophy: science, as the term is commonly understood, deals with the facts of the physical universe alone. Thus the statement that "religion and science regard reality from different angles, but it is the same reality that is . . . the goal of their search" (p. 6), though true for the author's definition, is not true for Prof. Karl Pearson's (which he quotes) or for that of the ordinary man. The statements about radium on p. 126 are condensed to the verge of inaccuracy. Radium is *not* the only element which breaks down; it does *not* evaporate; nor are all the particles into which it disintegrates electrons, as the phrasing suggests. The statement that "electricity is a species of energy which can be expressed in terms of Will" (p. 128) conveys absolutely no meaning as it stands, and suggests that the author has not wholly escaped the plausible but dangerous idea that the dematerialisation of matter to which scientific investigation is tending necessarily brings matter nearer in nature to mind, thus confirming the idealist position.

Philosophers may here and there disagree with the author's emphasis. For example, the contribution of Hegel is generally held to be more important than is here allowed, or at least than is brought out; while the statement of the influence of Kant gives more finality to his work than is perhaps justifiable. But these are all minor blemishes—for the most part verbal—in a valuable book. Though it is far from faultless, we do not remember to have seen so clear, simple, and balanced a summary of the main trends of human thought about the relation between man and the matter amid which he lives and moves.

Few young students of science, and as few clergy, have any clear view of the history of the philosophic thought that bears on their work. We would suggest that the time spent in reading this little book would bring them lasting gain. It is so simple that it will interest those quite untrained in philosophy. It is not technical; it is neither dogmatic nor aggressive; it does not moralise or urge a doctrinal point of view. Furthermore, it is redeemed from the deadliness of most summaries by its admirable clarity and its firm adherence to one path where tempting by-ways cross it. The layman in science and theology will be almost equally attracted, and will rise with whetted appetite; for the defect, or merit, of the book is that one wishes it were longer and fuller. Nevertheless, we believe that Mr. Hardwick has done wisely in keeping his limits so narrow. He might have written a much bigger book, done it equally well, and yet have missed his mark. As it is, we believe that his shot will go home.

S. A. McDowall.

Our Bookshelf.

Mrs. Warren's Daughter: A Story of the Woman's Movement. By Sir Harry Johnston. Pp. xi+402. (London: Chatto and Windus, 1920.) Price 7s. 6d. net.

In writing "Mrs. Warren's Daughter," and more particularly in his first and very successful novel, "The Gay Dombeys," Sir Harry Johnston has sought to reproduce some aspects of the life led by men of science in London during the decades which stretch from last century into the present. Both novels are speculations regarding the influence of environment on human character and action; in "The Gay Dombeys" the author seeks to depict the influence of the post-Darwinian period on the descendants of the Dombey family created by Dickens, and in "Mrs. Warren's Daughter" he gauges the effect of the feminist movement of recent years on the daughter of that rather tarnished lady, Mrs. Warren, placed first on the stage of literature by Mr. George Bernard Shaw. Those, however, who knew the Zoological, Geographical, Anthropological, and other learned London societies some thirty or forty years ago will read these books with a double interest, for they will find that Sir Harry's characters resuscitate past chapters in the history of scientific life in London. The author, it is needless to say, uses a light and nimble pen to draw word-pictures seen from a highly individualistic Harry Johnstonian angle.

In "Mrs. Warren's Daughter" we are introduced to Prof. Michael Rossiter, F.R.S., "a really admirable and fluent lecturer on anthropology, chemistry, ethnology, hygiene, geography, economic botany, regional zoology, germ diseases, agriculture, etc., etc." Prof. Rossiter, whom we should suppose to be a character compounded from the late very distinguished surgeon, Sir Victor Horsley, and from the pioneer of modern physiology in England, the late Sir Michael Foster, is given qualifications as a lecturer beyond the wide capabilities of the combined originals. Even Sir Harry Johnston himself, who has first-hand acquaintance of more branches of knowledge than almost any man living, would hesitate to carry out the programme he assigns to Prof. Rossiter.

Der Aufbau der Materie: Drei Aufsätze über moderne Atomistik und Elektronentheorie. By Max Born. Pp. v+81. (Berlin: Julius Springer, 1920.) Price 8.60 marks.

In the form of three essays the author has given a clear and simple summary of the advances which have been made during the last few years in our knowledge of atomic structure. The first essay consists of a survey of the results obtained by purely physical investigations. It describes the measurement of the charge and mass of the electron, the Kelvin-Thomson model of the atom and the Rutherford-Bohr model which succeeded it, the discovery of the diffraction of X-rays by crystals, and Moseley's work on X-ray spectra and atomic number. A short account is given of Bohr's theory and its development by Sommerfelt, of the general relationships between the spectra of the elements, and of Kossel's work on electrovalency, which determines the number of electrons in the several shells surrounding the positively charged nucleus. In the second essay, the former attempts to obtain a mechanical model of the æther are contrasted with the modern conception of all mechanical forces as being electrical in their origin. Our knowledge of crystal structures has made possible a closer examination of the inter-atomic forces in solid bodies; quantitative relationships can be obtained—for instance, in the case of sodium chloride—between purely physical constants, such as the distances between the atoms, the ionic charges, and the compressibility of the solid on one hand and the heat of formation of the compound on the other. This is amplified in the third essay. Both chemistry and physics deal ultimately with the structure of the atom, for the constants which govern chemical reactions are to be explained in terms of the forces between electrons and nucleus in the atomic structure.

In so small a volume, the author cannot do more than indicate the results which have been obtained in each line of investigation, but very complete references are given to the original papers on the subject. So much work of fundamental importance has been done in the last three or four years that this book will be welcome, both as an introduction to the most recent researches, and for the useful references which it contains.

The Elements of Electro-Technics. By A. P. Young. Pp. viii+348. (London: Sir Isaac Pitman and Sons, Ltd., 1920.) Price 7*s.* 6*d.* net.

THIS work is addressed as much to those connected with the electrical industry who are not directly associated with the technical side as to students about to embark upon an electrical career. The subject is looked at from the practical engineering point of view, but shows some departure from conventional lines. The elementary principles of currents and their effects are well set out, and of the later chapters those on the magnetisation of iron, measuring instruments, and insulating materials may be picked out as the best examples of well-selected information arranged with originality. In the last mentioned there is a good deal not found in the ordinary text-book, including a most useful summary of the composition, preparation, and properties of a number of insulating materials in common use. Another subject not always treated satisfactorily in elementary books is that of the magneto for ignition purposes, of which there is a brief but clear sketch.

The field covered is larger than would appear at first sight, and ranges over such diverse branches of electrical applications as Röntgen rays and electric furnaces. The continuous-current dynamo and motor are dealt with comparatively briefly, but alternating currents and their applications do not form part of the scheme. The student would be well advised to turn to Mr. Young for his introduction to the subject of measuring instruments.

Modern Explosives. By S. I. Levy. (Pitman's Common Commodities and Industries.) Pp. ix+109. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) Price 3*s.* net.

THIS book gives a popular and interesting account of the manufacture of explosives, with special reference to the work carried out during the Great War in the national factories in this country. Although avoiding technical details, the author has given a reasonable and well-balanced treatment of his subject in the space at his disposal. One or two slips may be noted. The oxidation of ammonia was not "discovered by the German chemist Ostwald" (p. 28), but by the English clergyman the Rev. A. Milner, although it is usually attributed to the French chemist Kuhlmann. The phrase "Haber-Ostwald process," mistakenly adopted by the Department of Explosives Supply during the war, has doubtless led the author astray. The statement that "the contact process . . . was not successful when first attempted in this country, and was first applied in Germany . . . by . . . Dr. Knecht [*sic*]" (p. 35), is inaccurate in view of Messel's work. The final chapter, on "Chemistry and National Welfare," although not directly connected with the subject, is very apposite at the present time, when many of the lessons taught by the war seem to be receding into obscurity.

An Introduction to Entomology. By Prof. J. H. Comstock. Part i. Second edition, entirely rewritten. Pp. xviii+220. (Ithaca, N.Y.: The Comstock Publishing Co., 1920.) Price 2.50 dollars net.

WE have no hesitation in commending this book as a clear and thoroughly up-to-date elementary account of the general structure and metamorphosis of insects. It constitutes the first part of a treatise on entomology that the author has in preparation. The section devoted to the external anatomy of insects is particularly valuable.

The detailed studies of recent morphologists have left the terminology applicable to the various sclerites and regions in a very confused state; the nomenclature adopted in this book is well chosen, and should contribute towards establishing stability. With regard to the internal anatomy we are of opinion that the author should deal with the muscular system more fully in the final work. Rather more detailed reference to the adipose tissue and a mention at least of the corpora allata are also called for. These points are raised in a friendly spirit, and in response to Prof. Comstock's invitation for suggestions of any desirable changes to be made before the present part is incorporated in the complete work.

Throughout the book the author exhibits clear insight in the selection of the essentials of his subject, and the printing and illustrations are particularly good; there is also a useful and not too lengthy bibliography. A. D. IMMS.

Physiography. By Prof. Rollin D. Salisbury. Third edition, revised. (American Science Series, Advanced Course.) Pp. xv+676+xxvi plates. (New York: Henry Holt and Co., 1919.)

PROF. SALISBURY contrives to maintain the somewhat colourless subject of modern physiography as a study for the class-room by representing it as a description of the shaping of the present surface of the earth, and of the relations of air and water to the land. Questions of earth-history are left to geology, and of life on the globe to geography. His book might serve as an introduction to either of these sciences. Huxley's "Physiography" made a far wider appeal, and Prof. Salisbury has recently stated his own appreciation of geography as encouraging personal observation and verification.

We cannot help feeling that in the present work, the success of which is shown by its third edition, the author has been hampered by educational custom rather than by choice of subject. The small size of many of the illustrations of broad natural features is in keeping with the crispness of description. The use of parts of the maps of the U.S. Geological Survey as full-page plates is an admirable feature. The work has been brought up to date, with cautious references to the "upper air," and a description of the activity of Lassen Peak from 1914 onwards. May we suggest that the crystals shown on p. 71 should not be described as snowflakes? G. A. J. C.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Restoration of Energy.

CONCERNING the pressure of light, we may safely say that it was predicted by Maxwell, discovered by Lebedew of Moscow, and independently by Nichols and Hull in America; while it was elaborately discussed, clinched by further experiments, and its significance greatly extended by Poynting and by Poynting and Barlow. We now learn from Prof. Eddington's brilliant address to Section A of the British Association at Cardiff this year that radiation pressure has a cosmic significance beyond what had been thought possible; that it holds back or sustains the outer substance of the brighter and hotter stars, and is responsible for their huge size; while at the same time it has the effect of limiting the possible aggregation of masses of matter, so that the mass reasonably permissible to any star ranges from five times to one-half that of our sun—something of that order.

According to Prof. Eddington's calculations, the radiation from an exceedingly hot central nucleus, heated it may be by atomic disintegration, acts like a rushing mighty wind on the outer portions, and sustains them against gravitative attraction;—surely a remarkable example of the significance inevitably attaching to the most minute and barely detectable forces. So long as any given kind of force exists at all, it may under proper conditions have an overpowering and surprising effect.

I write to convey a verbal suggestion made by my assistant, Mr. Edward E. Robinson, a year or two ago, that light-pressure may afford an escape from some popular eschatological conclusions based on the doctrine of the dissipation of energy. Engineers like Prof. Osborne Reynolds and Sir William Siemens have deplored the waste of solar energy, of which so minute a fraction is caught by the earth or any planet, and have sought to circumvent and reconcentrate it somehow—by total reflection at an æthereal boundary or otherwise. And when we think of the vast store of power ceaselessly being radiated from every star, and apparently fruitlessly lost in the depths of space, it is natural to look either for some usefulness in the torrent or for some sort of compensating mechanism. So also, under the influences of gravitative attraction and the general law of dissipation of energy, it has seemed to some as if the cosmos was tending towards a cosmic tomb—consisting of one large cold or cooling lump of matter, with all the energy of its gravitative falling together wasted by radiation into the depths of space, and no recovery possible, nor any more generation of heat.

But what about the sweeping or propelling power of that apparently waste radiation? It exerts pressure on matter; particles of suitable small size must be swept along with it. Why should we not contemplate a constant sweeping of cosmic dust away towards infinity, with full power of return when sufficiently re-aggregated? Is there not some hope of restitution and restoration in this, so that gravitative fall can once more recur and the whole cycle begin again?

To estimate the amount of matter which can thus be repelled, taking into account diffraction effects, is rather complicated. It must not be enough at any one time to cause effective opacity; but, considering the speed generated by any small acceleration in free space and the length of time available, the total amount of repelled matter need not be inferior to the amount of disintegrated material which collisions and friction and eruptions and electrical repulsion are likely to provide. *Something* preserves the transparency of space; may it not be this constant sweeping away of dust? Far away from any source of radiation the particles would not be hot enough to repel each other, so there would be nothing to prevent their beginning to collect together, and so preparing to fall once more from practical infinity.

Electrified particles, ions and electrons, of which interplanetary space must contain myriads, are also propelled by light. But these seem to attain a terminal velocity, of value depending on the intensity of the radiation and the square of its wave-length. Long waves travelling in space would therefore be most effective, but short waves would act in the right direction; and the electrons thereby driven among the cosmic dust—exerting mutual forces much stronger than gravitation—might act as the cement to weld it together again.

So long as matter is being accelerated by radiation-pressure, and so long as fresh ions are being produced in its path, the energy of the radiation would tend to be consumed. Hence the ultimate result of all the otherwise waste radiation might be just that energy of gravitative separation which is required for a new Lucretian universe.

There are other possibilities, of too speculative a character, depending on the semi-material nature of light. The suggestions so far made may be negatived, but they seem worth putting forward in a tentative manner.

OLIVER LODGE.

British Laboratory and Scientific Glassware.

I HAVE no interest in the manufacture of scientific glassware, except in so far that as I devoted most of my time to the subject during the war I should like to know that my work would lead to permanent results. I may, therefore, be permitted to address a word to users and manufacturers of scientific glassware.

To users I say: Use only scientific hollow-ware which bears the maker's name; and if you find it faulty, send it straight back to the manufacturer, whom you will be assisting, and who will replace it at once. Even the famous Jena glass was often faulty, and while working in the laboratory in the autumn of 1914 it was not only once that Jena beakers were found to have cracked without apparent cause. On two occasions I actually heard beakers crack while they were standing on the table.

In the autumn of 1914 I worked out the resistance glass and lamp-working glass which have been spoken of as standing at the head of the list, and early in 1915 I began to manufacture these glasses, and continued to do so throughout the war, maintaining the original compositions, but modifying the batch formulæ as different materials became available. The glasses were worked out on the basis of analyses of a large number of foreign glasses and a study of their properties. The investigation was a perfectly straightforward one, and no particular difficulty attached to it, and I will even admit that luck came to the aid of judgment in arriving at the final conclusions.

I am making this statement because I wish it to be recognised that a misunderstanding exists as to the difficulties which had to be overcome in connection with the manufacture of scientific glassware, and not because I wish to lay claim to particular credit for carrying through a simple piece of work. The real difficulty lay in the working out of methods of manufacture, particularly the devising of mechanical methods, and in imposing them upon an industry which was rather unwilling to adopt them. The glassmaker's chair and tools had to be replaced by moulds, and even then the procedure adopted in mould-blowing as practised in the country had to be modified. Instead of employing men to finish such articles as beakers, machines had to be devised to carry out the processes which could be operated by girls. Drastic alterations in the methods of annealing had to be introduced. In some branches, such as the manufacture of graduated ware, the technical processes for production in mass had to be worked out from the commencement.

Now the fullest information as to the composition of German chemical glassware was at the disposal of anyone who had access to a chemical laboratory, such as Prof. Baker kindly placed at my disposal in October, 1914, and could make an analysis of glass. The reproduction of these glasses, on the basis of the analyses, called for some knowledge of commercial materials, and such information as was available as to the qualities of the glasses actually on the market made improvement a matter of no very great difficulty. If the chemical problems had been the essential ones the scientific public would have had every reason to complain if the manufacturers had not at the outbreak of war at once produced perfectly satisfactory scientific glassware, and had never failed to give them the most complete satisfaction. However, the actual fact is that the chemical difficulties were almost non-existent; but, on the other hand, the technical difficulties were very real, involving the expenditure of a vast amount of energy and money which had to be provided by the manufacturers themselves. I can say most definitely that all those who have been concerned in the industry have actually lost money in the venture, but that they do not grudge the cost.

During the war a vast amount of information was collected and shared between the various firms engaged in the industry, but it was often impossible to make use of it owing to the difficulties which stood in the way of obtaining machinery and plant. It would now be possible to make use of this information, to reorganise completely factories for mass production, and to install new plant, but the manufacturer is hampered by the stringency of the financial position, the enormous increase in the cost of machinery, etc., and the absolute uncertainty as to the policy of the Government. However, if the industry is doing its best to meet the situation, it deserves the support of the scientific public, which has also the right to demand guarantees. I suggest, therefore, that the manufacturers should invite the Institute of Chemistry and the Institute of Physics, which represent the professions most closely concerned, to investigate the position of the industry and to report upon it.

