NATURE

SATURDAY, SEPTEMBER 22, 1928.

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Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The Revolution in Physics.

ON April 19 last, Sir Oliver Lodge gave the nineteenth Kelvin lecture to the Institution of Electrical Engineers.[1] When he gave the fifth Kelvin lecture in 1914, he chose as his subject the electricity of the atmosphere—both natural and artificial. This year he took as his subject the revolution in physics and expounded it in his inimitable way. He controverted the statement so confidently made a few years ago that the effect of the revolution has been to abolish the ether of space. He considers that not only has the existence of the ether been established, but also that a rational theory of it has already begun. He points out what a tremendous discovery it would be if the universe could be proved to be finite. Possibly the finiteness of space only means that it is our particular cosmos that is finite. We cannot say what is beyond it ; there is no means of getting at what is beyond it. Still, absolute units have been discovered, that is, discontinuous things which can be counted ; for example, the electron and the quantum. Many years ago the discontinuity of matter was observed. Now the atom itself has been resolved into electric charges which are localised portions of energy embedded in the ether. It is a great discovery that matter is a form of energy.

There is a great conflict, beginning in ancient times and continuing ever since, between continuity and discontinuity. Every discontinuity discovered is a step in advance. But there is little doubt that continuity will conquer in the end. Twenty or thirty years ago it seemed that a great deal was known about the electron. Its size, mass, and so on could be computed. Some of this knowledge still remains valid, but the twentieth century has put everything back into the melting pot. We are ignorant of the nature and constitution of the electron, and we are now uncertain as to its size and speed. The mathematical methods now employed are of a novel and almost of an experimental kind. Mechanical theories of the ether have had to be abandoned. This is what is meant, or should be meant, by the statement that the ether no longer exists.

Electrons are what electrical engineers specially deal with. We have had these active little creatures harnessed for a good time, and have propelled many things by their aid, from telegraph messages to railway trains. But we have never been allowed to see them even metaphorically. They are

[1] *Jour. Inst. Elec. Eng.*, vol. 66, p. 1005; 1928.

cloaked, so that we are like a costermonger with a shrouded animal between the shafts; it may be a dog, a zebra, or a donkey. We can only infer its nature from its more or less tractable behaviour. Electrons have proved themselves very obedient to the smallest guidance, and very energetic.

The only semi-dynamical theory of the ether which seems likely to survive is the perfect incompressible fluid in vortex motion, the fine-grained rotational structure worked at by Kelvin and FitzGerald. A fluid in vortex motion is able to transmit transverse waves, for vortices have many of the peculiar properties of a gyrostat. Difficulties arose about stability. Nowadays, however, a doubt about stability is not fatal, since something unexpected like the quantum may turn up to stabilise matters. Bohr's orbits, for example, were not stable until the quantum arrived. Even now no one can fully explain the quantum, though admittedly it has stabilising qualities, since it emphasises whole units and declines to admit fractions. It refuses continuous emission, it favours jumps rather than slides, and prefers staircases to slopes. Jeans has said that if it were not for the quantum, matter would very quickly radiate itself away into space. The only reason why everything does not go off in a flash is because of the quantum. It has rendered matter permanent.

Modern physics aims at simplifying the complex by the aid of relativity and quanta, but it has raised difficulties where previously we detected none, and has made simple things complex. A beam of light seems a simple thing, but now the structure of light has become puzzling and has acquired some of the properties of matter. Reciprocally, matter has acquired some of the properties of light. The particle and the wave are more closely related than a few years ago we should have thought it possible to imagine. The quantum theory made waves behave something like particles; conversely, the new dynamics makes particles behave something like waves. Planck has said that in many of our theories we must build up again from the very beginning. In the nineteenth century everything was reduced to mechanics; now the very motion of matter itself is in need of explanation.

One difficulty in verifying experimentally theories in connexion with corpuscles and waves is that we cannot make direct experiments on the ether. We have no means of examining radiation in free space; we can only deal with it when it interacts with matter. Nevertheless, some experimental confirmation of the existence of a wave structure as part of a flying electron has recently been made by Prof. G. P. Thomson, of the University of Aberdeen. He sends cathode rays through a metal film of molecular thickness. He gets on the examination plate not a point, but a point with rings round it. He gets a diffraction pattern, and this must mean waves. The experiment is a verification of the theory which associates wave motion with rapid particles and enables us to calculate the wavelength from the potential drop which propelled the particles. Magnetic force deflects the waves, wiping out most of the pattern from its original place and putting it round the deflected spot. This is a very important discovery. The important difference between these rays with nuclei in them and ordinary X-rays must not be forgotten. One variety is affected by a magnetic field and the other is not. Matter is one extreme and light is the other. Here we recognise an intermediate thing which establishes the reality of light quanta.

Sir Oliver made a suggestion of the possible structure of an electron. He imagines it to be a minute bubble or minute cavity in the continuous structure of the ether. To produce such a hollow against the enormous pressure must involve the expenditure of a great amount of energy. Lines of strain permeate the ether in all directions from the hollow. These constitute the electrostatic field. The energy resides not only in the hollow but also in the inseparable electrostatic field. If we call c the 'constitutional' velocity of the ether, its pressure will be ρc^2 where ρ is the density. This is an enormous pressure, but when we consider that the ether has to transmit gravity and all the other forces we apply to it, the magnitude of its properties must vastly exceed those of the substances we are familiar with. The hollow sustains itself because of its electric charge. The electric charge produces a tension tending to make it expand. This is balanced by the external pressure. Calculations are given to show that the radius of the hollow computed in this way is of the same order as the recognised electronic charge.

Recent recondite speculations in mathematics and physics were barely touched upon. These theories are so striking that some of us who saw their beginning in the nineteenth century can scarcely follow their developments, let alone their eccentricities. The mathematical speculators are doing more than going out of our depth; they are soaring up into the clouds of tensors and matrices, with any number of dimensions of space and imaginary operators. In the old days, explorers used captive balloons, and we might occasionally swarm up the rope or haul them back to earth. Now they have no earth attachment and have quite gone out of sight. We can only follow their progress when they drop a bomb. Then we sit up and attend. But the bombs, although perturbing, are not destructive; when they are opened they are found to contain interesting things, more like seeds than explosives, and those which take root flourish exceedingly and overshadow the ancient fields. The older method was to plant a seed quietly in the ground so that we could watch it grow. Radioactivity was one, the electron was another, and so also was Bohr's theory. We must now recognise that wave mechanics is the beginning of one branch of a theory of the ether, which must be contemplated by every physicist who is interested in physical reality.

Continental Drift.

Theory of Continental Drift: a Symposium on the Origin and Movement of Land Masses, both Inter-Continental and Intra-Continental, as proposed by Alfred Wegener. By W. A. J. M. van Waterschoot van der Gracht, Bailey Willis, Rollin T. Chamberlin, John Joly, G. A. F. Molengraaff, J. W. Gregory, Alfred Wegener, Charles Schuchert, Chester R. Longwell, Frank Bursley Taylor, William Bowie, David White, Joseph T. Singewald, Jr., and Edward W. Berry. (Published under a Fund established by the New York Committee for the Mid-Year Meeting of the Association, November 1926.) Pp. x + 240. (Tulsa, Oklahoma: The American Association of Petroleum Geologists; London: Thomas Murby and Co., 1928.) 15*s*. net.

THE complex problem of continental drift has everywhere been the subject of animated discussion in geological circles during recent years, and the publication of the papers presented at a symposium held in New York late in 1926 serves a valuable purpose in bringing together the considered opinions of some of the leading geologists of America and Europe. The American Association of Petroleum Geologists is to be congratulated not only on having staged a spirited and fruitful discussion, but also on its enterprise in making the contributions available in printed form to a world-wide audience. The book opens with a broad-minded and constructive review of the problem by Dr. van der Gracht; this is followed by papers from thirteen other authors, for the most part severely critical; and finally, Dr. van der Gracht summarises the various arguments brought forward, and restores the balance by showing that many of the objections raised need not stand unanswered.

There is a general agreement that Wegener's methods in advocating his particular group of hypotheses are to be condemned. His plausible selection of data, frequently erroneous age determinations, faulty analysis of causes and devious reasoning, have undoubtedly had the effect of weakening his case. There is, indeed, a distinct danger that the easy disproof of large sections of the Wegener hypotheses may be mistaken for a demonstration of the impossibility of continental drift as a geological process. The important issue is now not so much to prove Wegener wrong as to decide whether or not continental drift has occurred, and if so, how and when.

Schuchert, Longwell, and White wonder what forces can have conspired to hold the sial together in one great land-mass—Pangæa—until Mesozoic time, when the alleged fracturing and drifting apart began. There is, of course, neither proof nor probability that there ever was a single 'Pangæa,' and it is reasonably suggested by van der Gracht that there may have been a pre-Carboniferous 'Atlantic' which was closed up by the Caledonian diastrophism. He is careful, however, to commend Wegener for not leading us into a discussion of remote periods, regarding the palæogeography of which our evidence is still lamentably meagre.

Several authors are concerned to prove that the opposing shore lines of the Atlantic do not fit so closely as Wegener supposes. Van der Gracht rightly lays no stress on the validity of geographical pattern as an argument, for surely if drift has occurred it is mechanically impossible that the sial blocks should have moved without internal and peripheral distortion. Argand's conception of varying plasticity is a valuable corrective to the exactly fitting coast lines of Wegener's too dogmatic maps. Schuchert presents a valuable summary of the geological similarities and differences between the opposing Atlantic lands. He admits that Wegener is correct in connecting the Caledonian trends of Britain with those of Newfoundland, but denies that the Hercynian trends of Europe connect with the Appalachians. Against this we may refer to Mr. E. B. Bailey's statement of the comparison in NATURE of Nov. 5, 1927. Mr. Bailey is by no means one of Wegener's sponsors, yet he says, "It is as if the Atlantic did not exist or, in other words, as if Wegener, after all, were a true prophet." Attention should also be directed to the recent discovery of Caledonian overthrusts along the east coast of Greenland, apparently representing structures that are missing from Norway. Similarly, against adverse criticisms such as those of Krenkel, based on a comparison of western Africa and eastern South America, we can set the recent work of du Toit (*Pub.* No. 381, Carn. Inst. Washington; 1927). Although actual contiguity of the opposed shores can definitely be ruled out, the geological parallels are too significant and intimate to be brushed aside or explained by long narrow land-bridges. Schuchert is undoubtedly right, however, in regarding the supposed separation of Newfoundland and Ireland so recently as the Pleistocene as out of the question.

Molengraaff and Taylor both regard the mid-Atlantic swell as the cicatrix of the main fracture which led to the separation of America and Eur-Africa, and van der Gracht is inclined to agree. A relative movement of the African mass to the east would possibly explain the pre-Gosau Oman arc, which, as Lee has pointed out (*Geog. Journal*, May 1928) is inconsistent with Wegener's scheme. Wegener has certainly insisted too strongly on the dominance of westerly drift, and both he and van der Gracht are probably wrong in regarding the island festoons of Asia as a consequence of such drift.

Taylor's contribution to this problem, in which he draws an apt analogy between continental ice-sheets and continental sial-blocks, is worthy of serious attention. Like du Toit, he regards the lands of the northern hemisphere as being surrounded by a nearly closed orogenic ring; he describes the arcuate ranges as marking the terminal regions of "currents in the crust." Extending the conception to both hemispheres, he writes: "The crustal movements were radial and dispersive from both polar regions, and tended to culminate in a piling up of mountain ranges and plateaus in low latitudes." Taylor probably goes astray when he suggests that the "crust-moving force was of external origin." He thinks that tidal forces would be adequate to explain the phenomena if the moon had been captured during the Cretaceous period. Unfortunately, even if this extravagant claim could be justified, we should still be without an explanation for the Hercynian, Caledonian, and older systems of folded mountains.

This introduces the vexed question of the forces available to 'engineer' the drifting process. Longwell clearly presents the geophysical position, which at present is distinctly unfavourable to the possibility of drift. He points out that a force adequate to overcome the strength of the sima is required, and that it is extremely improbable (most of us would less cautiously say 'impossible') that sima can yield like water before a floating raft. Bailey Willis raises the objection that the sial must be weaker than the sima if the mountains of western America are a result of pressure encountered by the moving sial, and Bowie points out, conversely, that if the sima has no strength, as postulated by Wegener, the continental front could not meet a sufficient resistance to crumple it up into mountains. The reply here is surely that both sima and sial would fracture or crumple according to their strengths and viscosities, but that the crumpling of the sial would alone appear at the visible surface. Singewald reminds us that no one can say whether the ocean floor is folded or not, and van der Gracht adds that a mountainous form, if ever developed, could not be preserved in sima. My own view, assuming the movement, is that the overthrust, folded and metamorphosed sima would be pressed down or would sink into the substratum, so making way for the continents to advance.

Joly's fluid substratum would facilitate slipping between the crust and the interior, but the postulated tidal drift would be likely to affect the whole crust. Joly himself makes three important points: that differential forces would act on the continents while they were in flotation; that disintegrating forces would arise during the expansion and contraction accompanying each revolution; and that the necessity for thermal escape would possibly prevent the permanent existence of an aggregate of continents such as 'Pangæa.' Nevertheless, it is widely recognised that while acceptance of Joly's hypothesis would help to ease the problem of the mechanism of drift, the hypothesis fails to lead to the required consequences, and has, moreover, special difficulties of its own to overcome.

Gregory does not positively object to the drift hypothesis, but he maintains his well-known opinion that movements of uplift and subsidence due to the shrinking of the earth (not necessarily by cooling only) are to be regarded as the main causes of the present distribution of land and water. It is perhaps not sufficiently realised that those who hold this, the orthodox view of the older geologists, including the exponents of land-bridges, have to face geophysical difficulties quite as serious as any with which they can confront the advocates of lateral displacement. The accepted phenomena of isostasy stand in flat contradiction to the subsidence of land to oceanic depths. If there is ocean where once there was land, then the former sial of that area must now exist somewhere else.

The only alternative to lateral drift is removal of the sial at the base by magmatic currents in the substratum, but if this be a possible method of sinking land-bridges, then it implies a process capable of transporting continents. Van der Gracht hints at this when he asks, " Is not possibly the whole process more similar to ice floating on flowing water (Ampferer's ' undercurrents ') than to a raft sailing over a currentless pool ? " Geophysics will not be in a position to deny continental drift until it has thoroughly explored the possibilities of convection or other currents in a highly viscous substratum, and the forces set up by the interaction of magnetic and electric fields. Apart from van der Gracht's suggestion of " a plastic outflow of the interior continental masses toward their margins " and a vague reference by Taylor to " magnetic force," these possibilities appear to have been entirely overlooked in favour of quite inadequate gravitational forces.

In the absence of any clear geophysical lead, the geologist must choose either lateral or vertical displacement of former land-masses (unless he wants both) on their merits in relation to other problems. Schuchert, though iconoclastic towards the Wegener hypothesis, feels " obliged to conclude that the continents do actually move extensively " in order to explain the crustal shortening implied by mountain structures. Termier, who describes the Wegener hypothesis as " the dream of a great poet," does not hesitate to regard the mountains of Central Asia as representing a crustal foreshortening of the order of 1800 miles. Van der Gracht naturally points out that if this be admitted, then continental drift even on the Wegener scale becomes fully possible.

The opponents of drift have also no way of explaining the distribution of the Permo-Carboniferous glaciations of Gondwanaland, which accordingly remains the basis of Wegener's most powerful argument. Wegener himself discusses the Squantum ' tillites.' If these are truly glacial, they stand in flagrant contradiction to his views, since they occur near his Permo-Carboniferous tropical belt. He pleads for an independent and impartial decision of the problem, but he adds with complete justification that the glacial hypothesis of these puzzling beds is also hopelessly in conflict with the adjoining palæoclimatic evidence of the time. Neither the drift nor any other theory can be reasonably expected to explain interpretations that are mutually contradictory. No one in the symposium pointed out that the distribution of Carboniferous laterites and bauxites adds further support to Wegener's reconstruction of the climatic belts then existing.

The impression that remains with me after considering all the adverse criticism is that the latter is mainly directed against Wegener, and that when all has been said, there remains a far stronger case for continental drift than either Taylor or Wegener has yet put forward. At least two kinds of movement seem to be required : a general drift of the crust as a whole with a northerly component (removing the neighbourhood of Natal from the South Pole since the end of the Carboniferous) ; and radial movements, outwards from Africa in the southern hemisphere, and outwards from Eurasia in the northern hemisphere (in each case towards the Pacific and the Tethys), giving rise to peripheral mountains and interior disruption basins. But so vast a subject is not one for ' resounding convictions.' As van der Gracht insists again and again, the details of the picture, and particularly the mechanical and physical explanation, will require generations of further research.

ARTHUR HOLMES.

Palæolithic Times in Italy.

Archives de l'Institut de Paléontologie humaine. Mémoire 3 : *Le paléolithique italien.* Par Raymond Vaufrey. Pp. 196+7 planches. (Paris : Masson et Cie, 1928.) n.p.

THE prehistory of the Italian peninsula has, for some reason or another, remained very obscure, and any information upon it has been difficult to obtain. It is true, of course, that the magnificent researches of the Grimaldi caves, published in the Prince of Monaco's series, threw a flood of light on the early story of that district, and some scattered information on palæolithic finds appeared as a sort of introduction to T. E. Peet's volume on the " Stone and Bronze Ages in Italy." But as the author of the work under review says, it was really not until Dr. Mochi threw himself into the study of these early problems that investigations on modern lines were initiated.

M. Raymond Vaufrey's book is exactly what has been long wanted—a clear, concise, and logical account of all that is at present known about palæolithic times in the Italian peninsula and in Sicily. Not least in importance is a reasonably large map showing the distribution of Lower Palæolithic, Mousterian, Upper Palæolithic, and Campignian sites. There is also an excellent and comprehensive bibliography to which reference is made throughout the text. The volume is illustrated with a large number of line drawings figuring the industries from a good many sites, and there are seven full-page plates at the end. Personally, I should have preferred a larger proportion of these to have been devoted to typical views of the country and of well-known sites—there is only one. Implements are better illustrated by pen and ink drawings, and one or two plates of tools to act as a check on the draughtsman's skill would have been ample. A view of the important cave of Romanelli, with perhaps a reproduction of the Aurignacian wall-engraver's art found there, about which too little is said, would have been a valuable addition. However, it is clearly impossible in a work of some 200 pages to include everything, and we can only be very grateful to M. Vaufrey for giving us such an excellent account of Italy's palæolithic past.

After a short introduction, a brief account is given of the various investigations that have been undertaken since 1850. At first a considerable amount of work was done, but, in gentler and more polite language, Pigorini, the former Director of the Prehistoric Museum at Rome, is described as having acted as a blight on all palæolithic research. Doubtless it is a fact, and I do remember going to Rome many years ago and finding industries arranged in show-cases without their associated fauna, the remains of which were shot without order or labels into an attic! Such things did not interest Pigorini, I suppose. Still, I hope that those who come after us will not have to denounce too many things which we do quite happily to-day. It is undoubtedly true that since Pigorini has died and Mochi has been interested in palæolithic studies, our knowledge of Old Stone Age Italy has increased by leaps and bounds.

First the problem of the Lower Palæolithic culture in Italy is attacked. Only two localities yielding a definite stratigraphy—the one at Capri and the other near Venosa—are known, though finds referable to a Lower Palæolithic culture on typological grounds occur elsewhere. Scarcely any Lower Palæolithic finds, however, have been made in Sicily, and it is suggested that the Lower Palæolithic folk could not, therefore, have entered the peninsula from the south. All the same, a glance at the distribution map will show that there is but little indication of any definite migration from the north-east, and Lower Palæolithic tools—except for one or two examples from a cave at Monaco—are conspicuous by their absence along the Riviera. The author, I fancy, is a follower of M. Boule, so far as questions of chronology are concerned, and he assigns the Acheulean industries to the last interglacial period. But whether in Italy this corresponds to Penck's *Riss-Würm* in the Alps is not discussed, though it seems to be assumed.

The Mousterian culture is next described, and here the information M. Vaufrey is able to give us seems to me to be of particular interest. There seem to be two distinct industries—perhaps indeed cultures—probably more or less contemporary (?); one appears to belong to the true Mousterian of France, the other to the Levallois phase. This latter is becoming increasingly important and is being found in many of the older gravels in England. What its exact relationship to the Mousterian culture on one hand and to the Acheulean culture on the other is, is not yet known.

There follows a chapter devoted to the Upper Palæolithic sites in Italy which is particularly interesting in bringing together in a convenient form all that, up to the present, has been determined in this connexion. Finally, chapters on the palæolithic finds in Sicily, and the Campignian sites in the peninsula, conclude the volume.

The first two volumes in this series have already set a very high standard. Prehistorians will not find that this volume has in any way lowered it. It is indeed a very useful and important contribution to learning.

M. C. Burkitt.

Forest Utilisation in the U.S.A.

Forest Products, their Manufacture and Use: Embracing the Principal Commercial Features in the Production, Manufacture, and Utilisation of the most important Forest Products other than Lumber, in the United States. By Prof. Nelson Courtlandt Brown. Pp. xvii + 447. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

When issuing the first edition of this book in 1919, Prof. Brown had as his object to present to the student and reader the chief commercial features involved in the manufacture and use of the principal forest products in the United States, other than lumber (that is, timber logged or squared to be used in cabinet and furniture work, shipbuilding, wagons, etc.), and to record something useful for reference purposes. The second edition brings the work up-to-date, including the intermediate development, and generally revises the U.S.A. statistics and prices.

The scope is a large one, and the author, within the limits of the book, has achieved the major part of what he set out to do. The forest products dealt with are wood-pulp and paper, tanning materials, veneers and plywood-cooperage, naval stores (rosin and turps), wood distillation, charcoal, box and box-shooks making, sleepers, poles and posts, shingles, maple sugar, and a few others.

Each is described comprehensively, generally under the sequence of history, requirement, methods of extraction and manufacture (giving details of machinery and plant), the kinds of timber used, and the annual consumption; concluding with notes on the utilisation of waste and the grading rules in force. The whole is supported by useful statistical and costing figures, appropriate illustrations, as well as by the common American and botanical names of the timbers mentioned in the text, and the factors for conversion to European volumes and units.

To give some idea of the manner in which the subjects are presented, the details on cooperage may be further considered. For this the annual timber consumption is said to be 300 million cubic feet of timber, producing 800-1000 million staves, with the appropriate number of headings and hoops. There are two classes, slack and tight, the former including barrels, etc., for non-liquids and the latter for liquids. The variety of these is large, and each class in its turn is quality graded according to the prospective contents. For example, tongued and grooved staves are required for sugar and flour barrels, and the roughest of manufacture for those for vegetables: whereas for the valuable liquors, the best timber, with most careful adjustments, is necessary.

For this class of work the qualities required in the timber used are strength, straight grain, even texture, seasoning well; and for liquids, non-porous. In the best quality tight cooperage staves, only American White oak, *Q. alba*, and to a less extent *Q. minor*, *Q. acuminata*, *Q. macrocarpa*, and *Q. platanoides*, are used, inferior qualities being made of White oak, Red oak, *Q. borealis*; Red gum, *Liquidamber styraciflua*; Douglas fir, *pseudotsuga Douglasii*; Birch, *B. leuta*; and Hard maple, *A. saccharum*: for the headings, White oak is again the best, but Red oak, Douglas fir, Red gum, White ash, *F. americana*, Hemlock, *Tsuga spp.*, and Pine find a place, and for hoops, iron and steel have been substituted for wood. For the slack class, according to importance, similar woods are used for staves; Red gum is at present the most in demand, with almost any other kinds adaptable: for headings, Red gum and Pine, *P. palustris*, *P. echinata*, *P. taeda*, *P. resinosa*, *P. strobus* supply the bulk; and for the hoops, Elm, *Ulmus racemosa* and *U. americana* (at one time the leading slack stave woods) make the best, with hickory and ash, these being tough, with high tensile strength.

