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Awards for Discovery and Invention.

AN example of the changed conditions brought about by the policy of Government encouraging the application of science to industry will be found in the "Report of the Inter-Departmental Committee appointed to consider the Methods of dealing with Inventions made by Workers aided or maintained from Public Funds" (pp. 25, H.M.S.O., price 6*d*. net). Before the War this subject was dealt with by Departments in a manner which frequently caused workers to desire arbitrators who, if not more sympathetic, might at least have knowledge of affairs, and act in accordance with some guiding principles. There were three courses which might be adopted by Government Departments, involving complete control, control by Government with delegation of its rights to its contractors but leaving commercial use to the inventor, and finally release from any obligation, with freedom to deal with invention as the inventor pleased. In those days, however, the cases coming up for decision were few, and the number of individuals affected small, whereas now Government employs a large body of persons on scientific and technical work, any of whom may, at any time, produce an invention. The importance of such an invention, although emanating from a laboratory belonging to the Fighting Services, may be even greater from a civil than from a military point of view.

Urgency was imported into the consideration of the question when inventions of commercial value began to be produced by the Department of Scientific and Industrial Research. Regulations had already been framed by that Department by which, while the results of an assisted worker who has chosen some field for extending knowledge, are under no restriction as to publication, an obligation was imposed on him to consult the Department if he desired to make commercial use of his investigations. A patent might then be taken out in the joint names of the inventor and of an Imperial Trust, and the proportional interests of the Department, of the inventor, and of any co-operating bodies were determined by the Department. The inventor assigned all rights in the patent to the Imperial Trust, which it is understood found a difficulty in exploiting patented inventions commercially. Variation in treatment of the subject and the unsatisfactory nature of some of the prevailing conditions thus called for a settlement of the method of treating inventors aided or maintained from public funds, and of the method of utilising their inventions in industry.

The Report proceeds to consider the difficult subject of the ownership of inventions made in Government employment. It deals first with the case of research workers, and secondly with persons not specially employed on research, expressing the view that in connection with such questions as rewards and the enjoyment of commercial rights each case should be decided on its merits. It is clear from the context that, as regards inventions made by research workers, divergent views have been expressed by the numerous witnesses who have been called before the Committee, and the result of a consideration of these views is embodied in the following passage :—

"In the case of a research worker employed by Government, the view has been expressed that, since he is employed for the purpose of making investigations and is provided with equipment, accommodation and other facilities at the cost of the State, he should not, as a general rule, be entitled to a reward or to any rights in any invention made in the course of his duty. On the other hand, there is a feeling amongst scientific men that rewards for specially meritorious work would have the effect of encouraging further effort. While we are, on the whole, in agreement with the former view, we consider that these are questions which should be decided in the light of all the circumstances in each case, the general principle being that the invention is the property of the State, and that the reward to the inventor (either by way of a money grant or of a share of patent rights or otherwise) should be increased or diminished in proportion to the remoteness or proximity of the invention to the work for which he was engaged or for which he had special facilities or knowledge as the result of his employment."

From this statement it is apparent that the Committee appreciates that it would be unwise to lay down a rule governing all cases, and that in dealing with the question of rewards the merits of each individual case should be taken into consideration. To bring the matter to an issue certain principles are enunciated, the chief features of which are that a competent authority should define in the light of all the circumstances of the case the respective rights of the Government and of the inventor, and decide any reward to which he may be entitled; that where the rights in an invention capable of commercial exploitation belong to the Government, it should be exploited commercially for the benefit of the Government; and that the system of dealing with these matters should be uniform for all Government departments.

The mechanism for dealing with these matters is next sketched, and from the preceding argument it clearly has to take the form of a central organisation for all Departments of State. Accordingly it is recommended to set up an Inter-Departmental Patents Board having two main functions, one on the lines of the Royal Commission on Awards to Inventors, for the purpose of dealing with awards, deciding as to the extent of the assistance due to the inventor's position in a Department, and determining the share of the Government in commercial profits, and the other to arrange for the exploitation of patents to the best advantage. The Board itself would fulfil the former function by acting as an Awards Committee, but for the latter, which deals with commercial matters, it would establish an independent Exploitation Committee with its secretary as intermediary.

In order to secure the full confidence of the inventor, it is recommended that the Inter-Departmental Patents Board should be a neutral and impartial body, on which are to be found neither representatives of the Departments concerned nor of the technical workers, but that it should have a permanent chairman of sound legal training and experience, and members characterised by their knowledge of the application of research and invention to industry. As this aspect of the work of the Board is judicial, it is deemed well to keep separate from the commercial aspect, which would be delegated to a committee of a different type—the Exploitation Committee—composed of nominees of the Departments, of the Treasury, and of business men with suitable experience and willing to assist in the exploitation of patents.

The Report proceeds to consider more closely the proposed mode of working of the Inter-Departmental Patents Board, this Board sitting as an Awards Committee, and of the Exploitation Committee. The Inter-Departmental Patents Board would have a permanent Chairman, and a small staff, under the Chairman's direction, would co-ordinate the work of the two Committees. Its cost would be borne by the Treasury, part of whose functions it would have delegated to it; its awards, however, would not be subject to revision by the Treasury on the ground of amount, but only on questions of principle. An inventor would, in the first place, be deemed to hold in trust on behalf of the Government all rights relating to his invention, but would be entitled to obtain from the Board a decision defining his rights, and he would undertake to assign his patent if called upon to do so, or the Board might decide to leave the completion of the patent to the inventor for his sole benefit. All non-secret patents in which the State has an owning interest would be assigned, not as at present to a Secretary of State, or to a Departmental Trust, but to a single organisation. The Board would also consider the case of the Government servant who was not specially engaged on research or development work, but who produced an invention.

The Awards Committee would consider the rights of the inventor in the light of the principles enunciated above. Except only in respect to awards would this Committee or the Board itself deal with secret patents for which the inventor has no possibility of securing commercial rights and the use of which is limited. Decisions as to maintaining their secrecy must remain in the hands of the respective Departments, who, if they desired, could consult in private with the Board. To avoid an undue burden being thrown upon the Inter-Departmental Board, it is provided that the Departmental Awards Committee of any Department should act as a committee of the Main Board and have power to deal with minor cases, forwarding to the Main Board only such cases as appear important as involving principles, or as being likely to result in an award exceeding 1000*l*.

Indications are given in the Report as to the mode of treatment by the Awards Committee of inventions which are a result of work by a team of part-time workers, and by workers aided by grants given for the sole purpose of increasing the bounds of knowledge.

The work of the Exploitation Committee is a matter of peculiar difficulty, seeing that this Committee would have to advise as to the advantage of completing protection by patents and exploiting them commercially when patented, and arrange with their business agents for placing them in the most favourable manner. It is hoped from experience during the War that men engaged in industry and commerce would still be willing to place their services at the disposal of the State for the achievement of these national aims. It would be the duty of this Committee to secure profits from the useful application of the patents under its charge, whether from their sale or from licences for their use. It would have the power of making a final decision, as this is vital in order that business dealings may be brought to an issue quickly and satisfactorily, and would employ sales agents paid on commission. If demonstrations on the semi-industrial scale, or works trials on the large scale, appeared desirable, this Committee would be empowered to carry them out. The

Exploitation Committee would also advise on the taking out of foreign patents, to be sold outright, however, so as to avoid the inconvenience of a Government organisation having to maintain a question of validity in a foreign country.