It must not be imagined that the cost of scientific glassware will ever approach the pre-war standard, and it does not appear that the increase in cost is in excess of the increase in cost of other commodities. During the war, while I had the opportunity of checking the figures, I know that our prices were lower than the pre-war prices relatively to the increase in the cost of production. Temporarily, owing to the rate of exchange, German glass is obtainable at a lower rate than English, but if this fact is taken advantage of now, the scientific public is likely to have to pay for its short-sighted policy so soon as the industry is once more completely in German hands.

M. W. TRAVERS.

November 6.

Negative Electron Curve.

THE elements are constructed, so it is now believed, of collections of hydrogen atoms bound together by negative electrons. The atomic weight of an element is not, as a rule, a whole number. I think the importance of this departure from integers is most significant.

If we can consider that the element is composed of a number of hydrogen atoms, then the departure from the simple sum of the weight of the hydrogen atoms composing the element must be due to the negative electrons. For example, the element vanadium has an atomic weight of 51·06. Suppose we consider it to be composed of 51 hydrogen atoms,

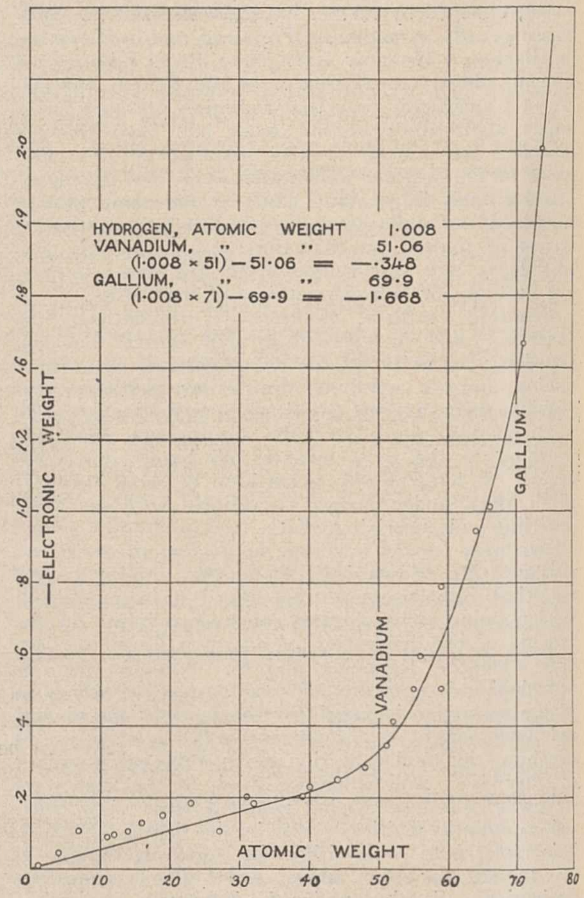


FIG. 1.

then its atomic weight should be $1{\cdot}008 \times 51 = 51{\cdot}408$; but its atomic weight is 51·06. The difference is $-0{\cdot}348$, due, I take it, to the negative electrons which have entered into the composition of the element.

I have obtained *minus* quantities for a number of the elements, starting from hydrogen, atomic weight 1·008, and stopping at Ge, and I find that they space themselves along a regular curve, as shown in Fig. 1. That the *minus* quantities of the atomic weights should have arranged themselves in this regular way by pure accident I cannot believe, so I suggest that there is some natural law at work to account for it. The explanation is to be sought, I think, in the supposition that the hydrogen atoms attract each other, producing the force of gravity, while the negative electrons are repulsed by gravity; the elements are, therefore, lighter than the sum of the hydrogen atoms themselves.

Referring again to the curve, if the helium atom is composed of 4 hydrogen atoms and 2 negative electrons, then vanadium should have 51 hydrogen atoms and somewhere about 34 negative electrons.

The elements beryllium, neon, magnesium, silicon, chlorine, and argon do not seem to come properly in the curve. If their atomic weights have been correctly determined, then there must be something peculiar about these elements.

I have also drawn a curve from the atomic weights as given in Bloxam's "Chemistry," hydrogen being taken as 1, and have produced a similar curve to the one given here, except that the latter part does not rise so steeply. S. G. BROWN.

52 Kensington Park Road, W.11.

Chemical Warfare and Scientific Workers.

LIKE Prof. Soddy (NATURE, November 4, p. 310), I have received an invitation from the War Office to become an associate member of the "peace" organisation which is to "develop to the utmost extent the offensive and defensive aspects of chemical warfare." I have had enough practical experience of the experimental side of chemical warfare to know what it involves, and I have without any hesitation refused to join the new Committee.

In the first place, the project is simply wicked. Education stands for something more than the acquisition of knowledge, and if at the present time I lent any support to the activities of the Committee I feel that I should necessarily be quite unfit to take any part in the training of young minds. To do what I can to promote in everyone the faith that war is done with has become part of my business because it is the world's business. In the second place, the project is futile. No real progress will be made in discovering new methods of offensive chemical warfare except by people who have their heart in it; perfunctory adhesion to an official organisation will discover nothing worth knowing.

Is any intelligent person—and only intelligent people would be of any use in this very complicated subject—at this point in the world's progress going really to put his heart into the search for methods of killing other people? I think not, even in the case of professional soldiers. Some may comfort themselves with the idea that they will escape the moral difficulty by engaging only with defensive methods. This will be equally futile, for adequate defence can only follow discoveries on the offensive side; it cannot precede them. It is impossible to devise protection against offensive agents which are unknown, just as on the medical side it is impossible to work out methods for the cure of lesions of an unknown nature. The only effective preventions and cures which can be prevised are ethical, and a War Office Committee is not quite the best atmosphere for that.

It may be extravagant to expect that all civilians will refuse to support this part of our "peace organisation," but I hope they will. A. E. BOYCOTT.

University College, Gower Street, W.C.1,
October 5.

Testing Einstein's Shift of Spectral Lines.

A WORD of caution may not be amiss in respect of the suggestion made by Sir Oliver Lodge in NATURE of October 28, p. 280. The rotational stresses in the disc, though very large, may not portend immediate dissolution in steel, but what of the glass (?) of the vacuum tubes? The stresses, like the gravitational effect, increase as the square of the angular velocity. The method would seem well calculated to develop pleochroic effects in glass. CHARLES CHREE.

October 30.

Contractile Vacuoles.

CONTRACTILE vacuoles are found only in those cells which lack a continuous cell-wall. This appeared to suggest that the function of the contractile vacuole is to eliminate dissolved crystalloids and so to keep down the osmotic pressure distending the semi-permeable protoplasm. Otherwise the latter, lacking the support which a continuous cell-wall gives, would continue to stretch and would finally rupture.

There is, however, another, and possibly more plausible, point of view, namely, that the contractile vacuole is, in point of fact, this rupture. Suppose a small accumulation of a soluble crystalloid in a semi-permeable gel which exhibits slight elasticity and slight tenacity—qualities which the protoplasm of the cell appears to possess. The osmotic pressure of the crystalloid will push back the protoplasm, overcoming its rigidity. Thus a cavity is formed which enlarges as water flows into it. Expansion will proceed until but a very thin film of protoplasm separates the solution from the surrounding water. Later expansion causes continued thinning of the film until its tenacity suddenly gives way, and the solution contained in the vacuole becomes, through the rupture, continuous with the surrounding water. The elasticity of the protoplasm now asserts itself, and the walls of the cavity are driven together. The semi-fluid, viscid constituents of the protoplasm secure the healing up of the rupture and the obliteration of the cavity, while the viscosity of the surrounding substance leads to a delay in recovery marked by the appearance of the radiating canals.

Thus we may look upon a contractile vacuole, not as an organ of a cell, but rather as the effect of the local accumulation of any soluble substance. In fresh-water naked protoplasmic organisms the formation of a cavity surrounding this accumulation and the periodic forcible ejection of some of the solution are rendered inevitable by the physical properties of protoplasm. When once a cell acquires a complete cell-wall, the protoplasmic film receives sufficient support and the vacuoles become permanent.

HENRY H. DIXON.

School of Botany, Trinity College, Dublin,
October 22.

Visibility of the Landscape during Rain.

ON a recent visit to the mountains of North Wales the writer was impressed with the variations in the visibility of the landscape when rain was falling. In the lower valleys a storm which may be sufficient to wet thick clothing through in a few moments may leave the contours of the mountains quite distinct at several miles distance. On the other hand, a mountain drizzle or "Scotch mist" may render everything invisible at a few yards. An elementary treatment of the subject brings out one or two points of interest.

Let it be assumed that the raindrops are perfectly opaque and that the atmosphere is otherwise perfectly transparent, both assumptions being, in general, close approximations to the actual state of affairs.

Consider a heavy rainstorm during which rain falls at the rate of 1 cm. per hour, or 0·00028 cm. per second. The raindrops appear to be most often of 1 to 2 mm. diameter. Taking the lower value (1 mm.), the volume of the drop is $0{\cdot}5 \times 10^{-3}$ c.c.

According to Stokes's law

$$v=\frac{2r^2(\rho-\rho_1)g}{9\eta},$$

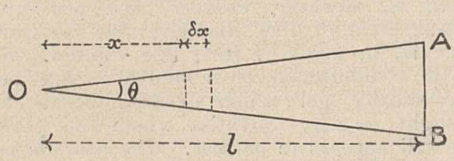
and at 15° C., η, the viscosity of air, is 181×10^{-6}, so that $v=3000$ cm. per sec.

Consequently, the depth of water which falls in one second (0·00028 cm.) is spread while falling over a vertical column of air 3000 cm. high.

There is, therefore, 1 c.c. of water in about 10^7 c.c. of air, or 1 raindrop in every 5 litres or so . . . . (1)

Now, in the state of maximum disorder (the "most probable" state) the raindrops will be spaced equally in all directions, vertically as well as horizontally, and the average distance between two spots will be

$$\sqrt[3]{5000}=17 \text{ cm.} \quad . \quad . \quad . \quad . \quad . \quad (2)$$



Consider a circle of landscape, of diameter AB, subtending an angle θ at the observer at O, distant l from AB. $AB=l.\theta$.

A spot of rain at x is projected against the background as a disc of diameter

$$\frac{l\,.\,d}{x}$$

(d being the diameter of the spot) and blots out an area

$$\frac{\pi}{4}\left(\frac{ld}{x}\right)^2.$$

If n denotes the number of rain spots in unit volume of air, then in the element ∂x of the cone in the figure there are

$$n\,.\,\frac{\pi}{4}(x\,.\,\theta)^2\partial x,$$

and these, projected on the background, blot out an area

$$n\left(\frac{\pi}{4}\frac{x\,.\,\theta\,.\,ld}{x}\right)^2\partial x,$$

or

$$n\frac{\pi}{4}\,.\,d^2\delta x\times\frac{\pi}{4}(l\,.\,\theta)^2,$$

or

$$n\frac{\pi}{4}\,.\,d^2\,.\,\partial x\times\text{Area of background} \quad . \quad (3)$$

Hence each element ∂x contributes the same amount of blotting-out of the landscape, the larger apparent diameter of the nearer spots being compensated by their smaller numbers, and the visibility of the landscape falls off as a linear function of the distance.

The total area blotted out is the integral of (3), *i.e.*

$$\frac{\text{Area of projected rain spots}}{\text{Area of landscape}}=nl\left(\frac{\pi}{4}d^2\right),$$

and the landscape is entirely blotted out when the above ratio equals unity.

Putting

$$n=\frac{\text{Depth of rain falling per sec. (D)}}{\frac{\pi}{6}\,.\,d^3\,.\,v}$$

in this equation, we get as the limiting distance at which the outlines of the landscape can be distinguished

$$l=\frac{2}{3}\frac{d\,.\,v}{D} \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Using the values suggested above, $d=0{\cdot}1$, $v=3000$, and $D=28\times10^{-5}$, the value of l comes out as 7 km., or $4\frac{1}{2}$ miles.

Thus a very heavy rainstorm may be remarkably transparent.

Let N = the number of spots falling per second on unit area ($N=n.v$), then, combining equation (4) with Stokes's law, and calling $\frac{1}{l}$ the obscuring power of the storm, we have

$$\frac{1}{l}=\frac{9\pi}{4g}\,.\,\eta\,.\,N \quad (\text{since } \rho-\rho_1=1) \quad . \quad . \quad (5)$$

That is, the obscuring power of a storm is simply proportional to the number of spots falling per second, or every raindrop has the same obscuring power, whether it be large or small and whether the total rainfall be heavy or light.

The very great obscuring power of a "Scotch mist" is thereby accounted for.

F. W. PRESTON.

90 Howard Road, Leicester, October 21.

Museums in Education.

IN NATURE of October 28 appeared a review of the Final Report of the Committee (British Association, Section L) on "Museums in Relation to Education," in which it was stated that "our great public schools have some excellent museums, but there is little or no evidence that they are used in school teaching." May I be allowed to point out that this sweeping indictment of incapacity or lack of imagination on the part of masters in public schools is not without exception?

The museum of natural history at Oundle School is, I suppose, fairly typical of such collections. It consists of specimens representative of zoology, botany, palæontology, and petrology. Owing to lack of space, not all the specimens can be exhibited with advantage, and the excess has been temporarily stored, so as to avoid detracting from the educational value of the exhibits, pending the erection of a more spacious building. The present museum, which is apart from the laboratories, is accessible at all times to all boys whether or not they are taking natural history subjects in the curriculum. The zoological collection forms an index to the animal kingdom; it consists of specimens representative of all the phyla and of a considerable number of classes. These are distinctly grouped and clearly labelled. In further amplification of this series a certain number of drawings, dissections, and skeletons, also clearly labelled, are interspersed among the types. This work has been carried out entirely by the boys, under supervision, and forms, therefore, an elementary introduction to research. There are also table-cases representative of protective coloration, insect pests, metamorphosis, etc. Owing to lack of time and space the botanical exhibition is not so far advanced, but there is a good collection of types of timber on view, while a collection representative of the dispersal of fruits and seeds is in the making. During the summer term the younger boys maintain a constant display of the flowering plants of the neighbourhood. (The lack of botanical exhibits in the museum is largely compensated for by a botanical garden comprising natural-order beds, a rock garden, a rose garden, marsh and aquatic flora, etc.) The palæontological collection consists of a series of wall-cases containing fossils arranged according to their strata. The petrological collection comprises table-cases illustrative of the more common rock-forming minerals, with a considerable number of good specimens clearly arranged and classified. For the two latter collections, as regards both material and arrangement, the school is indebted to the great kindness of Profs. Marr and Solly respectively.

More than three hundred boys (out of five hundred) are undergoing biological training at Oundle School in any one term. In teaching biology I have constant recourse to the school museum. For example, a class may be taken into the museum and a demonstration given of the general characters of the animal kingdom; or certain exhibits illustrative of one particular subject can be removed from the cases to the laboratory, where, after a short description, they can be sketched by the class. A similar use of the museum for practical education is made by my geological colleague. Further use of the collections has been made for popular demonstrations to members of a local society as well as to parents of boys who visit the school on Speech Day; on these occasions the boys themselves act as demonstrators. Such, in brief, are some of the uses to which a school museum is put in the service of education.

That the knowledge of such efforts in education has not come to the powers-that-be only emphasises the deplorable fact of the present lack of co-operation between the school and the university. As assistant in the zoological departments of Manchester and St. Andrews Universities I learnt the immense value of the museum as an aid to biological education. My experience of school work is confined to the brief period since the close of the war, but I cannot believe that no effort is being made similarly to use the museums of natural history in other schools where a biologist has been added to the staff of masters. E. W. SHANN.

Oundle School, Northamptonshire,
October 31.

Mating Dances of Spiders.

I HAVE not, up to the present, found any account of anything approaching to a mating dance, such as is common among the Salticides, in the Lycosides. The following observations tend to show, I think, that some such dance must exist among certain members of this family. I should be glad to know if any readers of NATURE have met with similar experiences with these spiders.

The species observed was *Lycosa saccata* (Blackwall), which is exceedingly common in the spring. I was watching a number of these spiders at about 3 p.m. on April 29, 1919. They were sunning themselves on a vertical wooden board leaning against a cucumber frame. I first noticed a male, which was about 1 in. from a female, going through some most curious movements. He extended one palp downwards (at about 45°) and the other upwards, at the same sort of angle. He then withdrew them and extended them again in the same way, but with their positions reversed. Each time he withdrew them he usually took a step towards the female. He repeated this two or three times, and then brought the palps to their normal position with a curious quivering movement. The front legs were also caused to quiver, being held just off the ground. The front legs of the female were occasionally seen to quiver also.