In the manufacture in slack cooperage, the logs and raw material are usually hauled to a central mill for conversion, but for the other class small plants are moved from place to place in the woods. In both cases selected trees are logged to size, split into small, convenient-sized blocks, and transported to the mill, where they are steamed, or boiled, and sawn by specially designed machines into staves and headings of the kind and qualities required. A very small proportion are now cleaved. The pieces are then air-dried, machine-shaped to size, bilge, and bevel; graded, and finally bundled for removal to the assembling works. In the description Prof. Brown goes into full detail, describing the machines, the various operations with their difficulties, giving the number of men employed in the operation with their piece-work costs, and winds up with the specifications and grading rules.

Space does not allow of further details here, but each product is similarly dealt with, giving, as has been mentioned before, a comprehensive description of the industry.

In Chap. i., under 'General,' the author alludes to waste in conversion, which is most important to forest officers. The volumes utilised are so enormous as to cause one to wonder what the condition of the forest is to allow such exploitation with due regard to the future. The rapid development of utilisation in America has overshadowed forestry, with the result that those concerned with sustained yields must be anxious if the figures are anywhere near correct. They seem to give an incidence of 40 cubic feet per acre per annum on the present gross forest area of 545 million acres, though it is not mentioned if this area is permanently and legally set aside to provide the raw material. To this incidence has to be added some 15-20 per cent, said to be lost by wastage in the forest in the felling and logging. Further, the author states that America is using its forests three times as fast as they grow. The United States, of course, is quite able to look after itself, but if the above is a criterion of the present position in that country (and Prof. Brown is an authority on the subject), the Colonial authorities of the British Empire have cause to take care that a similar condition is not repeated where they are custodians.

Finally, the treatment of his subject discloses the author's close connexion with the industries he describes, and the book can be recommended to all who are interested in the subject discussed.

Our Bookshelf.

University of Wisconsin Studies in Science. No. 4: *The Optic and Microscopic Characters of Artificial Minerals.* By Prof. A. N. Winchell. With Determinative Tables for Identifying Artificial Minerals Microscopically, chiefly by means of their Optic Properties. Pp. xv + 215. (Madison, Wis.: University of Wisconsin, 1927.) 1.50 dollars.

THIS new production of Prof. A. N. Winchell is, we believe, unique, at any rate so far as the English language is concerned. It is a compilation of data collected by the author during the preparation of the second edition of the descriptive part of his "Optical Mineralogy." The title is misleading, since by far the greater number of the chemical compounds the optical properties of which are described are not found in Nature, and hence are not 'minerals' in the commonly accepted sense of the term.

The author's original intention was to prepare a descriptive mineralogy to include all inorganic substances the optical properties of which were sufficiently well known to allow them to be identified microscopically. Afterwards he wisely decided to eliminate for separate treatment the data collected with regard to all synthetic inorganic substances (which, however, include a considerable number of artificially prepared *minerals*). The work brings together a large number of observations widely scattered throughout many American and European scientific publications.

Abundant references to the original sources of information are given. The artificial 'minerals' are arranged in chapters under such headings as sulphides, halides, carbonates, silicates, etc.; on a system based on Dana's well-known scientific mineral classification. The description of each individual substance includes, so far as is possible, all those optical and physical properties usually given in complete descriptions of natural minerals, especially those properties used in the identification of minerals in thin slice under the microscope. At the end of the descriptive portion of the book two determinative tables are given, one for isotropic and the other for anisotropic substances. In the latter, uniaxial crystals are distinguished by the use of italics. In each table the compounds are arranged in order of increasing refractive index. Including as separate individuals those substances which, owing to variation in their refractive indices, occur more than once in the determinative tables, upwards of 700 chemical compounds are listed.

The book should prove of value and interest to mineralogists, inorganic chemists, physicists, and, to some extent, to petrographers. V. A. E.

Diesel Engine Design. By H. F. P. Purday. Third edition. Pp. xviii + 360. (London: Constable and Co., Ltd., 1928.) 21*s.* net.

IN covering the whole field of Diesel engine design in a volume of about 350 pages, Mr. Purday has attempted a difficult task. It may be at once said that he has written a very good book, in which a noteworthy feature is the way in which he has treated all sections of the subject without overdoing those parts in which he himself is particularly interested.

The book is pre-eminently one for the draughtsman and for the student who is specialising: it can obviously not go far enough, in its limited space, for the engineer controlling design, while for the general student it must naturally treat too much of the details of actual design rather than of principles. It should be among the books of all interested in oil engines, and should find a place in the libraries of institutions where the subject of heat engines is studied.

The large number of figures in the text—there are more than 300—are well done, and add greatly to the clearness of the description. The bibliographical lists given at the ends of chapters are valuable, but there are unfortunately slips in them—for example, one reference appears twice in the same list under two slightly different titles. Vague statements which may mean almost anything should also be guarded against, such as "a pressure of about 1 lb. or even less." The nomenclature of the oil engine is still uncertain, so that it is perhaps scarcely fair to mention those cases where the terms used do not seem to be strictly accurate. Altogether, any criticisms can only relate to details, and the author is to be congratulated on having written one of the best books of its kind.

The Fatigue of Metals: with Chapters on the Fatigue of Wood and of Concrete. By Prof. H. F. Moore and Prof. J. B. Kommers. Pp. xi + 326. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 20*s.* net.

EVERY advance in engineering practice makes new demands on the materials used in construction, especially in regard to their resistance to fatigue and to the action of prolonged stress. The authors of this book have themselves carried out exceedingly thorough investigations into the behaviour of steels and other engineering materials towards repeated stress, and these have been described in reports which are well known to all students of the subject. They have now written a manual of fatigue which will be indispensable to engineers. The treatment of the subject, a highly controversial one, is scrupulously fair, and the authors generously dedicate the volume to the British investigators who have done so much to advance this study. The various types of machine which may be used to produce alternating stress by bending, by tension and compression, or by torsion, are described and illustrated, and the results obtained by the several methods are compared. Numerous tables and diagrams sum up the results of tests, and the application to engineering practice is well illustrated by examples. On the theoretical side the treatment is cautious, and the account of changes in microscopic structure is rather meagre, so that the general effect on a scientific reader is less stimulating than that of the work on the same subject by Gough, but the authors no doubt feel bound to extend the data still further before attempting broad generalisations. Some account is given of the relation between fatigue and 'creep,' which is of undoubted importance, and deserves further study. Short chapters on the fatigue of wood and concrete are added, and there is an excellent bibliography. Text and diagrams are clearly printed.

C. H. D.

Fundamentals of Dairy Science. By Associates of Lore A. Rogers. (American Chemical Society Monograph Series, No. 41.) Pp. 543. (New York: The Chemical Catalog Co., Inc., 1928.) 5·50 dollars.

This is a very valuable monograph which presents an up-to-date account of the principles upon which the dairy industry is based, and brings together the results of much research that has been prosecuted in this field. The contributors are, or have been, members of the staff of the Research Laboratories of the Bureau of Dairy Industry of the United States Department of Agriculture, and included in the list are several well-known names.

Part I. deals with the constituents of milk, the chapters on the proteins and the milk fat being of particular interest; in the latter is included a summary of the methods used in the examination of milk fat. Part II. is devoted to the physical chemistry of milk and milk products; the influence of physical conditions upon the separation of milk, the making of butter; the coagulation of milk and the making of cheese are treated very fully.

Part III. deals mainly with the bacteriology of milk and milk products. The sources of the bacteria are explained, as well as the effects they produce and the factors which influence their growth. Part IV. starts with the nutritional value of milk and discusses the part which it plays in the feeding of young and adult animals. The part played by milk in regard to the requirements of the body for vitamins is also dealt with. The final chapter is devoted to the physiology of milk secretion, the influence of food upon milk production, and especially the part played by the protein and fat of the diet.

The volume is excellent in every way; its arrangement brings out the results of inquiries which have often been neglected in books on dairying, and the list of references at the end of each chapter will be found most helpful to workers on the subject.

Materialprüfung mit Röntgenstrahlen: unter besonderer Berücksichtigung der Röntgenmetallographie. Von Prof. Dr. Richard Glocker. Pp. vi+377. (Berlin: Julius Springer, 1927.) 31·50 gold marks.

There are now many text-books which deal with the examination of metals by means of X-rays, and the work of Prof. Glocker has many good features. It is excellently printed, and contains a full account of the various methods of obtaining X-ray spectra and of deducing from them the structure of metallic crystals.

The most modern types of X-ray tube are described, but the reader misses a discussion of the difficulties connected with their use, and a critical review of experimental methods. It is true that one worker will obtain good results with a form of apparatus with which another is entirely unsuccessful, but the reasons for differences in behaviour of different tubes have not, to the reviewer's knowledge, been examined in detail in a text-book. The subject of the examination of metals for defects by the absorption of X-rays is dealt with very briefly, and the main portion of the book is concerned with the determination of structure. The known data respecting space-lattices of metals and alloys are collected, whilst non-metallic substances only receive brief notice.

The most conspicuous defect is the almost complete neglect of English work, in a field in which this country has made such important discoveries. Even the work of the Braggs is only quoted from the comparatively elementary book by those authors, and not from original papers, and their collaborators are scarcely mentioned. As a review mainly of German work, however, the volume may be recommended as being both clear and thorough.

Biologie der Früchte und Samen (Karpobiologie). Von Prof. Dr. E. Ulbrich. (Biologische Studienbücher, herausgegeben von Walther Schoenichen, Band 6.) Pp. viii+230. (Berlin: Julius Springer, 1928.) 12 gold marks.

A handbook on the biology of fruits and seeds has long been needed. This work only partly supplies the need. While the morphological aspects are adequately dealt with, considering the size of the book, the biological data given are less satisfactory. This is largely due to the relative neglect of field investigation and experiment by the majority of those who have studied fruits and seeds. Many biologists cannot feel satisfied that opinions stated as a result of herbarium and museum studies are trustworthy accounts of what actually happens in Nature. It is certainly risky to conclude that morphological peculiarities function for wide dispersal in the absence of observational and experimental facts, and deductions from analogical resemblances may be entirely misleading.

Prof. Ulbrich divides the main part of his subject on the basis of the agents of dispersal. Self-dispersal (autochory) is first considered. Agents external to the plant result in allochory, of which the following types are recognised: zoochory (animal dispersal, endozoic, synzoic, epizoic), hydathochory (water dispersal), and wind dispersal (anemochory). Short accounts of polychory, polycarpy, and vivipary conclude the book. An adequate index is provided, but the list of literature is far from complete, especially for English research. The work is well illustrated with fifty-one text-figures.

Letters to the Editor.

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

Experimental Proof of 'Negative Dispersion.'

THE intimate connexion between absorption and selective dispersion suggests that the process of 'negative absorption' implied by the Planck-Einstein theory of temperature radiation should be accompanied by a corresponding negative selective dispersion. The idea of 'negative dispersion' was first introduced by H. A. Kramers in his correspondence theory of the scattering and dispersion of light (see NATURE, **113**, p. 673 ; 1924). It now appears also in the quantum mechanics of these phenomena.

By considering the dispersion of a gas only in the neighbourhood of an isolated spectral line connected with the quantum states j and k, it follows from these theories, as well as from simple considerations analogous to the Einstein proof of the Planck formula (see R. Ladenburg, *Zeit. f. Phys.*, **4**, p. 451 ; 1921 : **48**, p. 15 ; 1928), that the change of the refractive index will be proportional to the product

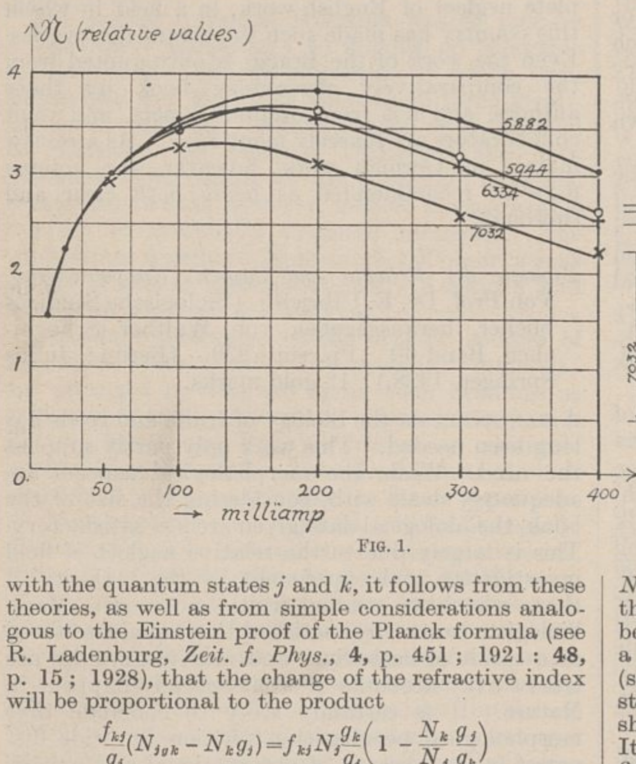


FIG. 1.

$$\frac{f_{kj}}{g_j}(N_j g_k - N_k g_j) = f_{kj} N_j \frac{g_k}{g_j}\left(1 - \frac{N_k}{N_j}\frac{g_j}{g_k}\right)$$

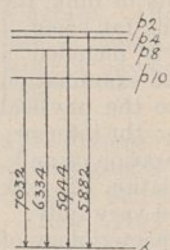
instead of to the number $\mathfrak{N}$ of dispersion electrons required by classical theory. Here N_j and N_k are the number of atoms per c.c. in the states j and k ; g denotes the statistical weight of the state ; and f_{kj} is the 'relative strength of the corresponding oscillator,' being proportional to the Einstein probability coefficient for the spontaneous transitions $k-j$, or to the square of the amplitude of the corresponding electric moment of the undisturbed radiating atom.

According to this formula the negative dispersion is determined by the expression $\frac{N_k}{N_j}\frac{g_j}{g_k}$. Usually this value, and therefore the amount of negative dispersion, is negligibly small. It will only be considerable if the gas is excited very strongly and if the difference of energy between the two combining states j and k is not too large.

Led by these considerations, we have succeeded in obtaining negative dispersion by extending our experiments on anomalous dispersion near the different spectral lines of electrically excited neon (see *Zeit. f. Phys.*, **48**, p. 26 ff. ; 1928) to high current densities (c. 1 ampere per cm.[2]).

The results of our measurements of anomalous dispersion near the lines 5882 (s_5p_2), 5944 (s_5p_4), 6334 (s_5p_8), and 7032 (s_5p_{10})—all belonging to the same lower state s_5—are given in the accompanying diagram (Fig. 1). It shows the amount of anomalous dispersion, measured by the number $\mathfrak{N}$, on the amount of current passed through the neon tube of $\frac{1}{2}$ cm.[2] cross-section. Only the relative $\mathfrak{N}$ values of the different lines, all reduced to a common scale, are represented. The absolute values of $\mathfrak{N}$ differ from each other according to our formula, by the factor of the 'relative strength' f_{kj}.

The common increases of the different s_5p_k-lines up to about 50 milliamperes correspond with the increase of the Ns_5 values of the atoms in the common lower state s_5 (see our previous experiments). At larger currents, however, the curves of the different lines behave in quite another way: after reaching a maximum value they all decrease again, but in doing so they separate considerably from one another; those of largest wave-length decrease most, and those of shortest wave-length decrease least, *i.e.* the smaller the difference of energy between the common lower state s_5 and the different upper states p_k, the larger is the effect of decreasing.



This is just what we should expect as a consequence of negative dispersion and the influence of the expression $\frac{N_k}{N_j}\frac{g_j}{g_k}$ (j corresponds in our experiments to s_5, and k to p_2 or p_4, or p_8 or p_{10}). The larger the current the larger is the number of the atoms in the upper state p_k (according to our former experiments, above 50 milliamperes the atoms in the lower state s_5 do not increase much, as these states are continually destroyed upon electron impacts) ; and therefore the larger will be the relation N_k/N_j. Further, the number N_k of the atoms in the different upper states (that is $p_{10} \ldots p_2$) will be greater the lower the energy of that state—as a consequence of a kind of statistical equilibrium (see our former experiments). The influence of the statistical weights also comes into play, as will be shown in a more close discussion of the experiments. It is theoretically very improbable that the electric field associated with the high current density should exert an effect upon the f-values so as to be responsible for the described phenomena. On the other hand, we have not succeeded in detecting a corresponding anomalous dispersion near the infra-red lines p_k–d_l; as a matter of fact, the lines are rather broad, so that the proof for anomalous dispersion is not very sensitive. Besides, it may be that the 'relative strengths' f of these lines, *i.e.* the probabilities of the spontaneous transitions, are not large enough for an appreciable amount of anomalous dispersion.

As a matter of fact, we meet with the same consequences in considering the action of negative absorption. In the Planck formula of temperature radiation, the -1 in the denominator $(e^{\frac{h\nu}{kT}}-1)$ results from taking the processes of negative absorption into account. This -1 gives the whole difference between the formulæ of Planck and that of W. Wien. It is well known, from the experiments of Lummer-Pringsheim and Rubens-Kurlbaum, that the difference between these two formulæ and also the validity of the Planck formula, come out the more clearly the smaller the relation ν/T, that is, the larger the temperature (or the excitement) and the larger the wave-length.

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July 28.

Wave Mechanics and Radioactive Disintegration.

AFTER the exponential law in radioactive decay had been discovered in 1902, it soon became clear that the time of disintegration of an atom was independent of the previous history of the atom and depended solely on chance. Since a nuclear particle must be held in the nucleus by an attractive field, we must, in order to explain its ejection, arrange for a spontaneous change from an attractive to a repulsive field. It has hitherto been necessary to postulate some special arbitrary 'instability' of the nucleus ; but in the following note

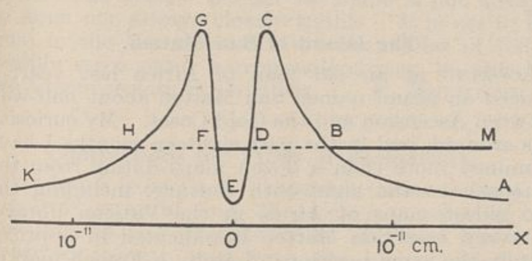

FIG. 1.

it is pointed out that disintegration is a natural consequence of the laws of quantum mechanics without any special hypothesis.

It is well known that the failure of classical mechanics in molecular events is due to the fact that the wave-length associated with the particles is not small compared with molecular dimensions. The wave-length associated with α-particles is some 10^5 smaller, but since the nuclear dimensions are smaller than atomic in about the same ratio, the applicability of the wave mechanics would seem to be ensured.

In the classical mechanics, the orbit of a moving particle is entirely confined to those parts of space for which its potential energy is less than its total energy. If a ball be moving in a valley of potential energy and have not enough energy to get over a mountain on one side of the valley, it must certainly stay in the valley for all time, unless it acquire the deficiency in energy somehow. But this is not so on the quantum mechanics. It will always have a small but finite chance of slipping through the mountain and escaping from the valley.

In the diagram (Fig. 1), let O represent the centre of a nucleus, and let $ABCDEFG$ represent a simplified one-dimensional plot of the potential energy. The parts ABC and GHK represent the Coulomb field of repulsion outside the nucleus, and the internal part $CDEFG$ represents the attractive field which holds α-particles in their orbits. Let DF be an allowed orbit the energy of which, say 4 million volts, is given by the height of DF above OX. Approximately, we can say that with this orbit will be associated a wave-function which will die away exponentially from D to B. Again, corresponding to motion outside the nucleus along BM, there will be a wave-function which will die away exponentially from B to D. The fact that these two functions overlap in the region BD means that there is a small but finite probability that the particle in the orbit DF will escape from the nucleus along BM, acquiring kinetic energy equal to the height of $DFBM$ above OX, say 4 million volts. This occurrence will be spontaneous and governed solely by chance.

The rate of disintegration, that is, the probability of escape, depends on the amount of overlapping of the wave-functions in the regions DB and FH, and this is extremely sensitive to the height to which the potential curve at C rises above BDF. By varying this height through a small range we can obtain all periods of radioactive decay from a fraction of a second, through the 10^9 years of uranium, to practical stability. (In considering the transmutation of a molecule into its isomer, Hund found a similar vast range of transformation periods, *Zeit. f. P.*, **43**, 810 ; 1927.) If the potential curves for the interaction of an α-particle with the various radioactive nuclei are similar, we can obtain a qualitative understanding of the Geiger-Nuttall relation between the rate of disintegration and the range of the emitted α-particles. For the α-particles of high energy the wave function for outside motion will overlap that for the inside motion more, and the rate of disintegration will be greater.

Besides obtaining a general idea of the mysterious instability of the nucleus, we can visualise in this way one of the most puzzling results of recent experimental work. An α-particle having the same range (2·7 cm.) as those emitted by uranium should, if fired directly at the uranium nucleus, penetrate its structure ; while faster α-particles should do so, even when not fired directly at the nucleus. It was therefore disconcerting when, on examining the scattering of fast α-particles fired at uranium, Rutherford and Chadwick (*Phil. Mag.*, **50**, 904 ; 1925) could find no indication of any departure from the inverse square laws. But from the model outlined above, this is what would be expected. For if the height of BM above OX represents the energy of the uranium α-particles, then a faster particle fired at the nucleus will simply run part way up the hill ABC and return without having encountered any change in the repulsive field or any nuclear particles (which are describing orbits within the region GEC).

The peculiar property of the wave mechanical equations which finds application here has also been applied to the theory of the emission of electrons from cold metals under the action of intense fields (Oppenheimer, *Proc. Nat. Acad. Sci.*, **14**, 363 ; 1928; and Fowler and Nordheim, *Proc. Roy. Soc.*, A, **119**, 173; 1928). Ordinarily, an atom does not lose its electrons because the attractive field of the atom remains attractive to all distances. But when an intense field is applied, then the attractive field is reversed in sign a short distance from the atom. This makes the resultant potential energy curve similar to that in the diagram, and so the atoms begin to shed their electrons.

Much has been written of the explosive violence with which the α-particle is hurled from its place in the nucleus. But from the process pictured above, one would rather say that the α-particle slips away almost unnoticed.

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July 30.

X-Ray Studies of the Structure of Salts Adsorbed on Cellulose.

THE ability of cellulose to take up salts from aqueous solutions and retain them upon drying is well known, but little has been shown as to the condition in which they are retained. The following possibilities which might be distinguished by X-ray analysis are suggested: (1) a mechanical holding, in which both cellulose and the salt retain their original structure; (2) a reaction forming a new structural arrangement; (3) a molecular or ionic dispersion of the salt throughout the cellulose units, the cellulose being structurally unchanged. It has just come to our attention that Ruff, Ebert, and Luft (*Z. anorg. allgem. Chem.*, **170**, 49; 1928), in an X-ray study of salts adsorbed on activated carbon, found in the majority of cases no evidence of the presence of the salts in their crystalline state. This observation would correspond to the third possibility.

Our X-ray examination of salts adsorbed on cellulose has shown that up to a certain 'saturation concentration' of the salt, the third possibility is the correct one. Above this concentration the excess salt has its characteristic structure, and probably corresponds

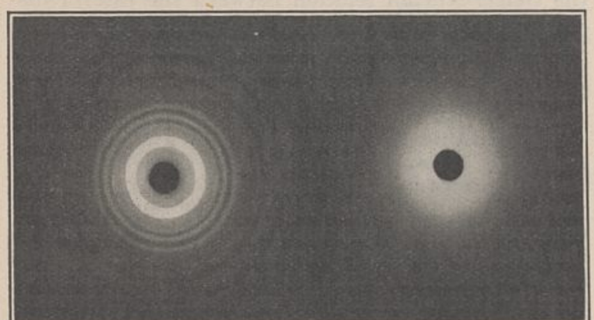

FIG. 1.—Tungstate-starch pattern, before wetting. FIG. 2.—Tungstate-starch pattern, after wetting and drying.

to the first possibility. In no case did we observe any evidence of a new structural arrangement.