Some other matters of interest in this Report may be briefly mentioned. Doubt is expressed as to the soundness of the practice obtaining in one Department at least, of stopping short at provisional protection in the case of inventions of value for the preservation of health or of life, or the general use of which could be enforced by a Government Department; completion of the patent is now advised on the ground that very often no commercial use can be made of an invention unless a definite monopoly is granted to a manufacturing firm. Similarly, foreign patents for such inventions should be taken out.

For the encouragement of meritorious research workers, it is recommended in the Report that the head of a department should be given the power to promote successful investigators, or to secure for them special increases of salary, within certain limits, and without promotion out of their grade. The opinion is also recorded that the remuneration of scientific workers should be adequate and that they should have reasonable security of tenure.

While the Committee states it has not found that Government Departments are more reluctant than industrial firms to allow the publication of the results of scientific investigations, it is strongly of opinion that no obstacle should be placed in the way of research workers who wish to publish such results, regard being had to the national interest, and it proceeds to point out that the Government will secure the services of men of scientific ability and reputation, only if such permission is not withheld except under exceptional circumstances.

A mode of procedure is recommended to secure for the worker the opportunity of lodging a provisional application at the Patent Office without submitting it through his superior officer, who would, however, be supplied with a copy from the perusal of which he could decide as to whether the invention should be regarded as secret. Attention is directed to the importance of advertising to all concerned the conditions in force regarding the taking out of patents.

Such are the main features of this important Report. It cannot be denied that there existed an urgent need for a detailed consideration of the whole patent question for which different Departments of State had varying provisions and regulations. The matter is one of peculiar difficulty, on account of the personal association of a worker with the idea which ultimately leads to a successful patented process, while at the same time he is in receipt of maintenance and facilities. In spite of one phrase in this Report where the position of Government servants not specially engaged on experimental work is being discussed, in the words that "it was no part of the bargain made between them and the Government Department concerned when they entered into its employment, that they should make discoveries or inventions," it can safely be said that no such contract of service could reasonably be demanded. By maintaining a well-equipped establishment with adequate facilities and conditions for a well-chosen investigating staff, the employer has a good ground for belief that an atmosphere will be created in which at any time striking new ideas may arise, but he cannot claim to expect more than this in the way of striking developments. It is to this balance of interests that the Committee has applied itself, and in the passage quoted earlier in this notice has defined the position of research worker maintained by the Government, with regard to his claim to ownership in inventions. While laying stress on the general principles that the invention of such a worker is the property of the State, and that the reward to the inventor is contingent on the connexion of the invention with the work for which he was engaged, the Report makes clear that in settling the question all the circumstances of the case will be taken into account, having in mind, no doubt, such matters as the case when a Department desires to keep the invention secret, the merit and importance of the invention, together with any peculiarity in conditions of employment.

The tribunal suggested to adjudicate on such points, in view of its neutral character, should go far towards securing the confidence of the inventor, more especially as he should no longer be able to point to lack of uniformity in treatment by different branches of the Service. From the body of decisions of this tribunal there will, no doubt, gradually emerge sufficiently definite guiding principles to enable new applications to be dealt with expeditiously and fairly.

Much will depend on the interpretation of the principles described above in the first decisions arrived at by the Patents Board, and the extent to which encouragement to the scientific worker, one of the objects laid down in the terms of reference, is to result will be watched with interest.

Up to this point the Report is fairly clear, and there is no reason why its recommendations should not be carried out satisfactorily. It is to be hoped that it will be equally successful in the much more difficult task of exploiting inventions. Although, under the existing system in some Departments, a Government servant may be able to obtain permission to have reassigned to him the non-Governmental rights of an invention made in the course of his work in order to exploit it commercially, he is rarely in a position adequately to carry this through, either from want of time on account of his normal duties, or from want of business ability. The inventor had the alternative in the event of a process proving an important one either to leave the Government Service and devote himself to his patent, or to remain in the Service and see the success of his invention jeopardised in its civil applications. The exploitation of Government-owned inventions by business men who have had experience in work of this kind is the only other way out of the difficulty that can readily be seen, and it is to be hoped that the confidence of the Committee will be justified by suitable public-spirited men coming forward to take up the work.

The Report bears internal evidence of much thought and consideration of diverse opinions, and thanks are due to members of the Committee for their hopeful effort to suggest an organisation which, by settling claims and disputes definitely and rapidly, will thereby remove an impediment to progress in investigation and at the same time afford the worker the opportunity of stating his case.

Principles and Problems of Aeronautics.

The Mechanical Principles of the Aeroplane. By Dr. S. Brodetsky. Pp. vii + 272. (London: J. and A. Churchill, 1921.) 21*s*. net.

THE entry of Dr. Brodetsky into the ranks of workers on aeronautical topics marks an important development in the higher study of aerial navigation. Why the achievements of modern aviation have not from the outset been built up on a substructure of purely abstract mathematical theory such as has arisen concomitantly with other branches of physics and engineering is difficult to understand. The behaviour of laminæ and other bodies moving through a medium under assumed laws of resistance, whether artificially propelled or otherwise, opens up a vast collection of problems which might well have occupied the attention of mathematicians and been illustrated by experiments with models long before the evolution of the full-sized aeroplane. Instead of this being done, flying machines have been built, flown, wrecked, and their pilots killed, by designers who have not even fully appreciated such elementary facts as that when an aeroplane is moving with uniform velocity the forces acting on it must be in equilibrium, that three forces in equilibrium must meet in a point, that an aeroplane has six degrees of freedom, that stability and equilibrium are not the same thing, and so forth. Whether the Tarrant triplane could have been saved by a full appreciation on the part of its pilots of the validity of the equation of *initial* angular acceleration, $Id^2\theta/dt^2 = M$, or numerous aviators saved from death by a better knowledge of the forces and couples on which longitudinal and lateral stability depend, are debatable questions. Meanwhile mathematicians of repute have attacked the writer of this review for intimating that a fuller theoretical study of the problem should be undertaken.

The National Physical Laboratory and the Royal Aircraft Establishment have absorbed many of the most enlightened of our university graduates who are competent to study aeronautical problems, and they are doing excellent work there. But, unfortunately, the amount of constructional work that had been going on while the mathematicians of our universities were making and marking examination questions, with their eyes shut to the outside world, has thrust on our Government institutions vast arrears of questions arising out of the engineering and physical difficulties associated with aviation. It is therefore not surprising that scarcely any one previous to Dr. Brodetsky has started at the opposite end and tried to fathom the capabilities of pure mathematical reasoning as distinct from experiment in throwing light on the study of aeronautical problems.