When the male got up quite close to her ($\frac{1}{4}$–$\frac{1}{3}$ in.) the female ran off, and the male searched about within 2 ft. of where he lost her, exploring crevices, etc., as though looking for her. At last he suddenly encountered her round a corner, and she ran away. He proceeded with his antics, however, without her being there.

A new male then appeared and began similar antics in front of the female, except that he merely extended each palp separately and returned them to their former position. The original male then came up and a fight ensued, in which both spiders fell off the board, leaving the female to continue her basking in the sun. G. H. LOCKET.

Lincoln College, Oxford, November 1.

The Energy of Cyclones.

IN NATURE of October 28, p. 286, Lt.-Col. Gold refers to the theory of the late Dr. Margules, that storms would arise if two masses of air of different temperatures were in juxtaposition. The situation would be unstable, and in passing from this unstable situation to a stable one the potential energy would be reduced, part of it being converted into the kinetic energy of the ensuing "storm." The theory takes it for granted that the warm air rises and the cold air descends.

But storms are generally associated with cyclonic depressions, and of recent years the temperature distribution in cyclones has been carefully studied. Sir Napier Shaw (Meteorological Office Geophysical Memoir, No. 210*b*, p. 14) sums up the facts as follows: "The conclusions which we may draw are, first, that the pressure changes at the surface are a reproduction of the pressure changes at the 9-km. level, and that they must be regarded as produced, not by, but in spite of, differences of temperature in the air."

The theory of Dr. Margules, consequently, fails entirely to account for cyclones. On the other hand, his theory may play some part in the production of line squalls and some thunderstorms.

With regard to "polar fronts," the theory of Dr. Margules is also at fault in a great measure. The low-pressure areas over the polar regions produce the two great polar cyclones. The atmospheric columns over the poles must be relatively warmer than those over middle latitudes. As a result, the warm air is drawn polewards. But, although the atmospheric columns over the polar areas are relatively light, there are cold, dense layers of air resting on the earth's surface. These cold polar layers are pressing outwards, and where they meet the warm cyclonic inflows we have the "polar fronts."

The facts seem to point to the stratosphere as being the main source of energy of storms and trade winds. R. M. DEELEY.

Tintagil, Kew Gardens Road, Kew, Surrey,
October 30.

DR. MARGULES wrote his paper mainly in connection with phenomena of the line-squall type, but he realised that it might have wider applications, and later investigations do indicate that discontinuity of temperature is the prime factor in the "birth" of cyclones. If one had an atmosphere with uniform pressure at sea-level, but with masses of warm and cold air, then at 9 km. pressure would necessarily be low in the mass of cold air, and a cyclonic circulation would ensue; but the energy of the motion would be derived from the potential energy of the initial state.

Differences of temperature originate in the lower atmosphere. The stratosphere may be able to draw upon a source of energy of which we are ignorant; it cannot of itself provide the energy of storms. E. GOLD.

Luminosity by Attrition.

IN reference to the letter in NATURE of November 4, p. 310, by Sir E. Ray Lankester on the above phenomenon, it may be of interest to some to know that Thomas Wedgwood was the first to direct attention to the fact that light could be produced by the rubbing together of quartz or sugar. His paper on "Experiments and Observations on the Production of Light from Different Bodies by Heat and Attrition" may be found in Phil. Trans. Roy. Soc., 1792, part i. C. CARUS-WILSON.

November 6.

Industrial Research Associations.

I.—British Scientific Instrument Research Association.

By J. W. Williamson.

THE British Scientific Instrument Research Association is one of the earliest research associations formed under the scheme of the Committee of Privy Council for the promotion of scientific and industrial research. It was founded, as is stated in the third annual report of that Committee, "through the efforts of the optical industry, guided by the whole-hearted energy and zeal of Mr. Conrad Beck, the president of the British Optical Instrument Manufacturers' Association." The association was incorporated on May 30, 1918, and established on lines broad enough to include all scientific instrument makers. In November, 1918, a group of firms representative of the electrical scientific instrument, electro-medical, and X-ray industries joined the association, which may now claim to be what the above-named report of the Committee of Privy Council stated in August, 1918, it had every prospect of becoming—the representative industrial body dealing with the application of science to the manufacture of scientific instruments. The association was fortunate in securing from the outset as its director of research Sir Herbert Jackson, K.B.E., formerly Daniell professor of chemistry at King's College. Mr. J. W. Williamson was appointed secretary of the association, and, later, Mr. H. Moore assistant director of research, with special reference to the electrical and X-ray researches of the association.

The first task of the newly formed association was to secure suitable premises for offices and research laboratories, and in November, 1918, the remaining term of the lease of 26 Russell Square, W.C.1, was purchased, and the association entered into possession on Armistice Day, November 11, 1918. Steps were immediately taken to effect the necessary structural alterations and to equip the premises with laboratories and secretarial offices, and now, on the completion of its first two years of life, though more remains to be done, the association has a relatively well-equipped research institute, with a scientific staff of six research workers, all university graduates experienced in research, in addition to the director of research and the assistant director of research.

In the beginning the association suffered a grievous loss by the untimely death, in August, 1918, of its first chairman, Mr. A. S. Esslemont, on whose wisdom, zeal, and powers of organisation the members had confidently counted to guide the association in its early career. He was succeeded in the chairmanship by Sir Arthur Colefax, K.B.E., who rendered valuable service to the association, and when, owing to the pressure of other duties, he was compelled to resign the chair some months ago the association was fortunate in securing as chairman Mr. A. A. Campbell Swinton, whose high scientific attainments and wide experience will be of great benefit to the association.

The council of the association consists of fifteen elected members, five co-opted members, and five members appointed by the Department of Scientific and Industrial Research. The addition to the elected members of council of these Department representatives and co-opted members has been of great service to the association in enabling the council to view from a wide angle and to a far horizon the varied problems presented to it, without impairing the predominant interest of the members representing the industry or modifying the necessary bias of the association's activities towards practical results.

The main and immediate functions of the association, the council has agreed, are :—

(*a*) To prosecute research into the questions of pure and applied science arising out of the urgent needs of the scientific instrument industry.

(*b*) To take long views and to investigate those questions, whether of pure or applied science, upon which the future of the industry may be conceived largely to depend.

(*c*) To investigate systematically and continuously the field of application of scientific instruments.

Time and experience will show whether and how far these guiding principles need to be modified or amplified.

Just as the actor's art, however subtle, will fail if it does not get over the footlights, so will these associations for scientific and industrial research fail in one of their primary functions if they do not get the results of their researches over into the workshops of the industries. Two years is all too short a time for any association to accomplish much in this way. The first year is necessarily spent mainly in organisation and preliminary surveys of work under contemplation. But the British Scientific Instrument Research Association has, nevertheless, obtained results of research of immediate utility which have already found practical application in the workshops, and are of considerable benefit to the industry.

For example, as the result of an extensive research on polishing powders, a rouge was prepared for the hand and machine polishing of lenses, prisms, etc., which, tested by optical firms, has proved to be thoroughly successful in the workshop. It has been manufactured on an industrial scale, and is now standardised and in regular use by optical firms. This research has given rise to much investigation on the purely scientific side, and to further work of an applied nature with the view of decreasing substantially the time of polishing glass and similar materials. The comprehensive researches of Sir George Beilby on this subject, especially in connection with the flow of solids under mechanical disturbance, has been of great value.

Another line of investigation which has been occupying the association from the start is on abrasives. Much work has already been done both from the purely scientific point of view and on the production of abrasive powders. Materials made in the laboratory are being tested in workshops, and it is hoped soon to publish reports on the whole investigation and on the practical results.

Again, in response to a need expressed by the industry a solder was prepared in the association's laboratories capable of being used for all the ordinary metals, including aluminium, and of withstanding a temperature of approximately 350° C., so that it could be used when the later heating of joints made by it was necessary—*e.g.* in enamelling. This also has been manufactured on a large scale, and industrial firms are engaged on extended tests of it. The reports to hand are very promising. Another solder, fusing at a low temperature, for special use with aluminium, has also been made on the laboratory scale, as the outcome of the previous research, and is now being tested by certain firms.

The association has also been able to give immediate assistance in the matter of securing suitable and trustworthy liquids for level bubbles, and is now engaged on problems connected with standardising the glass for the bubbles and with methods of preparing the inside surface. In this connection it has been considered important that purely scientific research on the fundamental physical problems connected with this investigation should be prosecuted so that not only may the practice in manufacturing level bubbles be improved, but also the reasons underlying it may be fully elucidated. This is being done for the association, extramurally, in one of the London technical colleges.

An interesting investigation, apparently dealing only with a small detail brought to the attention of the association, led to a considerable amount of research work on the cause of the tarnishing which had been found with certain tissue papers used for wrapping up polished glass. A report on the whole research has been issued to members, and so far as the practical issue is concerned the position is apparently quite clear as to the properties which the paper must have and the method of testing whether it has them. Here, again, the research has given rise to problems which are of great interest in connection with physical and chemical questions about colloids, and would be suitable for further investigation on academic lines. It is under consideration what arrangements can be made for this work to be done elsewhere in some university or technical college.

Another research of immediate practical importance to the optical industry is the research on cements for prisms and lenses. A report on this subject has been issued to members, and in the important matter of obtaining cements which have no tendency to change either in the direction of crystallisation or in the gradual deposition of insoluble matter, and do not tend to break away from the glass surface, very considerable progress has been made. This investigation on cements has led to a large amount of relevant work in the matter of insulators, a subject of importance to the electrical members of the association, and is an example of the advantage of the wider outlook which is obtained in an association such as this where the needs of one of its departments are co-ordinated with those of another. There are, of course, many scientific problems raised here which might well prompt pure science research—*e.g.* into the causes and conditions of crystallisation or of other instability in resinous and similar substances.

Questions on the purity of chemical compounds and on the relation of purity to stability are raised by the research being undertaken by the association to study the durability of different types and meltings of optical glass under a variety of conditions. Similarly, another research of the association into the question of the production of a glass of truly neutral tint raises fundamental questions of the theory of colour in glass.

It is impossible in a short article to do more than take almost at random a few examples of the researches being undertaken by the association, but enough has been said, perhaps, to show that, even in those researches being prosecuted for immediate practical ends, fresh problems in pure science are raised, or wider vistas opened out, which may well be suggestive and stimulating to the workers in the laboratories of purely scientific institutions.

The programme of research of the association is, naturally, rather the private affair of the association, but it may be said that it ranges from problems in pure science involving the fundamentals of optical, electrical, or chemical theory to technological investigations on the methods and materials of manufacture, including, for example, such a practical problem as the best lacquer for making an instrument look well finished.

It may be well to point out that, besides the specific researches included in the programme of research, the association in its character as the scientific centre of the industry is called upon from time to time to assist the industry by contributing from a scientific point of view suggestions and criticisms to the appropriate Government and other quarters on such matters as the supplies of raw materials and the manufacture in this country of products essential to the development of the British scientific instrument industry. Much work in this direction has already been done. Moreover, users of scientific instruments have already brought to the notice of the association, and, as the association becomes better known, will doubtless tend increasingly to bring to its notice, their specific needs. In this way the association will perform a useful scientific *liaison* office between the users and the manufacturers. Already, by means of conferences and otherwise, the association has enabled the manufacturing members to become better acquainted with the scientific needs of the users, and the users to appreciate the limitations imposed on the manufacturers by design, material, or other conditions.

In the task of industrial reconstruction after a devastating war which the British scientific instrument industry, in common with other British industries, has now to face and accomplish, its most potent means must be the extension of scientific research to the varied problems of the industry. In this work the co-operative research of the association and the particular research of the individual firms are essential and complementary. The work of the association does not supersede, but emphasises the need for, and assists, the scientific research undertaken by individual firms. In the same way, the pure science research of the universities and kindred institutions is essential and complementary to all research carried out by the research associations or by industrial firms. The universities and their like are the great sources of purely scientific research, and to them we look for that fundamental work which, probably in many cases not of immediate applicability to industry, is bound to be the foundation of future guiding principles. Nowhere is this more fully recognised than in the British Scientific Instrument Research Association. Its work is also largely purely scientific, but to fulfil its purpose of immediate utility to its relevant industries it necessarily cannot always follow through to completion the numerous lines of investigation which arise out of the problems studied.

Microseisms.

By J. J. SHAW.

HOW often we use the term "terra firma"! It is used despite the fact that no square yard of the earth's surface is ever at rest; an unending train of waves, waxing and waning in amplitude, are unceasingly coursing along the earth's crust and to unknown depths. The wave period ranges between 4 and 8 secs.; the amplitude is between 1/50,000 and 1/2000 in., but with a wave-length of 8 to 16 miles. The speed of the waves is believed to be about 2 miles per sec. These microseisms have been known to seismologists for twenty years or more, and were originally thought to be air tremors. Later, the rocking of the observatory buildings in the wind was suggested as their origin, or the rocking of the ground due to the motion of trees in the vicinity; but it is now established that these disturbances are pure earth-movements travelling over long distances. With sensitive seismographs, microseisms are easily recorded, but whilst hypotheses have not been lacking, their origin and cause still remain unknown.

Prof. John Milne, in 1898, suggested ("Seismology," p. 285) that the cause may be two-fold: (1) air currents and convection currents within the instrument cases; (2) a ground movement produced by rapid changes of barometric load. Before that time, Bertelli and Rossi had noted the connection of microseisms with barometric change.

In America, Burbank observed an increase in amplitude when a barometric load passed from land to sea, or *vice versa*. At the International Seismological Congress held in Manchester in 1911 funds were provided for the investigation of microseisms, and Prof. O. Hecker, of Strasbourg, was deputed to undertake the work.

Daily comparisons were made between the microseisms recorded and the state of the sea at Cape Grisnez, Heligoland, and Borkum, a connection between sea waves and these movements having long been suggested. The war intervened, and the conclusions do not appear to have been published.

In earthquake investigation observers are by this time fairly familiar with the easily recognisable chief phases, viz. "primary" and "secondary" waves, followed by "long waves" which rise to a "maximum"; hence it is comparatively simple to trace any particular phase around the globe, and by this means to determine the respective rates of propagation and to compile seismological tables for future guidance.

Microseisms do not lend themselves so readily to this kind of treatment. Fig. 1 illustrates a section of a record when microseisms are pronounced, and shows how similar one train of waves is to the next, thus defying identification of any particular wave at distant stations.

In May, 1917, the present writer was testing two similar seismographs in different buildings 60 ft. apart. The machines were arranged on the same electrical time circuit, and both oriented in the same azimuth. It was observed how closely similar were the microseisms on both records, showing that the air tremor hypothesis was untenable. A seismograph has two kinds of sensitivity—one to tilt, in which the period of the pendulum plays the more important part; the other to a horizontal thrust, where the ratio of the leverage, operating about the "steady-point," is the chief factor. These seismographs were constructed with the same sensitivity to horizontal thrusts, but, as an experiment, the period of one pendulum was raised until the sensitivity to tilt was four times that of the other. Under these conditions the recorded amplitude of the microseisms was approximately the same, whereas the large waves of an earthquake which were recorded were from three to seven times greater on the machine more sensitive to tilt. This seems to suggest that microseisms are principally a horizontal motion; but against this must be noted that seismographs designed for vertical motion record microseisms quite freely.

The fact that microseisms could be identified on instruments 60 ft. apart pointed to the advisability of attacking these waves on entirely new lines, viz. gradually to extend the distance between the observing stations so long as the identification of the individual waves remained possible. The use of a "dug-out" in a pit bank was secured, distant two miles from the home station, in a direction 17° west of north, and one of the instruments installed there. Both instruments were arranged in the same azimuth, with the same period, damping, and ratio of magnification. The clocks could be synchronised only by motoring between the two stations with a watch that varied about one-fifth of a second per hour. Comparisons were made

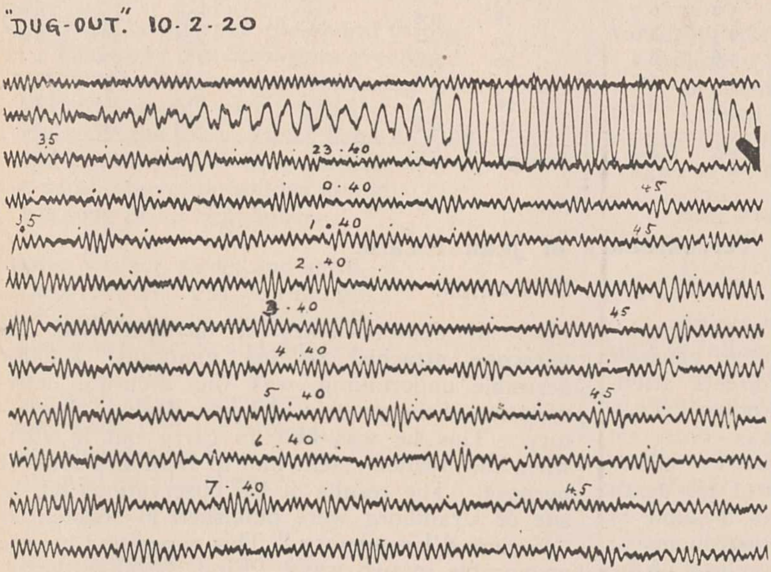


FIG. 1.—Earthquake and microseisms.

both ways, and the precision was calculated by interpolation. On favourable occasions the clocks were set alike within about one-tenth of a second.