Investigations were made with cellulose both in the form of starch and as filter paper. The two salts studied were NaCl and $Na_2WO_4 . 2H_2O$. Varying amounts of salts (from 0–10 per cent sodium chloride and 0–35 per cent tungstate) were soaked into weighed samples of filter paper, which were dried and re-weighed. Ten thicknesses of the paper served as a specimen. The starch was mixed with the salt in the desired proportions, wetted with a few drops of water, and dried in a desiccator. The specimen containers for the starch were $\frac{1}{16}$-inch metal strip, with $\frac{1}{4}$-inch hole, covered on both sides with thin cellophane windows. The wetting process took place in these specimen containers. The powder diffraction method was employed, using unfiltered radiation from a Coolidge molybdenum target tube operated at 30 k.v. (eff.).

To have standards for comparison, diffraction pictures were taken of the filter paper alone; salts alone; filter paper with salt mechanically rubbed in until its salt content equalled that of the 'soaked in' specimen; and the starch–salt mixtures before wetting. The 'rubbed in' sodium tungstate specimen showed the superimposed patterns of the salt and of the paper, as would be expected. The tungstate–starch series before wetting (Fig. 1) also showed the two characteristic patterns, over all concentration ranges investigated.

After wetting and drying, however, the tungstate pattern disappeared entirely at all concentrations below a point between 25 and 35 grams per 100 grams of starch, leaving only the unchanged starch pattern (Fig. 2). The filter paper series showed the same disappearance of the tungstate pattern at a corresponding concentration. Above this concentration in each case both the cellulose and the salt patterns appeared.

This phenomenon indicates that below a certain concentration the salt is molecularly or ionically dispersed. Above this concentration crystals of the salt exist as such. At no concentration was there evidence of any new structure.

The sodium chloride–starch study was similarly carried out, and with identical results, except that the 'saturation concentration' was much lower (in the vicinity of five grams per 100 grams of starch). Since the ratio of 'saturation concentrations' of the two salts is approximately six to one, and since their molecular weights are in a similar ratio, it seems quite probable that the phenomenon is a molecular one. Thus these 'saturation concentrations' would be more properly expressed as molecular concentrations than as weight concentrations.

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July 24.

The Island of San Matteo.

LOOKING at an old map of Africa last year, I noticed an island named San Matteo about half-way between Ascension and the Gold Coast. My curiosity was aroused, and in the past eighteen months I have examined more than a dozen maps dating from the sixteenth to the eighteenth century, including the two oldest maps of Africa in the Vatican library. In every case San Matteo is indicated in approximately the same position. Lately, a French map of 1722 has come into my possession, which gives the following note: "Isle St. Mathieu découverte par les Portugais l'an 1526. Il y a une Source de Bonne Eau." The position of the island on this map is lat. 2° S., long. 16° E. of Ferro. Is it likely that a Portuguese navigator could have been so far out of reckoning, both in latitude and in longitude, as to have rediscovered Ascension without knowing it? Or did San Matteo really exist?

S. J. SHAND.
Stellenbosch, South Africa,
Aug. 2.

THE recurrence on a large number of maps, for at least two centuries, of the supposed Island of St. Matthew in the position named by Prof. Shand is a striking example of the vitality of error when once established. At the moment I am unable to trace a previous discussion of the question, but the following seems a possible solution of the problem.

There seems little doubt that the legend on the French map of 1722 was based directly or indirectly on a story told by the Portuguese historian Barros, Dec. I, Liv. 2, Cap. 2 (edit. of 1778, I. 1, p. 147), which had no doubt been current before he wrote in 1552. The story, given under the date 1525, comes at third hand from a Portuguese pilot, who told of having touched at an uninhabited island named S. Mattheus, in which were two watering places, one good, the other not good; and of an inscription seen on two trees which recorded that Portuguese had been there 87 years before. The island of S. Thomé in the Gulf of Guinea is spoken of in the same passage, so the reference would seem to be to an island in the same region. I find, in fact, in the "Hamy" Chart of about 1502, a name which may possibly read "Y. de S. Matteo" applied to one of the islands in the gulf. Moreover, in Sir George Peckham's discourse on Western Planting, printed by Hakluyt (Maclehose's Edition, viii. p. 127), 'S. Matthewe' is named along with Principe, Anobom, and S. Thomé, as an island under the equinoctial line, peopled by the Portuguese.

The shifting of the island to a very different longitude need cause no surprise in view of the vagueness of the early records, and could easily be matched by other similar instances. An excuse for so placing it might perhaps be found in the marking of an island, in the exact position eventually adopted for Saint Matthew, in a Portuguese MS. chart of about 1516, ascribed to the Reinels. Here the island is named 'A Trynidade,' due possibly to confusion with the island of Trinidad in the S.W. Atlantic, discovered in 1502 by Estevão da Gama. But like Ascension (which was an alternative name for the latter Trinidad) the name was no doubt bestowed on many different islands.

The earliest map in which I have so far found the fictitious island is the famous Ribero map of 1529. Later it reappears regularly in the charts of the Desceliers School of Dieppe, in the Portuguese charts of the Homems, in the Italian engraved maps of Gastaldi and others, though the name is not always the same nor always clearly legible. It is *not* to be found in the MS. chart of Pero Fernandez of 1528. Possibly some other correspondent may be able to give a more certain explanation. E. HEAWOOD.

Contractions for Titles of Periodicals.

THE letter from Capt. Sheppard, under the above title, in NATURE of Aug. 25, raises a question of no little interest and importance to all those who are concerned in any way with the use of scientific periodicals, for the general adoption of a standard list of contractions for the titles of periodicals is much needed.

Unlike Capt. Sheppard, however, I can see no reason why the list given in the "World List" should not be used for this purpose. It is immaterial that we do not all agree with the contractions used for the individual words. Should we ever agree? The point is that here is for the first time a very carefully compiled and complete list, with a ready key to the abbreviations used, and if it were universally adopted, whatever blemishes it contains would soon be lost sight of in the advantages that would be provided.

Capt. Sheppard's criticism that the contractions for the separate words are not uniform is, I think, beside the point. The compilers of the list have, as it seems to me, disregarded the separate word entirely and have taken the whole title as the unit. They have attempted so to contract the title as a whole that this becomes quite short and is yet distinguished from all other titles in the list. That is why *Argus* is not qualified by the place of publication—there is no other title *Argus*, and therefore no chance of confusion. Where there is likely to be confusion, a distinction is drawn—as, for example, *Farmer, Chicago*, and *Farmer, St. Paul*. For quite obviously, the second volume of the "World List" containing the contractions is intended to be used with the first volume, to which it is cross-referenced by the numerical order of the entries. An inquirer does not have to guess what *Argus* means. He turns up Vol. 1 and, by means of the number given against the contraction, at once finds the full title and place of publication.

There is, it is true, a snag here which must be avoided when tracing a contracted title. For the contractions, being in the exact order of the full titles, are not always in strict alphabetical order among themselves. Thus the contraction *Ann.* has five distinct alphabets representing in the full list *Annaes*, *Annalen*, *Annales*, *Annali*, and *Annals*, and care must be exercised to ensure that a contraction is being looked for in its proper group. But a little experience of the list will soon accustom a reader to the arrangements of such entries as this, and no difficulty should arise. (*Glasers Ann.* is perhaps a glaring example, for it occurs amongst the *A's* where it would certainly not be looked for, but in this particular case the periodical is so well known that few should be misled.)

There is no other list in existence so comprehensive, and to the compilation of which so much thought has been given, and it will be a pity if, instead of making use of it, we waste our time in arguing over details which, after all, will always remain matters of opinion.

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Isotopes of Neon.

IN one of his earlier papers, Aston (*Phil. Mag.*, **39**, 444; 1920) found three isotopes of neon, Ne^{20}, Ne^{21}, and Ne^{22}. Distinct indications of Ne^{21} were obtained only on the clearest spectra, and he estimated that, if this constituent exists, its proportion was probably less than one per cent. In his more recent work (*Proc. Roy. Soc.*, **115** A, 487; 1927) apparently no evidence of the isotope Ne^{21} was obtained.

In a study of the ionisation process of methane, using a mass-spectrograph of the Dempster type, we have had occasion to use neon as a calibrating gas, and, under a great variety of experimental conditions, we have always observed an ion with a mass 21 corresponding to Ne^{21}. This ion was never observed when neon was absent, nor could it be a hydride of Ne^{20+}, since it was obtained with pure neon and no corresponding ion of mass 23 was found.

There are, then, three isotopes of neon, as was first reported by Aston, and we estimate that atmospheric neon is composed of about ten per cent Ne^{22}, two per cent Ne^{21}, and the remainder Ne^{20}.

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Corpuscular Theory.

HAVING been urged to direct attention to a paper by myself read to the British Association fifty years ago, on a corpuscular-wave-theory of light, founded upon Le Sage's theory of gravity, I sent a letter to NATURE which appeared in the issue of Sept. 8. In that letter I say that, in 1878, the chief difficulty seemed to relate to refraction, and the reduced velocity of light in a dense medium. I ought to have added that the hypothesis that then seemed the most suitable for explaining the diminished velocity of light in dense media is due to the necessary wriggling of ultramundane corpuscles round the atoms, thus lengthening the distance to be traversed, and diminishing the velocity of the wave-front.

GEORGE FORBES.

The Relation of Physiology to other Sciences.[1]

By Prof. C. LOVATT EVANS, F.R.S.

PHYSIOLOGY AND THERAPEUTICS.

FROM the earliest times physiological knowledge, whether known by that name or not, has had the closest association with medicine. It would indeed be difficult to imagine any great advance in one that was not immediately reflected in the other. Their methods, though necessarily different, are convergent, their meeting-point being the disclosure of normal functions. It is the business of the physician to attend to the urgent call of pain and disease, and to use for their relief such information as he has at his disposal. As he does so he observes, compares, and draws conclusions on the basis of which a theory of the causation of the disorder may be built. The clinical observations and deductions drawn from them give a basis of rational physiological theory from which we have learnt that a state of disease is never a thing in itself, but is always a result of a quantitative change in some physiological process, an increase or diminution of something that was there to begin with.

No aspect of scientific activity is so generally misunderstood as that which concerns the making of discoveries, and in matters of medical research ignorance is particularly widespread. Discoveries are infrequent, in a sense fortuitous, and often dependent on rare qualities of intellect as well as on accurate observations, and they mostly come out of the fullness of time. We all feel great pride in recalling that one of the greatest of all discoveries, which has recently been celebrated as the tercentenary of the publication of William Harvey's famous book "De Motu Cordis," was made in our own country. Here was a genuine revelation that put old facts in a new light.

Incidentally it has been claimed, with more audacity than insight, that experiments upon living animals serve no useful purpose, and it has even been pretended that Harvey had no need for such experiments in the classical researches which formed the foundations of physiology and gave reason to physic. Riolan, in advancing against Harvey the criticism that "it is a mockery to attempt to show the circulation in man by the study of brutes," was, as Gley has recently remarked, "already employing the argument, if it can be called one, which is encountered under the pen of the antivivisectionists of all times, and which illustrates the diuturnity of ignorance and folly."

Let anyone with sufficient acquaintance with physiology try to write an account of such of the main facts concerning the functions of the heart and of the circulation as are most valuable in medicine, without reference to any fact obtained directly or indirectly by animal experimentation, and he will find his essay a very sorry one indeed: for no doctor can use a stethoscope, feel a pulse, take a blood-pressure, administer a hypodermic, give an anæsthetic or a transfusion, perform any modern operations, or indeed take any steps in diagnosis, prognosis, or treatment, without utilising at every turn knowledge derived from the results of animal experimentation and obtainable in no other way.

The subject of pharmacology is very closely connected with physiology on one hand and with therapeutics on the other. Rational therapeutics, based on the results of pharmacological study, also will carry into the wards the spirit of true scientific investigation, and the provision of beds in some hospitals for the use of the professor of therapeutics is an indication that definite progress is being made in this direction. Such an advance has not come before it is needed. If the medical practitioner is to compete successfully with osteopaths, chiropracters, and other similar unqualified persons, he is most likely to do so by only prescribing treatment with proper scientific basis. He should be able to form some opinion with regard to the claims of advertisers of remedies who contribute so large a share towards his daily mail deliveries.

It is, in my opinion, quite impossible, and perhaps undesirable, at the present time to frame instruction in physiology so as adequately to equip the ordinary medical student to proceed directly to the prosecution of research in any of its branches; this can only be achieved by a further year or two of study of the subject, such as by a science course for an honours degree. One of the objects of instruction is to enable the latest results of physiological investigation to be utilised in the clinic, and it seems to me that one of the best ways for this to be effected is for some workers specially trained in physiological methods to enter the staff of clinical units where facilities for research work are at hand.

The opinion was at one time prevalent among many clinicians, that if their problems required the use of methods similar to those of experimental physiology, these should be farmed out to a physiologist, and although there are cases where this procedure may be followed with advantage, the rich harvest which has already been reaped by the importation of physiological knowledge and methods into, rather than the export of problems from, the clinic, is adequate justification for the former. It is in any case encouraging to note the present-day decline of the attitude that experimental investigation is work of a lower order, which can be put out like so much washing, for the employment of an inferior caste.

The close connexion which is now generally admitted between physiology and medicine was clearly foreseen by Claude Bernard in 1855. Medicine, he said, is a science, and physicians who describe it as an art injure it, because "they exalt a physician's personality by lowering the importance of science." "True experimenting physicians," he says, "should be no more perplexed at a patient's bedside than empirical physicians. They will make use of all the therapeutic means advised by

[1] From the presidential address to Section I (Physiology) of the British Association, delivered at Glasgow on Sept. 10.

empiricism ; only, instead of using them according to authority and with a confidence akin to superstition, they will administer them with that philosophic doubt which is appropriate to true experimenters."

Physiology takes its place as a science in proportion as its data are accurate and its principles fall into line with those in the other sciences. My great teacher Starling said that science has only one language, that of quantity, and but one argument, that of experiment. The qualitative observations of one generation tend to become quantitative at a later stage of development of a science, and the degree of development of a science can indeed to some extent be judged by the extent to which it falls into a scheme of the unity of science by giving results which are capable of mathematical treatment and of expression in broad general principles.

What has happened in physics and chemistry may be reasonably expected to happen in biology, so soon as it is able by improvement in the accuracy of its methods and by progress in the formulation of its problems to employ mathematics with profit in the manipulation of data and in the construction of those generalisations which are landmarks of progress in all the sciences ; indeed we are, I think, now witnessing the commencement of such a phase in the development of our own subject.

Mathematics and mathematical physics have been of considerable use to physiology in increasing the accuracy of its experimental data, and this in two ways. First, by bringing the accurate experimental and intellectual methods of physics to bear on the construction and use of the numerous physical instruments which it employs. It has been said by Prof. A. V. Hill, that many of the early investigations on muscle were in reality studies of the properties of levers, and it is certain that similar remarks apply to only too many investigations in which the properties of the apparatus used have not been suitably investigated.

Even when the apparatus at the disposal of the physiologist is unexceptionable, however, it is often the fact that, owing to the nature of the subject, results are not susceptible of repetition with the same ease and certainty as are those of chemical or physical experiments. The variability of the results is due in such cases to what are called accidental circumstances, a term which in reality means circumstances over which we have no control, owing either to our ignorance of their nature, or else to our inability to alter them. In those cases where further study provides methods of more fully understanding and therefore more adequately controlling these circumstances, valuable results follow almost at once.

Under the most favourable conditions, however, it has up to the present been usual to find a considerable unavoidable margin of variation in the results of many physiological experiments. By regarding these provisionally as 'chance' variations, considerable help may be obtained by the application of the theory of errors, based on the theory of probability.

Lastly, as a means for evolving generalisations out of experimental data, and of bringing these into relation with the generalisations of other branches of science, the use of mathematics is incontestable. One need only mention as examples the fresh outlook which has been provided for further investigation by the exact study of the data relative to the segregation and recombination of hereditary factors, the beautiful investigations of L. J. Henderson on the equilibria in the blood, the theoretical study of the phenomena of excitation, the employment of thermodynamics and the numerous other applications of physico-chemical theory.

Chemistry and physiology having both originally sprung from the art and practice of medicine, it is little matter for surprise that such a rich harvest has been reaped by their reunion in the form of biochemistry. Although these developments were foreshadowed by the intuition, if not by the actual achievements, of the iatro-chemists of the sixteenth century, little advance was possible until chemistry had, by separation from medicine, established its position as an independent science. So that it was not until about 1840 that organic chemistry and biochemistry were able, chiefly owing to the inspiration of Liebig, to make rapid progress, at least on the Continent. It is significant that at the present time a steadily increasing number of young highly trained organic chemists consider it worth their while to turn to biochemistry ; their welcome entry into our ranks gives us fresh hope and faith in our future, as well as in theirs.

As is usually the case, rapid developments in biochemistry have followed improvements of technique ; the advances in micro-methods of analysis, without which insulin would probably not have been discovered, or the constitution of thyroxin made known, have played a very important part ; the same applies to the whole subject of physical chemistry, much of which, like colloid chemistry and the theories of buffer action, has been built up in response to biochemical requirements. Since the central problems of biochemistry are dynamical, most of its subject matter must be treated from that point of view, and here again the debt to physical chemistry must be recognised.

Whether a biochemist should be primarily a chemist or a biologist is a question which has been much debated in private, though little in public. Personally I see no reason why he should not be both. If he must have one label, it is better that of the chemist, provided always that the biochemist works in the closest possible association with the physiologist. In fact, I am convinced that within the limits of administrative possibility, the greater the variety of workers brought together the better the results.

So much for the exact sciences. Their value to physiology is immense. They help us to interpret phenomena, but not to predict. In a word, physiology is something more than biochemistry and biophysics ; it is, and will always remain, a biological subject.

As its nearest neighbour among the biological sciences, zoology should have the closest relations with physiology, yet it is curious that during several decades, for reasons which need not now be discussed, these two subjects were as the poles apart. The newly disinterred subject of comparative physiology, however, bears witness to a returning interest of zoologists in the experimental study of function as against mere morphological classification, as well as of physiologists in comparative function as a valuable means of throwing light on their own special problems.

The relation of anatomy to physiology can best be understood if we recall the fact that when the time was ripe physiology separated off from anatomy, taking with it all those dynamic problems which concerned function, and leaving anatomy literally little but the dry bones. The stationary condition of anatomy during the last decades of the nineteenth century was similar to that of zoology, and indeed had similar causes, and was little relieved by the subsequent incorporation of anthropology and embryology.

Histology had in most countries remained with anatomy, and had for the most part been content, like it, merely to describe the structure of preserved dead things. In Britain, it is true, histology had until quite recently everywhere remained with physiology, and had perhaps fared no better, for although the British, like their Continental friends, did 'nothing in particular,' they did not do it very well, for we must admit that histology had degenerated into a merely descriptive subject, supplemented by training in a useful technique, and by the identification of specimens. Nevertheless there were rays of hope, and occasional hints, that the problems of function had not been entirely lost sight of, and that the large mass of histological information which had been collected might become valuable if only the fundamental question as to the reality of the structures described could be settled.

At the present time some English schools have followed the American and Continental practice, and handed histology over to anatomy and though I am personally not at all convinced of the justification of this step, yet in view of the indications of quickening in the subject of anatomy during the past two decades, it no doubt is best to suspend judgment as to the ultimate result of the transfer.

I have, I hope, said enough to lend emphasis to my principal point, which is that the subject of physiology has the most intimate and vital contact with all biological subjects, with the fundamental sciences, and with medicine. It is, in fact, one of the best possible illustrations of Herbert Spencer's idea that "the sciences are arts to one another." It has often been said that science knows no frontiers and no nationalities. If we apply this a little nearer home, we shall all look forward to the day when departments will merely indicate administrative boundaries and not intellectual compartments.

Although the application of those sciences which are called 'exact' is of immense value to physiology, we must be under no misapprehension as to their real relation, which is merely that they enable the phenomena of life to be described more accurately. They in no way furnish an explanation of those phenomena or enable us, without direct reference to physiological facts, to forecast them. The so-called exact sciences appear to be so because of the simplifications of which they are capable, by reason of which problems can readily be formulated and attacked. Disturbing conditions can provisionally be ignored or allowed for, and a first approximation reached which can be corrected later. In biology this can less readily be done. It is the failure to appreciate this elementary fact which leads some of those trained only in the methods of the exact sciences into the most palpable and unpardonable blunders when they attack biological problems.

The process of application of the exact sciences to physiology consists in reality of studying the phenomena themselves and then adopting the most plausible explanation capable of formulation in terms of the exact science. There is no other way. But let us be under no illusion about finding final explanations of what life is by this or any other methods.

It was pointed out long ago by Claude Bernard that all *a priori* definitions of life, like those of time, space, or matter, are futile, since they usually themselves imply the thing defined. Let us take one or two famous definitions of life as examples. Bichat in 1818 defined life as "the sum total of those functions which resist death." Here we have two opposed ideas, life and death. "All that lives will die; all that is dead has lived." For Bichat, life is a struggle of the living thing against an environment which seeks to destroy it, but it is clear that the idea of life as opposed to death is implicit in the definition. This idea of an internal teleological principle, of entelechy, runs through all biological writings back to Aristotle, with whom we believe it to have originated. The amœba which encysts itself does so in order to defy adverse conditions in its environment. The 'calculating intelligence' postulated by Kant directs this response.

Another definition of life which has been much favoured of late is the mechanistic one in various forms; 'life is a special activity of organised things.' Here again the definition implies the idea itself. The possession and maintenance of a definite structure cannot any longer be held to be an outstanding feature of living matter as commonly understood, for recent researches in physics show us that, although electrons may come and go, the atomic structure of matter is relatively stable, even though in particular circumstances mutations may occur. Nevertheless, the view of life as a mechanism created by and entirely dependent upon its environment gained strength owing to the developments in other sciences, particularly by reason of the synthesis of organic compounds, the principle of the conservation of energy and the introduction of the Darwinian theory of evolution. According to this view, a revival of that of Empedocles, teleological manifestations are accidental. As that thoughtful writer Hjort remarks, however: "When we, as human beings, call a thing accidental, it only means that we give up the hope of understanding it. . . ." "In the physical sciences those factors are termed accidental which we voluntarily disregard in the course of an investigation, or which we find we have omitted to notice." Kant, however, in his "Kritik of Judgment" calls the teleological "the link whereby our understanding can alone be supposed to find any agreement between the laws of Nature and our own power of judgment."

Mechanistic interpretations tend in the long run to become arrogant and superficial, as vitalistic ones predispose to scientific nihilism. For, while it is inconceivable that living things do not obey the laws of Nature, yet it is equally unthinkable that a chance encounter of physico-chemical phenomena can be the explanation of their existence. This being so, how can we, in Kant's words, "arrive at an understanding of Nature"?

It seems clearly impossible to harmonise or to decide between these opposed views of the nature of life, and I do not think any final conclusion to be possible or even necessary. To quote Hjort once more, "Philosophy has no other starting-point than a problem, and the current results of scientific research; it never leads to any absolute conclusion. It grows with the science of Nature, since in reality it comprises the most general results of that science and comprises nothing more. It does not explain the nature of the human understanding, and provides no means of getting behind the understanding itself . . . the existence of which is the first and necessary condition for the existence of science at all."