A notable exception is afforded by Mr. Lanchester, whose two volumes certainly represent a genuine attempt to investigate the behaviour of aeroplanes as deduced from *a priori* reasoning. But the subject was bristling with mathematical difficulties of a cut-and-dried character quite outside the scope of Lanchester's resources, and no mathematician would take up the challenges so oft repeated in NATURE until Dr. Brodetsky came on the scene. Contrast this state of affairs with the past history of electrical engineering, in which subject mathematical tripos candidates were being worried with solutions of Laplace's equations for infinitely long charged cylinders and conditions for solenoidal and lamellar magnets long before Lord Kelvin presented Peterhouse with its electric light.

In recent years nearly every publisher has decided that there is a demand for an up-to-date book on aeronautics, and has got some one to write one. In all these books the effects of the policy of "putting the cart before the horse" is painfully evident. The mathematics is usually of a very elementary and insufficient character until we are confronted with the invariable chapter headed "Stability, Mathematical Theory." This is usually nothing more or less than a mutilated copy of part of the "Science Monograph" on "Stability in Aviation" by the present writer, accompanied by a misuse of signs and symbols and a total disregard for all the accepted doctrines regarding elegance of mathematical style and form that are calculated to produce chaos and confusion in the study of stability for years to come.

In presenting students of aeronautics with the first treatise that is thoroughly imbued with the ideals and spirit of the best mathematical school of Cambridge, Dr. Brodetsky is performing for aviation what Clerk Maxwell accomplished in anticipation of modern electrical engineering. In both cases the authors have undoubtedly been striking out on new lines and breaking fresh ground with scanty information to guide them as to choice of subject-matter, method, and order of treatment. The subject has thus opened up an almost illimitable collection of unsolved problems of which Dr. Brodetsky's treatise breathes in nearly every line.

As in electrical text-books, Dr. Brodetsky starts with the simplest problems, but unlike them, appears to avoid their subsequent contradiction of previous results. After a short introduction involving a summary of the problems presented by the heavier-than-air machine, section 1, dealing with "Motion in Air," opens with a chapter on "Dimensions," dealing with elementary dynamical principles, in which account is taken of such possible influences as viscosity. At this early stage important innovations in the matter of notation become necessary. If the object of the writers who are continually changing their axes is to avoid copying the original stability monograph, they would have caused less confusion if they had adopted different letters. Now that L_p may mean M_q or $-N_r$, it has become necessary to scrap the original notation and substitute an entirely different set of symbols. It is to be hoped that the same mistake will not again be made, but that Dr. Brodetsky's notation for the so-called "derivatives" and similar quantities will be accepted as a permanent solution for the present chaos. It certainly represents the best that could be evolved after many hours of consideration, in which the present reviewer took part when studying with Dr. Brodetsky through a grant from the Research Department under the hospitable roof of Bristol University.

The next chapter deals with problems on resisted motion falling within the range of particle dynamics, including a study of Lanchester's phugoid curves. The reference to "catastrophic instability" on p. 53 is important in view of the frequent Press notices of aeroplanes which are stated to have turned over suddenly and crashed to the ground.

Two-dimensional rigid dynamics forms the subject of the next chapter, which embraces not only the ordinary theory of longitudinal stability (including a *rigorous* proof of Routh's discriminant condition), but also applications to the kite and parachute. Further, there is an original investigation of the motion under gravity of a lamina under an assumed simplified law of resistance which is illustrated by diagrams deduced from theory and compared with experiment. The reference to periodic solutions should receive serious consideration. It must not be forgotten that an aeroplane may be stable for small deviations from steady motion and may yet be capable under suitable initial conditions of acquiring a periodic motion turning over and over in loops until it crashes to the ground, while it may be impracticable to extricate it from this state. The aeroplane which effected a successful landing after its observer and pilot had been shot dead did not necessarily possess immunity from this danger, which might have occurred if the machine had started under different initial conditions.

The next chapter deals with applications of three-dimensional rigid dynamics. Here the range of solved problems is necessarily limited. It, however, includes circular and spiral flights and lateral stability of the aeroplane, the parachute and the kite. In these sections Dr. Brodetsky's notation is a great improvement on its predecessors. It has the great advantage that, like the notation in the original treatment of stability, it makes the terms of the biquadratic all positive. In the same way it is much easier to write down the pressure equation in hydrodynamics with the old-fashioned velocity potential instead of the new one.

As regards section 2 ("Dynamics of Air") there is less to be said. The one direction in which mathematicians have made a serious attempt to do substantial work more or less connected with aeronautics (often less) has been in applying hydrodynamics — mainly two-dimensional hydrodynamics of perfect incompressible fluids—to the study of pressures on moving laminæ. In this connection Dr. Brodetsky gives a good general treatment of discontinuous motion. The book as a whole, however, is calculated to emphasise the importance of rigid dynamics as applied to aircraft in their entirety in contrast to these popular hydrodynamical investigations of flow of air round parts of their structure, which, as a matter of fact, are largely affected by mutual interference. It is to wind channel experiments that we must look for the determination of the quantities required in theoretical developments.

In section 3 Dr. Brodetsky returns to the original methods of treatment, and we are glad to notice his recognition of the concept of the ideal "narrow planes gliding at small angles" as having made it possible to initiate a formal study of stability in anticipation of the modern wind tumult. In the next sections he gives a theory of the propeller, while chap. 8 deals with the problem of the aeroplane in moving air. Following Prof. E. B. Wilson the treatment is based on the study of forced oscillations, but the reader will do well to follow Dr. Brodetsky's advice and read his alternative treatment by the method of initial motions. This latter method, by the way, opens up an almost unlimited supply of calculable problems which cannot fail to throw light on questions regarding design and control of aircraft which are under the direction of their pilots.[1]

A further important innovation is the insertion of collections of exercises, commonly described as "Examples." Here again Dr. Brodetsky has had the difficult task of striking out in a new line in incorporating the features of a Cambridge text-book in an aeronautical treatise. This feature will, we hope, be of great use in making the present important developments of applied mathematics available in our honours schools.

A further contribution to the study of aeroplane mathematics by Dr. Brodetsky appeared in the *Mathematical Gazette* for May 1921. It dealt mainly with the conditions of equilibrium of the forces acting on an aeroplane in steady motion of different types, such as horizontal flight, climbing, descending, gliding with or without varying the elevator, diving and upside-down flight, load variations, variation of air density with altitude, flight in steady wind, and circling and helical flights with and without sideslip. In conclusion Dr. Brodetsky remarked: "The present paper will perhaps suffice as an indication to teachers of mathematics and others of how much really useful and interesting information can be obtained with easy mathematics. The introduction of aeroplane mathematics into ordinary courses in all our schools and universities would be a great boon to teachers as well as to pupils."

In addition to strongly supporting Dr. Brodetsky's plea for the study of aeroplane problems by mathematicians and their pupils, we would refer to the equally important task which remains, of equipping the workers in the aeroplane industry with a better knowledge of the principles of mechanics involved in aircraft construction and manipulation. In this connection it is to be hoped that the Institute of Aeronautical Engineers, now two years old, will prove a valuable addition to the roll of similar technical and professional institutes that have been formed in nearly every other branch of applied science, the ranks of which are largely recruited from the students of our technical colleges and universities. For such students Dr. Brodetsky's book is specially suitable.