It was at once seen that there would be no difficulty in identifying the waves at stations two miles apart (see Fig. 2). The films were timed by a short

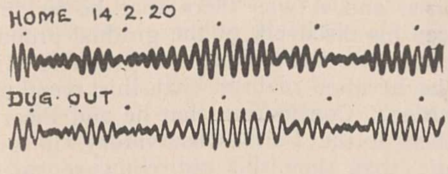


FIG. 2.—Comparative traces.

eclipse of the light every minute. In the first attempt the clocks were compared once daily, and the films timed by measuring from an eclipse to the nearest apex in the trace. By this method differences of as much as two seconds were noted, whereas one second was the maximum expected from the known rate of surface wave transmission. It was evident that a higher precision was necessary. The errors were chiefly traced to a lack of uniformity in the peripheral speeds of the recording drums. In a second series of observations the clocks were compared twice a day, and comparisons of the films limited to the point marked by the eclipse. For the success of this device it was necessary to obtain a record of the wave during the eclipse. This was achieved by cutting a fine slit across the shutter, so that whilst the beginning or end of the eclipse was still clearly defined, the leakage of light through the slit produced a "ghost" during the eclipse.

With the beginning and end of an excursion, and also the time-mark being defined, it remained only to resolve the harmonic motion to obtain the phase of the wave at each station at the instant the shutters closed, and so to deduce the time difference between the two observatories. By the first method there were readings ±1·13 sec. from the mean. By the second, this was reduced to ±0·3 sec.; but it is worthy of note that by either method the difference between the two means was only 0·04 sec. for the series.

It was noted that the wave period increased with the amplitude, and the amplitude increases generally with the daily movement of the air. There was, however, one marked exception on March 10, when a very moderate air movement coincided with nearly the maximum amplitude recorded. At this time rough weather was being experienced around the north of Scotland.

The chief objective in these proceedings was a comparison of wave direction with wind direction, and perhaps in its complete failure lies the greatest value of these observations, for it was discovered, it is believed for the first time, that there is practically no change in the wave direction, whatever the meteorological conditions may be. The microseisms always came, more or less, from the north—they always arrived at the "dug-out" first by about 0·8 sec. The small variations in time difference shown in column 2 of the table may or may not indicate a varying azimuth. It is equally probable that they are the result of personal or instrumental error.

To reduce the difficulties and shortcomings in the above experiments, it is proposed—with improved timing facilities and three machines placed at the corners of a 10-mile triangle—to continue this investigation, when it is hoped not only to obtain more precisely the rate of propagation, but also to determine to what extent the azimuth is constant. It would be of value if observers in other countries were to pursue the study of microseisms on this new system in order to determine whether this unidirectional character of the phenomenon is universal, and, if so, whether the direction is governed by the contour or physical features of the country.

By First Method.

Date, 1920	Difference, Sec.	Wind direction	Daily horl. motion of the wind, Miles	Amplitude μ	Wave period, Sec.
Jan. 31	0·0	S.—W.S.W.	427	5·8	7·3
Feb. 2	0·0	S.W.—S.	587	4·0	7·5
,, 6	1·5	S.S.E.	295	2·8	6·7
,, 9	1·0	W.S.W.	491	3·2	6·3
,, 10	1·0	S.W.	670	9·5	8·0
,, 12	0·0	W.N.W.—S.	354	3·6	6·2
,, 13	2·0	S.S.W.—W.	528	6·4	6·8
,, 15	1·5	S.	423	5·0	6·2
Average	0·87		472	5·0	6·9

By Second Method.

Date, 1920	Difference, Sec.	Wind direction	Daily horl. motion of the wind, Miles	Amplitude μ	Wave period, Sec.
March 4	1·0	W.S.W.—S.	260	4·9	7·5
,, 5	1·0	S.	285	1·6	6·7
,, 6	0·75	S.	476	4·5	6·0
,, 8	1·1	N.W.	407	2·4	6·7
,, 9	—	W.	178	—	—
,, 10	0·7	S.S.W.	272	7·0	7·0
,, 11	1·1	N.W.	257	4·9	6·5
,, 12	0·5	W.	541	5·7	6·0
,, 13	1·0	S.	377	4·5	6·2
,, 18	0·8	W.	500	4·0	6·7
,, 19	—	W.	228	2·0	6·0
,, 20	—	W.	131	0·8	5·5
,, 24	0·8	S.	348	4·0	7·3
,, 26	0.7	S.	613	5·3	7·3
,, 28	0·8	S.	498	3·2	5·7
Average	0·83		371	3·9	6·5

The Tercentenary of Jean Picard.

By DR. J. L. E. DREYER.

AN article on "Le tricentenaire de l'abbé Picard," by M. E. Doublet, in the *Revue générale des Sciences* (September 15–30), directs attention to the tercentenary of the well-known French astronomer, Jean Picard, who was born on July 21, 1620. Very little is known about Picard's life, so that even the year of his death is uncertain (about 1683). He was a pupil of Gassendi, and took up the study of astronomy at latest in 1645, when he observed the eclipse of the sun on August 21 of that year, and it was as an observer that he was chiefly distinguished. Though he was not the first to apply telescopic sights to astronomical instruments, he was almost certainly not aware that this had many years before been done by William Gascoigne; but Picard was at any rate the first to make use of this invention in an extensive series of observations, when he, in 1669 and 1670, determined the size of the earth. This was done by a triangulation from Sourdon, near Amiens, to Malvoisine, south of Paris, on the plan first proposed and carried out by Snellius about fifty years earlier. Picard measured a base along a level and well-built road from Villejuive to Juvissy, 5663 toises long. It is deserving of special notice that he compared his standard toise with the length of the seconds pendulum, "lest the same should happen to it as had happened to all previous standards"; and that did indeed happen, for his toise is lost. The results of this, the first modern geodetic operation, were published in Picard's "Mesure de la terre" in 1671.

In 1669 Picard presented to the Academy a memoir on the most important astronomical observations which ought to be undertaken. Among these is a new determination of the right ascensions of stars by direct comparison with the sun; this had never been done before without observing an intermediary body (the moon or Venus) which could be seen in the daytime. But it was now possible, as Picard had found in the previous year, to observe stars in daylight with the telescope attached to his quadrant. Another desirable undertaking was the accurate determination of the position of Tycho Brahe's observatory. This he was able to carry out in 1671, when the Academy sent him to Denmark for that purpose. The results of his observations on the site of Uraniborg were published in 1680 in his "Voyage d'Uranibourg." This expedition became memorable in two ways. First, because Picard, in his account of it, describes certain apparent motions of the Pole-star towards or away from the pole, of which the period was a year, and which, he says, he had noticed for about ten years. From the details given, it is evident that Picard was the first to notice the effect of aberration on the apparent place of a fixed star; and when he adds that these irregularities were in some years smaller than in others, it shows that the effect of nutation was also beginning to be felt. But it was reserved for Bradley both to discover the laws governing these phenomena and to give the correct explanation of them.

The second valuable result of Picard's journey to Denmark was that he made the acquaintance of Römer at Copenhagen, and persuaded him to go to Paris with him. Römer stayed nine years in Paris, and it was there that he in 1675 announced his discovery of the gradual propagation of light. We know from his letters to Huygens that he at once realised that this must produce aberration. Considering that he and Picard lived together at the Paris Observatory, it is rather strange that they did not compare notes and remark how perfectly this agreed with Picard's observations of the Pole-star. But Römer scarcely ever published anything, so it is not impossible that he may have noticed the agreement, and did not care to publish it.

Picard from time to time carried out various geographical operations in France, the results of which are included in his "Ouvrages de Mathématique" (1736). He was a very active observer at the Paris Observatory from 1666 to 1682, and his observations, which were chiefly made with a 9-ft. quadrant, were finally printed in Le Monnier's "Histoire Céleste" (1741). Though his work was less showy than that of his colleague Cassini, Picard deserves an honourable place in the ranks of astronomers as one of the comparatively few observers with instruments of precision in the period between Tycho Brahe and Flamsteed, and as the pioneer in the application of the telescope to this work.

Robin's Water-music.

By PROF. W. GARSTANG.

SCARCE heard amid the choral throng
That gave the Spring its greeting,
You triumph, Robin, when your song
Marks Summer's joys retreating;
Then, while the green leaves flame to gold,
And rain drips o'er their embers,
You raise, above the sodden mould,
The song of all Septembers.

Erratic, wistful, sweet and shrill,
The grave and gay you mingle,
As changeful as the trickling rill
That voices glade and dingle,—
From high to low,
Now swift, now slow,
Like water o'er the pebbles,
Meandering here,
And darting there,
To sparkle in the trebles.

Chir′ri-tew! Ir′ri-tew!
Wis′-yoo, Wis′-yoo!
Wee′!—Swee′!—Tew-ay′!
Tew, tew′, tew, Psee′!
Chirri-wee′! Tyo-to′!
Se-Wis′sy-wissy, Wis′sy-wissy, Wee′!

Until, in soft soliloquy,
You enter realms more tender,
And drop, from heights of ecstasy,
A falling trail of splendour,—
Brilliant gems no casket treasures,
Crystal tones no music measures,—
A glittering, flickering, tinkling streamlet,
Fragile as a dream.

See, See′, See, TSEE′. . . !
Choo-it′ty, Tu-it′ty, Choo-it′ty, Tu-it′ty, Choo-ee′!
Wee-chee′! Wee-tsee′ . . . !
Che-wir′rio-ir′rio-wir′rio-ir′rio-ee′!
As rockets soar
Aloft to fall in twinkling disarray,
As fountains pour
To break adrift in showers of glistering spray.

* * *

Tit-it′! Tit-it-it-it′! Tit′! Tit′!
Yes, Robin, yes! I must admit
(*Tit-it′-it-it′! Tit-it′-it-it′!*)
My actions were suspicious,—
For no true gardener stops his spade
To hear a little bird's cascade
Of music, though delicious!
But when, enraptured, down the scale
You dance by steps so slender,
The Nightingale's *Tyo-tyo′-tyo-tew′*,
The Throstle's *Tirra-lirra-loo*,
Grow pale
Before your rich chromatic splendour!

Notes.

THE following is a list of those recommended by the president and council of the Royal Society for election to the council at the anniversay meeting on November 30:—*President:* Prof. C. S. Sherrington. *Treasurer:* Sir David Prain. *Secretaries:* Mr. W. B. Hardy and Mr. J. H. Jeans. *Foreign Secretary:* Sir Arthur Schuster. *Other Members of Council:* Mr. J. Barcroft, Sir William Bragg, Dr. A. W. Crossley, Prof. J. B. Farmer, Sir Walter Fletcher, Prof. A. Fowler, Dr. A. C. Haddon, Sir Robert Hadfield, Sir Thomas Heath, Prof. J. Graham Kerr, Prof. H. Lamb, Sir William Leishman, Dr. S. H. C. Martin, Prof. J. W. Nicholson, Mr. R. D. Oldham, and Prof. W. P. Wynne. Prof. Sherrington, who is to succeed Sir Joseph Thomson as president, is the Waynflete professor of physiology in the University of Oxford, and was formerly professor of physiology in the University of Liverpool and Fullerian professor of physiology at the Royal Institution. He was elected F.R.S. in 1893, and was awarded a Royal medal in 1905 for his researches on the central nervous system.

DR. E. H. GRIFFITHS has been elected general treasurer of the British Association in succession to the late Prof. John Perry. The council of the Association has agreed to the formation of a separate Section of Psychology, as recommended by the Sections of Physiology and Educational Science at Cardiff, and approved by the general committee. Consideration of the number and scope of the various Sections is to be referred to a special committee. It has been decided to invite national Associations for the Advancement of Science to send representatives to annual meetings of the British Association in future.

THE council of the British Association has recently had before it the suggestion made by Prof. Herdman in his presidential address at Cardiff for a new *Challenger* expedition for the exploration of the great oceans of the globe with modern instruments and methods. It will be remembered that this proposal received the support of all the Sections of the Association by formal resolution, and the council was asked to appoint a committee to take the necessary steps to urge its need upon the Government and the nation. This committee has now been appointed, and the scientific world will follow its activities and their result with close attention. An oceanographical expedition along the lines contemplated, and equipped with the instruments which modern science can provide, would lead to a great increase of knowledge both for scientific study and for profitable development, and no nation could carry it out more appropriately than Great Britain in co-operation with our overseas Dominions. There will be an eclipse of the sun in September, 1922, with the line of totality crossing the Maldive Islands, and the expedition could very well include an astronomical party to observe it. It is believed that the Admiralty is favourably disposed towards the scheme, and every scientific man hopes that the necessary support will be forthcoming to carry out the enterprise on a scale worthy of the British Empire.

MR. H. G. WELLS, who has recently been in Russia, describes in the *Sunday Express* of November 7 the position of some leading men of science whom he met at Petersburg, by which name, and not Petrograd, this city is now called. He saw Pavlov, the physiologist, Karpinsky, the geologist, Belopolsky, the astronomer, Oldenburg, the Orientalist, and Radlov, the ethnologist, among others who have survived the complete social disruption which Russia has undergone since the catastrophe of 1917–18. Such privileges as are possible in the country under existing conditions appear to be extended to scientific workers; for Mr. Wells mentions that the ancient palace of the Archduchess Marie Pavlova is now a House of Science, where a special rationing system "provides as well as it can for the needs of four thousand scientific workers and their dependents—in all, perhaps, for ten thousand people." In spite of this, however, there are much privation and misery, and unless food and clothing are provided few are likely to survive the coming winter. What struck Mr. Wells more than anything else was that even under the present disordered conditions, and with physical vitality reduced almost to its lowest limits, a certain amount of scientific work is still carried on, and there is a burning desire to know what has been done for the advancement of natural knowledge in other parts of the world since the Russian collapse. "The House of Literature and Art," we are told, "talked of want and miseries, but not the scientific men. What they were all keen about was the possibility of getting scientific publications; they value knowledge more than bread." There would, we are sure, be no difficulty in obtaining the books and publications needed by, or funds for providing warm clothing for, the great survivors of the Russian scientific world, if their colleagues here were assured that the parcels would reach their destination. This specific aid is, however, a different matter from general provision for the physical and mental needs of the "four thousand" scientific workers to whom Mr. Wells refers. We should scarcely have placed so many men in that category even before the war, and the ranks of scientific forces in Russia must have been greatly reduced by the revolution.

A GOOD deal of uneasiness has recently been manifested with regard to the free importation of German dyes into this country, and in reply to questions on this subject the President of the Board of Trade stated on November 1 in the House of Commons that proposals to protect the industry for a time, so as to enable it to be placed on a secure foundation, will be embodied in a Bill relating to key industries which will be introduced and proceeded with as soon as possible. It appears that during the first nine months of this year 1574 tons of dyes were imported from Germany, of which 877 were consigned under the reparation clauses of the Peace Treaty. The value of the whole quantity was 1,399,027*l.*, and as the average price per lb. is thus about 7*s.* 11*d.* it would not appear that there can be any question of dumping as alleged in some quarters. The amount imported is at the rate of about 2000 tons per annum, whilst in 1913 there were imported from Germany about 13,000 tons. It is evident that there is a demand in this country for certain dyes of German origin, and this is not surprising when it is considered that with one conspicuous exception British manufacturers at the commencement of the war, like the Americans, concentrated their attention on the production of those dyes which were most in demand, simple to make, and required readily obtainable intermediate products. It is high time, however, that a serious effort should be made to produce such important dyes as the rhodamines and others, for which special plant and intermediate products not easy to make are required; and it may be noted that the former, in consequence of the remarkable discovery of a new catalytic method of preparing phthalic anhydride at a very low cost, are already appearing in America. Until this can be done the introduction of legislation such as that foreshadowed by the President of the Board of Trade is quite essential.