Physiologists, in attempting to know what life is, have in my opinion attempted too much, and I think that a new point of view is essential. One of the greatest of contemporary thinkers, L. J. Henderson, has recently submitted an argument with which I venture humbly to agree. The idea of adaptation, urged by Claude Bernard, should be adopted by physiology as its basal principle, as the chemist accepts the conservation of matter, or the physicist the conservation of energy. We need not seek to know why it is so: that is the province of the philosopher; all our experience tells us that it is so. It is not a definition of what life is, but a brief statement of its way, which is valuable, stimulating, and true. But we must treat the organism and its environment as one if we are to gain a proper insight into the adaptations manifested by the former. Life is conserved by adaptation, and I think that this conception will be useful alike to general biology, to physiology and perhaps most of all to pathology.

It is the concern of physiology to study the normal functions, and here the normal must be regarded as a statistical group. For particular purposes it is convenient to consider normals as of fixed value; but for other purposes it is equally convenient to regard each of these in turn as variable, to study its variations and find how they are produced. When we do so, we find, with increasing clearness the more deeply the subject is investigated, that the variability and the constancy are closely related, the fixed value of one thing being due to the interplay of the variables of others.

We have in the study of physiology many beautiful examples of this closely woven texture of interdependent phenomena. Modify any condition concerning any one of them, and we at once set the machinery moving in such a way as to counteract what we have done; and this is not what life is, but what it does, which distinguishes it—it adjusts the organism to its environment.

Glancing now towards the future, what may we say represents in a few words the trend of modern physiology? In many ways a great future lies before it. Utilising the other sciences as its tools and itself reacting powerfully on them, we can confidently predict progress to undreamt-of heights, an enormous development of experimental pathology and medicine, and far-reaching effects on economic and sociological conditions. Yet, implicit in these very potentialities, there is another and a gloomier side to the picture. The rapidly accumulating wealth of detailed knowledge and of special technique demands an increased specialisation; unless there is a periodic intellectual stocktaking, there must inevitably be a loss of perspective and of grasp of great general principles.

The establishment of special research professorships, however profitable in isolated cases, cannot in my opinion make good this growing specialisation, because it will tend to divorce research and teaching and place the teaching professor on a level of real or apparent inferiority. The idolisation of research for the sake of the advancement it brings is another of the dangers which threaten us. If there is one thing worse than 'a mediocrity who does no research' it is 'a mediocrity who does.'

There are at the present time a large number of junior research posts available, but not enough well-trained people adequately to fill them. This is all to the good provided that those who on trial show no aptitude for the work can be ruthlessly eliminated. As they often cannot, there are in consequence a number of young people who drift from one research scholarship to another, perhaps not aimlessly, but with no better objective than the manufacture of papers designed to justify their employment. The hapless editors of each of the swelling tide of journals are coaxed, hoodwinked, and, if necessary, bullied, to ensure that these papers see the light of day. In the fullness of time the list of short-time research posts is exhausted, and the young investigator must now either turn to some entirely different occupation or else, as one of my friends expressed it, 'subside into a professorial chair' for which, incidentally, he is probably entirely unfitted.

The pursuit of science is nowadays, perhaps unfortunately, a career, and one in which moreover it pays to advertise. Science, we are often told, is the cream of civilisation. If we believe this, let us use all our endeavours to ensure that it be not a whipped cream, specious, puffed up with wind, and presenting a fictitious appearance of solidity.

Secondary Schools and Examinations.[1]

By CYRIL NORWOOD, D.Lit.

THE public schools and the great day schools of the nineteenth century were inspired both in regard to curriculum and method by Oxford and Cambridge, and they were largely classical; a reaction against this undue narrowness led to the experiment of the organised science schools of the last ten years of that century. These in their turn certainly carried the reaction too far, and produced juvenile chemists and physicists without culture or general education. In 1904 the Board of Education issued its first regulations for secondary schools, and sought something broader than either of these two rival institutions; they established a four-year course in which English, geography, and history, at least one language other than English, mathematics, science, and drawing should be studied, together with manual work, physical exercises, and, for girls, housewifery. As that course has been worked in practice in the last twenty-five years, it has been in the main academic in spirit, and the important subjects have come to be the native tongue, the foreign language or languages, and mathematics and science; the schools have continued to look to the universities, and to the development of those advanced courses which lead up to university studies. All this effort has been directed and stabilised, and some would say stereotyped, by the setting up of the system of school certificates, for which in England and Wales eight university authorities examine. All the secondary schools, therefore, have in the main the same outlook, which is primarily that each pupil should at the end of the first stage of the course be able to matriculate at a university; the school certificates have been brought into relation with the matriculation examinations, and the system is now organised in all its details.

Meantime the number of schools, and the number of pupils at each school, have greatly increased. In 1904 in England the number of secondary schools for boys, for girls, and for boys and girls together was 575; there are now 1184 recognised for grant by the Board of Education, and 305 recognised as efficient, but not eligible for grant. In 1904 the number of pupils was 97,698; in October 1927 it was 349,430, and if you add the 57,655 in the schools not eligible for grant you get a total of 400,000 boys and girls who are in England pursuing a course of secondary education. While the content of secondary education has not changed, and remains academic in spirit and outlook, the number of schools has more than doubled, and the number of pupils has increased by more than four times. To put it clearly in another way, in the first year in which the school certificates examination was held, there were 14,232 candidates; for the last one for which figures are available there were 54,593, again very nearly an increase of four times.

The result of pouring all this mass of new material into a single mould has produced a slowly increasing volume of protest, but those who protest are much more sure in describing the symptoms of the distresses of the secondary schools than they are in pointing to their cause or in finding the cure. It is said that there is a good deal of overstrain among the pupils of the secondary schools, particularly among the girls, and that for the average, the effort of reaching a satisfactory level in English and English subjects, in a foreign language or languages, and in mathematics and sciences is too much.

That this is so is shown by the fact that when the examination was established it was supposed that nearly all would be successful at the end of their course in obtaining a school certificate, but as a matter of experience less than two out of three have been able to do so. It is alleged that the examination hampers the freedom of the teacher, who during the whole four years' course can never turn aside to browse in the pleasant paths of literature or to pursue interests common to himself and his class, but must concentrate the attention of his class and himself wholly upon what will pay in the examination room. Great schoolmasters of the past are quoted who could never have pursued their favourite methods with success under present conditions. It is asserted that for many boys, and for still more girls, the present curriculum is unsuitable, that they are not all, or indeed comparatively many, of them going to the universities, and that they ought not to be sacrificed to the interests of the few who do contemplate that course. The question is raised whether as a matter of fact the intellectual training of the girl ought to be the same as that of the boy, and whether the tyranny of imposing the preparatory curriculum of the university upon the girls is not even more unreasonable than it is asserted to be in the case of the boys. On this point the committee which reported on the differentiation of the curricula as between the sexes spoke with an uncertain voice, probably because they knew that there were many feminine associations ready to tear and devour any committee or any individual who said anything which might be taken to imply that women were not the full equals of men, and girls of boys.

The practical outcome of all this is the suggestion that boys and girls should be awarded a school certificate even if they omit a foreign language entirely, or mathematics and science entirely, so long as they make up for it by proficiency in subjects such as music, art, handicraft, housecraft, and other subjects of more motley character and more dubious claim. On this proposal the English teaching profession is divided, the Headmasters' Conference and the Assistant Masters' Association being against it, the Headmasters' Association doubtfully in favour, and the Headmistresses' Association and the Assistant Mistresses almost as one woman in favour also. From this state of affairs one can judge where the shoe pinches most, but there is no

[1] From the presidential address, entitled "Education: The Next Steps," delivered before Section L (Educational Science) of the British Association at Glasgow on Sept. 7.

doubt that it does pinch, and anyone who remembers the figures which I have just quoted will quite readily understand why. There are more boys and girls taking the full secondary course to-day than are either fit for it or fitted by it. The malcontents are quite right in the criticisms which they level against the system and its results, but they are in my opinion wrong as to the nature of the cure and the method by which they would bring it about.

The standard of secondary education in England is high, and is something of which we have a right to be proud. Its methods and objects are the fruit of long experience and of the efforts of several generations. The boy or girl who has taken a school certificate before the age of sixteen, followed an advanced course, or specialisation in a sixth form, to the age of 18 +, has reached a level attained in few educational systems other than our own. I question, indeed, whether any country is producing boys and girls of as high a level of intellectual excellence and training as those hundreds who go up every year to compete for scholarships and places at Oxford and Cambridge. I believe this to be true of the boys, and it is certainly true of the girls. This system is now built on the general education of the school certificate and the specialised education of the higher certificate, and I hold that it should stand unimpaired, and not be tampered with; for it is far easier to relax a standard than ever to recover it. To say that every boy and girl who goes to a secondary school for four years should be awarded the same certificate, whatever subjects they may have studied and offered, is to say that things which are not equal to one another are equal to the same thing; it is to say that the boy who has been successful in English, history, geography, Latin, French, mathematics, and science is *prima facie* the same article as the boy who has been successful in English, general elementary science, drawing, handicraft, and shorthand, or the girl who has offered English, botany, music, drawing, and needlework.

I am not representing either course as better than the other; one may be right for *A* and the other for *B*. I hold no brief to argue that the high-brow is better than the low-brow, or the blue stocking than the flesh-coloured stocking. All that I maintain is that they are palpably not the same, that it is illogical therefore to call them the same, and that nothing but confusion will result from calling them the same. It may be democratic and in accordance with the spirit of the age to hold that we are all the same as one another, and ought therefore to be labelled with the same labels; but no man who has taught a class for one term can really hold that Nature gives any warrant to such nonsense. Surely the logical course is to award two kinds of certificate, one which shall fulfil the academic conditions and maintain unlowered the existing system which causes no difficulty to the boy or girl of average academic ability, and the other which shall be a proof that the boy or girl has taken at school that course of education which in the particular case was the most fitted.

I would therefore have in any secondary school these two types definitely recognised to be different, not superior or inferior, the one to the other, but different. It would be recognised at the school certificate stage by one type sitting for the school certificate awarded as it now is, and the other for a general certificate which shall show that they have made good use of a good and sensible type of education. If they stay at school, one type will continue to go on to the higher certificate, again organised as it now is, and the other to a second certificate, which shall again test the subjects of a quite unspecialised education, designed to meet the individual need in each case. There will then be a good deal of variety inside secondary education, and when the central schools become more numerous and more organised, and the modern schools come into existence in increasing quantity, there will be a good deal of variety outside the old secondary schools as well.

Even so my discussion of the problem of the right curriculum for the higher forms of the secondary school is not complete. In saying that the standard should remain unimpaired, and not be tampered with, I have in mind the work of the best boys and girls. But many more than the best go on to the universities, and it is right that they should do so; I am not convinced that any of these should attempt specialised study before they enter the classes of the university. On one hand, the colleges of Oxford and Cambridge, through their open scholarship examinations, enforce on the schools the attempt to reach a very high standard along narrow lines; some universities, by allowing their intermediate examinations to be taken through the higher certificate, confuse the courses proper to themselves and to the schools; some universities admit their students too early; the higher certificate courses themselves often involve specialisation built on a very slender foundation of general knowledge. On the other hand, many professors and university teachers are loud in their condemnation of the state in which their pupils come to them, with minds ill-balanced and ill-furnished. I submit that this region of the last two years of school is insufficiently explored, and the nature of the work that should be done by the average student not thought out. I submit further that it is a matter which might well engage the attention of all the universities of the country in conference. They have perhaps no common mind, but I do not know that they have attempted to arrive at one: they have never clearly stated what they want; they have never faced the fact that through their scholarships they make extreme specialisation necessary, and through their professors complain of the result. I regard the matter as urgent, for as chairman of the Secondary Schools Examination Council, I know that the curriculum and the examinations proper to this later period of school life stand in great need of definition, and that in proceeding to the work, which cannot long be deferred, we have no clear guidance from the universities as to what they really want.

However, it is not only in the secondary schools that some thinking needs to be done about the requirements of the immediate future ; there is also some advance that needs to be made, after due thought, in that very complicated field which is known as technical and further education. Technical education is a field which has been developed all by itself, and in isolation from almost everything else. Each part has grown to meet a need, and usually a local need. It is cut off from the elementary education which precedes it, for elementary and technical education have been controlled by different departments of the Board of Education, and it is cut off from the university education, which in the case of the best students ought to follow. There is frequently a gap of one, two, or even more years between the end of the elementary course and the beginning of technical instruction, and that instruction is frequently sterilised by the fact that students have come to it tired, late in the evening, and in the centre of cities. Finally, there is need of much fuller contact, of more mutual knowledge and sympathy, not only between technical education and industry, but also between all forms of industry and commerce and all forms of education. There ought to be a full inquiry into this difficult and complicated problem ; educationists ought to know and consider more thoroughly what is wanted, and employers ought to take much more trouble to find out what is being done.

There is a large question of very general interest which I can state, though I do not know that I can supply an answer. What is the proper part which formal and external examination should play in our educational courses ? Examinations at the present time play a very large part. In a great many places there is competition and examination for scholarships and for free places at the secondary schools ; some four years later there follows the school certificate, theoretically for all. One or two years later follows the higher certificate examination, and then there are for some all the university and professional examinations in prospect. Entrance to the public schools is obtained by an examination known as the Common Entrance Examination, which is said in some cases to be competitive, but in all cases involves the reaching by the candidate of a certain definite standard. Competitive examination admits to the Army, Navy, and the Civil Service. The system is so thorough and so universal that the victim, if that is the right word, may never be out of the shadow of an examination from eleven years old to twenty-three, or even later. It is argued, first, that this gives almost inevitably a totally wrong view of knowledge, and makes a boy or a girl from school days on feel that his or her object is not to study a subject, but to acquire the capacity to answer on paper examination questions about it, and that therefore, once examinations are over, he or she learns no more. It is argued, secondly, that the teacher's freedom is destroyed, since he has to teach his subject not in the best way, but in the way which will pay best in the examination, and that the more inspiring, original, and fresh he is in presentment, the less he is likely to succeed on a mechanical system. It is alleged, thirdly, that the system is really unsuccessful, that it picks out for honour those who have the examination faculty and can write fast and to the point, but that, judging by what happens in after-life, it does not really pick the best men and women, and those who will go furthest in their study.

There is a certain amount of truth, but a good deal of unreasonableness and lack of practical common sense, in all this attack which is so frequently made to-day. My own profession, the schoolmasters, are not consistent, though the schoolmistresses dispute the palm with them, for they insist on a certificate to mark the successful completion of all their courses, and do not rest until all the subjects which they teach have been brought, for example, within the ambit of the school certificate. The subjects which of all others ought to be the most free, and are in my opinion in their own interests least examinable—music and art—are, I suppose, the means for awarding more certificates by examination than any other, and the blame for this I lay largely at the door of my professional brothers and sisters. It is not, I think, seriously true that teachers are cramped by the examinations; on the whole, examinations follow the school curricula, and do not control them ; the teachers, moreover, are well represented on the examining authorities, and can make their voices heard. It is not possible to say whether a boy or girl knows a subject save by asking questions ; these must be the same for all, answered under the same conditions in the same time, and that makes a written examination necessary. No one suggests that examinations are more than they are, a very human and sometimes fallible means of finding out whether a candidate knows what he ought to know, and no one in his senses claims that they pick out the person who will be ultimately the most successful. What is true is that in early years they tend to dull the edge of the desire for true knowledge, and that throughout school life there are plenty who are quite incapable of showing on paper what they have in their head ; they are not fools, though they may be written down as such, but they are bad examinees. Moreover, in any system of examination which is more or less universal—as is the case with the school certificate—we have to think of the dull and of the slow developers, who suffer badly when they are crammed and forced to an unnatural level.

I believe, therefore, though the time is not yet, that the right course will be to abolish all external examination for the average boy and girl, though leaving it as the avenue to the universities and the professions. In the case of the average boy and girl, the properly inspected and efficient school will issue its own certificate that *A* or *B* has attended for four or six years as the case may be, and has reached a satisfactory level of performance. The power to make such an award implies a high standard of professional honour, and perhaps a higher level of efficiency than yet exists, but it would enable the schools to teach a pupil what he could learn, to teach him in the right way, and not drive him in the wrong way to a wrong standard.

Obituary.

Dr. John Rennie.

By the sudden death of Dr. John Rennie, of the University of Aberdeen, on Aug. 30, zoology has lost an investigator of high quality. Educated at Aberdeen under the late Prof. Alleyne Nicholson and others, Dr. John Rennie became in 1899 chief assistant to Prof. J. Arthur Thomson, and he so continued until 1917, when he was promoted to be lecturer in parasitology and experimental zoology, and was put at the head of a laboratory of his own. He had previously become lecturer in agricultural zoology in the College of Agriculture, and he was also in charge of the nature-study classes at the Training College.

Dr. Rennie had great gifts as a teacher, for he was singularly clear in his lecturing, thorough, deliberate in manner, and of unruffled patience. He had a discernment of profitable problems to work at, for one of his early successes was an account of the minute structure of the Islands of Langerhans, which he had found in sharply defined form in some teleostean fishes. Along with a physician, he began trying the effect of extract of these Islands on diabetic patients, a distant hint of insulin treatment. For various reasons, especially the difficulty of steady supply, this experiment was not carried far.

In connexion with his agricultural work, Dr. Rennie became much interested in entomology, and this led him, along with Mr. John Anderson, lecturer in bee-keeping in the College of Agriculture, to attack the problem of Isle-of-Wight disease in hive-bees. Thanks to the generosity of Mr. A. H. E. Wood, of Glassel, one of the leading apiarists in Scotland, Dr. Rennie was able to secure the assistance of Dr. Bruce White, who worked in Prof. Shennan's Pathological Laboratory, and of Miss Elsie Harvey, who worked in his own. It was a case of team-work, for it was Dr. Bruce White who first recognised the significance of the tracheal mite, *Acarapis woodi*, and it was Dr. Rennie who demonstrated convincingly the causal relation between the mite and the disease. At this time he was working far too hard, examining thousands of bees, week after week, and he probably weakened his never robust, though carefully husbanded, health. In the last two or three years Dr. Rennie was working at the curative treatment of Isle-of-Wight disease and had made some important steps.

Dr. Rennie had many friends, won to him by his quiet, unassuming ways, his sincerity and reliability, and his unfailing generosity to other workers. His researches were marked by their high standard of precision and by their cautious thoroughness. Dr. Rennie was about sixty-three years of age; he is survived by a widow, three daughters, and a son. A month or so ago his eldest daughter was married to Dr. Norman Wright, of the West of Scotland Agricultural College.

We regret to announce the following deaths:

Dr. Jean Brèthes, entomologist at the National Museum of Natural History, Buenos Aires, on July 2.

Mr. Charles Curtis, superintendent from 1884 until 1903 of the Botanic Gardens at Penang, on Aug. 16, aged seventy-five years.

Prof. E. C. Grey, formerly professor of chemistry in the University of Cairo, who carried out investigations for the League of Nations on the food problems of Japan and was known for his work on the chemistry of fermentation, on Aug. 10.

Prof. Wilhelm Wien, professor of experimental physics in the University of Munich, editor of *Annalen der Physik* and of "Handbuch der Experimentalphysik," who was a distinguished worker on the nature of cathode and canal rays, aged sixty-four years.

News and Views.

The brochure entitled "Broadcast English I. Recommendations to announcers regarding certain words of doubtful pronunciation," which was recently published by the British Broadcasting Corporation, is a scholarly production, and one that should appeal to a wider audience than that for which it is primarily intended. Though the pen is the able one of Mr. A. Lloyd James, of the School of Oriental Studies, the voice is that of the expert committee, which includes, among others, the Poet Laureate and Mr. G. Bernard Shaw, and was appointed by the Corporation in 1926. Speech, it is pointed out, is governed by local convention and public taste, and although most people think there are right and wrong ways of speaking, these adjectives are only applicable where the different considerations of propriety all lead to the same conclusion. "The higher a community climbs in the social scale, the greater is the uniformity in its speech." There is no standard pronunciation of English, so there cannot be one and only one right way of pronunciation. Our language is rich in alternative pronunciations of equal authority, and the task of the B.B.C. has been that of deciding between them. The special difficulties of the task originate in the discrepancy between sound and written symbol, the presence of many foreign words, the relationship between the value of a symbol in the modern language and the value it had in a classical tongue, and the absence of any principle to govern the incidence of stress.

The task of the Committee, it will be admitted, was not easy, and if one does not agree with all the findings—unanimity was not expected—the main principles of selection, as set out in the booklet, will probably meet with little criticism. The recommendations, having the praiseworthy object of providing some measure of uniformity in the pronunciation of English, will be welcomed by scientific men, who will be particularly interested in those which relate to words, often troublesome to pronounce, that are frequently used by them. Among such words are the following (a doubled vowel letter indicates a long vowel sound, and a double-consonant letter indicates that the previous vowel is short): Acoustic — acóostic, basalt — bássolt, ceramic — serámmic, data—dáyta, evolution—eev-, fetish—féetish, gyratory—jýratory, iodine—éye-o-dyne, laboratory—stress on second syllable, metallurgy—métalurjy, nomenclature—nōménclature, patent—páytent, except in 'Letters Patent' and 'Patent Office,' which have páttent, ration—rhymes with fashion, reverberatory—chief stress on second syllable, secondary stress on fourth syllable, rotatory—rōtáytory, zoological—zō-ŏlój-ical, except in 'Zoological Gardens,' where the pronunciation is zoo-lój-ical. Although most of these recommendations are in accord with current practice, we believe the chemists will object to 'éye-o-dyne,' the metallurgists to the secondary stress in 'reverberatory,' and perhaps both to 'labóratory.'

Two of the centenaries of greatest scientific interest which occur next year will be those of the deaths of Thomas Young and Sir Humphry Davy, both of whom died in May 1929, the former in London and the latter at Geneva. The birth of Young took place in 1773, that of Davy in 1778, the centenaries of which, in 1873 and 1878, however, the scientific world allowed to pass without proper recognition. In the case of Davy we commented in our columns at the time on this lack of recognition, adding, "We leave it to a foreign nation to honour the memory of one of our greatest explorers and to a petty provincial town to commemorate the birth of one of our greatest chemists." It is with interest, therefore, we learn that inquiries are already being made as to what steps are being taken to pay due homage to Young, who was the first to explain the phenomenon of the interference of light, who described the optometer, the precursor of the ophthalmoscope, who first gave the word 'energy' its present scientific significance, who provided engineers with 'Young's modulus,' and who deciphered the Rosetta Stone. Of Davy it is only necessary now to recall his experiments with nitrous oxide, his isolation of potassium and sodium, his determination of the elementary character of chlorine, and his invention of the safety lamp.

BOTH Young and Davy came from the 'West Country,' —the former from Somerset, the latter from Cornwall —both became distinguished fellows of the Royal Society, both were connected with the Royal Institution, both were foreign associates of the Paris Academy of Sciences, and both are commemorated in Westminster Abbey. If Young surpassed Davy in the depth and range of his scientific inquiries and his immense learning, Davy by his manipulative skill, his command of language, and his poetic imagination secured a popularity denied his great contemporary. Both, however, had a world-wide reputation, and while Davy's work is commemorated by the Davy Medal of the Royal Society, Young's is recognised by "The Thomas Young Oration" of the Optical Society. It is to those societies that the scientific world will look for the initiation of the proper celebration of the centenaries of these eminent men of science.