G. H. BRYAN.

[1] The investigations which the writer of this review was able to initiate and undertake with the assistance of a three-years grant from the Research Department could not for various reasons be incorporated in Dr. Brodetsky's treatise, but have been published in the Reports and Memoranda of the Advisory Committee for Aeronautics and the Aeronautical Research Committee, Nos. 555, 640, 684, 689, and 744, the last two dealing with the general equations of motion of aeroplanes studied from several novel points of view with the use of Brodetsky's notation. The last Report constitutes a brief exposition of the general theory of initial motions in its application to aeroplanes.

The History of Whaling.

A History of the Whale Fisheries: From the Basque Fisheries of the Tenth Century to the Hunting of the Finner Whale at the Present Date. By Dr. J. T. Jenkins. Pp. 336. (London: H. F. and G. Witherby, 1921.) 18*s*.

AT the close of the last century whaling appeared likely to terminate at an early date, in view of the great reduction in the numbers of whales which had been brought about by a relentless and long-continued persecution. The rate of destruction had been accelerated by the introduction of modern methods, and if new fields had not been discovered whaling might by now be almost a thing of the past. Dr. Jenkins's book contains a large amount of information which will be of great value to those who wish to satisfy themselves whether the lessons of history confirm the forebodings which have been expressed about the future of whales.

The work opens with an account of whales, their species, habits and migrations, and zoologists may turn with interest to an Icelandic classification (p. 87) of 1777, which within its limits is not inferior to the most modern system, or to the excellent account of the Greenland whale (p. 116) given by Edge, who took part in Arctic whaling in 1610. The next chapter deals with the products of whales, the method of hunting, and whaling legislation, giving also a brief review of the successive phases of the industry, a subject which is considered in greater detail in later chapters. Whale-oil, a material which was formerly indispensable for the lighting of houses, public buildings, and streets, has remained one of the most important raw materials for the manufacture of soap and glycerine, the great quantities of glycerine which were extracted from it during the war having been of vital importance to this country. Spermaceti, ambergris, and whalebone are still highly valued materials, while the greater part of the carcasses of whales is utilised in the preparation of agricultural manure, the flesh being partly converted into cattle-foods or even used for human consumption.

The first known account of whaling is that of Ochther, who voyaged beyond the North Cape towards the end of the ninth century, and afterwards described his journey to King Alfred (p. 59). The whale industry of the Bay of Biscay, depending principally on the Atlantic right whale, can also be traced back to an early date, since it was at its apogee in the twelfth and thirteenth centuries (p. 61). The Basques appear to have voyaged to Newfoundland as early as 1372 (p. 64), thus anticipating Columbus by more than a century. It will perhaps surprise the general reader to learn that train oil, a name derived from the Dutch *traan*, a tear or drop, is mentioned as a material "to the great commodity and benefit of this our Realm of England," in a grant by Queen Elizabeth, 1576–7 (p. 303).

For nearly three centuries the Greenland whale occupied a position of special importance in the industry, at first in the neighbourhood of Spitsbergen (from about 1604), later in Davis Straits (from 1718), and in the North Pacific and the Arctic Ocean beyond Bering Straits still later (from 1846). The sperm whale industry had meanwhile become so important as to rival that based on the Greenland whale, starting off New England about 1614 (p. 223), and afterwards extending into the Atlantic, Pacific, and Indian Oceans. The Pacific grey whale was hunted for a relatively short period off the coast of California, an original method of capture having previously been invented by the Indians. The operations off Iceland, Newfoundland, Japan, the British coasts (on a larger scale than is generally recognised), and Spain are described in the concluding chapter, which also deals with the specially important modern development of whaling, carried on since 1905 in the neighbourhood of the Antarctic continent, as well as off the coasts of South Africa and South America. This subject, of urgent public interest, deserved fuller treatment.

Dr. Jenkins does not sufficiently emphasise in his work the deplorable reduction in the number of humpbacks within five or six years from the commencement of operations off South Georgia, and he seems to regard this species as still very common off the South African coasts (pp. 295, 296). In suggesting a winter Antarctic close season (p. 299) he is not up to date, as this measure has recently been authorised by the Colonial Office, while the list of the chief existing southern whaling areas on p. 292 gives no hint of the predominance of South Georgia and the South Shetlands, nor does it indicate that whaling operations in the South Orkneys, Australia, Kerguelen, and other localities are extinct or of negligible importance. It would scarcely be inferred from the account of the African stations how great has been the shrinkage of the industry within the last decade. The impoverishment of the natural resources of the world due to the operations of the whalers, and obvious from their own records, might have been explained with greater emphasis. The statement (p. 234) that the discovery of petroleum in 1859 sealed the fate of American whaling can scarcely be described as the only cause, for the diminution in the number of whales which was taking place must have had some influence in producing this result.

It is melancholy to compare the existing distribution of whales with their former abundance. The Greenland whale occurred in profusion in the bays of Spitsbergen at the commencement of Arctic whaling, and the Varanger Fjord during March "simply bubbles or boils" with humpbacks (p. 32). Atlantic right whales regularly passed Biarritz towards the end of the seventeenth century (p. 64), while whales were plentiful off New England in 1614, where an early writer speaks of "mighty whales spewing up water in the air like the smoke of a chimney, of such incredible bigness that I will never wonder that the body of Jonah could be in the belly of a whale" (p. 223). These occurrences are now mostly things of the past and though Dr. Jenkins fully recognises the fact, he is perhaps not sufficiently convinced of the danger of extinction.

The production of whale-oil is usually estimated in barrels, and some discussion of the capacity of this measure would have been useful. The book must be read carefully to discover a reference (p. 244) to barrels of thirty gallons each and a statement (p. 293) that the standard size is now six barrels of oil to one ton. On p. 294 the question is unnecessarily complicated by giving the oil production for Natal in pounds for 1909, in barrels and tons for 1910, and in pounds for British South Africa, 1910. Scoresby (1820) had already stated that the ton consisted of 252 gallons, and had given experimental estimations of the number of pounds of oil to the gallon at different temperatures; from his remarks, however, on the gauging of casks and from his list of stores, where he says that the casks should be of sizes suitable for stowage, it is obvious that the barrel was not a definite measure. There is probably considerable uncertainty as to the extent of a catch estimated as so many barrels of oil.

The figures given by Dr. Jenkins occasionally arouse doubts as to their accuracy, as on p. 268, from which it would appear that, after deducting the value of the baleen, a blue whale is worth 90*l.* and the smaller fin whale 110*l.* In other cases sufficient care has not been taken to explain that a statement is no longer correct, as in the account (p. 29) of the Pacific grey whale, which has ceased to be common on the coast of California. Exception may also be taken to p. 265, representing the facilitation of the capture of the *smaller* whales as the principal result of the introduction of Svend Foyn's harpoon-gun. The statement (p. 293) that whalebone is worth from 39*l.* to 45*l.* a ton is ambiguous, since the list to which it refers includes not only the Rorquals, but also the Greenland whale. It appears from another page that the whalebone of the Greenland whale fetched 1250*l.* a ton in 1901, and even this falls far short of the highest price it is known to have reached.