IN view of the increasing population in England and the imperative necessity that this country should in the future be more self-supporting in the matter of food than in the past, few subjects are of more vital importance than that of the reclamation of waste lands. The Association of Economic Biologists, presided over by Sir David Prain, discussed this problem at its meeting in the Imperial College of Science on Friday, November 5. In addresses very fully illustrated by lantern-slides Prof. F. W. Oliver considered the question of reclamation by botanical means and Dr. E. J. Russell that of reclamation by agricultural means. The former devoted his attention primarily to the reclamation of salt marshes and other maritime tracts, showing the manner in which this process slowly occurs in Nature through the accreting activities of certain ordered successions of plants, and then indicating how such action might be accelerated and made of immediate practical value by the wise interference of skilled botanists. Knowledge of the ecology of maritime-strand plants is, however, very small, and the necessity was emphasised for the establishment of experimental stations where such problems could be studied. Dr. Russell considered the reclamation of inland tracts of country, such as moor and fen, sandy commons, etc., and lands deficient in particular mineral constituents. Each class of waste land was discussed in turn with illustrations drawn from a wealth of personal experience, and the different procedures required in the several cases were described. Prof. Farmer, Dr. Voelcker, Mr. Lobjoit, Dr. Salisbury, Mr. Bernard Davis, and Sir David Prain took part in the discussion.

"OUR Wasteful Use of Coal and a Remedy" is the title of an article by Mr. W. O. Horsnaill appearing in the November issue of the *Fortnightly Review*. The author discusses in turn various recent publications, and concludes that "it is quite evident from the foregoing facts that coal should never be burnt direct for the production of heat if the greatest economy in its use is to be realised." He mentions the proposals made by Dr. Ferranti in 1910, according to which all coal would be consumed centrally for the generation of electricity, and points out once more the fundamental weakness of any such proposal, viz. that any attempt to deal with heating by such a scheme would mean an extravagant expenditure of fuel. The author finds that "the recommendations of the Coal Conservation Sub-Committee which was appointed by the Reconstruction Committee closely accord with the suggestions made" in his article, and goes on: "Put briefly, the Sub-Committee recommendations comprise the establishment of sixteen super-electric generating stations for supplying the whole country and the gradual suppression of the existing 600 undertakings. At these stations the coal would be so treated as to extract the tar, sulphate of ammonia, and gas, the latter, together with the coke, being utilised to produce the electricity. So far as practicable, the super-stations would be established near the coal-pits." There is a lack of precision about this paragraph which is observable in other parts of the article. The soundness of treating coal for by-products at the proposed super-stations was regarded by the Sub-Committee as requiring consideration. Moreover, the position of modern super-stations is of necessity determined by supplies of condenser water, and not by proximity to coal-pits. Mr. Horsnaill concludes: "Whether the use of electricity for heating and cooking is contemplated is not clear, but, in view of heavy losses already set forth as accruing from this practice, it is to be hoped that coke and gas will be employed for these purposes"—with which surely anybody who has looked into the subject at all carefully will agree.

WE are glad to welcome a new contemporary in the *Mining Electrical Engineer*, of which the first issue is now before us. This publication is the official journal of the Association of Mining Electrical Engineers, a society which has been doing important work for the last eleven years in the spreading of knowledge regarding the use of electricity in mines. Such a journal is of particular interest at the present time, when the need for the application of scientific methods to the aid of labour in improving the output of the coal-mines is so urgent, and we are pleased to see this sign of vitality in a society which from its earliest days has worked hard to break down prejudice against the use of electricity in collieries, to facilitate the interchange of experience, and to encourage those researches which conduced so much to improved safety and trustworthiness in this field. Besides some sound common sense regarding the industrial situation, there are several interesting technical articles, including a discussion of the ventilation of enclosed motors by Mr. W. M. Landon, and a fully illustrated description of an electrically driven main shaft winding plant, employing a geared three-phase motor. A complete system of electrical signalling in collieries, worked out in great detail by one of the well-known electrical firms, is also described. The proceedings of the various branches of the association are recorded, and many interesting notes on matters of electrical interest appear.

THE October issue of the *Scientific Worker*—the official organ of the National Union of Scientific Workers—contains the report of the Executive Committee on the policy and administration of the Government Department of Scientific and Industrial Research. After describing the present regulation for the formation of research associations under the Department, the report condemns the policy of assisting these close corporations with public funds, and would substitute for them the universities, colleges, and other national institutions at which research has been carried out so satisfactorily in the past. The report alleges that the faults of the present arrangements are due mainly to the constitution of the Advisory Council of the Research Department and to the absence of members with first-hand knowledge of the working of modern faculties of applied science at our universities and colleges. It is held that scientific eminence should not be the only qualification for membership of the Advisory Council, but aptitude for the conduct of affairs should be essential. These questions are to be discussed at the meeting of the council of the union on November 13.

PROF. F. GOWLAND HOPKINS is to deliver the eleventh biennial Huxley lecture on "Recent Advances in Science in their Relation to Practical Medicine" at Charing Cross Hospital at 3 o'clock on Wednesday, November 24.

DURING the coming session the meetings of the Röntgen Society will be held in the physics lecture theatre, University College, Gower Street, W.C.1, on the Thursday before the third Friday of each month at 8.15 p.m.

THE opening meeting of the new session of the Institution of Electrical Engineers will be held on Thursday, November 18, and not to-day (November 11), as originally announced, at the Institution of Civil Engineers at 6 p.m., when the president, Mr. Ll. B. Atkinson, will deliver his inaugural address.

THE Eugenics Education Society is organising a lecture to be given by Dean Inge on Tuesday, November 16, at 5.30 p.m., at the Wigmore Hall, Wigmore Street, W.1, entitled "Eugenics and Religion." The lecture will be free and open to the public.

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be delivered by Dr. A. C. Haddon in the lecture-room of the Royal Society on Tuesday, November 23, at 8.30. The subject will be "Migrations of Cultures in British New Guinea."

THE New York correspondent of the *Times* states that the fifth quinquennial election to the American Hall of Fame has resulted in the choice, from among 177 names submitted, of six, which include James Buchanan Eads, a famous engineer, and William Thomas Greene Morton, the Boston dentist who introduced sulphuric ether as an anæsthetic. Of the 27 women nominated, one, Alice Freeman Palmer, the educationist, was chosen.

THE following have been elected officers of the Cambridge Philosophical Society for the session 1920–21:—*President:* Prof. Seward. *Vice-Presidents:* Sir E. Rutherford, Mr. C. T. R. Wilson, and Dr. E. H. Griffiths. *Treasurer:* Prof. Hobson. *Secretaries:* Mr. H. H. Brindley, Prof. Baker, and Mr. F. W. Aston. *New Members of the Council:* Prof. Marr, Mr. C. T. Heycock, Mr. H. Lamb, Prof. Hopkins, Dr. Bennett, and Dr. Hartridge.

MR. ARTHUR MACDONALD has reprinted from the *Medical Times* of July last an interesting paper on "The Anthropology of Modern Civilised Man." He describes the conclusions at which he has arrived after a long course of study. He dwells upon the importance of head measurements as a test of mental ability. The smaller circumference of the head among children of mixed nationalities in America is held to indicate an unfavourable result of race intermixture. One of the main objects of the study of humanity is to lessen pain through the knowledge gained by the study of pain itself. Investigations into sensibility give some interesting results. Coloured children are more sensitive to heat than white children, and bright children as compared with dull children. All children are more sensitive to heat and locality on the left than on the right wrist, probably because the greater use of the right hand causes obtuseness of feeling. Girls are less sensitive to heat and more sensitive to locality on the wrist than boys, and all children are more sensitive to heat and locality on the wrist before than after puberty.

IN the issue of *Man* for October Mr. L. W. G. Malcolm describes a settlement of Tasmanian half-castes on Cape Barren Island, included in the Furneaux group of islands in Bass Strait, between Tasmania and the Australian continent. The settlement dates from the latter half of the seventeenth century, when Bass demonstrated that Furneaux Land was a group of islands, and not, as was generally supposed, connected with the mainland. The sealers who visited it carried off aboriginal women from Tasmania, and from them the present population has sprung. Among them Mr. Malcolm found two old men who claimed descent from aboriginal Tasmanian mothers. There were only nine families on the island, comprising in all about one hundred persons. One noticeable fact about these people is the pronounced odour of their bodies, which was decidedly fishy owing to the character of their diet. Their chief industry is catching and salting mutton-birds, which are exported in casks to the mainland. The Government provides medical attendance, and a school has been established. This survival of half-castes derived from a race now extinct is of considerable interest to anthropologists.

THE *Museums Journal* for November contains a useful history of the Winchester City and Westgate Museums by Mr. R. W. Hooley, who as honorary curator has of late been devoting much time and labour to putting the collections in order. In the course of his inquiries Mr. Hooley has made the lamentable discovery that the original bushel measure deposited in the city by King Edgar, and still in its possession only fifty years ago, is now missing.

IT is an excellent custom of the Smithsonian Institution to print as an appendix to its annual report a selection of papers covering a wide range of sciences and each of some general interest. The volume for 1917, recently received, devotes 546 pages and 242 plates to twenty such papers, of which eleven are original. Except for one original memoir and two of the reprints, all are by American authors, and about half deal with American subjects. It is scarcely possible to abstract such an assemblage, but we would direct the special attention of British readers to two of the papers—in the first place to "The Correlation of the Quaternary Deposits of the British Isles with those of the Continent of Europe," a hundred-page memoir by Mr. C. E. P. Brooks. This does not reveal a first-hand acquaintance with the deposits, but it is a most useful summary of the voluminous literature. Dr. T. Wayland Vaughan has an intimate knowledge of "Corals and the Formation of Coral-reefs," and his paper should interest the countrymen of Darwin, whose atoll hypothesis Dr. Vaughan is unable to substantiate in fact. The advocates of a new *Challenger* expedition may note his conclusion that "further investigations of the phenomena associated with coral-reefs are among the pressing desiderata of geologic research."

AN account of the round-headed apple-tree borer (*Saperda candida*) and its control is given in Bulletin 847 (1920) of the U.S. Bureau of Entomology. This insect is a Longicorn beetle which is indigenous to the United States and Canada. Its larva bores into the bark and wood of apple, pear, and quince, thus causing a great deal of injury. Certain wild trees are also affected, including crab, hawthorn, mountain ash, etc. The complete life-cycle of the insect occupies, as a rule, two years, but the developmental period may be lengthened or shortened according to locality and other factors. No easier and cheaper method of control was found than the old method of removing the larvæ from the trees with the aid of a pocket-knife, a narrow chisel, and a piece of wire. It is claimed that two men, on an average, with an insignificant expenditure for tools and materials, should be able to "worm" 500 trees per diem. Ordinary white-lead paint is a cheap and effective method for preventing the females from ovipositing on the bark.

THE important question of the control of the cotton-boll weevil by means of poison is dealt with by Messrs. B. R. Coad and T. P. Cassidy in Bulletin 857 (1920) of the U.S. Bureau of Entomology. Extermination of the species is not attempted, the result aimed at being a sufficient reduction of the weevil infestation to permit of the production of a full cotton crop. About 60 per cent. of the squares which appear on the cotton plant fail to mature as bolls, and are normally shed at some time during their development. It has been found that up to a certain point the first shedding due to boll-weevil attack merely takes the place of this perfectly normal shedding, which would be encountered even if the weevils were absent. The system of poisoning advocated is intended to keep the weevils controlled to such a degree that they will not be able to do more than offset the above-mentioned shedding. The authors advise dusting the plants with calcium arsenate at the rate of 5 lb. per acre. In order to avoid injury to the foliage the powder should not contain more than 0·75 per cent. of water-soluble arsenic oxide. It appears safe to assume that, with fertile soil and a fairly severe weevil infestation, average gains of 500 lb. or more of seed cotton per acre may be expected from the treatment advocated.

WE have received a copy of the Mauritius Almanac for 1920, published by the Mauritius Stationery and Printing Co. It is a large volume containing a mass of statistical and descriptive matter on all aspects of the life of the colony. The account of the agriculture is particularly full and interesting. There is a general map of the whole island, and another showing the distribution of rainfall.

THE results of some oceanographical researches on the coast of South-West Africa are published by the Deutsche Seewarte in *Archiv*, No. 1, vol. xxxviii., the first part of this publication which has appeared since 1915. The work, which was carried out by the *Möwe* so long ago as October, 1911, to July, 1912, includes the investigation of depths and sea temperatures along the coast between the Orange and Kunene Rivers seawards as far as the 200-metre contour. The results are discussed by Dr. A. Franz, and include charts of the depths, water, and air-temperatures. There is also a section dealing with the distribution of pressure and winds. The work is particularly interesting in relation to variation in the strength and temperature of the Benguela current.

THE degree of inaccessibility of various parts of the Arctic regions has a direct bearing on future exploration. Mr. V. Stefansson has an article on this subject, accompanied by a map, in the September issue of the *Geographical Review* (vol. ix., No. 9). By measuring distances of 500 miles northward along the meridians from the more northerly points attained by various exploring ships, an area of comparative inaccessibility is found to remain. The distance of 500 miles is chosen, on the basis of Peary's journey from Cape Columbia to the Pole, as a fair maximum possible with dog-teams from the base of supplies. By these estimates the "pole of inaccessibility" is found to be at latitude 83° 50′ N., longitude 160° W. Various modifying factors must be borne in mind. Open leads or heavy pressure ridges are great impediments to sledge travelling in several parts of the Arctic basin, while the action of currents may nullify advance or, if known and taken advantage of, may greatly facilitate progress. The question of food supply, if the traveller is "living off the country," also influences the problem. Certain areas of Arctic ice are known to be almost devoid of seals. These deserts must be avoided or crossed hurriedly. But Mr. Stefansson believes that the well-known drift across the Pole carries to this region, least accessible to man, a certain number of seals from the Beaufort Sea, where they are abundant.

As previously recorded in NATURE (August 23, 1917, p. 510), certain plant remains found in the wide tract of sandstones and conglomerates on the west coast of Norway led Nathorst to assign those rocks to the Middle Devonian. Some fish remains found since, and now described by Dr. Johan Kiaer (*Bergens Museums Aarbok*, 1917–18, 2 Hefte, 1920), fully confirm this conclusion, and, though incapable of specific determination, warrant a comparison of the Norwegian rocks with the upper part of the great Orcadian group as displayed in the north of Scotland, and particularly in the more closely adjacent Shetlands. There were at least two kinds of ganoid fishes (apparently Diplopterus and Tristichopterus) existing in large numbers, and, whether they fed on other fishes or not, their presence implies the existence of a large animal and plant life for their maintenance. Some of the plants are regarded by Nathorst as aquatic, and tracks of some crustacean have been observed. The present discoveries will doubtless lead to further investigation of these rather inaccessible Devonian regions, and we may hope that remains of other animals will before long be found.

PARTS 1 and 2 of vol. vi. of the Proceedings of the Indian Association of Science contain together eight papers which extend to 112 pages. Although the papers cover most branches of physics, investigations connected with the behaviour of musical instruments are most popular. Amongst these one by Prof. Raman on the variation of the bowing pressure with the pitch of the note, with the part of the string bowed, and with the speed of bowing in a violin may be noted. The observations were made with a violin moved mechanically to and fro at a constant speed over an iron track, while above it was suspended a bow in a balanced frame which allowed the pressure on the string to be varied. If the position of the point bowed is changed, the bowing pressure must vary inversely as the square of the distance of the point from the bridge. If the speed of bowing is increased, the pressure must be increased, at first slowly, then more rapidly. If the pitch of the string is changed by stopping, the pressure varies with the frequency, and is a maximum at each of the resonance frequencies of the string.

IN the course of his presidential address to the North-East Coast Institution of Engineers and Shipbuilders, delivered on October 29, Mr. A. Ernest Doxford made reference to the educational functions of the institution. The promotion and maintenance of professional proficiency are among the chief duties accepted by the technical societies. Their policy is to increase the professional knowledge of their members by fostering the interchange of useful information by the members themselves, and there would seem to be no more useful method of attaining the end in view than that of the reading and discussion of thoroughly good papers. In the more scrupulous institutions no paper appears except from the pen of a practical expert, and the information provided has to be either quite new or sufficiently up-to-date to require further dissemination and discussion. If the engineering technical societies are truly representative of engineers in the particular territory to which they refer, they represent the only people who are able to provide new information on engineering questions, and it is the self-imposed responsibility of these societies to furnish such information. Strictly speaking, a society cannot *train*; it only finds the information with which its members must instruct themselves. Mr. Doxford puts the question as to whether the technical societies do, or can, fill a place in the educational system of this country, and considers that they are unique and indispensable factors in any complete national educational system. The institution is not endowed, and Mr. Doxford considers that the members, the local engineering and shipbuilding industries, and the shipowning businesses might find some opportunity of encouraging it by contributions to an endowment fund; he does not think that the institution should appeal to the State, particularly in these times when State generosity in some directions has become dangerous.

WE have received from Messrs. Dulau and Co., Ltd., of Margaret Street, Oxford Circus, W.1, two catalogues of books which they are offering for sale. One includes a number of old French and Italian books and a collection of some seventy volumes from the library of Adam Smith. There are also four volumes which belonged to Newton, two of which contain his autograph. The other catalogue contains a list of about one thousand books on mathematical and physical sciences, many of them very old copies. Among other important items we note that one set of the thirteen volumes in which the Paris Académie des Sciences published the works of Laplace is offered for sale. There are also some early works on sundials and a number of sets of the Proceedings of various British and American scientific societies and other scientific periodicals.