IN *Science* for July 27, is a report of the address by Prof. L. C. Newell of Boston University on "Count Rumford—Scientist and Philanthropist," given at Woburn, Mass., on Mar. 26, the 175th anniversary of Rumford's birth. Rumford is known as the founder of the Rumford Medals of the Royal Society and of the American Academy of Arts and Sciences of Boston, and also of the Royal Institution; his whole career was permeated by the desire to apply knowledge to practical ends, and Prof. Newell speaks of him as "the first man to advocate sensible home economies and rational dietetics." Born plain Benjamin Thompson, it was George III. who knighted him, and the Elector of Bavaria who made him a Count of the Holy Roman Empire. Rumford's versatility can be measured by no ordinary standard, and it was Gibbon who dubbed him "Mr. Secretary—Colonel—Admiral—philosopher" Thompson. Of the Royal Institution, Prof. Newell remarks that Rumford's "conception was a perfect expression of himself. It combined science and philanthropy; its twofold purpose was to seek the truth and make it useful. But, like many institutions established on broad foundations to meet the specific needs of a period, it was not developed as the founder planned. The practical and the useful as seen by Count Rumford were soon overshadowed by the scientific. Stoves, kitchens, and contemporary mechanical contrivances were gradually set aside and quietly forgotten. Models were replaced by men—in succession: Davy, Faraday, Young, Tyndall, Rayleigh, Dewar, Bragg, and many others. These men have carried out Count Rumford's aim—not his special plans, but his aim as a scientist and philanthropist—discovery of truth which helps mankind."

THE *Journal of the Society for the Preservation of the Fauna of the Empire* is an excellent means of propaganda for a very worthy object. Instead of the formal reports usually contained in such a publication, the recent issue of the *Journal* has many short and readable articles on various aspects of the fauna of the British Empire and the methods adopted for its preservation. Extracts are given from the informative reports of the game wardens of the Transvaal Game Reserve, of Kenya Colony, and of the Uganda Protectorate, and these indicate that the regulated slaughter of game animals by licence may be a profitable business as well as a means of conserving the stock. Col. J. Stevenson Hamilton writes upon the bush pig, and an article on game and tse-tse fly in Nyasaland states that the slaughter of big game only has not succeeded, and cannot succeed, in reducing the numbers of tse-tse, the indication being that one result is to cause the fly to range farther and become more prone to attack man. The game warden of Kenya praises the introduction, with a view to future liberation, of Scottish red deer to the hills of Kipipara, and proposes to turn down Indian blackbuck in the Colony. He refers to objectors to this policy as taking 'the parochial view.' On the contrary, the objection to the setting free of such importations is the scientific view, and the warden's comparison of the stocking of a wild country with foreign animals to the cultivation of exotic plants in a garden is beside the point. It is sufficient to point out here that the turning loose of aliens has had in other lands a very direct and injurious effect upon the native faunas into which they were thrust, and, although the Society specifically disclaims responsibility for opinions expressed in articles in its *Journal,* we trust that this is no part of its policy and that it will use its influence against such introductions unless they be made to meet some real need of the district.

THE collection of chemical memorabilia assembled by the late Dr. Edgar Fahs Smith has been presented to the University of Pennsylvania by his widow; it will be preserved intact in its present setting in the Harrison Chemical Laboratory of the University, and will be known as "The Edgar Fahs Smith Memorial Collection in Historical Chemistry." The University is making special arrangements by which it will continue to be accessible to visitors and students of the history of chemistry, many of whom during Dr. Smith's lifetime had frequent recourse to it for study and research work. Dr. Smith, who died on May 3 this year, had served as emeritus professor of chemistry at the University after resigning the provostship in 1920. The collection comprises three main divisions. The first contains about 500 autographed letters and manuscripts of eminent chemists of all nationalities; the second is made up of approximately 1000 portrait prints and engravings of prominent chemists from the days of the alchemists to the present time, and the third consists of nearly 1000 books on alchemy and chemistry. In addition, there is an unusually rare collection of books and manuscripts relating to the history of the University of Pennsylvania and the lives of outstanding alumni and members of the faculty. Dr. Smith had long been interested in the life and works of Priestley, and in 1926 had deposited in the Priestley Museum at Northumberland, Pa., a collection of Priestleyana which was said to be the largest of its kind and included Priestley's balance and the original manuscript of "Priestley's Memoirs."

A JOINT expedition of the Percy Sladen Memorial Fund and the American School of Prehistoric Research (of which Prof. G. G. MacCurdy is the Director), is leaving England towards the end of this month to carry out a prehistoric survey in southern Kurdistan. The party will consist of Miss D. A. E. Garrod, Mrs. C. A. Baynes, Mr. F. Turville-Petre, and Mr. Robert Franks. The special object of the expedition is to make soundings in the numerous unexplored caves which lie near the Iraqi-Persian frontier in the neighbourhood of Sulaimanieh. It is hoped that this district, which offers a completely new field to the prehistorian, may yield important traces of palæolithic man. The prehistoric survey carried out this year for the Field Museum by Mr. Henry Field has shown that the North Arabian desert, hitherto regarded as a geographical barrier, was, on the contrary, a highway for the palæolithic tribes, and the presence of palæolithic man in north-eastern Iraq was demonstrated, in the course of a short preliminary survey which Miss Garrod made last February, by the finding of Mousterian implements in gravel-spreads near Kirkuk. These discoveries point to the caves of Kurdistan as a promising field for prehistoric work, and this fact is fully recognised by the Department of Antiquities at Baghdad, which is assisting the expedition in every possible way.

AN important new process for the production of wood pulp is now being developed. An ideal method undoubtedly is to boil the raw wood under pressure with caustic soda solution, so that the ligno-celluloses are dissolved and almost pure cellulose left as a pulp, ready for paper making, artificial silk manufacture, and so on. But hitherto the residual liquor, known as 'black lye,' has been a waste product. Dr. Erik L. Rinman, a Swedish chemist, aided by an English engineer, has now found a method of utilising this 'black lye.' The latter is evaporated down *in vacuo* to a treacle-like product, which is then carbonised at not above 750° F. in retorts, giving a whole series of valuable products, including methyl alcohol, acetone, methylethylketone, acetone oil, light tar oils, heavy tar oils, and turpentine. The residue from the retorts, known as 'soda coal,' consists essentially of sodium carbonate and free carbon, and is burnt on a special new design of mechanical stoker, which consumes more than 97 per cent of the carbon, the heat being used for steam generation, while the sodium carbonate is extracted with water and reconverted into caustic soda. A large plant on these lines is now operating under the superintendence of Dr. Rinman at Regensburg in Bavaria, with water from the Danube, turning out 600 tons of pulp a month, while extensions are being carried out to give 2000 tons a month. A British financial group is now to develop the process throughout the world in association with the original company, Aktiebolaget Cellulosa of Stockholm. A production of 1000 tons of 'Kraft' pulp is stated to result also in 25 tons of methyl alcohol, 18 tons acetone, 18 tons methylethylketone, 12 tons acetone oil, 8 tons light oil, and 50 tons heavy oils.

THE seventh session of the International Commission on Illumination is being held at Saranac Inn, N.Y., on Sept. 22–28, under the presidency of Mr. Clifford C. Paterson, Director of the Research Laboratories of the General Electric Company, Ltd., London. A tour of the principal cities of the eastern United States, organised by the Illuminating Engineering Society of New York (Sept. 7–17) and also the annual Convention of the Society at Toronto (Sept. 17–20), preceded the meeting. The British delegation is particularly strong and consists of fourteen representatives of the technical, professional, and commercial organisations interested in illumination. Twelve papers are being presented on behalf of the National Illumination Committee of Great Britain, which is responsible for the British representation at the meeting. In addition, the British National Committee, which has the secretariat responsibility for the subjects of coloured glasses for signal purposes and of daylight illumination, is presenting a report on each in collaboration with the various experts nominated by the countries which are members of the Commission. The programme includes fifty-two papers covering a wide range of subjects of importance to illuminating engineers, architects, medical officers, and students of pure science. Delegates from ten different countries are attending, and there is every prospect of a very successful meeting of the Commission under its first British president, who, together with its secretary, Dr. J. W. T. Walsh, are to be congratulated on the splendid support received from all the countries participating in the work of the Commission.

SOME time ago we mentioned in these columns the efforts of the Astronomical Society of the Pacific to cultivate public interest in astronomy by the issue of leaflets containing popularly-written and authoritative information on the latest views and discoveries of workers in this branch of science. We are pleased to learn that this practice is followed also by the New Zealand Astronomical Society, and a set of pamphlets which we have recently received testifies to the valuable work which that Society is doing in this direction. The pamphlets are mainly reprints of articles and notes on astronomical matters which have been published periodically in various New Zealand journals. They deal with such matters as the aspect of the heavens in various months of the year (in connexion with which, opportunity is taken of imparting interesting information concerning the various objects visible), freely interspersed with poems and 'reveries' inspired by the contemplation of celestial objects. The New Zealand press evidently makes ample provision for those of its readers who are interested in astronomy, and we congratulate the Society on the efforts it is making in preparing the newspaper articles and in extending their usefulness by the issue of reprints.

A HURRICANE which has caused much loss of life and damage to property passed over the West Indies a few days ago. According to the New York correspondent of the *Times*, the wind at San Juan on Sept. 13 blew for six hours at 100 miles an hour, occasionally rising to 150 miles an hour; the anemometer at the weather bureau registered 132 miles an hour before it was carried away. The storm was travelling west-north-westwards at about 300 miles a day. It reached the Florida coast between Miami and Jupiter Inlet on Sept. 16, and a wind velocity of 135 miles an hour was reported at Palm Beach. The storm traversed a belt about 80 miles wide, and considerable damage to houses, communications, and particularly to crops, is reported. The greatest loss of life seems to have been at Porto Rico, where the deaths are estimated to exceed a thousand. In NATURE of Oct. 9, 1926 (p. 524), Mr. E. V. Newnham, of the Meteorological Office, discussed the incidence of tropical cyclones, showing that they may be expected at this time of year, and reference to this article will show that the present hurricane is following the usual course of such storms.

READERS of NATURE will remember that about a year ago a discussion arose out of a review of Prof. C. Spearman's work entitled "The Abilities of Man: their Nature and Measurement" (NATURE, Aug. 6, p. 181; Nov. 12, p. 690). The subject has been carried further in two recent papers, one by Prof. Karl Pearson and Miss Moul in *Biometrika* (Dec. 1927) and the other by Prof. Spearman in the *British Journal of Psychology* (vol. 19), which those interested in the discussion are invited to consult.

A STARLING picked up in Leicester, ringed with the inscription "Museum, Göteborg, Sweden, No. 3436," has led the Leicester Museum to prepare a case illustrating long-distance flight and methods of ringing. A similar exhibit illustrating bird-migration has been installed at the Castle Museum, Norwich, where a committee is preparing a scheme for the adequate display of the fine collection of British birds in accordance with modern museum methods. Among accessions mentioned in the recent Report of the Norwich Museums Committee is a set of Eskimo weapons, garments, and domestic utensils, collected in Baffin's Land by the Rev. J. W. Bilby, who resided there for twenty-five years.

NOTICE has been issued of the forthcoming second International Conference (and Exhibition) on Light and Heat in Medicine, Surgery, and Public Health. This will be held at the University of London on Oct. 29–Nov. 1. Sessions will be held in the afternoon and evening of the first three days, and in the afternoon only of the last day. Several continental authorities are expected to take part in the discussions, among whom may be mentioned Prof. Jessinek, Dr. Nagelschmidt, and Dr. Harkamp. An exhibition of apparatus will be held in the Great Hall and the East Gallery of the University adjoining the Conference Hall; it will be open from 2.30 to 9.30 P.M. each day, closing at 6 P.M. on Nov. 1. The chair will be taken by Lieut.-Col. F. E. Fremantle, M.P., chairman of the Parliamentary Medical Committee. Those wishing to take part in the discussions should send their names to the Conference Department, *British Journal of Actinotherapy*, 17 Featherstone Buildings, London, W.C.1.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include four superintendents to the Agricultural Department, Nigeria, namely, Mr. O. J. Voelcker, Mr. G. N. K. Turnbull, Mr. J. H. Palmer, and Mr. E. W. Leach. Mr. E. S. Morgan is appointed a produce inspector to the same Department. A forest surveyor, Mr. J. Brushwood, and a veterinary officer, Mr. W. G. McKay, have been appointed to Kenya Colony. Mr. G. Cowan has been appointed superintendent to the Gold Coast Agricultural Department; Mr. H. Bruins-Lich, horticulturist, St. Helena; Mr. H. P. Smart, agricultural officer, British Honduras; Mr. E. E. Martyn, botanist and mycologist, British Guiana. Six of these appointments are of scholars selected for two years training in Great Britain and at the Imperial College of Tropical Agriculture, Trinidad, under the Colonial Office Agricultural Scholarship Scheme, whose course finished last June. Amongst the transfers notified is that of Mr. C. W. J. Line from the Gambia to the Gold Coast Agricultural Department.

THE Committee on photochemistry of the National Research Council of the United States has recently issued its first report. This consists of a collection of six papers which appeared in the *Journal of Physical Chemistry*, April 1928, together with a short introduction by H. S. Taylor. The subject is considered from both the experimental and theoretical points of view, and the authors are: H. S. Taylor, W. D. Bancroft, G. S. Forbes, H. G. De Laszlo, S. C. Lind, and L. A. Turner.

WE have received a copy of Messrs. Oertling's new catalogue of British chemical balances and weights, in which a brief outline of the history of this well-known firm from its foundation in London in 1849 to the present day is sketched. Precision instruments suitable for the finest work are now being made extensively in London by the firm, which claims to be employing only British capital and labour. Recent developments have necessitated the acquisition of a new factory, and the showrooms have been removed to 65 Holborn Viaduct, London, E.C.1, where the latest models may be inspected. The list includes balances suitable for use in schools and colleges, and also more elaborate instruments for research laboratories and factories. Special features are the precision torsion-balance, designed for the rapid weighing of very light objects up to 500 milligrams in weight with a sensitivity of 1 milligram, a micro-chemical balance with a concave cylindrical reflector for magnifying the fine divisions on the index, a flour-moisture tester and the 'chainomatic' balance, which has a capacity of 200 grams and a sensitivity of 0·1 milligram, although riders and fractional weights below 0·1 gram are not required. The prices compare favourably with those of continental makes.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A reader in physics in the University of Dacca (East Bengal, India)—The Registrar, University of Dacca, East Bengal (Sept. 30). A male senior lecturer in education at the Rhodes University College, Grahamstown —The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Sept. 30). An assistant lecturer in education at the University College of Swansea—The Registrar, University College, Swansea (Oct. 1). A lecturer in dental prothesis and orthodontics in the Dental School, Cairo—The Dean of the Faculty of Medicine, Kasr-el-Ainy, Cairo (Oct. 3). A physicist with electrical engineering experience, under the directorate of radiological research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An advisory entomologist in the West Midland Province of Shropshire, Staffordshire, and Warwickshire, at the Harper Adams Agricultural College, Newport, Shropshire—The Principal, Harper Adams Agricultural College, Newport, Shropshire. A temporary architectural and civil engineering assistant at H.M. Dockyard, Rosyth—The Superintending Civil Engineer, H.M. Dockyard, Rosyth. A lecturer in zoology and botany at the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham.

Our Astronomical Column.

CONJUNCTION OF URANUS AND A STAR.—On the night of Sept. 23, Uranus will make a very near approach to a small star of the sixth magnitude in the constellation Pisces. The two objects will appear in a telescope as a double star of faint and nearly equal magnitude. It will be interesting to find if they can be distinctly seen and separated by the unaided eye. An opera or field glass will show them well, and will exhibit their changes of position on succeeding nights due to the motion of the planet. The latter will pass the star on its southern side, its motion being from east-north-east to west-south-west.

The objects may be readily identified though they occupy a position in a decidedly barren region of the sky. If a line is drawn southwards from Sirrah to Algenib, the two bright stars forming the eastern side of the "Great Square of Pegasus," at about the same distance as that separating the two stars, the planet Uranus and the star 44 Piscium will be found a little to the south-east of the end of this line. The objects will be just visible to the naked eye on a dark moonless night, but whether they may be individually discerned is a little uncertain, as a good deal must depend upon the observer's vision and the state of the atmosphere. The gibbous moon will set on the night following Sept. 23 at midnight.

A RECENT LARGE SUNSPOT.—A large group of sunspots which showed considerable changes from day to day has recently been under observation. The group, which was of the stream type, did not develop in the usual manner, and on Sept. 11 several irregularly shaped spots composing the train became nearly linked up with the leader, thus almost completing one big composite spot. As indicated by changes directly observable within some hours, the group was active spectroscopically. Mr. Newbegin, using a spectroscope of the Littrow type which he has added to his private observatory at Worthing, noted Doppler displacements of the *C*-line of hydrogen on Sept. 11, and later a bright reversal of this line was seen. A magnetic disturbance might reasonably have been expected about Sept. 13, but although the Greenwich magnetograph traces were somewhat disturbed for a few days about this time, no pronounced disturbance was registered. This group of spots, together with another large one seen six weeks ago, continues the list of naked-eye spots given in NATURE of July 28 (p. 142).

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
6	July 27–Aug. 6	July 31·8	14° N.	1/1000
7	Sept. 6–18	Sept. 12·7	14° N.	1/1000

Areas are expressed as proportion of sun's hemisphere covered.

METEOR OF SEPT. 9.—Mr. W. F. Denning, 44 Egerton Road, Bristol, informs us that a bright meteor was observed by Mr. R. Kingman at Bristol on Sept. 9, at $8^h\ 35^m$ G.M.T. It passed almost vertically through Ophiuchus along a path of about 27° from $270° + 24°$ to $261° - 2°$. The meteor was about as bright as Venus, and it gave a flash at the end which illuminated the southern sky. The motion was swift and the flight of the object seemed directed from a radiant at $290° + 52°$ in Cygnus, which is well known as supplying many meteors in August and September. A duplicate observation would be valuable and enable the radiant to be ascertained with certainty, as well as the height and velocity of the object.

Research Items.

RELIGION IN SZECHUAN, CHINA.—No. 1 of vol. 80 of the *Smithsonian Miscellaneous Collections* is a study of Chinese religion in Szechuan Province by Mr. David C. Graham, who points out that this area provides an excellent ground for the study not only of the religious beliefs of the Chinese themselves, but also of those of the aborigines. In the family, which is the social unit, and not the individual, the ancestors are a part, and the most honoured part. The ceremonies of their cult can only be performed by the eldest son. Hence, not only are sons desired, but also every means taken to protect them from harm. The conception of a multiple soul makes it possible to commemorate the dead person at the tablet and the grave, while the soul, or one part of it, may also reside in the underworld. At death every effort is made to entice the soul to return and take up its abode in the ancestral tablet. In the popular religion the conception of *mana* is the primary key to understanding. Demons, the spirits of the dead who for some reason are not at peace, play a large part in the lives of the people and are the cause of all diseases and other calamities. Both gods and charms protect from their influence. The element of luck creates and maintains a belief in a mysterious potency, producing belief in lucky and unlucky days and being responsible for a number of superstitious practices. The organised religion is so arranged as to arouse the feeling of awe and loyalty by its large temples situated on hills, and the imposing character of the great deities with their robes and their retinues of priests and their festivals. This feeling reflects the attitude towards and the practices connected with their one-time temporal rulers. Notwithstanding the spread of democratic ideas, to which anything connected with royalty is abhorrent, this aspect of religion remains unchanged.

THE HAVASUPAI.—In a detailed study of the Havasupai, a small and obscure group of Yuman-speaking Indians living near the Grand Canyon in north central Arizona (*Anthrop. Papers, American Museum Nat. Hist.*, vol. 24, pt. 3), Mr. Leslie Spier points out that much of their old life is still open to observation, social life, religion, art, and—only to a less extent—material culture being practically intact. Yet they have been little studied. They are closely related in speech to the neighbouring Walapai, with whom they intermarry. Members of each tribe commonly live with the other. In 1919 they numbered 177; the limitations of the cultivable area make it improbable that at any time did they number more than three hundred. They are seasonal migrants. In the spring and summer they live in villages along the canyon, cultivating the fields; in winter they live on the plateau in the cedar thickets, existing on the corn saved from the harvest, and seeds and nuts, as well as by hunting. An abundant harvest is marked by wide-spread invitations to Walapai, Hopi, and Navajo to the harvest feast and dance. Marriage is normally monogamous and forbidden between blood-kin. This tie, however, is not recognised beyond the grandparents. The basis of their life is the family; there are no indications of the existence of clans or gentes at any time. The unit family lies within a larger group of family relations—those of the husband's or wife's parents; a grouping based upon the inheritance of land and a temporary matrilocal residence. The larger groupings have been intensified by a shortage of competent marriageable women. Hence men and children have often been compelled to rely upon the services of a female relative. There are six chiefs, of whom one is recognised as head. Men may become chiefs through inheritance, prestige, or ability. The chieftainship, however, is emphatically not a position, but the embodiment of certain functions. A woman may not become a chief.

THE POISON OF THE STONE FISH.—Various opinions have been expressed as to the situation of the poison glands of the spines of the stone fish (*Synanecja horrida*). Dr. J. V. Duhig and Gwen Jones have summarised the literature, investigated the problem, and carried out experiments on the effects of the poison (*Mem. Queensland Mus.*, vol. 9, part 2, 1928). The poison is secreted in sacs upon the dorsal spine. Venom from a single fish was emulsified in normal saline solution so as to give a dilution of 1 in 10. Of this emulsion 0·1 c.c. injected beneath the skin of a guinea-pig, produced a toxic action on the voluntary and involuntary muscles, so that in the course of an hour respirations became slow and shallow, and all the limbs became paralysed. After 8½ hours the most marked of the symptoms had passed off. As well as producing these, probably neurotoxic reactions, the poison has a lytic action on the red blood cells. Recovery from the gross effects of the venom conveyed some degree of active immunity. The authors give full clinical notes on a case where a man trod on a stone fish, the spine of which penetrated the sole of his foot. They are inclined to attribute a marked respiratory failure of the patient a fortnight later to the effects of the venom.

THE FLOCK PIGEON OF AUSTRALIA.—Australian ornithologists are exercised by the rapid disappearance of the flock pigeon (*Histriophaps histrionica*), the history of which threatens to repeat that of the American passenger pigeon. During the nineteenth century many observers recorded enormous flocks of these birds even up to two miles in length, and so late as 1901 they were seen in Western Australia in "countless myriads." Since then their numbers have unaccountably dwindled. They are unknown throughout the country where the two miles flock was seen in the 'sixties of last century, and extensive inquiries made by F. L. Berney (*Mem. Queensland Mus.*, vol. 9, part 2; 1928) show that in most places where they were once common they are either absent or are represented by but a few individuals. From Queensland only comes a recent record (February 1928) of considerable numbers, a flock of four or five hundred having appeared in the Flinders River basin. There has undoubtedly been an extraordinary decrease during the past twenty-five years, and this cannot be attributed to the spread of farming or to actual destruction by man. But the flock pigeon, unlike the passenger pigeon, is a ground nesting and ground feeding bird, and we suggest that the cause of the decrease may be looked for in the increase of ground vermin, particularly the small carnivores which have been introduced by earlier settlers. In other lands, and especially in islands, ground nesters have been the first to disappear under the pressure of animals thus introduced.

AMERICAN ROTIFERS.—In continuing their work on American rotifers, H. K. Harring and F. J. Myers ("The Rotifer Fauna of Wisconsin. IV. The Dicranophorinæ." *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, vol. 23, January 1928) occupy themselves with the large family Notommatidæ. The family is divided into two sub-families, the Notommatinæ, which are plant and detritus feeders, and the Dicranophorinæ, which are carnivorous. So large is the group that the authors state that they can visit old favourite collecting grounds regularly and still bring back new species. The distribution apparently depends to a large extent on the hydrogen ion concentration of the water, some species living under very acid conditions, others preferring alkaline surroundings; the range of hydrogen ion concentration for individual species, however, appears to be quite narrow. Among the Notommatinæ are some green forms belonging to the new genus *Itura*, which shelter symbiotic zoochlorellæ and have no gastric glands. The Dicranophorinæ have the mastax or pharyngeal mill specialised into forceps for capturing their prey, and the rest of the apparatus is very slender, the various differences being important in classification. Careful figures are given of the whole animal and mastax of more than seventy species, most of which belong to the genus *Dicranophorus*.