Some points might have been brought out more clearly by relegating details to tables in which one year could easily have been compared with another. By setting these facts out at length in his main narrative the author has failed, to some extent, to give a correct perspective of the general trend of events. There can be no doubt that whales have diminished in number, and Dr. Jenkins's book will do real service if, by calling attention to the history of the past, it awakens interest in the urgent necessity of so regulating the industry as to avoid the disaster of completing the destruction of animals which must rank as among the most wonderful of mammals. The book contains much information extracted from State papers and other old records at home and abroad, special attention having been given to the Dutch whaling literature. Many of these documents are so inaccessible that the gratitude of zoologists is due to Dr. Jenkins for this service.

Inorganic Chemistry as a Science.

Handbuch der anorganischen Chemie in vier Bänden Edited by Prof. R. Abegg and Dr. Fr. Auerbach. Vierter Band. *Erste Abteilung, zweite Hälfte. Die Elemente der sechsten Gruppe des periodischen Systems. Zweite Hälfte.* Edited by Dr. Fr. Auerbach. Pp. xiii + 1072. (Leipzig: S. Hirzel, 1921.) 140 marks.

ALL chemists will rejoice at the appearance of another volume of the well-known Abegg-Auerbach "Handbook of Inorganic Chemistry," and we desire to offer Dr. Fr. Auerbach our hearty congratulations on his success in carrying on so worthily the great work begun by Abegg. The last volume, dealing with F, Cl, Br, I, and Mn, appeared in 1913. As the editor states in the preface, the appearance of the present volume has been delayed by the European war. It deals with the elements Cr, Mo, W, and U, which belong to the sixth group of the periodic table. It is intended that O, S, Se, and Te shall be dealt with in a later volume.

The authorship of the monographs contained in the present volume is as follows: Chromium, Molybdenum, and Tungsten, J. Koppel; Uranium, R. J. Meyer; Hetero-poly-acids, A. Rosenheim.

The famous writer of the articles on atomic weights in the previous volumes—Brauner—has now dropped out and his place is taken by J. Meyer. Similarly we miss the name of Lottermoser in connection with the articles dealing with colloid chemistry, these being now written by G. Jander.

A very important part of the volume under review is the extensive monograph by Rosenheim on the hetero-poly-acids and their salts. Although the corresponding complex anions may be derived from elements other than those dealt with in this volume, these compounds have been treated as a single group and included in the present volume, since molybdenum and tungsten are amongst the constituents which occur most frequently in these anionic complexes. This is a happy idea and a most useful one, for the monograph by Rosenheim is probably the first really comprehensive and satisfactory survey of this difficult subject that has appeared.

Of the 1064 pages (omitting the subject index) in the present volume, 465 are occupied by the article on chromium. This is undoubtedly one of the finest chemical monographs ever written and must have cost the author an immense amount of thought, labour, and time. We all owe him a great debt of thanks for his splendid work. Attention may be directed specially to his exhaustive treatment of the complex chromiammines (which alone occupies eighty-two pages), the anionic chromi-complexes, the passivity and "electromotive" behaviour of chromium, and the heterogeneous equilibria in which chromium compounds are involved.

Under tungsten there is an excellent account of the tungsten filament lamp and the methods of preparing and treating metallic tungsten, while the monograph on uranium and its compounds by R. J. Meyer contains a very good account of the physical chemistry of the uranyl compounds.

But where everything is so good, it is difficult to select any special part for particular mention. Thus the articles on atomic weights and on colloid chemistry by J. Meyer and G. Jander respectively appear to be quite up to the high standard set in previous volumes. We can give the present volume no higher praise than to say that it would have rejoiced the heart of Abegg. Of the great "Handbook" it can still be said that it must be in the possession of, or readily accessible to, every scientific chemist, whatever may be his special occupation or province of work. It constitutes a re-writing of inorganic chemistry on the basis of the pioneer work of Mendeléeff, Gibbs, Rooseboom, Thomsen, Arrhenius, van't Hoff, Ostwald, Nernst, Abegg, Bodländer and Werner. It does for the present generation what the great work of Gmelin did for a previous one. It utilises thermodynamics and the theory of ions in carrying inorganic chemistry another stage forward on its journey towards the ever-unattainable goal of perfect knowledge. It is still the history of the individual written from the behaviour of the crowd. Some day another Abegg will tell the story of the next stage, perhaps the history of the crowd written from the behaviour of the individual. However that may be, we chemists of the present generation cannot be too grateful to Abegg for the work which he did in bringing inorganic chemistry abreast of the progress of chemical science.

F. G. DONNAN.

Cloud-Forms.

Le Nubi. By L. Taffara. Parte 1, Testo. Pp. 67. Parte 2, Atlante. Tav. 26. (R. Ufficio Centrale di Meteorologia e Geodinamica Roma.) (Roma: Tipografia Ditta L. Cecchini, 1917.)

THE recent revival of interest in cloud-forms which has expressed itself in the publication of various collections of photographs is well illustrated by the atlas which was prepared by Signor L. Taffara and issued in 1917 by the Meteorological Institute of Rome, together with an introductory text which is reprinted from vol. 37 of the Annali of the institute.

The text leads up to a chapter on procedure in the observation of the height and motion of clouds. On the way it explains the history of the study of clouds on the basis of international agreement, the original specification of ten cloud types, the international atlas of 1895, the revision at the International Conference at Innsbruck in 1905 and the republication of the atlas in 1910, which included the ten types and nine variants with a special note on clouds of a type called "lenticularis," the importance of which becomes increasingly evident. In the meantime (1907) the late M. Vincent, of the observatory at Uccle, Brussels, had published an atlas of cloud-forms with much more elaborate classification, which had been followed by Dr. Loisel, of the observatory of Juvisy (Paris), in 1911. The suggested classification includes nine species, comprising twenty-one varieties of lower cloud; two species, twelve varieties of middle cloud (which may further require one of the adjectives "undulatus," "striatus," or "mammatus"); and four species, nineteen varieties of high cloud, which may require further discrimination as "undulatus," altogether fifty-two forms of cloud to be discriminated, or upwards of one hundred if discrimination by adjectives is included. Of the many additional variants that are thus introduced, two—namely, pallio-nimbus, which seems to be a good formula for a rainy day, and alto-cumulus castellatus, a sign of approaching thunder—seem to have acquired merit. Signor Taffara accepts this classification as being the most complete, and in his atlas gives forty-nine photographs (including three autochromes), most of them by himself, but some by Mascari, Loisel, Gamba, Ponte, Peret, Neuhaus, a pastel by Scalla, and two water-colour drawings, which illustrate thirty-six of the hundred examples, and one more type in addition, which is defined as "lenticularis." It does not occur in the list quoted from Vincent. The reproduction of the photographs is excellent; the art of photography of clouds is the subject of a special chapter of the text. The collection forms a beautiful book.