Our Astronomical Column.

THE DISTRIBUTION OF THE STARS IN SPACE.—The *Astrophysical Journal* for July contains an important paper by Prof. Kapteyn and P. J. Van Rhijn on star-density in different regions of the stellar system. The authors have lately accumulated from various sources much new material on star parallaxes and motions, and state that they could not resist the temptation to attempt a general solution of the problem of the universe, though they admit that it will need revision. They adopt the parsec as unit of distance, and the magnitude at unit distance as absolute magnitude. That of the sun is $-0{\cdot}2$, while the median magnitude of all stars is $+2{\cdot}7$. The expression for the logarithm of the number of stars of absolute magnitude M per 1000 cubic parsecs in the region near the sun is found to be $-2{\cdot}394+0{\cdot}1858\,M-0{\cdot}0345\,M^2$, indicating a parabolic curve when M is taken as abscissa. This gives 0·0451 stars per cubic parsec near the sun, or 23·6 within 5 parsecs of the sun. Observation gives some twenty-seven stars in this sphere—a satisfactory agreement.

The next step is to investigate the rapidity with which the stellar density falls off with increasing distance from the sun (provisionally assumed as the centre). Curves are drawn showing the lines of various densities on a plane drawn through the galactic polar axis. For example, the line of density 0·01 (the density near the sun being unity) is distant 1300 parsecs towards the galactic poles, and 8900 parsecs in the galactic plane. Density 0·063 is reached at about half these distances.

Prof. Kapteyn has re-investigated the formula connecting parallax and proper motion. The new formula is

$$\log \pi_{m,\mu} = -0{\cdot}690 - 0{\cdot}0713m + 0{\cdot}645 \log \mu,$$

m being the apparent magnitude and μ the annual proper motion in seconds.

THE MULTIPLE SYSTEM ξ URSÆ MAJORIS.—Dr. G. Abetti contributes a study of this system to *Mem. della Soc. degli Spett. Ital.* (vol. viii., Ott., Nov., Dic., 1919). He reminds us that it was this star which Sir W. Herschel, who discovered its duplicity in 1780, used to demonstrate the extension of the law of gravitation beyond our system. On plotting the numerous observations of the last sixty years a minor oscillation clearly appears superposed on the orbital motion. This was explained by the discovery made by Wright and Campbell at the Lick Observatory in 1900 and 1908 that each star of the visible pair is a spectroscopic binary. The period of the pair A, *a* is 1·82 years, and their respective masses are given as 0·52 and 0·16 of the sun. The joint mass of B, *b* is given as 0·49 of the sun, but there is scarcely enough material to assign the respective masses of B, *b*. The parallax of the system is assumed to be 0·156″. If the mass of *a* is correct, this is about equal to the companion of Krueger 60, these being the smallest stellar masses known.

CHARLIER'S CRITICAL SURFACE IN ORBIT DETERMINATION.—Prof. Charlier showed that a certain surface divides those regions in space where there is a dual solution of the orbit problem from three observations from those where there is only one. Herr A. Wilkens gives in *Astr. Nach.*, 5067, tables for laying out this surface accurately. It suffices to give the intersection with the plane of the ecliptic, the surface being one of revolution about the earth-sun line. The curve resembles a looped *limaçon*, the double point being at the earth, the inner loop extending to the sun, and the outer one to a point 1·7844 beyond the sun on the earth-sun line produced. The table includes some other auxiliary quantities of use to orbit computers.

Physics at the British Association.

THE programme of Section A included papers of wide and varied interest, ranging over the subjects of pure mathematics, experimental physics, geophysics, and astronomy. A great deal of the time of the Section was absorbed in atomic problems, and it was in relation to these that much interesting discussion arose.

Dr. Aston gave a concise and comprehensive account of his work on isotopes, starting from his original discovery of the complex nature of neon and chlorine, and he spoke of his early attempts to separate the components of these gases. He described his very elegant modification of Sir J. J. Thomson's method of positive-ray analysis, by which it has now become possible to obtain mass spectra of the rare gases and many other elements with high dispersion of the component lines. He showed how the spectra of various elements could be analysed into groups of lines due to the individual isotopes, and the results interpreted by examining the spectra of different orders produced by atoms carrying multiple charges. In this way it has been possible to eliminate uncertainties arising from radiations consisting of compound molecules and to determine the number of components due to each element. Thus it was shown that chlorine consisted of three isotopic components, krypton of as many as six, and xenon of five, corresponding with atomic weights represented by whole numbers, taking oxygen of atomic weight 16 as standard. Hydrogen alone gave an atomic weight of 1·008, differing from an integral value, and this discrepancy could be explained by considering that the spectrum of hydrogen was due to a hydrogen atom from which an electron had been withdrawn, and which from theoretical considerations should have a mass differing by the observed amount from that of the hydrogen atom. The results thus show that the elements may be considered as being composed of these hydrogen nuclei, or "protons" as Sir Ernest Rutherford would have us call them, and we thus return to Prout's conception of the constitution of matter, modified only by the recent discoveries and ideas of modern physics.

Sir Ernest Rutherford followed with an account of his researches on the structure of the atom, starting from the point of view of radio-activity. When α-particles pass through matter they are scattered, and when they pass sufficiently near to the atomic nucleus they may even be turned back upon themselves. In such cases, at any rate with the lighter elements, the forces involved are so enormous that the nucleus may suffer disruption and charged hydrogen atoms, or "protons," be torn from the nucleus. Hydrogen atoms travelling with high velocities thus appear, and can be detected by their scintillations produced on a fluorescent screen. These have been found when nitrogen is bombarded with α-particles, as have elementary projected particles of atomic weight 3, probably an isotopic form of helium. The investigation has been extended to other elements, and it would appear that the nuclei of atoms of the lighter elements can be regarded as made up of suitable combinations of hydrogen and this new isotope of helium with electrons. In the heavier elements it would seem that a condensation occurs by which is formed the ordinary helium atom of mass 4. Models were shown illustrating the possible constitution of some of the lighter nuclei, but the complete elucidation of this suggestive and ingenious line of thought must await further experiments.

The discussion of the origin of spectra directed attention to other scarcely less important aspects of atomic phenomena. Prof. Fowler opened the discussion with a masterly description of the known phenomena of spectroscopy, referring to the latest results obtained in examining and classifying the different spectral series of the elements, leaving the consideration of the theories which have been devised to explain the observations to Prof. Nicholson, who described Bohr's well-known theory of atomic radiation. This simple view is, however, insufficient to explain the complicated structure of the lines composing the series, and Prof. Nicholson outlined the extension of Bohr's theory recently developed by Sommerfeld, in which the electronic orbits are considered as elliptical instead of circular. By this extension the relations obtained by Bohr are modified so as to explain the structure of the components of the various spectral series, and the predictions of theory have been strikingly verified by the work of Paschen, whose observations also indicate that the Zeeman and Stark effects are of the magnitude to be expected by theory. Prof. W. L. Bragg directed attention to the difficulty of reconciling the above theory with X-ray observations on crystals and with the chemical evidence leading to Langmuir and Lewis's theory of atoms containing stationary electrons; and Dr. Oxley in a separate paper pointed out the bearing on the question of the magnetic properties of the atom—a subject which has hitherto not received the attention it deserves. From the magnetic evidence Dr. Oxley postulates a binding of the atoms in the hydrogen molecule by a rotating electron system—a complication which, it is to be hoped, will find some simpler substitute.

The subject of relativity was represented by two papers, one by Mr. Evershed and the other by Sir Oliver Lodge. The former paper was concerned with the observations made during the last seventeen years at the Kodaikanal Observatory on the shift of the Fraunhofer lines in the solar spectrum. The conclusion is reached that the general shift of the lines at the centre of the sun's disc and at the limb is not due to pressure, and it is suggested that the increase of shift in passing from the centre of the disc to the limb may be explained by a constant shift towards red over the disc, which is partly compensated by a shift towards violet, due to a movement of ascent radial to the sun. A comparison was drawn between solar phenomena and the results of observations in the electric arc, and the experiments of Royds were quoted as showing that the vapour density in the sun is probably less than is found at the centre of an iron arc. Mr. St. John's measurements on band lines were discussed and compared with observations made at Kodaikanal, which give values at the sun's limb nearly in agreement with the Einstein theory. There are, however, difficulties involved in fully interpreting the results on this theory, and the alternative hypothesis that motion is the sole cause was considered. This view demands an earth effect and a general recession of the iron vapour from the earth. Mr. Evershed described his ingenious experiments in which the displacements were observed by examining the light reflected from Venus. When the angle Venus-sun-earth is about 90° such observations should be crucial, for in this case we should be observing the sun at right angles to the supposed movement. The results are regarded as being favourable to the motion hypothesis, but it cannot be considered that they are as yet decisive.

Sir Oliver Lodge discussed the assumed necessary constancy of the observed velocity of light in free space as contrasted with the universally admitted constancy of its true velocity. He contended that there is no experimental evidence for the dogma that wave-fronts are concentric with a travelling observer initially situated at the source. The Michelson-Morley experiment is consistent with such concentricity, but does not necessitate it. He argued that the Einstein equations exercise no physical discrimination, and are consistent either with this mode of expression or with the FitzGerald-Lorentz conception of the contraction of matter, which was a safer mode of expressing physical results than the attempt to impose complications upon time and space. The paper gave rise to some lively discussion from the supporters of the more modern views.

Mr. F. J. M. Stratton exhibited some spectrograms of Nova Aquilæ III. recently obtained at the Lick Observatory by Mr. Moore, which show important changes taking place in the distribution of radiation from the growing disc of Nova Aquilæ. It appears that the disc given by the $H\beta$ radiation is growing at only half the rate of that given by the nebular lines N_1, N_2, while the complex bands in the spectrum corresponding with all three lines give the same multiple of the wave-lengths for the displacement of separate maxima. Moreover, the separate maxima originate in different portions of the disc, and are inclined to the normal position of spectral lines. A complex combination of expansion, rotation, and vortex motion is needed to explain the effects in terms of the Doppler principle. While the maxima remain fixed in position, the most displaced ones are growing brighter as compared with the central ones.

A further paper on astrophysics was communicated by the Rev. A. L. Cortie, who drew some remarkable comparisons between observations on solar faculæ and photographs of calcium flocculi. The occurrence of magnetic storms on the earth was attributed to the emission of electrons from low, disturbed areas of the sun, giving rise to the formation of clouds into which the earth then passed.

The programme also included an interesting paper by Prof. S. Chapman, who gave an account of some recent extensions of his work on the subject of magnetic storms. Prof. Horton described the results which he had obtained on ionisation phenomena in neon; and Prof. Whiddington showed how he had been able to detect distances of molecular magnitude by observing the variations of frequency in a thermionic-valve circuit produced by the minute changes of capacity resulting from the displacement of one plate of a condenser included in the circuit.

The reports of the Committees on Tidal Observations and on Seismology were of more than usual interest, and in the latter report Mr. J. J. Shaw referred to his recent observations on microseisms. Both communications are being published in the reports of the Association. Much interest was added to the proceedings of the Section by the opportune appearance of the new star in Cygnus. The discovery was announced by the Astronomer Royal at the first session of the Section, and reports of later observations on the new star were received during the meeting.

Chemistry at the British Association.

THE meetings of Section B at Cardiff were fairly well attended, although the programme did not contain any remarkable novelties, and the war papers, which were so conspicuous a feature of the meeting at Bournemouth, were absent. Mr. Heycock's presidential address dealt with the development of metallography, a branch of physical chemistry which owes so much to the work of Heycock and Neville, whose investigations not only opened up important new lines of research, but also set a standard of accuracy which has had a most beneficial effect on later work in metallography, especially in this country. The lesson of the intimate connection between pure science and the advance of industry was well enforced by the address. The president was able to show lantern-slides made from the original photographs of Sorby taken just half a century ago, and members were enabled to appreciate the remarkable skill of the Sheffield amateur who was a pioneer in so many branches of science.

The Section held only one joint meeting for the purpose of hearing the papers in Section A on the subject of isotopic elements. There was a very large attendance at this meeting, and the latest discoveries concerning the isotopes of the commoner elements were described with admirable clearness by Dr. Aston. It is to be regretted that no chemist took part in the discussion. The doctrine of isotopes was founded on chemical evidence, and although recent developments have come chiefly from the physical side, the subject is one of intense chemical interest, and the conclusions which have been reached, inevitable as they appear to be, call for a drastic revision of conventional ideas regarding the elements. No chemist specially associated with the work of determining atomic weights was present, or it would have been interesting to learn whether accurate atomic-weight determinations have ever been made for a single element, other than those of the radio-active group, from materials of widely different origin and geological age; whether, for example, such differences as have been observed between specimens of lead from minerals containing thorium and uranium respectively could be found between chlorides of widely differing origin so as to indicate that the isotopes of chlorine were present in a different ratio from that which has led to the accepted atomic weight of that element. The later paper of Sir E. Rutherford on the structure of the atom was also of great chemical importance, and considerations of this kind have, in the hands of Langmuir and others, been brought into direct relation with chemical facts. It is to be hoped that by the time of the next meeting of the Association chemists will be prepared to join with physicists in the discussion of these questions.

The three subjects selected for discussion on the technical side were fuel, lubrication, and non-ferrous metallurgy. Capt. Desborough's paper on industrial alcohol gave an excellent review of the prospects of production of this fuel from vegetable sources in temperate regions, and showed that, whilst the present cost of root crops grown on cultivated land is too high to allow of their profitable utilisation as sources of alcohol, the possibility of growing suitable crops on reclaimed land is by no means excluded, and figures were given to show that artichokes, sugar-beet, and a South American tuberous plant are all deserving of consideration. The use of maize in certain climates and of waste cellulose is also being studied. The experiments now in progress at the Royal Naval Cordite Factory may be expected to throw some light on the question, and the Section took occasion to pass a resolution urging on the Government Departments concerned the desirability of continuing such experiments with existing plants. Some controversial matters arose in the discussion of the Third Report of the Fuel Economy Committee, which was presented by Prof. Bone. The report includes a memorandum by Prof. Louis urging improvements in the collection and presentation of mining statistics, and these recommendations have been adopted by the Committee. The Committee further disagreed with the policy of the Fuel Research Board in regard to the regulation of the quality of gas, and insisted on the importance of the limitation of inert constituents and sulphur. The hope was expressed that a further opportunity would be afforded to the Committee to submit its views to the Board of Trade before the matter was finally settled. The policy of the Fuel Research Board was defended by a later speaker, and references were made in the discussion to the use of colloidal fuel and to the recovery of ethylene from coke-oven gas. The Section asked for the reappointment of the Committee, which has done valuable work in directing public attention to the urgent national need for fuel economy. An allied subject was dealt with by Dr. Owens in his paper on the measurement of smoke pollution as carried out by a Committee of the Meteorological Office. The methods of determining acidity in air have been improved, but a good method of estimating the amount of acidity borne by the suspended solid particles is still lacking.

The discussion on lubrication covered similar ground to that of recent meetings of technical societies. Messrs. Wells and Southcombe described the influence of small quantities of free fatty acids in lubricating oils, and Dr. Dunstan directed attention to the present ignorance of the chemical nature of mineral oils. The mode of action of acids on these oils is almost completely unknown. Mr. Tizard regarded lubrication as dependent on the formation of an adsorbing layer on the surface of the metal bearing, and mentioned curious results obtained in determining surface tension between mercury and oils by the drop method. Castor oil and glycerol have about the same viscosity, but the former is a good lubricant and the latter worthless. Mercury drops falling through castor oil remain intact at the bottom of the vessel like lead shot, whilst in glycerol they coalesce immediately.

Mr. Vogel's paper on tungsten described the methods employed in the manufacture of the metal at Widnes, and included an interesting account of the steps taken by the steelmakers of this country, when the outbreak of war deprived them completely of supplies of this most essential metal, to meet the requirements of the industry, with such success that all the tungsten needed is now manufactured at home, whilst a surplus remains for export, the quality being superior to that of the metal used before the war. Prof. Desch gave an account of the preparation and properties of ductile tungsten, and directed attention to the remarkable properties of the metal in the drawn state, a complete theoretical explanation of which is still lacking. Mr. Field's paper claimed great advantages for the electrolytic method of extracting zinc over the usual distillation process, and urged its more widespread adoption. Two short analytical papers were presented by Dr. Stanford, and the last session closed with an exceedingly interesting account by Prof. Jaeger, of Groningen, of his determinations of the surface tension and electrical conductivity of organic liquids and fused salts over the remarkably wide range of $-100°$ C. to $+1600°$ C.