Sagitta FROM THE NORTH SEA AND BALTIC.—A recent issue of "Die Tierwelt der Nord- und Ostsee" (Lieferung XI, Teil VII*b*; Akademische Verlagsgesellschaft m.b.H., Leipzig) contains amongst other groups the Chætognatha by W. Kuhl. There has been much controversy as to the distribution of *Sagitta bipunctata*, which, although still recorded for the North Sea by many workers, is not admitted by the author into the area covered. The policy of Ritter Zahony in restricting the species is strictly followed, and those forms hitherto regarded as *S. bipunctata* are put down to either *S. setosa* or *S. elegans*. Only three species of *Sagitta* are allowed in this work from the North Sea and Baltic, *S. setosa*, *S. elegans* (with the tree forms *elegans*, *arctica*, and *baltica*), and *S. maxima*, together with one species of *Eukrohnia*, *E. hamata*. Thus *Spadella* (*S. cephaloptera*), which is common in the neighbourhood of Plymouth, and probably is to be found in other parts of the Channel near the coast, is not recorded. The Chætognatha occur in enormous numbers in the plankton, and are interesting in their habits, being extraordinarily voracious and feeding on almost any planktonic animals available. As their food includes young fishes, especially the newly hatched herring, *Sagitta* is of practical economic importance as an enemy besides being useful as valuable food for the larger animals. The plankton-eating fishes and many cœlenterates, including medusæ and ctenophores, devour huge quantities of *Sagitta*, which, as is to be expected, act as intermediate hosts for a variety of parasites duly noted in the present work, the adult hosts usually being fishes which have eaten the *Sagitta*.

METAXENIA IN THE DATE PALM.—The problem of metaxenia (*i.e.* the direct effects of pollen on the parts of the seed and fruit lying outside the embryo and endosperm) has been investigated in the case of the date palm *Phœnix dactylifera* by W. T. Swingle of the U.S. Dept. of Agriculture (*Journal of Heredity*, vol. 19, No. 6). In this particular case, the pollen has been found to exert a direct influence on the size, shape, and colour of the seed, on the size of the fruit, on the speed of development of the fruit, and on the time of ripening of the fruits of the vegetatively propagated female varieties. This direct influence of the male parent is precise and definite, and varies with the particular males used to fertilise the female flowers, each male exerting the same effects on fruits of all varieties and producing the same result in different years. Metaxenia, unlike xenia, cannot be explained by hereditary elements or chromosomes brought in by the pollen, as no such chromosomes occur in the tissues that show the direct effect of the pollen parent. Swingle thinks that the simplest and most probable theory is that the embryo or endosperm or both secrete "hormones or soluble substances analogous to them," which diffuse out into the tissues of the mother plant that constitute part of the seed and fruit, and exert on these tissues a specific effect varying according to the particular male parent used. Evidence is adduced to show that the embryo and endosperm of the date show remarkable chemical activities during their development, and interact to some extent on each other, and probably on the near-by tissues of the seed and the surrounding ovary walls that constitute the fruit. In support of his theory Swingle mentions the 'growth stuff' found at the very tip of the coleoptile in germinating grasses according to Boysen-Jensen and Paál, and also describes some recent work on similar lines by F. W. Went.

FOSSIL MOLLUSCA FROM THE GALAPAGOS ISLANDS.—Some of the scientific results obtained by the expedition from the California Academy of Sciences to the Galapagos Islands in 1905–6 are now, after much delay, seeing light. One of the most important was the discovery by Mr. Ochsner of fossiliferous strata where hitherto only volcanic rocks were supposed to exist. A brief preliminary note on these by Dr. W. H. Dall was published in 1924 (*Geol. Mag.*, Oct. 1924), and now, both Dr. Dall and Mr. Ochsner having died early in 1927, the final preparation of their manuscript has been undertaken by Dr. G. Dallas Hanna (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 17). The deposits contain marine shells, and occur on three of the islands. That on Albemarle Island is believed to be of Pleistocene age; those on Indefatigable and Seymour Islands are thought to be of Pliocene age. From Albemarle 48 species were collected, of which 32 are still living in the Panamic fauna. On Indefatigable Island 68 species were found, of which 27 are still living and 23 apparently new, while Seymour Island yielded 9 species, of which two are living and 5 appear to be new. The characteristics of these fossils are typically American, but while most of the species belong to groups now represented in the Panamic fauna, there are a few which recall forms existing only on the Antillean side, and quite a number which belong rather to the subdivision of the Panamic fauna present in the Gulf of California, than to the warmer waters of the Gulf of Panama. The possible inference is that the Galapagos fossils were living in seas somewhat cooler than those at present surrounding the islands. Sketch maps of the islands, showing the localities of the deposits, with check lists of the fossils and full descriptions of the new species drawn up by Dr. Dall are given. Five plates from photographs taken by Dr. Hanna illustrate the paper, while portraits of the two authors are appended.

STRUCTURE CONTOUR MAPS OF OILPOOLS.—Those whose technical interests compel constant reference to such bulletins of the United States Geological Survey as are devoted to oilfield development can never fail to be impressed with the clarity and excellence of the structure contour maps provided, and with their real value in aiding visualisation of the attitude of underground oilpools. In Great Britain, the structure contour map is by no means as prominent in geological publications as it might be, though there are notable exceptions, especially in the coalfield regions. The usual criticisms levelled at American structure maps are that they tend to be geometrical and rather artificial, being, in fact, generalisations of supposed structures based on restricted well-data, hence often only true at certain precise points. This element of uncertainty is not in itself a vitiation of the data portrayed, nor reason for passing over with scanty glance these interesting supplements to the literature. American oil geology, especially where it concerns the mid-continent and Rocky Mountain regions, lends itself directly to representation by means of structure contour maps, largely owing to the comparatively simple nature of the structures involved. One has only to mention such examples as the Cushing Oilfield, Oklahoma (*Bulletin* 658) and the Midway-Sunset field, California (*Prof. Paper* No. 116), to give point to these remarks, while the small publication on the oil and gas prospects of North Eastern Colorado (*Bulletin* 796-B), recently issued, contains one such map (plate 17), which, however artificial it may or may not be, serves to illustrate structural types and renders detailed perusal of the text unnecessary: this in itself may often be sufficient reason for blessing an organisation which possesses both knowledgeable enterprise and financial backing to publish periodically such useful contributions to science.

FIREDAMP EXPLOSIONS.—Safety in Mines Research Board Paper No. 42 (H.M.S.O. 6*d.* net) entitled "Firedamp Explosions. The Projection of Flame," by M. J. Burgess, is a continuation of a previous paper (No. 27). This recorded laboratory experiments, the conclusions of which have now been confirmed by tests on the experimental gallery 7½ ft. in diameter, installed at the Board's research station at Buxton. It was shown that even with a weak mixture containing 6·3 per cent only of methane, the flame produced on its explosion was projected 60 ft. into the pure air of the gallery, or more than twice the length of the column of gas mixture exploded. With richer mixtures the flame was projected further, the maximum being 4·5 times the length of the column of mixture containing 10·5 per cent of methane. When constrictions were left between the gas mixture and the air, the effects were more destructive. The results show that the flame of a firedamp explosion may be projected a considerable distance beyond the confines of the original mixture.

THE STRUCTURE OF FORMALDEHYDE.—A very complete description of the formaldehyde molecule is given by Prof. V. Henri and S. A. Schou in the issue of the *Zeitschrift für Physik* for July 26 (pp. 774-826), the data being obtained by applying the usual methods of analysis of molecular spectra to the absorption bands of the vapour in the ultra-violet. The molecule is Y-shaped, with the carbon atom at its centre, and the two hydrogen atoms placed symmetrically on opposite sides of the produced oxygen–carbon axis, its principal dimensions being H–H, 1·4 A.; C–O, 1·1 A.; and C–H, 1·3 A. It has two sets of vibration frequencies, corresponding to the natural frequencies of carbon monoxide and hydrogen, whilst since the observed electronic transitions are triple, there are probably four molecular valence electrons present, and the fundamental term is $3\,^3P$. Numerous other relations have also been found amongst the energy levels of formaldehyde itself, and between these and the levels of other atoms and molecules, but probably the most important consequence of the discussion of these is the prediction and discovery of a new absorption band of carbon monoxide near 2060 A. which is related to the Cameron emission bands. An incidental point of some interest which has emerged in connexion with the properties of formaldehyde in solution is that its absorption spectrum in hexane is similar to that of the vapour, whilst that in water is of a totally different character.

SOLUTIONS IN PURE ACETIC ACID.—Some preliminary experiments on the solubilities and chemical reactions of salts in pure acetic acid are described by A. W. Davidson in the *Journal of the American Chemical Society* for July. The results so far obtained show that many salts, such as calcium chloride or barium iodide, are readily soluble in acetic acid, and that double decomposition reactions take place as readily in this solvent as in water. Thus, silver chloride is precipitated from a solution of silver nitrate in acetic acid by the addition of sodium chloride. In some cases, however, the course of the reaction was found to be less familiar; for example, the addition of a drop of anhydrous sulphuric acid to the solution of any inorganic salt in acetic acid causes the precipitation of the corresponding sulphate. Even the sulphates of the alkali metals behave in this way, and sulphates, such as cupric sulphate, which normally form hydrates, separate in the anhydrous form even when some water is present. It is interesting to note that sulphates are also insoluble in liquid ammonia. The behaviour of many acetates in acetic acid closely resembles that of the corresponding hydroxides in water.

STRUCTURE OF MERCERISED CELLULOSE.—Mercerised cellulose gives a diffraction pattern with X-rays which is somewhat different from that of untreated cellulose, and from an examination of X-ray data obtained from mercerised ramie fibres, O. L. Sponsler and W. H. Dore have developed a space lattice for this material. Their paper, which appeared in the *Journal of the American Chemical Society* for July, also contains suggestions as to the probable mechanism of mercerisation. Untreated ramie cellulose appears to be built up of parallel chains of glucose units running lengthwise in the fibre, and the action of sodium hydroxide seems to cause a lateral shift of these chains in the wall of the fibre together with a partial rotation of the alternate glucose units in each chain. The hydroxyl group attached to each sixth carbon atom also appears to change its position. Sponsler and Dore conclude that mercerisation is not a progressive change dependent upon the concentration of the alkali solution as suggested by Herzog, but they consider that there is a critical concentration (about 13 per cent for sodium hydroxide) below which a permanent change does not occur. Their results also tend to support the view that the units of cellulose are connected in chains by primary rather than by secondary valence linkages.

PURE PHOSPHORUS TRIOXIDE.—The *Journal of the Chemical Society* for July contains an account by Christina C. Miller on the preparation and properties of pure phosphorus trioxide. Many attempts have been made to connect the glow of ordinary phosphorus trioxide with that of phosphorus, but it now appears that the luminescence of the oxide is due to the presence of dissolved phosphorus. The latter may be removed by low temperature recrystallisations followed by exposure to light and subsequent separation from the red product by volatilisation. The pure trioxide is a transparent, crystalline solid free from the waxy, opaque appearance of the impure substance, and melting at 23·8°, whereas the oxide prepared in the usual way melts at 22·4°. The pure substance neither glows nor oxidises in moist or dry oxygen, but when heated to 200° in a sealed tube with dry oxygen at 300 mm. pressure, a faint glow was observed. It dissolves phosphorus in small quantities and then regains all the properties generally ascribed to it.

The Fourth International Congress of Entomology.

THE fourth International Congress of Entomology, held at Ithaca, New York, on Aug. 12–18, was much more largely attended than any of the previous congresses of entomology. More than 650 delegates and associates were registered, and 36 different countries were represented. Unlike the Zurich congress of 1925, France, Italy, and Belgium sent official delegates. In all, more than one hundred persons came from foreign countries. The largest foreign delegations were those of England, France, Spain, Germany, and Russia. Very many Canadian entomologists were present, and Canada really joined with the United States in welcoming to North America the delegates from other parts of the world.

Ithaca proved to be an ideal place for the Congress. The buildings of Cornell University are admirably adapted to such gatherings; the summer climate is a good one; the so-called Finger Lake region of New York is one of great interest to naturalists, and the scenic beauty of that part of the State is very great. Since Cornell had experienced the organisation work for an international congress two years ago, when the botanists met there, every need was anticipated, and the delegates from abroad expressed themselves as greatly pleased by all of the arrangements and by the courtesy and hospitality shown by the people.

Many of the older European entomologists were absent. Lameere, of Belgium, the president of the first Congress, held at Brussels in 1909; Poulton, of England, president of the second Congress, held at Oxford in 1912; Handlirsch, of Austria, who would have been president of the Congress at Vienna in 1915 had it not been abandoned on account of the War; and von Schulthess, of Switzerland, president of the third Congress, held at Zurich in 1925, were all regrettably absent. But a large number of younger men were present, all of them being well known by their admirable published work.

Many notable papers were read at the morning general sessions. The speakers at these sessions were: René Jeannel of Paris, Karl Jordan of England, Ivar Tragardh of Sweden, E. L. Bouvier of Paris, Erich Martini of Hamburg, Walther Horn of Berlin, Filippo Silvestri of Italy, W. M. Wheeler of Harvard, W. J. Holland of Pittsburgh, M. N. Rimski-Korsakov of Leningrad, H. C. Efflatoun of Egypt, E. P. Felt of Connecticut, C. L. Marlatt of Washington, F. Heikertinger of Vienna, R. J. Tillyard of Australia, and A. D. Imms of Rothamsted.

The sectional meetings, which were held during the afternoons, carried out very full programmes. There were so many entomologists present who were interested in the economic phases of the science that it was necessary to establish several sub-sections under the Section of Economic Entomology. I was not able to attend any of the sectional meetings, but, judging from what I have heard, there was a very important forum on nomenclature, which was led by Dr. Stiles, the secretary of the International Commission on Zoological Nomenclature. Mr. J. E. Collin, president of the Entomological Society of London, advanced a protest against the use of abbreviations in descriptions, which excited much discussion, although the delegates nearly unanimously supported the speaker. Mr. F. W. Edwards, of the British Museum (Natural History), gave a most interesting account of his recent expedition to Patagonia, in which he brought out many points bearing upon the theory of a past land connexion between South America and Australia. Dr. Walther Horn's paper on the future of insect taxonomy was rather pessimistic, but proposed the formation of an international institute to form a clearing-house for entomological information.

In the forum on problems of taxonomy there was an active discussion of the question as to whether types should be deposited in one or two large museums or distributed in regional museums. An important paper on some effects of temperature and moisture upon the activities of grasshoppers and their relation to grasshopper damage and control was read by Dr. J. R. Parker of Montana; and J. W. McColloch and W. P. Hayes of Kansas discussed the problem of controlling underground insect pests. Dr. W. J. Baerg of Arkansas reported upon the general subject of the poisonous Arthropods of North and Central America in a paper which shed great light upon this much discussed subject. A. d'Orchymont of Brussels, P. Vayssière of Paris, J. P. Kryger of Denmark and Dr. James Waterston of the British Museum, read excellent papers in the Section of Systematic Entomology and Zoogeography. The Section of Forest Insects was fortunate in hearing papers from the well-known forest entomologists, Unio Salas of Finland, H. Eidman of Munich, and I. Tragardh of Sweden. The latter's paper on "Some Methods of analysing the Fauna of a Dying Tree" was of great value.

In fact, the whole programme was filled with interesting papers and discussions which would have interested the readers of Nature greatly, and I am sorry that more space cannot be devoted to them.

I am sorry also, although I highly appreciate his courtesy, that the Editor of Nature did not invite a European, instead of me, to write this account, since were I to emphasise many of the delightful features of the Congress, it would appear like the boasting of a prejudiced American. Expeditions in groups were made to Niagara Falls, to many of the picturesque spots of central New York, to Pittsburgh, Philadelphia, Washington, New York, and Boston, and a number of the delegates took long journeys into the far west. The members of the Congress greatly regretted the absence of R. Stewart MacDougall, of Edinburgh, who wrote for Nature the delightful account of the Congress in Zurich in 1925, in which he played a very important part.

The European visitors were received, on landing at New York, by a committee composed of members of the New York and Brooklyn Entomological Societies and were given a formal dinner at the American Museum of Natural History. Those landing from the first vessel were taken on expeditions up the Hudson River and to various neighbouring points of interest.

After the Congress, a large party of delegates was received at the Carnegie Museum of Pittsburgh and given a formal dinner by Dr. W. J. Holland, the emeritus Director of the Museum. At Washington a special meeting of the Entomological Society of Washington was held which was attended by more than 200 entomologists. This meeting resolved itself into an intimate discussion of the entomological societies of the world, of their methods of procedure, and of the conditions of entomological science as represented by these widely spread organisations. At Washington also, in addition to visits to the U.S. National Museum, the U.S. Department of Agriculture, and places of historic interest, a reception and supper were given at the National Zoological Park, and a special expedition was taken to Plummers Island, a spot in the Potomac River north-west of Washington rather renowned for its interesting insect fauna, since here a remarkable mixture of southern and northern forms occurs. Following these Washington meetings the delegates dispersed, many of them returning to New York for embarkation, others visiting other parts of the country. The well-known authorities on cave insects, Dr. René Jeannel of Paris and Dr. Candido Bolívar of Madrid, started for an exploration of the great caves of Indiana and Virginia in company with Mr. Herbert Barber and Dr. Harold Morrison of the U.S. National Museum.

I should not, perhaps, write of the address of the president of the Congress at Ithaca, since I held that office myself, but that the principal theme of the address was the necessity for a reform in the teaching of zoology in the colleges and universities, so that entomology should receive vastly greater attention.

As it happened, the fourth day of the meeting coincided with the eightieth birthday of Dr. W. J. Holland. A dinner was given him by some of his scientific friends and admirers, and he was elected one of the fifteen honorary members of the International Congresses. Dr. S. A. Forbes, the dean of the economic entomologists of the United States, now eighty-four years of age, was also made an honorary member. The Congress also adopted resolutions of sympathy and respect addressed to Prof. J. H. Comstock of Cornell (aged seventy-nine) and Dr. E. A. Schwarz of Washington (aged eighty-three).

Other resolutions were passed by the Congress. By far the most important step taken in regard to entomological nomenclature was a resolution by the Congress conferring upon the Committee of Nomenclature of the Entomological Congress judiciary powers to hand down opinions on cases of entomological nomenclature in accord with the International Rules of Zoological Nomenclature. It is understood that the entomological committee and the International Commission will co-operate; that in the future the Committee will handle most of the cases of entomological nomenclature and will refer to the International Commission only those cases involving pronounced differences of opinion, or undetermined principles, or the relations of nomenclature in entomology to nomenclature in other groups.

The Congress also adopted certain definite recommendations regarding family names, these recommendations to be referred to the International Commission with approval; and it referred certain other proportions to the Commission without prejudice.

I have attended fourteen international congresses of scientific men, and I have never seen at any of them such great enthusiasm and so obvious a spirit of hearty co-operation. Surely mutual understanding among the scientific men of the world is fostered greatly by these gatherings and makes for world peace.

L. O. HOWARD.

The Fisheries of Australia.

A RECENT statement from the Australian Development and Migration Commission throws light on the interesting position of the fishing industry in Australian waters.

The history of this industry shows a succession of failures to establish what should be a thriving part of Australian life. In 1907 the Commonwealth Government appointed a director of fisheries and provided a research trawling vessel, the *Endeavour*, to investigate the possibilities of trawling in the southern seas. After a number of experimental cruises, during which it was established that valuable fishing grounds existed in the Australian Bight and off Cape Howe, the *Endeavour* was lost at sea with all hands, including the Director of Fisheries, in December 1914. The trawler was not replaced, and little further was done by the Commonwealth Department of Fisheries.

In 1915 the New South Wales Government decided to establish a State trawling industry with seven steam trawlers as the nucleus of a trawling fleet. Despite the fact that some of the richest trawling areas in the world, namely, those extending southwards from Port Stephens to Gabo Island, were revealed by the operations of the State trawlers, the venture was not a commercial success, and in 1923 the trawlers were disposed of to a number of private companies. These companies have since successfully exploited the Sydney and Newcastle fish markets and show signs of extending their fields of operation. Queensland also undertook State trawling in 1919, and good trawling areas were located between Cape Moreton and Caloundra. In other States, however, the fishing industry has failed to develop to the degree shown possible by fish imports. It is an anomaly, indeed, that a nation which imports annually fish valued at more than £1,500,000, and has an adequate supply of good edible fish around its coast, should fail to exploit such excellent natural resources.

This feature has been clearly realised by the Development and Migration Commission, which deals with the development of industry within the Commonwealth, as a prior necessity for increased migration.

At the instance of the Commission, the first Australian Fisheries Conference was held in September 1927. This was attended by representatives of the Commission, of the Commonwealth Council for Scientific and Industrial Research, and of the departments of fisheries of the various Australian States. It was decided that a complete programme of development must include not only trawling and related industries, but also studies of transport, distribution, and marketing of fish, of uniform laws and regulations affecting the capture of fish, and of factors of destruction in fisheries. The establishment of marine biological stations and the cultivation of oysters, crayfish, and turtles were also considered. After a thorough discussion of the position in each of these branches, committees were appointed to go fully into each subject and to make recommendations to the second Australian Fisheries Conference, which is to be held during this year.

The field borders, on one side, those questions in marine biology to be studied by the British Association Expedition to the Great Barrier Reef, and on the other, economic investigations of trawling and the difficult problems of transport and distribution.

These terms of reference are clearly very wide and, in the present inquiries, close attention is being given to the mass of knowledge and experience which has been accumulated in European and American fisheries. While much of the data from these sources is capable of direct application to Australian conditions, there are numerous scientific and commercial problems which are peculiar to the southern waters.

Refrigeration applied to fish taken from Australian sea waters does not always give the same satisfactory results as when fish from colder and less saline waters are treated. Thus, although Atlantic salmon may be satisfactorily stored in a frozen state for up to two years, it has been stated that the Australian flat head becomes practically worthless after removal from a few months of cold storage. The reason for this difference is not clear, but it appears to be partly dependent on marine temperature and salinity. In this case there is scope for useful research to determine the proper relations between temperature and salinity of sea-water and the best conditions for refrigeration of fish taken therefrom.

At the Conference held last year, the need for extending the pioneering researches on fishing grounds carried out by the *Endeavour* was considered in relation to the establishment of marine biological stations. It is a regrettable fact that there is an almost entire absence of trustworthy information about the seasonal migrations of the native fishes, their spawning habits and life histories, their growth-rate and ecology generally. As a result of the Conference, it now seems likely that in addition to a research trawling unit being provided at an early date there will be a vigorous advance, backed by the universities within the Commonwealth, on the marine biological problems in Australian waters. The visit of the present British Association Expedition to the Great Barrier Reef will undoubtedly have a stimulating influence in this direction.

Transport and distribution of fish in such an area as the south-eastern portion of Australia present perhaps the greatest hindrance to the rapid development of the fishery industry. Briefly, the problem is to develop that measure of co-operative organisation between fishery concerns, transportation agencies, and marketing bodies necessary for rapid and economic distribution from the three large centres of population —Sydney, Melbourne, and Adelaide—to the sparsely populated country districts. It is rightly felt that in Australia, until the problem of distribution is solved, research directed towards the increase of supplies is premature.