Among the pictures are two very definite types of cloud which belong to the region of Mount Etna and are admirably represented by reproductions of Signor A. Marcari's photographs; these are "la serpe," a long serpentine cloud shown straggling along like a snake, low on the mountain; and "Contessa del vento," a stationary cloud of the Valle del Bove, of which no fewer than five examples are given. These clouds are disposed of in the classification as being "cumulus humilis," in association with other cumulus of low level; but the obviously lenticular nature of the "Contessa del vento" marks it out as being something entirely different from any of the hundred forms. It looks like a gigantic white turban, the crown of which merges into other clouds, and it suggests the core of an eddy, possibly formed mechanically by the mountain, since all lenticular clouds seem to be associated with peculiar dynamical conditions due to the unevenness of the surface. If the lenticular shape indicates the locus of formation of cloud in wind that blows through the cloud, not with it, as it appears to do in other cases, we have apparently in these clouds an opportunity for studying the conditions at close quarters.

We are scarcely yet in a position to make a final classification of clouds, and the elaborate classification into some hundred forms is somewhat premature. Presumably we should begin by drawing a distinction between individual clouds and cloud-groups. Cumulus is a cloud, alto-cumulus a cloud-group. It is questionable whether a vast layer which discloses small cumulus on its margins is fairly classified by the appearance of the cloudlets there. We have no sufficient principles of classification, and for that reason a multitude of discriminatory characteristics scarcely helps us at this stage. The contribution to our knowledge of different forms which the Ufficio Reale has made through the agency of Prof. Taffara is a valuable addition to the material from which classification will at some time emerge. It seems desirable that the path should not be encumbered beforehand with too many adjectives, though it may be confessed that Latin adjectives have a peculiar fascination. They trip so lightly off the tongue that when one begins to use them one scarcely knows where to stop.

Napier Shaw.

Prehistoric Western Europe.

(1) *The New Stone Age in Northern Europe.* By Prof. J. M. Tyler. Pp. xviii+310. (London: G. Bell and Sons, Ltd., 1921.) 15*s*. net.

(2) *Man and His Past.* By O. G. S. Crawford. Pp. xv+227. (London: Oxford University Press, 1921.) 10*s*. 6*d*. net.

We gladly extend a welcome to these two books as real signs of a publishing revival as well as of the widespread interest in the far past due to the diffusion of the idea that, when some day we find the right clues, prehistoric Western Europe will become almost as fascinating as the prehistoric Ægean has become through the great advances of knowledge in the last generation. Both writers have in view the general public, but their aims are very different. Prof. Tyler has striven to interpret the results of research up to about 1912 so as to give the reader a fairly connected story, but in spite of cautious reserve, here and there he unfortunately obscures many difficulties, and suggests that knowledge exists where the careful worker knows only the depths of ignorance. Mr. Crawford, like Prof. Tyler, has also an annoying habit of discursive remarks on things in general, and these irrelevancies make his book larger than it need have been; but his valuable purpose is evidently to stimulate the local archæologist and to enlighten him as to methods in those provinces of study which he can legitimately occupy.

It is a sign of progress that both books look back to Déchelette, the acceptance of whose work now marks any book that claims serious attention, at any rate if it deals with Palæolithic times. But Prof. Tyler carries over a great deal from far older and less trustworthy sources into the new period and gives us a most dangerous sketch of the coming of the "Indo-Aryans," that name of ill omen in archæology. Moreover, he has not taken Déchelette's maps to heart, and needs to learn the lesson Mr. Crawford sets out to teach, namely, that finds and prehistoric remains of all kinds need to be mapped accurately for serious geographical study. Mr. Crawford will not think it amiss if we say that among his papers (*e.g. Geog. Journ.*, 1912) are many things that teach the lesson more effectively than this present book. None the less, precept does come with a certain appropriateness from a well-known practician, and Mr. Crawford's suggestions about road tracing imply that he is going to develop the archæological data on our ordnance maps in his new and appropriate position as Archæologist to the Ordnance Survey.

(1) After reading Prof. Tyler's book, one is more than ever convinced of the need for a careful resurvey of all the evidence for the periods that are commonly supposed to intervene between the Magdalenian and the beginning of the Bronze age. Some megaliths almost certainly belong to the Bronze age even if bronze finds do not occur in them, and some of the finds of polished stone axes, and so on, are in danger of being shown to belong to the Metal ages. On the other hand, some finds of flints of Azilian and perhaps earlier types are likely to be shown also to belong to later dates and even to the Iron age. In other words, survivals of late Palæolithic cultures seem to have lingered on into the Metal ages in N.W. Europe, and metal seems to have come in gradually, locally, and partially, so that the so-called Neolithic period, while still acknowledged to be real enough, is seeing both its limits fade away. Prof. Tyler is perhaps justified in neglecting these refinements, but a more definite consciousness of them, as well as a study of the files of the Journal of the Royal Anthropological Institute, especially for Mr. H. J. Peake's papers, would have helped him over many a stile.

Perhaps his chapter on Megaliths is the most inadequate in a book that must be considered, broadly, a failure, in spite of several points which are at any rate suggestive. Take, for example, the contrasts in distribution between so-called dolmens and *allées couvertes*, and the similarities between the spread of the latter and that of menhirs. The peculiar localisation of holed dolmens, the relation of the *allée couverte* to the English long barrow and the Scottish long cairn, whether holed or not, as well as to the *Ganggräber* of North Germany, are all points for serious study by the next person who tries to make a prehistoric synthesis. The views of Perry and others about the relation of dolmen building to metal seeking—prospecting for gold, copper, and tin—should have been studied critically; while Abercromby's "Bronze Age Pottery," with its discussion of the beaker, should have been brought into relation with the loess zone. With such study, a much more vital view of line of movement round about the end of the Neolithic age would have been gained. We greatly need a synthetic statement of the diverse movements of that transition time heralding the opening of the Bronze age with its concentration of attention on the gold of Ireland and so on the ways of getting to it. The succession of shell mound and dolmen (*allée* *couverte*) on the same site, as in Guernsey, is another fruitful line of thought, and no synthesis should neglect M. de Guérin's amplifications of Déchelette's views on ancient incised figures and idols.

The movements outlined above must be taken into account by linguists who wish to find a link with archæology, and it will probably be through the forging of that link that the great advance we look for will occur. It is possible to argue for the spread of at least some elements of the languages of the older philologists along the lines of distribution of beaker pottery, but it is quite likely that those language elements travelled far later, with other archæological correlatives, along the line determined in large measure by the presence of loess and the consequent weakness of forest and swamp. One may venture the statement that probably rather by such study than by the more exclusively philological ones suggested by Prof. Tyler will our knowledge of the sources of the European languages be improved, and our views as to their adoption, with modification, by peoples who were not bred with them, made precise. Anyhow, it seems more than likely that our great families of European languages in several cases illustrate adoption of a language-basis from foreigners rather than differentiation of languages by process of time from a single common ancestor. The references to early religion that Prof. Tyler gives seem specially dangerous in the dim light of present-day doubt.