The report of the Committee on Absorption Spectra, which was taken as read and not discussed, consisted mainly of an exposition by Prof. Baly of his theory of absorption. This paper might have furnished the basis of a good discussion, as the physical theory involved is novel, and criticism from both the chemical and the physical sides should be expected. Whilst numerous papers on the use of atomic frequencies and of the idea of quanta have been published in recent years, there has been no thorough discussion of such views, and most chemists have allowed the communications to pass without submitting them to any rigorous scrutiny, so that it is uncertain how far the new ideas are likely to meet with acceptance.

Cardiff afforded many opportunities for the inspection of chemical industries of varied kinds, and the Sectional excursions, which were well attended, included visits to iron- and steel-works, copper-smelting works, tinplate works, gasworks, and a rubber factory.

The Lakher Head-hunters of Upper Burma.

AT the opening meeting of the session of the Royal Anthropological Institute, held on Tuesday, October 26, Prof. F. G. Parsons, vice-president, in the chair, Mr. Reginald A. Lorrain, of the Lakher Pioneer Mission, read a paper on "Lakherland, the Home of the Head-hunters."

Lakherland lies on the border of Upper Burma, and is some twenty days' march from civilisation. The Lakhers, who are practically unknown to the civilised world, are of the Mongolian type, and chocolate-coloured. While the men wear a small loincloth only, save for a large blanket thrown round them in the colder evenings, the women wear more clothing, their garments consisting of a piece of cloth for a skirt reaching down to the ankles, while a breast-jacket nearly covers the upper portion of the body. This jacket is open at the back in order that the heavy loads the women carry should not wear out the garment. The men allow their hair to grow long, but it is fastened in a large knot on the top of the head with long brass pins. A plume of horsehair is entwined in the head-cloth to show that the wearer has taken a head. The children run about in a nude condition up to the age of ten or twelve years.

The Lakhers are skilled smiths, although their tools and appliances are of the simplest character. The forge consists of three slabs of stone, and the bellows are hollowed trunks of trees in which is fitted a plunger consisting of a circular disc fitted to a handle, feathers being attached to the rim of the disc to make the plunger practically airtight. Pottery is made by the women without a wheel. The clay, which is obtained from the white-ant heaps, is moulded between a stone held inside the pot and a hammer with rope wound over the head.

An interesting feature in a dance described by Mr. Lorrain was that the ceremonial headdress of the chief for this occasion, which is handed down from father to son, was always worn by the chief's daughter.

The dead are buried in graves immediately outside the dwelling-houses. The grave consists of a hole about 4 ft. square, but the body is placed in a small, sloping trench or tunnel underground excavated from one side of this hole. The body is pushed into the tunnel feet first, the cavity then being closed with a stone. An ornamental wooden pole, with projections or ears which distinguish by their number the sex of the deceased, is erected over the grave. Outside the village decorated memorial poles are erected. In the example described by Mr. Lorrain, one of the poles bore the horsehair plume denoting that the deceased had taken heads and the tail-feather of a cock denoting that he had carried off another man's wife, while on another pole was the skull he had taken. A third small pole showed projecting points, each representing a slave he had carried off when making raids. The animals which had fallen to his spear in the chase were represented by stones round the foot of the poles. A large, flat stone was possibly a sacrificial slab. On one side was placed a row of flat staves representing the deceased's wives.

Great value is attached to the heads of animals taken in the chase and to the heads of human beings taken in tribal wars and raids, as the possession of such is believed to give the owner not only power over the victims in the "world to come," but also ensures a permit into Paradise after the death of the one who has obtained a full set of heads. Sometimes the marriage price of a maiden consisted in part of a number of such heads of human beings, and this led to young men entering into raids upon their near or distant neighbours.

By religion the Lakhers are animists, but it would be more correct to say that they appeased rather than worshipped these spirits, which are believed to be the authors of all evil. A large tree in the centre of the village was held to be the abiding place of the most powerful spirit. At the foot of this tree was the sacrificial stone upon which cocks and pigs were sacrificed.

In the discussion which followed the paper Mr. Lorrain, in replying to certain queries raised by Col. Shakespeare, stated further that there were well-marked social distinctions between the clans. The headship of the village could be held only by the members of about six clans. Next in grade to these were the aristocratic clans, also about six in number, who could not hold the headship of the village. The lower classes comprised two grades, an upper of ten to fifteen clans and a lower of about thirty clans. Below these were the slaves. The headship of the village descended from the father to the youngest son of the chief legitimate wife: other sons became headmen of outlying villages. Mr. Lorrain had not found any regular institution of feasts similar to those held among the neighbouring Lushai, which, when given in a certain progression in the number and character of the victims, bring the giver honour in this world and favour in the world to come. He had found, however, one instance of a house in which the door had a rounded instead of a square top. The exact significance of this he had not been able to ascertain beyond that it was a privilege connected in some way with a special sacrifice.

Meteors of the Season.

THE November meteors are due to return on November 14 and 15, and, though no abundant display may be expected, Mr. W. F. Denning thinks that the shower is likely to prove fairly conspicuous. The parent comet of the meteors must have been in aphelion in 1916, and is now situated between the orbits of Saturn and Uranus, so that whatever meteors may appear this year must be at a vast distance from the cometary nucleus of the shower. The whole orbit, however, contains meteoritic particles, and observations during last century prove that this system re-appears annually at the middle of November. It is fortunate that the moon will be absent from the sky after the rising of the Leonid radiant, which occurs at about 10.15 p.m. on November 15. Probably the meteors will be far more abundant after midnight, when the radiant at $150^\circ+23^\circ$ has attained a fairly good altitude.

These November meteors belong to the swift class, moving at the apparent velocity of 44 miles per second, and, like the Perseids of August, they include flashing fireballs of the largest kind intermingled with the smallest shooting stars.

An abundant shower of meteors was observed between October 30 and November 5, and quite a large number of fireballs were seen. The meteors belonged to a radiant point in Taurus and a few degrees south-west of the Hyades, at about $59^\circ+12^\circ$. There was also another shower situated in Aries at $43^\circ+22^\circ$, which furnished a considerable number of meteors. These were slow-moving, brilliant objects, and have usually traversed long flights.

Both these showers were well observed by Miss A. Grace Cook from Stowmarket during a series of careful and prolonged meteoric observations between October 30 and November 4. Mr. F. Sargent at the University Observatory, Durham, also witnessed the fall of a number of meteors on October 30 and November 5. At Bristol Mr. Denning saw some of the meteors, and one of them, on October 30, about 7.14, was also observed by Mr. F. Sargent. The real path of this object was from about 77 to 55 miles in height, and its luminous course 110 miles at a velocity of about 24 miles per second. The radiant point was at $60^\circ+14^\circ$.

A very brilliant member of the same shower appeared on November 4 at 6.11, and came under observation by Miss A. Grace Cook at Stowmarket and by others at Bristol and Ilford. It had an extremely long path, and afforded a grand spectacle to many observers in the south of England. This was also a Taurid, and it traversed a horizontal course of about 235 miles at a height of about 63 miles from over the sea, about 40 miles east of Southwold, to over Somerset about 20 miles south of Bath. This shower of Taurid meteors is well known, but its recent display, like that on November 2, 1886, was of a rather exceptional character.

Heredity and Social Fitness.

DR. WILHELMINE E. KEY has made (Carnegie Institution, Washington, Publication 296, 1920, pp. 102) a careful study of differential mating in a Pennsylvania family. The study comprises 1822 individuals, nearly half of whom are in the direct line of descent from two pairs of German immigrants of more than a century ago. The remainder were considered in connection with the strains into which the descendants of these couples married. The research began with four young people, patients at the Institution for the Feeble-minded of Western Pennsylvania, and was followed into intricate networks of stocks. Some of the general results may be outlined. (1) The behaviour in inheritance of such qualities as far-sightedness, perseverance, and push indicates that the occurrence of these traits is due to a segregation of their determiners. (2) There was a decided decrease in fecundity in all lines, but not more marked in the socially inefficient than in the efficient. On the other hand, the survival ratios increase for the successive generations of the efficient lines, while they decrease for the inefficient lines, thus illustrating Nature's method of eliminating the unfit. (3) In migration the more efficient push into new areas, the less efficient tend to settle down. (4) The reactions of the degenerate members show that the variations in efficiency are due not to adverse conditions, or to isolation, or to lack of opportunity, but to native inability and to the mating of defective with defective. (5) Individual immigrants of high potentiality tend to marry with the better native stocks, while those of low potentiality gravitate towards inferior native stocks. The whole history emphasises the usefulness (*a*) of segregating the markedly defective, (*b*) of some colonisation scheme, together with sterilisation, for certain types of the socially unfit, and (*c*) of some expert board of control with authority to prohibit marriages of a cacogenic sort. There is danger in ameliorative methods which allow the markedly unfit to multiply and counteract natural agencies for the selection of fit strains. More positively, public opinion requires to be educated towards a keener realisation of the possibilities of establishing strong strains of efficient citizens.

University and Educational Intelligence.

CAMBRIDGE.—Mr. R. A. Fisher and Mr. A. R. MacLeod have been elected to fellowships at Gonville and Caius College, and Mr. R. O. Street, Mr. W. H. Bruford, and Mr. G. E. Briggs to fellowships at St. John's College.

LONDON.—A course of nine lectures on "A Historical Review of Meteorological Theory" will be given at the Meteorological Office, South Kensington, S.W.7, by Sir Napier Shaw, reader in meteorology in the University, on Fridays at 3 p.m., beginning on January 21 next. The course is intended for advanced students of the University and others interested in the subject. Admission is free by ticket, to be obtained on application to the Meteorological Office, South Kensington, S.W.7.

The informal meetings at the Meteorological Office for the discussion of important current contributions to meteorology, chiefly in Colonial or foreign journals, began on Monday, November 1, and will be continued on alternate Mondays, with the exception of December 27, until March 21, 1921.

DR. A. FULTON, hitherto lecturer on engineering in Dundee University College, has been appointed to the chair of engineering in the same institution.

THE Cambridge University Calendar for 1920–21 has been published by the University Press, price 20*s*. The volume contains lists of University officials, professors, lecturers, etc., and the regulations for prescribed courses, degrees, and prizes. The Tripos lists from 1911–20 are given, and also the list of degrees conferred during the year 1919–20. Some three hundred pages are devoted to notes on the individual colleges, which give all the essential information about the constitution of these bodies, the regulations for admission, scholarships, etc., together with the lists of fellows, graduates, and undergraduates attached to them. The volume is supplied with a general index, and also with a complete index to members of the University.

THE Calendar for the session 1920–21 of University College, University of London, has been received. In it will be found complete details of all the faculties of which it is composed, together with time-tables for all the courses provided and lists of the scholarships, prizes, etc., available. There is also an account of the assembly held on July 2, when the American Ambassador, Mr. John W. Davis, took the chair. The Provost of the college made his report for the session 1919–20, and mentioned that during that period the college had been the recipient of two gifts from the United States: one of 1,250,000*l*. from the Rockefeller Foundation for the promotion of medical research, and another, a collection of books on American literature, history, and institutions, from the Carnegie Endowment for International Peace. Other benefactions which were mentioned included a gift of 10,000*l*. from Lord Cowdray for the extension of the engineering school, and a grant from the Carnegie United Kingdom Trust which had made it possible to institute a school of librarianship.

DETAILS of the French Budget for 1920 are given in the *Fortnightly Survey of French Economic Conditions* of September 1. For the Ministry of Public Instruction and Fine Arts a sum of 1,067,328,770 francs is provided which will be allotted in the following way: For public instruction, 994,335,476 francs; for the fine arts, 44,008,800 francs; and for technical instruction, scholarships, etc., 28,984,494 francs. Of a total of 3,280,247,620 francs provided for the Ministry of Public Works, 128,650,830 francs is devoted to section 11, which deals with aeronautics and aerial transportation. In the section of the Budget dealing with extraordinary expenditure which is not provided for by taxation the Ministry of Public Instruction and Fine Arts is credited with a further sum of 109,175,400 francs. The Ministry also receives 129,762,000 francs for the reconstruction of schools, etc., which will be recovered under various peace treaties which have been signed; while the Ministry of Agriculture will be credited with 5,812,000 francs from similar sources for the purposes of reafforestation and the reconstruction of fences protecting State forests.

TEACHERS' Leaflet No. 9 of the Bureau of Education, Washington, illustrates the earnest endeavours now being made in the United States to place instruction in civic rights and duties upon a firm foundation. The leaflet, prepared under the direction of the Bureau's specialist in civic education, describes a series of lessons in civics for the three primary grades of city schools. Each lesson is based upon some situation of civic significance in which the child is normally to be found. The typical situations include: Riding in public conveyances; visiting public places; an accident; a fire drill; arrival of a new pupil or visitor to the school; the walk to school; the arrival of the mail; and contact with a sick person. In conversation style the children are led to give their observations and experiences, and through the teacher's interpretation and enlargements the civic significance is induced. The syllabus is replete with suggestions, dramatisation without material being especially recommended. Similar situations are dealt with in each grade, the instruction being cumulative and concentric. The proposed enlargement of the syllabus and its adaptation to the requirements of the intermediate higher grade will constitute an interesting and important experiment in civic training.

THE Department of Aeronautics in the Imperial College of Science and Technology announces an extensive series of lectures for the year 1920–21. Two full-time courses have been arranged: (1) Design and Engineering and (2) Meteorology and Navigation. The former course includes lectures on aerodynamics by Prof. Bairstow, with practical classwork under his direction; a special course of mathematics for students of aerodynamics; design lectures and drawing-office work under Prof. Bairstow and Mr. F. T. Hill; and lectures on the construction and strength of aircraft by Mr. A. J. Sutton Pippard. Engine design is dealt with by Mr. A. T. Evans, the theory of the internal-combustion engine forming the subject of a series of lectures by the director of the department, Sir Richard Glazebrook. A special course of meteorology and navigation for students principally concerned with aerodynamics is being given by Sir Napier Shaw, while in the latter half of the session Wing-Comdr. Cave-Brown-Cave will lecture on airships. The full-time course on meteorology and navigation comprises a very detailed study of meteorology with special attention to its bearing on aeronautics. The work is under the control of Sir Napier Shaw, the late director of the Meteorological Office, with the assistance of Squadron-Leader Wimperis as lecturer on navigation. The whole programme for both courses is very well arranged, and as the services of such excellent lecturers have been obtained it is to be hoped that a sufficient number of students will be forthcoming to make the courses a success and to establish firmly this new department of the Imperial College.

Societies and Academies.

LONDON.

Royal Society, November 4.—Sir J. J. Thomson, president, in the chair.—Prof. H. **Lamb**: The vibrations of an elastic plate in contact with water. The chief problem considered is that of determining the gravest frequency of a thin elastic diaphragm filling an aperture in a plane rigid wall which is in contact on one side with an unlimited mass of water. This had an interest in connection with submarine signalling. An exact solution is not attempted, but a sufficient approximation for practical purposes is obtained by Rayleigh's method of an assumed type, which gives good results if the type be suitably chosen.—Prof. H. M. **Macdonald**: The transmission of electric waves around the earth's surface.—Lord **Rayleigh**: A re-examination of the light scattered by gases in respect of polarisation. II.: Experiments on helium and argon. The light scattered by helium and by argon is investigated. It is found in the case of helium that the total light scattered is in accordance with what would be expected from its refractivity. The polarisation in helium, contrary to what was found in 1918, is approximately complete. No intensity was detected in twenty-four hours of exposure in the component vibrating parallel to the exciting beam, and certainly this component was less than 6·5 per cent. of the other. Argon polarises much more completely than any other gas examined (with the possible exception of helium), the weak component being only 0·4 per cent. of the other.—Prof. C. F. **Jenkin**: Dilatation and compressibility of liquid carbonic acid. The paper describes the measurement of the dilatation and compressibility of carbonic acid between temperatures of -37° C. and $+30^{\circ}$ C. and up to pressures of 1400 lb. per square inch. The measurements were made to supply accurate data for determining the starting point for drawing the $\theta\phi$ and $I\phi$ diagrams and to replace the approximate results (known to be inaccurate) given in a former paper (Phil. Trans., A, vol. ccxiii., p. 76).—W. T. **David**: Radiation in explosions of hydrogen and air. This paper contains a record of the results of experiments on the emission of radiation during the explosion and later cooling of mixtures of hydrogen and air contained in a closed vessel. The results of experiments on the transparency of the exploded mixtures are also recorded. Some of the main conclusions arrived at are as follows: (1) The rate of emission is approximately proportional to the fourth power of the absolute mean gas temperature. (2) The maximum rate of emission occurs at the point of maximum temperature. (3) The exploded mixtures are very transparent throughout cooling to radiation of the same kind as they emit. (4) The intrinsic radiance increases both with the lateral dimensions and with the thickness of the radiating layer of gas. (5) The $2 \cdot 8\,\mu$ band of steam ceases to be emitted when the gas temperature has fallen to about 700° C.—Dr. R. E. **Slade** and G. I. **Higson**: Photochemical investigations of the photographic plate. (1) It has been shown that the silver halide grain is the photochemical unit in the photographic plate. (2) A method has been devised whereby the law of photochemical behaviour of these grains can be investigated free from the disturbing effects of development, etc., which occur in the photographic plate itself. (3) From experimental results obtained a formula has been deduced which shows the relation between the behaviour of the silver halide grains, the light intensity to which they have been exposed, and the time of exposure. (4) The results show that it is impossible for the mechanism of the process to be the absorption of light in discrete quanta, and that a given amount of light energy has a greater effect photographically when concentrated into a short range of wave-lengths than when it is distributed over a large range.—Dr. E. H. **Chapman**: The relationship between pressure and temperature at the same level in the free atmosphere. The paper deals with the exceptionally high values contained in the table of coefficients of correlation between changes of pressure and changes of temperature at different levels in the atmosphere included in Geophysical Memoir 13 of the Meteorological Office, by W. H. Dines. The coefficients are computed for observations taken at random, and arranged in four groups for the year of three months each. For the layers between 4 km. and 8 km. these coefficients range from 0·75 to 0·92. It is assumed that if the observations were freed entirely from errors of measurement the coefficients would be still higher. A method is therefore worked out for correction of coefficients of correlation for probable errors of observation in measurement.—Prof. J. C. **McLennan**: Note on vacuum grating spectroscopy.