Governmental participation in industrial affairs nowadays trends rather to the removal of those factors hindering developments than towards State trading. It is in this spirit that the two Commonwealth Government departments—the Development and Migration Commission and the Commonwealth Council for Scientific and Industrial Research—are co-operating with State authorities to bring the light to economic and scientific problems affecting fishery developments in Australian waters and to point the way to their solution. A. S. F.

Royal Photographic Society's Exhibition.

THE annual exhibition of the Royal Photographic Society is now open at 35 Russell Square, and admission is free. It closes on Oct. 13. We are glad to see that our oft-repeated desire that in the scientific and technical division the general appearance of the exhibits should be considered as secondary to their classification is this year acted upon to a certain extent, and to that extent the work of the student examining them is facilitated. What is now needed are a few cross-references in the case of exhibits that might belong to more than one section. For example, under the heading "Spectrography" there is only one item, but it would be entirely wrong to suppose that this is the only example of spectrographic work.

The Astronomer Royal has sent a photograph that shows the relative intensity of the principal doublet in the violet (H, K) and the diffuse doublet in the infra-red of the calcium chromospheres. The photograph was taken with a diffraction grating in the reflecting spectrograph with the slit tangential to the edge of the lens. The infra-red is of the first order and the violet of the second order, and they were photographed simultaneously, using light filters to exclude overlapping spectra. The 'astra' light filter is a new filter by Ilford, Limited, for use when photographs are taken with visually corrected refracting telescopes. It eliminates the secondary spectrum to a very considerable extent. Mr. A. Coleman demonstrates the advantages of this filter by photographs taken with and without it. Ten examples of Zeeman effects (the effect of a magnetic field on lines of the spectrum) are shown by Mr. A. S. M. Symons of the Imperial College of Science. Messrs. Green and Freeman show a series of Fabry and Perot interferometer fringes.

Of the numerous examples of photomicrography, the most notable are of slowly cooled steel by Col. N. T. Belaiew at magnifications of 200 and 2000, which illustrate the deformation of crystals of cementite under the influence of internal stresses due to an allotropic transformation in the matrix. Other interesting points with regard to the nature of these crystals are clearly shown. Dr. G. H. Rodman has two series of nearly thirty each, showing the life history and structure of the greenhouse white fly and of *Zygina* (*Erythroneura*) *parvula* respectively, the latter being a pest that has lately become very prevalent at Kew and in greenhouses round London. Each is accompanied with rather long descriptive and explanatory notes.

The present possibilities of the photography of bullets in flight are well shown by Mr. Philip P. Quayle of Ohio. Spark photographs of the firing of a 0·30-calibre Springfield show the state of affairs (1) as the bullet emerges from the muzzle, (2) when the bullet has travelled about 6 inches, and (3) when it is about 18 inches from the muzzle. Similar photographs of the firing of a 12 gauge Winchester shot gun, full choke, show the charge as it leaves the muzzle and at distances from it of 4 inches and 12 inches and at 11 yards.

Some fine examples of X-ray photography are contributed by Kodak, Limited; Ilford, Limited; and Dr. J. H. Mather. Kinematography, photography in colours, photography from the air, telephotography, and practically every branch of photography are well illustrated in the exhibition.

The trade section of examples and apparatus seems to be rather larger than usual, a good deal of the apparatus being designed specially for scientific work. A light of standard quality for testing photographic negative materials is contributed by The British Photographic Research Association. This exhibit comprises a standard lamp, and a colour filter as worked out by Messrs. R. Davis and K. S. Gibson, of the Bureau of Standards, Washington, to make the light similar to ordinary average daylight.

University and Educational Intelligence.

LEEDS.—The foundation-stone of the new buildings will be laid by the Duchess of Devonshire on Oct. 2. After the ceremony a congregation will be held in the Great Hall of the University to confer the honorary degree of Doctor of Laws on Her Grace, Sir. A. E. Bain, Mr. Alexander Campbell, and Mr. Morton Latham.

WE have received from the Bradford Technical College a prospectus of diploma and special day courses for 1928–29, including three- and four-year diploma courses in textile industries, chemistry, dyeing, civil, mechanical, and electrical engineering, physics, and biology. Special courses in advanced study and in training in the methods of research, special courses involving full-time attendance during one or two years, and part-time day courses are also offered. The relations of the College with industrial firms have of late been extensively developed by the arrangement of visits to local chemical and dyeing works.

Calendar of Customs and Festivals.

September 27.

St. Cosmas and St. Damian, who are said to have been beheaded under Diocletian in Italy, have appropriated the cult of a deity connected with fertility. Sir William Hamilton, ambassador to the court of Naples at the end of the eighteenth century, recorded that at the church of St. Isernia it was the custom of Italian women to make votive offerings of phallic character to these saints to secure children. They are in particular the patron saints of physicians and surgeons, as well as of philosophers.

September 29.

Ganging Day.—A septennial custom at Bishop Stortford, when a group of young men assembling in the fields chose one of their number as leader, whom they followed over fields, ditches, and places of difficult passage. All whom they met, whether male or female, were 'bumped,' two persons taking them up in their arms and swinging them against each other. The landlord of each inn they visited was bound to furnish them with ale and cakes. The night should be, and usually was if the weather permitted, spent in the fields.

Michaelmas.—The feast of St. Michael being the most important of the Church festivals which approximates in date to the close of the agricultural year with the harvest, a number of customs have come to be associated with it which either close the old or inaugurate the new season. Such are the choice and inauguration of the new officials of the community for the coming year, or the renewal of terms of tenure. These are often marked by some special observance, such as the chopping of a stick by the senior alderman present in acknowledgment of the service of a manor in Shropshire, or the presentation of the horseshoes and nails on behalf of St. Clement's in the London civic ceremonial. At Abingdon the streets used to be decorated with flowers and garlands hung on poles at the inauguration of the new mayor at Michaelmas; while at Nottingham a ceremony known as the Burial of the Mace took place in St. Mary's Church, when the mace was laid on a table in the vestry beneath sprigs of rosemary and bay before it was handed to the new officials.

That the election was a time of special privilege and the place of assembly of a special character—in early times such communal assemblies were held in temple or sacred grove—is perhaps indicated by the custom of Seaford in Sussex, where the freemen, after assembling in the town hall, retired to the gate-post of a field at one end of the town and there elected their mayor, in order, it was said, to be free from the influence of the jurats who were sitting on the bench in the town hall. The 'lawless hour' of Kidderminster (see Oct. 1) finds its parallel in the 'lawless court' of King's Hill in Essex, at which tenants did suit and service before cock-crow. There are other cases, such, for example, that at Roscarrock in Cornwall, in which service of tenure had to be performed before sunrise, a time which, sometimes, at any rate, appears to have been regarded as a 'lawless' hour.

The fair at Chichester which began on this day, and lasted for eight days, was another of the occasions on which civil authority was abrogated. Here it was delegated to the bishop, who collected all tolls. On one occasion he claimed, but without success, the right to hold the keys of the town.

Among customs of a more popular character, the late harvest of the north of Scotland is responsible in Skye and other islands of the west coast for the baking of a huge cake on this date. Of this all the members of the family and any strangers had to partake. It was also customary, where conditions allowed, to hold horse races, and for the sexes to give one another presents. A curious custom of the island of Lingay mentioned in the early eighteenth century was that any one might steal his neighbour's horse the night before and ride it all day provided that he returned it unharmed. In Barra the women brought the horses and rode behind the men, it being a lucky sign if they fell off. They bore the expenses, and each brought a large bannoch made with treacle, butter, etc. In Skye it was the practice that the cavalcade should ride round the church, which is strong presumptive evidence of a religious and probably pagan origin.

The Michaelmas cake appears in Ireland, where the inclusion of a ring makes it a prognostication of the marriage before the next Michaelmas of the one who received the portion containing it. In the west of England also, Michaelmas was made an occasion for forecasting marriage. Girls gathered ripe crabs from the hedges and laid them out in the form of initials in a loft. The initial which best retained its shape on Old Michaelmas Day was that of the future lover or husband.

St. Michael's cake was also baked in Wales, where it was incumbent upon every member of the household to eat a share.

Many attempts have been made to explain the Michaelmas goose. Its origin as a Michaelmas dish has been attributed to Queen Elizabeth and the celebration of the news of the defeat of the Armada; but it is mentioned long before in the reign of Edward IV. As it is a dish eaten at this date in Denmark and in Germany, its origin is probably more universal. The name sometimes given of 'stubble goose,' and the fact that geese having been allowed the run of the fields after the harvest were then at their best, suggest that it was probably a convenient form for payment in kind, especially for dues and tenancy—a view which is supported by numerous references to it in this connexion—and hence became an appropriate and staple dish for the Michaelmas feast.

Snake Worship in Southern India.—In Malabar the snake is held in special reverence, and in some corner of the garden of every respectable family is a little grove with a masonry platform on which are sculptured granite stones representing hooded serpents. Every evening a lamp is lighted and offerings of eggs, milk, and plantains are made after the lamp has been lit to invoke the serpent's aid.

Mannarsala in Travancore is well known for its serpent worship. Here in a grove live the snake king and queen with thousands of their followers in the form of snakes of granite. A priest is in attendance who is provided with a house in the grove. An annual festival, known as the Ayilyam festival, is held here in the months of Kanny and Thulam (September-October) when a large number of people assemble with offerings of gold, silver, salt, melons, etc. On the day preceding the festival something like three thousand Brahmins are entertained at the house of the priest. On the day of the festival the serpent gods are taken in procession to the house of the priest by the eldest female member of the house, and offerings of neerumpalum (a mixture of rice-flour, turmeric, ghee, water of tender coconuts, etc.), boiled rice, and other things are made to the serpent gods. It is said that the neerumpalum mixture would be poured into a big vessel and kept in a room for three days, when the vessel would be found empty, the serpents having drunk the contents.

Societies and Academies.

Paris.

Academy of Sciences, Aug. 6.—**A. Lacroix**: The pegmatitoids of volcanic rocks with basalt facies.—**S. Winogradsky**: The oxidation of cellulose in the soil. The greater part of the work of the disintegration of cellulose in the soil is done by aerobic organisms. A method of culture is described which permits of the direct observation of the changes in the structure of filter paper brought about by the organism under examination.—**V. Grignard** and **J. Dœuvre**: Citronellol and rhodinol. The results of a quantitative study of the products of the ozonisation of rhodinol. It is concluded that the rhodinol of Barbier and Bouveault does not exist as a chemical entity in natural essential oils.—**O. Borůvka**: A class of minimum surfaces plunged in a space of four dimensions with constant curvature.—**A. Danjon**: The photometric study of the earth shine from the moon.—**Pierre Leroux**: Study of the influence of the temperature on the absorption of a specimen of tourmaline. The apparatus utilised for the absorption measurements consisted of a photo-electric cell with a quadrant electrometer. For temperatures not exceeding 250° C., the variation of the absorption coefficient as a function of the temperature is linear and reversible.—**Minesaburo Akiyama**: The condensation of water vapour on the charged atoms of actinium-A.—**C. Marie** and **G. Lejeune**: Researches on the electrolytic oxidation of organic substances.—**Rangier**: The condensations of glycerol. A detailed study of the products obtained by heating glycerol with fused sodium acetate at varying temperatures.—**G. Vavon** and **N. Zaharia**: The extractibility of phenols by ether starting with their alkaline solutions. It is usually assumed that a mixture of phenols with other ether soluble substances can be separated by making the mixture alkaline and extracting with ether. This is not the case, since all phenols are partly removed from alkaline solution by ether, the quantity varying with the structure of the phenol.—**V. Babet**: The crystallophyllian rocks of the Mayombe (French Equatorial Africa).—**Henri Termier**: The ankaratrites of Central Morocco.—**Pierre Lamare**: A type of tectonic accident affecting the lower folds of the Pyrenees of the Spanish Pay Basque.—**Raymond Furon**: Geological observations on the Hodh (Circle of Néma, French Sudan).—**Jules Welsch**: Contribution to the knowledge of the Jurassic fauna of Poitou. Oxfordian Ammonites to the south of Niort.—**M. Collignon**: Explosions at a great distance.—**Emile F. Terroine** and **R. Bonnet**: The modes of utilisation by the organism of the energy set free by oxidations and the problem of the food value of alcohol. It is concluded that oxidations in living organisms fall into one of two classes: in one class, of which the oxidation of glucose is the type, the energy can be utilised both for mechanical and chemical work; the other class, of which alcohol is the type, can only give rise to heat.—**E. Kohn-Abrest** and **Lupu**: The fate of hydrocyanic acid in the blood.

Cape Town.

Royal Society of South Africa, July 18.—**J. W. C. Gunn**: A note on the skin secretion of *Xenopus lævis*. The South African clawed toad, *Xenopus lævis*, when irritated by mechanical, electrical, or chemical stimuli applied to the skin, on the inhalation of irritating gases, or after the injection of certain drugs, secretes a white viscous fluid from its skin. This consists mainly of albuminous material, but contains substances which are pharmacologically active and toxic to mammalia. A specimen of dried secretion has remained active for six years. One of the active substances has sympatho-mimetic reactions similar to adrenaline, but does not give the chemical reactions of adrenaline. An extract from the entire skin has a similar action to that of the secretion.—**J. W. C. Gunn** and **Louis Mirvish**: A preliminary note on the pharmacological action of *Homeria collina*. This tulip is known in the Cape Province as the yellow plant or geel tulip. The material was dried, powdered, and macerated in 70 per cent alcohol for forty-eight hours. The resulting tincture was employed in the experiments. Immediately before use the alcohol was driven off and replaced by an equivalent amount of Ringer's solution. Its effects are similar to those produced by the Digitalis group of drugs.—**L. Mirvish** and **L. P. Bosman**: (1) The effect of testicular extracts on the calcium blood-level. It is only when alcoholic extracts of testes given are increased to the extent equivalent to about 200 gm. of fresh testicular substance that a drop in the blood calcium occurs similar to that caused by ovarian extract. The same hormone that is present in the ovary appears to be present in the testis, but in lesser concentration. (2) The effect of extracts of the suprarenal cortex on the calcium blood-level. Bovine suprarenals from which the medulla was removed were extracted with alcohol. The adrenaline was removed, and the alcoholic extracts purified as in the preparation of the ovarian extract. This extract, when injected into rabbits, reduced the blood calcium by about 30 per cent. The nature and extent of the drop were similar to that produced by the ovarian extract.

Rome.

Royal National Academy of the Lincei, May 6.—**A. Bemporad**: The astrographic catalogue of Catania.—**A. Angeli**: Diazo-compounds. Further data and considerations concerning the behaviour of the diazo-compounds, like those previously published, allow of a satisfactory explanation of the reactions of such compounds without the aid of the hypothesis of stereoisomerism.—**J. Dubourdieu**: Certain applications of the theory of geodesic co-ordinates along a curve.—**L. Fantappiè**: The linear functionals of functions of two complex variables (3).—**Elena Freda**: The propagation of stationary electric currents in a conductor subjected to the action of a uniform magnetic field.—**L. Tieri** and **V. Ricca**: Electronic emission in a vacuum tube. Results are given of experiments made to determine the relationship between the variations of the filament current and those of the electronic current as the potential difference between the filament and the plate is varied. An interpretation of these results is to be given later.—**E. Fermi**: The statistical deduction of certain properties of the atom: calculation of Rydberg's correction for the S terms (3). It has been shown previously that the whole of the electrons surrounding the nucleus of a heavy atom may be regarded as a kind of gaseous atmosphere of electrons in conditions of complete degeneration. Application to the study of this question of a statistical method permits of the determination of the distribution of the electrons round the nucleus and of the mode in which the electric potential varies inside the atom as a function of the distance from the nucleus.—**C. Dei**: Circuits with a thermionic valve in derived saturation on a condenser.—**E. Perucca**: Polarimetry and photo-electric photometry. Todesco's photo-electric method for revealing slight traces of double refraction is useful, not so much as a means of measuring double refraction, but, as a highly sensitive zero method, to replace the eye in polarimetric and photometric measurements. The arrangement suggested by Todesco allows of the determination of the extinction azimuth of the analyser with respect to the polariser (crossed nicols) with an accuracy of about 1·5″, and is, therefore, at least as efficient as the best half-shadow polarimetric device.—**M. Baruzzi**: Further considerations on the periodic course of the mean diurnal temperature at Modena.—**G. Malquori**: (1) The system $KCl - HCl - H_2O$ between 0° and 80°. The presence of hydrochloric acid lowers the solubility of potassium chloride in water, but does not change the form of the curve expressing the solubility as a function of the temperature.—(2) The system $AlCl_3 - HCl - H_2O$ between 0° and 80°. In the system $AlCl_3 - H_2O$, the compound $AlCl_3, 6H_2O$ alone exists in equilibrium with the saturated solution from the cryohydric point to 80°. From the heat of solution of $Al_2Cl_6, 12H_2O$, in 900 molecules of water at 15·5°, determined by Sabatier, and the corresponding heat of dilution, now measured, it is calculated that the formation of a saturated solution at 20° from 1 molecule of $AlCl_3, 6H_2O$ is accompanied by the generation of +4606 cal. Just as with potassium chloride, so with aluminium chloride, the solubility is depressed by the presence of hydrochloric acid, but the solubility-temperature curve is not changed in shape.—(3) The system $AlCl_3 - KCl - H_2O$ between 0° and 80°. The solubility surfaces for this system are perfectly normal, the ratio between KCl and $AlCl_3$ in the saturated solution exhibiting, with rise of temperature, a certain variation in the direction of enrichment with the potassium salt.—**G. A. Barbieri**: The cobalti-carbonates.—**S. Pastorello**: The stability of rhodium sesquioxide and iridium dioxide. In an atmosphere of sulphur dioxide, rhodium sesquioxide is comparatively, and iridium dioxide highly, stable. Confirmation is obtained of the view that the formation of these oxides is the cause of the depression of the catalysis of sulphur dioxide to trioxide by the presence in the platinium catalyst of rhodium or iridium.—**E. Pace**: Ditertiary glycols and some of their heterocyclic derivatives. Various glycols of the form $CH_3.CR(OH).CH_2.CH_2.CR(OH).CH_3$ have been prepared by the action of magnesium alkyl bromides on acetonylacetone and treatment of the resulting product with water. By the action of dehydrating agents on these compounds, tetrahydro-furfuran derivatives are formed, and by the action of alcoholic ammonia solution, tetrahydropyrrole derivatives.—**N. A. Barbieri**: Tabacin or the toxic principle of tobacco. Tabacin, which may be regarded as an acid-nitrogenated glucoside, is decomposed by 2 per cent potassium hydroxide solution into its components, tabacol, tabacinic acid, and sugar, and at about 110° emits irritating tabacol vapour, which causes violent sternutation, coughing, and pronounced respiratory trouble. Both tabacin and nicotine cause death in guinea-pigs in doses of 9 milligrams per 100 grams of body weight. Tabacol is a very powerful convulsant poison, which, by the rapidity with which it proves fatal when injected, recalls the combined action of hydrocyanic acid and strychnine.—**Enrico Clerici**: An interesting outcrop of lava at Petronella.—**M. Comel**: Variation in the hydrogen ion concentration of equilibrating solutions by the action of the regulating power of the tissues. Experiments with pulped muscular and liver tissue show that this tissue exerts a marked influence on the hydrogen ion concentration of regulating phosphate solution, the relation between the value of the resulting $pH(y)$ and that of the $pH(x)$ of the solution used being expressed by the straight line formula, $y = a + bx$.—**M. Pennacchietti**: The significance of the degeneration of the reticular zone of the suprarenal of the new-born human organism.—**Aldo Spirito**: Observations on the grafting of the primary optical vesicle in *Rana esculenta* on the influence of the various embryonic stages in the subsequent differentiation.

Official Publications Received.

BRITISH.

New South Wales. Department of Public Instruction: Technical Education Branch. Technological Museum: Curator's Annual Report for Year ended 31st December 1927. Pp. 5. (Sydney, N.S.W.: Alfred James Kent.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 23, 1927, No. 1. Pp. 246+5 plates. (Calcutta.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1927, to March 31, 1928. Pp. 8. (Sidmouth.)

Trinidad and Tobago: Council Paper No. 67 of 1928. Conservator of Forests: Administration Report for the Year 1927. Pp. 18. (Trinidad, B.W.I.: Government Printing Office.) 8*d*.

Forestry in the Colony of Trinidad and Tobago. Statement prepared by the Conservator of Forests, Trinidad and Tobago, 1928. Pp. 26. (Trinidad, B.W.I.: Government Printing Office.)

FOREIGN.

Pubblicazioni della Università Cattolica del Sacro Cuore. Serie sesta: Scienze Biologiche. Vol. 4: Contributi del Laboratorio di Psicologia e Biologia. Serie Terza. Pp. v+436. (Milano: Società Editrice "Vita e Pensiero.") 40 lire.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 145-148: On the Oxidation of Stannous Hydroxide in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Oxidation of Sodium Sulphite in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Oxidation of the Mixture of Stannous Hydroxide and Sodium Sulphite in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Dissolution Velocity of Oxygen into Sodium Hydroxide, Sodium Carbonate and Hydrochloric Acid Solution, by S. Miyamoto. Pp. 225-245. 35 sen. No. 149: Photographic and Kinematographic Study of Photo-Elasticity. By Z. Tuzi. Pp. 247-267. 40 sen. No. 150: Electric Explosions. By H. Nagaoka and T. Futagami. Pp. 269-288+plates 25-36. 55 sen. No. 151: The Slip-Bands produced when Crystals of Aluminium are Stretched. By K. Yamaguchi. Part 1. Pp. 289-317+plates 37-42. 55 sen. No. 152: The Stark Effect of Balmer Series at High Field. By Y. Ishida and S. Hiyama. Pp. 14+2 plates. 30 sen. Supplement, Vol. 8, No. 1: On the Use of Quartz Rod or Sphere for Condenser in Spectroscopy. By H. Nagaoki. Pp. 3. 10 sen. (Komagome: Iwanami Shoten.)

CATALOGUES.

Books, Engravings, Original Drawings, Maps, etc., relating to South and Central America; with Short Lists on Cuba, Hayti, Porto Rico and Falkland Islands. (Catalogue 508.) Pp. 68+6 plates. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 21.

SOCIETY OF GLASS TECHNOLOGY (in St. Peter's Hall, Bournemouth), at 2.—I. Kitaigorodsky and S. Rodin: The Value of the Thermal Expansion Factor of Aluminium Oxide in Glass.—D. Starkie and Prof. W. E. S. Turner: A Study of the Ultra-Violet Light Transmission of Glass.—At 4.30.—Prof. W. E. S. Turner: Modern Art Glass (Lecture).

THURSDAY, SEPTEMBER 27.

INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (at Queen's Hotel, Leeds).—G. P. Haworth: Barleys and Malts.

PUBLIC LECTURE.

FRIDAY, SEPTEMBER 28.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: Characteristics of the Temperaments.

CONGRESSES.

SEPTEMBER 19–25.

FOLK-LORE SOCIETY JUBILEE CONGRESS, 1928 (at Society of Antiquaries).

Friday, Sept. 21.

At 10 A.M. and 2.30 P.M.—
Prof. H. J. Rose: Mummers' Plays in Attica.
Prof. R. M. Dawkins: The Study of Folk-lore in Modern Greece.
Mrs. Hasluck: A New Dervish Order in Albania.
Prof. Gwynne Jones: Some Survivals of Folk-belief in Modern Wales.
M. Beza: Demetrius Contemir's Contribution to Folk-lore.
Mrs. H. H. Spoer: Hebrew Amulets.

Saturday, Sept. 22.

Excursions to Oxford and Cambridge.

Monday, Sept. 24.