(2) Mr. Crawford's book shows he has been trying to set his thoughts in order after the trials and difficulties of war service, and, in the midst of discursive generalities, one does frequently come upon points of value for the student who wants to take his archæology regionally and to see man at each period in his proper relation to the local environment of that period. Fortunately, Mr. Crawford is alive to the fact that the environment changes with the period even after the close of the Ice age. He sees that the clearing of forests and the draining of swamps have made vast differences to men's opportunities for movement and lines of communication, and he understands the difficulties of argument on these complex problems. He is an impassioned eulogist of old roads and of the joys of tracing them, and the beginner in prehistory who is anxious to get hold of method, rather than of fact, will find Mr. Crawford's book interesting and profitable, though he may be left wondering why the author did not omit a good deal of general talk and give the student a great deal more help along his way.

H. J. F.

Rosenbusch's Petrology.

Mikroskopische Physiographie der petrographisch-wichtigen Mineralien. By H. Rosenbusch. Band 1. Erste Hälfte. *Untersuchungsmethoden.* Fünfte, völlig umgestaltete, Auflage. By Prof. E. A. Wülfing. Lieferung 1. Pp. xvi + 252. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele), 1921.) 16*s.*

ALL who are interested in petrological studies will welcome a new edition of this familiar text-book, which made its first appearance nearly forty years ago. Every subsequent edition has exceeded its predecessor in size and completeness, and the fifth, to judge from this instalment of the first half of the first volume, is not likely to prove an exception. It is true that some of the topics dealt with in earlier editions, such as the principles of stereographic projection, are omitted as being now sufficiently familiar to the student, but the space thus saved, and more, is required for the developments during the seventeen years that have elapsed since the previous edition was published.

This issue is the work of Prof. E. A. Wülfing, the author of the admirable account of the methods employed in the microscopical examination of minerals in the fourth edition of the book, and the successor of Rosenbusch at Heidelberg. It has been to a large extent rewritten, and there is a decided advance in the clearness with which the fundamental principles are explained, even if the mathematical aspect of the subject is perhaps still somewhat over-emphasised in places.

The first forty pages are mainly devoted to a detailed description of the most up-to-date methods of cutting, grinding, and mounting thin slices of rocks. This is followed by an exposition of the author's views on the nature of light and an account of its properties in both isotropic and anisotropic media, including the phenomena of absorption and pleochroism. There is also a useful section devoted to the methods of producing polarised light in which the different forms of prism that have been devised for the purpose are described, and another to the production of monochromatic light.

The text is accompanied by numerous clearly drawn illustrations, many of which appear for the first time, and there is a handsome coloured plate giving the succession of Newton's colours, the amount of relative retardation corresponding to the different tints, and the usual graphic representation of the relation between birefringence, thickness, and relative retardation.

JOHN W. EVANS.

Our Bookshelf.

An Agricultural Atlas of Wales. Made on behalf of the Institute for Research in Agricultural Economics, University of Oxford, by J. Pryse Howell. Pp. iii + 23 maps + 3 maps in pocket. (Southampton: Ordnance Survey, 1921.) 5s. net.

IT is to be hoped that the enterprise of the Ordnance Survey in publishing an agricultural atlas of Wales will be rewarded sufficiently to facilitate the publication of similar atlases for regions of England. Mr. J. Pryse Howell has worked at agricultural surveys for years at Aberystwyth and at Oxford, and the present atlas does considerable credit to his care and industry. It is based on parochial returns, and consists of twenty-three maps, one for each agricultural product. There are also three loose maps in colour giving the orography, geology, and rainfall of Wales, and as the agricultural maps are on translucent paper they can be superimposed on the loose maps in order to trace correlations.

It is a pity that the revision of Welsh geology is not yet sufficiently complete to give a better representation of the stratigraphy of West Wales based on the work of Prof. O. T. Jones and the correlation with geological facts. The correlations traceable often depend more on the drift than on the solid geology, though these maps of Wales are mostly of a kind simpler than one would find in England, for in Wales the greater part of the surface is impervious soil on hard rocks, and agriculture is dominated by orographical conditions which so greatly influence rainfall. In England the influence of soil would be more complex.

The agricultural relations of the belt between the Vale of Clwyd and the Dee at Corwen, of the lower Montgomeryshire Severn, the parallels between pigs and potatoes, and many other points, stand out clearly, while the curious distribution of lucerne, sainfoin, clover, and grasses under rotation prompts a number of questions. The atlas should be used widely by agriculturists and economists, by persons interested in local administration, and by teachers, especially teachers of geography.

The Silver Bromide Grain of Photographic Emulsions. By A. P. H. Trivelli and S. E. Sheppard. (Monographs on the Theory of Photography from the Research Laboratory of the Eastman Kodak Co.) Pp. 143. (New York: D. Van Nostrand Co.; London: Kodak, Ltd., 1921.) 15s.

THE research laboratory of the Eastman Kodak Co. has in preparation a series of monographs on the theory of photography. The time is ripe for the presentation in a connected sequence of the work done and the results obtained, for these are very numerous and very scattered. The present volume is the first issued, and presumably may be regarded as a sample of those that are to follow. The company, the laboratory, and the authors are to be congratulated in that they have made so good a beginning. The authors have been engaged for some years in the practical study of the subject with which they deal, and they give some results that have not been published before. A study of the relations that exist between the sizes of the grains and their photographic properties is reserved for a future monograph, though it is by no means neglected in the present treatise. The first half of the volume deals with the influence of ammonia on photographic emulsions and a theory of ripening; von Weimarn's theory and the determination of the dispersity of silver bromide precipitates; accessory factors influencing the dispersity of silver bromide emulsions; crystallisation catalysis; and capillarity and crystalline growth. The intimate relation between grain structure and photographic properties is, however, fundamentally a matter of crystallographic investigation, and the remainder of the volume is devoted to this matter in five chapters. The authors state that "when the experimental conditions regulating the three primary factors, (1) dispersity-distribution, (2) recrystallisation, and (3) sorption (both adsorption and desorption), are completely known, scientific control of the characteristic curve—*i.e.* of speed, latitude, and density—will be possible." The book is copiously illustrated and well indexed; it has many summaries, all necessary references, and an extensive bibliography. C. J.

Indian Science Congress: Handbook for the Use of Members attending the Ninth Meeting to be held at Madras from the Thirtieth of January to the Fourth of February, 1922. Pp. x + 165. (Madras: Capt. Clive Newcomb, Chemical Examiner, 1921.)

THE Indian Science Congress has held annual meetings in various parts of India yearly since 1914 much on the lines of the British Association for the Advancement of Science, and the handbook issued for this year's meetings contains a number of interesting articles by experts, including a brief history of Madras and its Corporation, descriptions of the museum and Connemara Public Library, the Madras Harbour, the new city waterworks and the chlorination purification of the supply, and an interesting account of places of historical interest within twenty miles of the city. General education in Madras is dealt with by the principal of the Presidency College, and medical education by the principal of the Medical College. The remainder of the little book is occupied with accounts of scientific work in the Presidency in different branches of knowledge, and includes the work of the King Institute of Preventive Medicine, situated several miles from the city and concerned chiefly with hygiene, and an interesting account of the valuable practical investigations being carried out at the Agricultural and Research Institute at Coimbatore by the Director of Agriculture. Contributions on prehistoric archæology, the anthropology of Southern India, marine zoology, the geology of Madras, and biological work there, complete an instructive handbook which is very suitable for the purpose for which it has been designed. L. R.