PARIS.

Academy of Sciences, October 18.—M. Henri Deslandres in the chair.—M. **Mesnager**: The applications of the Pitot tube. Remarks on the note in the last issue of the *Comptes rendus* by the late Yves Delage. It is pointed out that the three problems stated by him—transmission to a distance, independence of the experimental indications and of the support, and registration of the velocities—have already been solved, and the first two in a simpler manner. An account is given of the methods hitherto proposed, all of which would be difficult to use at sea.—M. **Hamy**: The photography of stars in full daylight. An account of some experiments carried out at the Observatoire des Bosses (altitude 4350 metres) on Mont Blanc.—H. and F. **Le Chatelier**: The mechanical properties of plastic bodies: the importance of reactivity. From a study of the torsion of glass kept at 550° C. and of steel at 825° C., it is shown that there are three kinds of deformation: an instantaneous elastic strain, which disappears on removal of the stress; a sub-permanent deformation, produced slowly and disappearing equally slowly; and, finally, a viscous deformation, produced with a constant velocity and not vanishing after release from stress.—M. **Le Prieur**: A route corrector: a new method of aerial navigation by estimation.—J. L. **de Olivar**: Correction of the lunar coordinates deduced from observations made at Montevideo of the annular eclipse of the sun of December 3, 1918.—E. **Belot**: The law of distribution of masses in the solar system, and the origin of the smaller planets.—A. **Véronnet**: Time and temperature of formation of a collection of stars in an indefinite homogeneous nebula.—L. and E. **Bloch**: The spark spectra of some elements in the extreme ultra-violet. Details of the spark spectra of antimony, arsenic, bismuth, and tin between the limits 1850 and 1400 Ångström units.—G. **Bruhat**: The specific heat of saturated vapours at low temperatures. Reply to some criticisms of M. Ariès.—P. **Vaillant**: The existence of intermediate states in the phosphorescence of calcium sulphide deduced from its conductivity.—P. **Théodoridès**: The thermal variation of the coefficient of magnetisation in anhydrous sulphates, and the theory of the magneton. The results of magnetic measurements on the sulphates of manganese, cobalt, and iron at varying temperatures are given. These are in general agreement with the magneton theory.—A. **Dauvillier**: A new theory of photographic phenomena. In a recent communication the author developed a new theory of the chemical action of cathode, β, X, γ, and ultra-violet rays. The production of photographic images is considered from the same point of view.—L. **Dubreuil**: Determination of the number of independent constituents of a system of bodies.—R. **Fosse**: The micro-chemical qualitative analysis of cyanic acid. The method is based on the crystallisation of silver cyanate from hot water. After examining the forms of the crystals, they may be used for several colour reactions.—P. W. **Stuart-Menteath**: The tectonic of the Pyrenees.—G. F. **Dollfus**: The geological probabilities of discovering petroleum in France. A summary of the trial borings made in various parts of France for coal, potash, and oil. The outlook is generally unfavourable except in the valley of the Saône.—P. **Négris**: Considerations on the Glacial period. In an earlier communication the author was led to attribute the invasion by ice and its retreat to epirogenic movements. Further direct evidence of these movements is now given.—A. **Lepape**: The radio-active analysis of the thermal springs of Bagnères-de-Luchon. Some of the springs are rich in radium emanations, figures of 26·5, 31·6, and 41·5 millimicrocuries of emanation per litre of water being recorded.—H. **Ricôme**: The orientation of branches of plants in space.—L. **Emberger**: Cytological studies of the sexual organs of ferns.—M. and Mme. G. **Villedieu**: The non-toxicity of copper for moulds in general and for mildew in particular. Copper in the form of copper-ammonio-citrate does not interfere with the growth of the spores of Penicillium or mildew.—M. **Nicolle** and E. **Césari**: The effects and constitution of the antigens.—A. **Lumière** and J. **Chevrotier**: A simple and inoffensive method of avoiding anaphylactic shock. Starting with the hypothesis that anaphylactic shock is due to the formation of a solid precipitate in the blood plasma, experiments have been made *in vitro* on mixtures of sera capable of giving flocculent precipitates. Various reagents were added to these tubes with the view of discovering a substance capable of preventing the flocculation. Of the large number of reagents tested very few were found to possess the required property, and of these sodium hyposulphite was the most suitable. Experiments on animals showed that this substance was capable of preventing anaphylactic shock, and it was further proved that sodium hyposulphite did not appear to destroy, or even to attenuate, antitoxic sera.—G. **Bertrand** and R. **Vladesco**: The distribution of zinc in the horse. Twenty-three organs of the horse have been examined for zinc, the quantities found varying from 12·2 to 98 milligrams per 100 grams of dried material. Zinc was found in every organ examined, and the proportion varied not only from one organ to another, but also in the same organ or tissue in different individuals.—A. **Němec** and V. **Káš**: The favourable influence of selenium on some moulds arising from the cheese industry.—J. L. **Dantan**: The development of the Antipathella.—M. **Delphy**: The reproduction of *Enchytraeoides enchytraeoides* and *Clitellio arenarius*.—V. **Galippe**: Researches on the presence of living organisms in cretacean, ferruginous, pyritic, and siliceous fossils.—A. **Paillot**: Immunity in insects.

Books Received.

Proceedings of the Aristotelian Society. New Series. Vol. xx. Containing the Papers read before the Society during the Forty-first Session, 1919–20. Pp. iv+314. (London: Williams and Norgate.) 25*s*. net.

The Fringe of Immortality. By Mary E. Monteith. Pp. xv+204. (London: J. Murray.) 6*s*. net.

An Introduction to String Figures. By W. W. Rouse Ball. Pp. 38. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*.

Ou en Est la Météorologie. By Prof. A. Berget. Pp. vi+303. (Paris: Gauthier-Villars et Cie.)

The Volatile Oils. By E. Gildemeister and Fr. Hoffmann. Second edition. Authorised translation by E. Kremers. Vol. ii. Pp. xx+686. (London: Longmans, Green and Co.) 32*s*. net.

A Course of Modern Analysis. By Prof. E. T. Whittaker and Prof. G. N. Watson. Third edition. Pp. vii+608. (Cambridge: At the University Press.) 40*s*. net.

Electricity and Magnetism: Theoretical and Practical. By Dr. C. E. Ashford. Third edition. Pp. xii+303. (London: E. Arnold.) 4*s*. 6*d*.

A Treatise on Airscrews. By W. E. Park. Pp. xii+308. (London: Chapman and Hall, Ltd.) 21*s*. net.

First Lessons in Geography. By E. Marsden and T. A. Smith. Pp. 185. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Diary of Societies.

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY, at 4.30.—Dr. W. G. Ridewood: The Calcification of the Vertebral Centra in Sharks and Rays.—Dr. A. Compton: Studies in the Mechanism of Enzyme Action. I. *Rôle* of the Reaction of the Medium in fixing the Optimum Temperature of a Ferment.—C. H. Kellaway: The Effect of certain Dietary Deficiencies on the Suprarenal Glands.—E. J. Collins: The Genetics of Sex in *Funaria hygrometrica*.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 (Annual General Meeting).—J. E. Campbell: Einstein's Theory of Gravitation as an Hypothesis in Differential Geometry (Presidential Address).—H. Bateman: The Conformal Transformations of a Space of Four Dimensions.—F. Bowman: (1) The Differentiation of the Complete Third Elliptic Integral with Respect to the Modulus; (2) Note on the Intersection of a Plane Curve and its Hessian at a Multiple Point.—T. S. Broderick: Dirichlet Multiplication of Infinite Series.—L. E. Dickson: Arithmetic of Quaternions.—P. J. Heawood: The Classification of Rational Approximations.—E. L. Ince: Integral Solutions of Ordinary Linear Differential Equations.—C. Jordan: The Series of Polynomials, every Partial Sum of which approximates *n* Values according to the Method of Least Squares.—H. J. Priestley: Some Solutions of the Wave Equation.—H. Steinhaus: An Example of a Thoroughly Divergent Orthogonal Development.—N. Wiener: The Group of the Linear Continuum.—G. S. Young: The Partial Derivates of a Function of Many Variables.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. E. G. Browne: Arabian Medicine after Avicenna (FitzPatrick Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir D'Arcy Power: The Education of a Surgeon under Thomas Vicary (Thomas Vicary Lecture).

ROYAL SOCIETY OF MEDICINE, at 6.30.—Sir Almroth Wright: Medical Research, and the conditions that are indispensable to the achievement of new knowledge.

OPTICAL SOCIETY, at 7.30.—Major E. O. Henrici: The Use of Internal Focussing Telescopes for Stadia Surveying.—Dr R. J. E. Hanson: Visual Fatigue and Eye Strain in the Use of Telescopes.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. H. Head, Dr. J. Collier, and Others: Discussion on Aphasia.

FRIDAY, NOVEMBER 12.

INSTITUTE OF CHEMISTRY, at 4.—To Receive Report of the Extraordinary General Meeting of October 28 and confirm the Resolutions and By-laws passed thereat.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5. —Dr. F. S. Goucher: Ionisation and Excitation of Radiation by Electron Impact in Helium.—J. Guild: Fringe Systems in Uncompensated Interferometers.—J. Guild: The Location of Interference Fringes.—Dr. G. Barr: A New Relay for Moderately Heavy Currents.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rev. J. G. Hagen: Differences between Long-period and Short-period Variables.—J. H. Reynolds: The Galactic Distribution of the large Spiral Nebulæ.—W. S. Franks: Micrometrical Measures of 202 Double Stars.—F. E. Baxandall: The Presence of Absorption Lines of Nitrogen and Oxygen in the Spectra of Nova Aquilæ III.—J. van der Bilt: Observations of Minor Planets made with the 10-in. Refractor of the University Observatory, Utrecht, Holland.—W. J. S. Lockyer and D. L. Edwards: Spectroscopic and Magnitude Observations of Nova Cygni III., 1920.—G. F. Dodwell: Note on the Longitude of Adelaide.—J. Evershed: Recent Work at Kodaikanal Observatory.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—Dr. F. Parkes Weber: Chronic Myeloid Leukæmia—Death from Acute Anæmia due to Massive Hæmorrhages (Hæmatomata), Simulation of Slight Pyuria by Leukæmic Oozing in the Urine.—Z. Cope: Diaphragmatic Shoulder Pain.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—R. H. Squire: Hydraulic Sand Packing and Colliery Workings in India.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8 30.—Dr. J. Taylor: Some Neurological Aspects of Ophthalmic Cases (Presidential Address).—P. Smith: The Blood-vessels in the Eye of the Ox.

MONDAY, NOVEMBER 15.

ROYAL BOTANIC SOCIETY, at 3.—Prof. A. W. Bickerton: The Relations of Astronomy to Botany. (1) The Importance of Scientific Correlation.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Prof. H. E. Schwarz: The Control of Climate by Lakes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.—Ll. B. Atkinson and Others: Discussion.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—R. Dircks: The Library of the Royal Institute of British Architects.

TUESDAY, NOVEMBER 16.

ROYAL HORTICULTURAL SOCIETY, at 3.

ROYAL COLONIAL INSTITUTE (at Hotel Victoria), at 4.—G. Howell: Petroleum Resources of the British Empire.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—Major Acton: Pharmacological Actions of the Main Cinchona Alkaloids, illustrating their Isomeric Relationships.—Dr. W. E. Dixon: Quinine Derivatives as Local Anæsthetics.—Dr. W. Crowe: The Vaccine Treatment of Rheumatoid Arthritis.—Drs. W. E. Dixon and D. Cow: Pituitrin-like Body in the Cerebro-spinal Fluid, and Hormones which cause its appearance therein.

ROYAL STATISTICAL SOCIETY, at 5.15.—Sir R. Henry Rew: The Organisation of Statistics (Inaugural Presidential Address).

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—F. W. Macaulay: Cross Connections on the Elan Aqueduct of the Birmingham Corporation Waterworks.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—L. W. Bates: Colloidal Fuel.—H. O'Neill: Properties and Characteristics of Colloidal Fuel.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. P. Chalmers Mitchell: Report on the Additions to the Society's Menagerie during the month of October.—Dr. W. A. Cunnington: The Fauna of the African Lakes: A Study in Comparative Limnology, with special reference to Tanganyika.—H. F. Carter: Description of the Adult, Larval, and Pupal Stages of a new Mosquito from Lord Howe Island, South Pacific.—Dr. C. L. Boulenger: Filariid Worms from Mammalia and Birds in the Society's Gardens, 1914-1915.

ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8.30.—Dr. H. Schutze: Blood Grouping with Dried Material and its Medico-legal Bearing.—Dr. J. A. Murray: Autoplasty after Exposure to Hot Air.—Dr. A. Powell: A Flagellate Organism persisting for Six Years in otherwise Sterile Urine.

WEDNESDAY, NOVEMBER 17.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—J. Berry: A Public Latrine of Roman Imperial Time.—Dr. M. Greenwood: Galen as an Epidemiologist.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

ROYAL SOCIETY OF ARTS, at 8.—A. A. Campbell Swinton: Wireless Telegraphy and Telephony (Inaugural Address).

ROYAL METEOROLOGICAL SOCIETY, at 8.—C. E. P. Brooks and H. W. Braby: The Clash of the Trades in the Pacific.—Dr. W. H. Steavenson: Note on the Mirage, as observed in Egypt.

ROYAL MICROSCOPICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 18.

ROYAL BOTANIC SOCIETY, at 3.—Prof. A. W. Bickerton: The Relations of Astronomy to Botany. (2) The Value of Basic Principles.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Sir Arthur Schuster: The Absorption and Scattering of Light.—Prof. O. W. Richardson: The Emission of Electrons under the Influence of Chemical Action. —Dr. A. E. Oxley: Magnetism and Atomic Structure. I.—Prof. A. O. Rankine: The Proximity of Atoms in Gaseous Molecules.—Prof. A. O. Rankine: The Similarity between Carbon Dioxide and Nitrous Oxide.—Dr. A. M. Williams: Forces in Surface Films. Part I., Theoretical Considerations; Part II., Experimental Observations and Calculations; Part III., The Charge on Colloids.

LINNEAN SOCIETY, at 5.—Prof. E. S. Goodrich: A New Type of Teleostean Cartilaginous Pectoral Girdle found in young Clupeids.—Dr. J. C. Willis: Endemic Genera and Species of Plants.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.—L. Damblanc: The Problem of the Helicopter.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—J. Morrow Campbell: The Origin of Primary Ore Deposits (Adjourned Discussion).—H. C. Robson: Converting High-grade Matte in Magnesite-lined Converters.—C. Brackenbury: An Automatic Counting Machine for Checking Tram Wagons.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Ll. B. Atkinson: Inaugural Address.

INSTITUTION OF AUTOMOBILE ENGINEERS, at 8.—London Graduates' Meeting.

CHEMICAL SOCIETY, at 8.

RÖNTGEN SOCIETY (in Physics Lecture Theatre, University College, Gower Street), at 8.15.

FRIDAY, NOVEMBER 19.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 5.—Sir William Milligan: Chronic Catarrhal Otitis Media; Some Thoughts and Suggestions.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Capt. J. S. Arthur: Sterilisation of Water by Chlorine Gas.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section) (at City and Guilds (Eng.) College, Exhibition Road), at 6.30.—C. C. Paterson: The Incandescent Electric Lamp from the Inside.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Sections), at 8.30.—Discussion: Radio-therapy; Prof. S. Russ: Physics.—Dr. Batten: Superficial Therapy.—Dr. Finzi: Deep Therapy.

SATURDAY, NOVEMBER 20.

PHYSIOLOGICAL SOCIETY (at St. Bartholomew's Hospital), at 4.

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