At 10 A.M. and 2.30 P.M.—
Prof. Pettazzoni: Confession of Sins in Primitive Religions.
Dr. J. L. Myres: Paper.
Miss B. C. Spooner: The Fragments that are Left in N.E. Cornwall.
Dr. MacCulloch: The Arthurian Legend.
Miss Mona Douglas: Animals in Manx Folk-lore and Song.
R. E. Enthoven: Tree and Animal Worship in Western India.

At 8.30 P.M.—
(At Caxton Hall.) Demonstration of Folk-dances; Children's Singing-games; Folk-songs.

Tuesday, Sept. 25.

At 10 A.M. and 2.30 P.M.—

Prof. Elliot Smith: The Survival in English Folk-lore of a Story from the Rig-Veda.

Dr. E. Jones: Psycho-analysis and Folk-lore.

Dr. Róheim: Mother Earth and the Children of the Sun.

H. Simpson: Medical Magic among the Berbers of Algeria.

Prof. G. Schütte: Bull Worship among the Kimbri.

SEPTEMBER 22-28.

COMMISSION INTERNATIONALE DE L'ÉCLAIRAGE (at Saranac Inn, New York).

Sept. 24.

C. C. Paterson: The British Standard Specification for Street Lighting.—L. Schneider: Die physiologischen Grundlagen der Strassenbeleuchtung.—A. K. Taylor: The Reflection Characteristics of Road Surfaces.—Calcul de l'éclairement moyen des voies publiques et des espaces découverts.—J. W. Ryde and Doris E. Yates: The Divergence of Beams from Parabolic Reflectors.—L. B. W. Jolley: The Automobile Headlight and its Standardisation, chiefly with Reference to the Linear Filament.—J. Wetzel: Étude de la répartition du flux des appareils de l'éclairage.—H. Desarces and D. Demeure: Définition des appareils de l'éclairage par la méthode de la répartition du flux.

Sept. 25.

P. J. Waldram: Daylight and Public Health.—J. G. West: Planning for Daylight.—J. A. Macintyre and H. Buckley: The Protection of Pictures and Museum Specimens from Fading.—H. H. Kimball: Distribution of Energy in Daylight.—P. Good: International Organisation.

Sept. 26.

M. Cohu: Essais concernant l'influence de l'éclairement sur le rendement et la fatigue dans les travaux manuels.—W. Trüb: Principles of Illumination.—A. Blondel: Sur les grandeurs et unités Photométriques.—W. Dziobek u. M. Pirani: Normung von Signalgläsern.—J. Guild: On the Selection of a Suitable Yellow Glass for Railway Signals.—F. Cellerier: Applications scientifiques du rayonnement de la lumière à l'étude des peintures des musées et collections.—E. Lau: Entladungsrohr für photometrische Messungen insbesondere im Ultraviolett.—H. Buckley: Some Problems of Inter-reflection.—M. Luckiesh: Contributions to the Lighting Art from Researches in Light and Vision.—D. M. Moore: Gaseous Conduction Lamps.—J. Wetzel: L'application des principes rationnels à l'éclairage décoratif.

Sept. 27.

J. M. Waldram: The Precise Measurement of Optical Transmission, Reflection and Absorption Factors.—E. Lax, M. Pirani und H. Schönborn: Experimentelle Studien über Flüssigkeitsmodelle trüber Medien.—W. Dziobek: 'Diffuse' und 'direkte' Durchlässigkeit und Methoden zur Messung derselben.—C. Müller und R. Frisch: Über die Realisierung der Warburgschen rationellen Lichteinheit.—C. Müller: Über die Realisierung einer rationellen Lichteinheit mit Hilfe absoluter Messung der Gesamtstrahlung.—E. C. Crittenden and F. B. Meyer: The Status of Candle-Power Standards.—E. König und F. Buchmüller: Photometrische Vergleichsmessungen zwischen dem National Physical Laboratory in Teddington und dem Eidg. Amt für Mass und Gewicht in Bern.—W. S. Stiles: Recent Measurements of the Effect of Glare on the Brightness Difference Threshold.—P. S. Millar: Glare.

SEPTEMBER 24-27.

INTERNATIONALE TAGUNG FÜR BRÜCKEN- UND HOCHBAU (at Vienna).

SEPTEMBER 24-27.

INTERNATIONALE TUBERKULOSEKONFERENZ (at Rome).

SEPTEMBER 24-28.

DIE TAGUNG DER BALTISCHEN GEODÄTISCHEN KOMMISSION (at Berlin).

SEPTEMBER 24-OCTOBER 6.

WORLD POWER CONFERENCE—FUEL CONFERENCE (at Imperial Institute).

Section A: The Coal Industry—Economic and General Considerations.

The Coal and Lignite Resources of the Australian Commonwealth.—The Combustion of Brown Coal in the Australian Commonwealth.—Dr. A. Gstöttner: The Coal Industry in Austria.—Austrian Coal—Technical Characteristics of the more important Varieties.—Dr. E. Stansfield: A Study of Post-Carboniferous Coals.—J. Formánek: Methods used for the Improvement of Lignites in Czechoslovakia.—A. D. Kissel: The Use of Coal as a Fertiliser.—D. J. L. C. Westenberg: Methods of Burning Dutch East Indian Coals.—Prof. M. Kamo: Korean Coals and their Utilisation.—Some Considerations regarding the Rational Utilisation of Roumanian Lignites.—Prof. L. K. Ramzin: (*a*) Utilisation of Low-Grade Fuels in U.S.S.R.; (*b*) Characteristics and Classification of Fuels in U.S.S.R.—Prof. J. A. de Artigas: The Calorific Value of Industrial Fuels.—Prof. R. V. Wheeler: The Constitution of Coal.—F. C. Wirtz: The Use of Fuel in the Netherlands.—Basis of Evaluation of Fuel Resources.

Section B: Sampling and Testing of Solid Fuels.

Sampling and Testing of Coal.—S. Felsz: A Practical Comparative Basis for the Calorific Value of Coal.—R. Vondráček: (*a*) Determination of Volatile Matter in Coal by Low Temperature Methods; (*b*) The Hygroscopic Qualities of Coals.—E. Norlin: On the Determination and Denomination of Values and Qualities of Coal.

Section C: Coal Treatment—(a) *Cleaning,* (b) *Drying,* (c) *Briquetting.*

Coal Cleaning.—Prof. H. Fleissner: The Drying of Brown Coal without Breakage.—R. A. Mott: The Dewatering and Drying of Coal.—Dr. W. R. Chapman: The Cleaning of Coal, with special reference to the Smaller Sizes.—E. Edser and P. T. Williams: The Cleaning of Coal by Froth Flotation.—G. Raw: The Dry Cleaning of Coal.—Major K. C. Appleyard: The Dry Cleaning of Coal.

Section D: Storage and Handling of Solid Fuels by the User.

H. Chenu: Methods of Control, Preparation, Handling, and Storage of Coals by the National Railways of Belgium.—G. J. Wally: Storage and Handling of Lematang Admiralty Coal.—D. Allemand: Storage, Handling, and Transport of Ombilin Coal at Emmahaven.—R. K. Stockwell: The Storage and Handling of Solid Fuels by the User.

Section E: The Oil Industry—Economic and General Considerations.

E. H. Davenport: The Economics of the Oil Industry, including the Influence of By-Products.—Keizaburo Hashimoto: The Oil Industry in Japan.—Natural Gas as a Source of Power.

Section F: Composition, Classification, Preparation, Storage, and Handling of Liquid Fuels.

The Characteristics of Motor Spirit.—K. A. Clark: The Availability of the Alberta Bituminous Sands for Production of Fuel Oil.—Wa. Ostwald: Properties required of Liquid Fuels for Use in Automobile and Aircraft Engines, and how the Oil Industry meets these Requirements.—Dr. A. E. Dunstan and J. Kewley: (*a*) Modern Developments in Oil Distillation; (*b*) Modern Developments in Oil Refining.—Prof. J. Elin: The Composition and Chemical Properties of Russian Oils.—B. Holmberg: Investigations in Distilling Processes of Swedish Oil Shales.—Dr. A. E. Dunstan and J. Kewley: Modern Developments in Oil Cracking.—The Cracking of Oil.—I. Lubbock: The Technical Aspects of the Storage, Handling, and Transmission of Liquid Fuels by the User.—Shale and the Production of Oil from Shale.—Oil Cracking.—Dr. K. Kling, L. Suchowiak, W. Leśniański, K. Katz, Dr. W. Dominik, and J. Wójcicki: Chemical Composition of Polish Natural Gases and the Determination of their Calorific Value.

Section G: The Carbonisation Industry—Economic and General Considerations.

B. F. Haanel: The Bearing of High and Low Temperature Carbonisation and Synthetic Fuel Processes on Canada's Fuel Problems.—K. Rummel: Heat Transfer through the Walls of Coke Ovens.—N. F. Nissen: The Use of Gross and Net Calorific Values for the Purpose of Guarantee Tests.—Hr. Elvers: Points of Importance for an Economical Comparison of the Value of the Heat Unit in Gaseous and Solid Fuels.—C. P. Finn and R. Ray: The By-Product Coke Oven as a Source of Industrial and Domestic Energy.—M. Mackenzie: The Economics of Coke Manufacture in the Coke Oven Industry.—W. Colquhoun: Coke Quenching and Cooling.—Prof. W. A. Bone, Prof. G. I. Finch, and Dr. D. T. A. Townend: The Fundamental Aspects of Combustion.—F. W. Goodenough: The Gas Industry as a Source of Domestic and Industrial Energy.—T. P. Ridley: The Utilisation of Coke Oven Gas by the Gas Industry.—Sakura Okamoto: A Brief History of the Gas Industry in Japan.—W. S. Edwards: Coke Screening.

Section H: Composition, Classification, Preparation, Storage, and Handling of Gaseous Fuels and of the Products of the Carbonisation Industry.

Uniform System of Designation for Gaseous Fuels.—Dr. H. Löffler: The Application of the Explosion Principle to Evaluation of the Heating Value of Gases.—The Testing of Gaseous Fuels.—Dr. W. Bertelsmann and Dr. F. Schuster: The Properties of Gases defining their Combustion.—F. Menzel: The Production of Gas and the Recovery of other Products by Carbonisation in the Vienna Municipal Gas Works.—Anthracite Substitute—Production of Solid Smokeless Fuels, whether by means of Low Temperature Carbonisation or by means of an Improved Coke.—Dr. J. G. King: The Fundamentals of Coal Blending and the Production of Solid Smokeless Fuel for Domestic Heating.—Prof. J. W. Cobb: The Production of Town's Gas and the Trend of Development.—C. Cooper: The Purification of Coal Gas.—Coke Oven Practice and Developments in Bulk Carbonisation.—Yoshikiyo Oshima: Coal Carbonisation in Japan.—J. Kewley: The Production of Gaseous Fuel from Liquid Fuels.—P. Parrish: By-Product Recovery in the Carbonisation Industries.—Prof. Bunte: New Methods of Fuel Analysis.—M. Langrogne: Production of Coke.—M. Baril: Production of Gas Coke.

Section J: Utilisation of Fuels for Steam Generation and the Production of Electricity.

Ing. F. Siedle: Development of Fuelling Arrangements at the Vienna Municipal Electricity Works.—J. Havlíček: New Experiments with High-Pressure Steam.—V. List: Thermal Central Station in Brno.—H. Th. Bakker: The Combustion of Tertiary Coal on Ships of the Royal Dutch Packet Navigation Co. in the Indian Archipelago.—E. Harprecht: Comprehensive Supervision of Fuel Economy as practised by the German Federal Railway Co.—R. P. Sloan: The Economic Utilisation of Fuels in the Production of Electricity.—Comdr. A. L. P. Mark-Wardlaw: Utilisation of Liquid Fuels for the Generation of Steam.—S. Felsz: The Burning of Polish Coal on Locomotives.—W. Wiśniowski: Estimation of Heat Losses when employing Natural Gas as Boiler Fuel.—S. Kruszewski: Polish Coal as a Fuel for Locomotives.—The Utilisation of Oil Residues as a Fuel for Use in Locomotives.—S. Felsz: Methods employed by the Polish Railways in order to promote Fuel Economy.—T. Sase: Formulæ for the Economical Ratio of Blending Coals for Steam Raising.—M. T. Lindhagen: (*a*) Application of Air-cooled Condensers to Locomotives; (*b*) Experiences with Pre-heated Air for Different Firing Equipment and Different Fuels with regard to Suitable Air Temperature and to Best Total Economy

Section K: Utilisation of Fuels, including Electricity, for Industrial Furnace Work.

Dr. A. Velisek: The Use of Electricity for the Production of Heat in Industrial and Manufacturing Installations.—M. Auclair: Heavy Commercial Vehicles using Producer Gas.—B. Helan: Economic Utilisation of Fuels in the Czechoslovakian Ceramic Industry.—E. Vaněček: Gaseous

Fuels in Czechoslovakia.—O. V. Morch: The Fuel Question in the Cement Industry.—A. van Hoek: Wood Producer Gas for the Treatment of Silver Ores.—Dr. Bansen: Production and Utilisation of Gas in German Iron and Steel Works.—The Use of Producer Gas by the Ashanti Goldfields Corporation.—Sir Robert Hadfield, Bart., and R. J. Sarjant: Industrial Heating by Solid, Liquid, and Gaseous Fuels.—S. E. Monkhouse: Industrial Electric Heating.—Tsunezo Kawasakiya: Thermal Efficiency of an Electric Heating Furnace for Industrial Use.—Yasuzaemon Matsunaga: The Application of Electricity to the Firing of Enamels on Porcelain.—K. Tsujimoto: Industrial and Domestic Uses of Coal.—T. Niemczynowski: Atmospheric-pressure Gas Burners.—Dr. Tsuruo Noda and Taizo Kuroda: Low Grade Coal for Blast Furnace Coke.—Prof. W. E. Groom-Grjimailo and Prof. M. Kirpitscheff: The Hydraulic Theory of the Movement of Gases as applied to the Construction of Furnaces.—T. Lindmark: The Principles of Flame Radiation.—Utilisation of Electricity for Industrial Heating.—Production and Utilisation of Producer Gas in Industry.

Section L: Utilisation of Fuels, including Electricity, for Domestic Purposes.

Dr. A. Velisek: The Use of Electricity for the Production of Heat in Houses, Offices, and Business Premises.—H. Güntner: The Use of Gas for Domestic and Industrial Purposes in Vienna.—E. Dvořák: Utilisation of Solid Fuels for Domestic Purposes in Czechoslovakia.—Dr. Ludwig: Some Considerations regarding the Development of Gas-burning Appliances.—Dr. Margaret Fishenden: A Comparative Study of Solid Fuel, Gas, Electricity, and Oil for Domestic Purposes.—Viscount Shimpei Goto: Electric Heating for Domestic Purposes in Japan.—A. Härlin: Fuel for Domestic Purposes and the Utilisation of Waste Wood in Sweden.—N. Ekwall and O. Stålhane: Electric Hot Plates for Domestic Cooking.—Domestic Heating by means of Solid Fuel, Oil, Gas, and Electricity.

Section M: Pulverised Fuel.

F. Wiesner: Pulverised Fuel Firing in Czechoslovakia.—Dr.-Ing. Förderreuther: Modern Developments in Pulverised Coal Research, and Suggestions for International Co-operation in defining Pulverised Coal Sieves and the Requirements of Coal Pulverisers.—F. H. Rosencrants: Pulverised Fuel Firing.—Dr. W. Lulofs: The Function of the Combustion Chamber of a Powdered Fuel-fired Boiler Installation.—Prof. Shuichi Yamaguchi: Progress of Pulverised Fuel Burning for Steam Boilers in Japan.—Powdered Fuel—Production and Utilisation in the Metallurgical Industry and for Steam Raising.—Prof. L. K. Ramzin: The Combustion of Anthracite Culms and Brown Coals in Pulverised Form.—M. Frion: Production of Pulverised Fuel and its Utilisation in the Metallurgical Industry.

Section N: Internal Combustion Engines.

Ing. M. Gelinek: Electrical Transmission with Heavy-driven Vehicles.—Prof. M. Defays: The Present Position of the Use of Heavy Oil for Motor Traction.—A. Büchi: Internal Combustion Engines with Exhaust Turbo-Supercharging.—E. Rackwitz und A. von Philippovich: Evaluation of Fuels used for Aviation in Germany.—Dr.-Ing. W. Riehm: The Present Position of the High-Speed Heavy Oil Automobile Engine.—H. R. Ricardo and O. Thornycroft: Petrol Engines and their Fuels.—H. Moore: Fuel Oil for Heavy Oil Engines.—P. Yanouschevsky: Experiments with Diesel Engine-driven Locomotives on Russian Railways.—Prof. E. Hubendick: (*a*) The Use of Ethyl-Alcohol as a Motor Fuel; (*b*) The Use of Heavy Oils in Internal Combustion Engines.

Section O: Transmission of Power.

Dipl.-Ing. Traenckner: Problems of Long Distance Gas Transmission—The Transmission of Power over Various Distances by the Alternative Methods of the Transport of Coal, the Transport of Oil, the Transmission of Gas, and the Transmission of Electrical Power.—Long Distance Gas Distribution.—V. L. Jones: Legal Aspects of Gas Transmission.

Section P: Waste Heat Recovery.

A Report on 'Waste' Heat Recovery.—Dr. S. Kasai: Waste Heat Recovery in the Japanese Cement Industry.—Waste Heat Recovery, including Utilisation of Waste Furnace Gas, Blast Furnace Gas, Sensible Heat in Waste Coke, Exhaust Gases in Gas Engines, etc.

Section Q: Low Temperature Carbonisation.

Dr.-Ing. P. Rosin: Possibilities for combining Low Temperature Carbonisation with the Generation of Electricity.—Dr. C. H. Lander and Dr. F. S. Sinnatt: Low Temperature Carbonisation.—Dr. R. Heinze: The Present State of Low Temperature Carbonisation in Germany.

Section R: Peat.

Prof. G. Keppeler: Peat Treatment.—N. Testrup and T. Gram: The Drying of Peat.—P. Nomals: Peat Fields in Latvia, and the Use of Peat as a Fuel.—Methods Employed in U.S.S.R. for the Production of Peat.—Peat Combustion Practice in U.S.S.R.—Experimental Work on the Artificial Dehydration of Peat, and its Conversion into Powder and Briquettes.

Section S: Power Alcohol.

M. Loskot: The Use of Power Alcohol in Czechoslovakia.—Col. Sir Frederic L. Nathan: Alcohol for Power Purposes.

Section T: Training of Fuel Technicians.

Prof. W. J. Müller: The Training of Fuel Engineers in Austria.—F. Smal: The Duty of the Fuel Technologist and the Training of the Stoker.—Prof. J. W. Cobb: The Training of Fuel Technicians.

Section V: Organisations concerned with the Efficient Use of Fuel in Industry.

Ing. B. Peča: A Survey of the Scope of Organisations in Czechoslovakia concerned with the Efficient Use of Fuel in Industry.—Dipl.-Ing. F. zur Nedden: Organisations for the Promotion of Fuel and Heat Economy in German Industry.—E. C. Evans: A Survey of the Scope of Organisations concerned with the Efficient Use of Fuel in Industry.—M. I. Lapiroff-Scoblo: General Problems of Fuel Utilisation.

Section W: Economic Possibilities in the Better Co-ordination of Fuel Utilisation.

Fuels in China.—Sir Arthur Duckham: A Fuel Policy.—M. Berthelot: Coal Briquetting and Co-operation between Coke Ovens, Blast Furnaces, and Martin Furnaces.

Section X: Technical Data on Fuel.

Technical Data on Fuel.

SEPTEMBER 25 AND 26.

IRON AND STEEL INSTITUTE (in Assembly Hall, Alfonso XIII. High School, Bilbao, Spain).

Tuesday, Sept. 25, *at* 10 A.M.—

J. Balzola: Iron Ore Mining in Vizcaya.

J. G. Pearce: The Use and Interpretation of the Transverse Test for Cast Iron.

L. B. Pfeil: The Change in Tensile Strength due to Ageing of Cold-drawn Iron and Steel.

C. A. Edwards and T. Yokoyama: The Influence of Varying Strains and Annealing Temperatures on the Growth of Ferrite Crystals in Mild Steel.

Wednesday, Sept. 26, *at* 3.30.—

A. Herrero and M. de Zubiria: The Phenomena of Corrosion of Iron and Steel.

J. Orland: The Influence of Pearlitisation below the Ar_1 Point on the Mechanical Properties of Carbon Steels.

J. H. Whiteley: Effects Observed in Quenched Liquid Steel Pellets and their Bearing on Bath Conditions.

S. H. Rees: Some Properties of Cold-drawn and of Heat-treated Steel Wire.

SEPTEMBER 26–29.

PALÄONTOLOGISCHE GESELLSCHAFT (at Budapest).

SEPTEMBER 28 AND 29.

FARADAY SOCIETY (in Physical Chemistry Laboratory, University of Cambridge).—General Discussion on Homogeneous Catalysis.

Friday, Sept. 28, *from* 2.30-4.30 *and* 5-7.15.—

Prof. T. M. Lowry: Introductory Paper. Some Problems in Homogeneous Catalysis.

Part I. General Relations.

C. N. Hinshelwood: Homogeneous Catalysis.

C. H. Gibson and C. N. Hinshelwood: The Influence of Nitrogen Peroxide on the Union of Hydrogen and Oxygen. A Problem of 'Trace Catalysis.'

H. Moureu: Catalytic Phenomena in the Tautomerism of certain α-Diketones.

Dr. E. K. Rideal: Negative Catalysis.

N. R. Dhar: (*a*) Ionisation in Chemical Change; (*b*) Negative Catalysis in Slow and Induced Oxidations.

F. Gill, E. W. J. Mardles, and H. C. Tett: Phosphorescence and Autocatalysis during Slow Combustion.

H. Baeckstroem: Negative Catalysis.

Part II. Intermediate Addition-Compounds and Chain Reactions.

J. Kendall and Lilian E. Harrison: Compound Formation in Ester-Water Systems.

J. A. Christiansen: Report on the Theory of Chain Reactions.

M. Polanyi: Bromine Inhibition of Chain Reactions.

J. Böeseken: The Theory of Molecular Dislocation Applied to Homogeneous Catalysis.

Saturday, Sept. 29, 10 A.M.-1 P.M. *and* 2.30-4 P.M.

Part III. Neutral Salt and Activity Effects.

J. N. Brönsted: The Theory of Acid and Basic Catalysis.

Dr. H. M. Dawson: Catalytic Effects of Acids and Bases and the Influence of Inert Salts.

H. von Euler: Compounds between Catalysts and Substrates and their Reactivity.

H. Goldschmidt: On the Catalytic Activity of Hydrogen Ions in Ethyl Alcohol.

H. S. Harned and G. Åkerlöf: Investigations of Salt Action in Homogeneous Catalysis.

F. O. Rice and J. J. Sullivan: Keto-Enol Isomerism and the Mechanism of Homogeneous Reactions.

F. G. Soper: The Activity Theory of Reaction Velocity. The Rate of Interaction of a Chloroamine and Hydrobromic Acid.

OCTOBER 1-3.

INTERNATIONAL FEDERATION OF INTELLECTUAL UNIONS (at Prague).

Oct. 1.

C. P. Blacker: The Modern Conception of the World.—F. Dessauer: Der Geist der Erfindung.

Oct. 2.

H. de Man: Le rôle de la technique dans le domaine social.—A. Fontaine: La transformation d'État sous l'influence de la technique.

Oct. 3.

Jeanneret-Le Corbusier: Les formes nouvelles de l'art protique.—C. G. Jung: Das Seelenproblem des modernen Menschen.