Treatise on Fractures in General, Industrial, and Military Practice. By Prof. J. B. Roberts and Dr. J. A. Kelly. Second edition, revised and entirely reset. Pp. x + 755. (Philadelphia and London: J. B. Lippincott Co., 1921.) 42s. net.

THE authors of this volume have set out, as they claim in their preface, to present a lucid view of the subject in the light of recent discoveries, to point out an accurate scientific procedure, whether operative or other, according to the character of individual injuries, and to urge the general practitioner, as well as the surgical specialist, to the study of methods which, as experience indicates, have given the best results.

As a consequence of experience gained during the war, the treatment of gunshot and other wounds of bones has been revolutionised, because the distinction between aseptic fractures with unbroken skin and those breakages of bone which have been exposed to infection has been fully grasped. The authors insist that much of the old teaching as regards the treatment of fractures still holds good, as, for example, Lucas-Championnière's dogma as to early mobilisation and gentle massage being valuable for restoring contour and function in fractures of shafts and joint-ends of bones. They urge the critical, intelligent, and frequent examination of fractures instead of a too absolute reliance on radiographic interpretations by inexperienced laboratory workers. The illustrations so very necessary in a descriptive book of this nature are, without exception, excellent, and will be found a great help in following the text. Indeed, it is the most complete and comprehensive book on a very important branch of surgery that we have yet seen and it may be regarded as one of the few good results of the world-war.

The Raw Materials of Perfumery: Their Nature, Occurrence and Employment. By E. J. Parry. (Pitman's Common Commodities and Industries.) Pp. ix+112. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3*s.* net.

During the last half-century perfumery has in part become a branch of synthetic organic chemistry. Many of the odoriferous constituents of natural perfumes (*e.g.* vanillin and heliotropine) are prepared synthetically in a pure state, and some substitutes (*e.g.* "artificial musk," trinitrobutyl xylene) for natural perfumes are now in use. The rare natural perfumes such as musk have not yet been produced in the test-tube. With the production of the materials, however, the perfumer's art has made only a beginning and much depends on the skilful blending of the constituents. Mr. Parry has given a simple and interesting account of his subject. It is non-technical, and perhaps might have included a little more of the chemistry involved. The latter is of so complicated a character that it would perhaps not have been intelligible to the ordinary reader. The address of the president of the Chemical Section of the British Association last year (Nature, October 20, 1921, p. 243) shows, however, that something can be done in this direction.

Handbuch der biologischen Arbeitsmethoden. Edited by Prof. Dr. Emil Abderhalden. Leiferung 45, Abt. 5, *Methoden zum Studium der Funktionen der einzelnen Organe der tierischen Organismus.* Teil 7, Heft 2, *Sinnesorgane.* Pp. 197-260. (Berlin und Wien: Urban und Schwarzenberg, 1921.) 28.80 marks.

The section on the analysis of sounds in Prof. Abderhalden's extensive "Handbuch" is written by Dr. E. Budde. It contains accounts of the use of mechanical integrators for the analysis of a periodic curve, and of the method of calculating the terms of the Fourier series from ordinates at regular distances apart. Tables are given to facilitate the calculation when seventy-two ordinates are measured per period. It is not often that so many ordinates are taken, but when it is necessary or desirable the tables will save much time and trouble.

A Course of Practical Organic Chemistry. By Dr. T. Slater Price and Dr. D. F. Twiss. Third edition. Pp. xiv+239. (London: Longmans, Green and Co., 1922.) 6*s.* 6*d.*

In this edition minor alterations have been made to bring the subject-matter up to date. The methods of preparation of typical organic compounds and the quantitative analysis of compounds of carbon, hydrogen, nitrogen, the halogens, sulphur, and phosphorus, are well described. The scheme given for the identification of "an organic compound" is too incomplete to satisfy ordinary requirements, and could usefully be extended in future editions. Mixtures should also be considered.

Letters to the Editor.

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

The Langley Machine and the Hammondsport Trials.

The leading articles in Nature of November 3 and January 26 last appear to have missed the point of my discourse on the Langley Machine and the Hammondsport Trials. My paper was written to expose a fallacy in which officials of the Smithsonian Institution had used their great opportunities for imposing upon the public a false belief that the Langley machine had been flown in 1914.

The leading articles in Nature, instead of making any denial of the charge that vital changes were made in the Langley machine at Hammondsport before any flight was attempted, contend that my "paper tends to give an erroneous impression of the importance of the part played by the Wright Brothers" in the producing of the first man-carrying aeroplane. Nature suggests that it was Langley who did the laborious work of preparing the scientific data upon which the first aeroplane design was based, and that the Wright Brothers merely contributed the system of wing warping—the final step or "keystone"—in the problem of flight. The writer of the articles in Nature refers to Sir Richard Gregory's book "Discovery," from which he makes two quotations.

I agree with the author of "Discovery" that many great inventions are based upon pure science, and that often the person who receives the credit for an invention is the one who has added some mechanism which turns the scientific knowledge of another to practical use. In the facts in regard to the invention of the aeroplane, however, the author of "Discovery" and the writer of the leading articles in Nature are in error. The real truth of the discovery of flight is that the Wright Brothers first established a scientific basis for aeroplane design; they then invented the mechanical means for putting this scientific knowledge to practical use. The spectacular nature of the latter has blinded the public to the importance of the former.

In 1914, when I was beginning the preparation of my paper on the "Life and Work of Wilbur Wright," which was read in 1916 as the fourth Wilbur Wright Memorial Lecture, I visited America to collect material for this lecture. During my stay, which extended over several months, I also studied the practical side of aviation and, at the age of forty-seven, made over a hundred flights on the "unstable" Wright machine. While in Dayton I was allowed to examine, with the privilege of copying, much of the personal correspondence and diaries, as well as the records of the early purely scientific work, of the Wright Brothers. I saw the original balances and twenty or thirty (out of the great number) of the original test surfaces with which the Wright Brothers in 1901 made thousands of measurements in a wind tunnel of the lift and drift and the travel of the centre of pressure on plane and curved surfaces. Copies of the tables obtained from these tests were also given to others who were interested in the problem of flight.

These laboratory measurements (*Century Magazine*, September 1908, pp. 646-647) covered a field many times greater than had been covered by the work of all other experimenters together. But the importance of the measurements lay in their accuracy. These tables did not agree with the measurements made by Langley or by any of the other experimenters. The Wright Brothers, finding that all marine propellers at that time were based upon empirical formulæ, made a study of propellers by analysing the various dynamic reactions. From these studies they evolved a theory. The propellers used on their first power machine were probably the first ever designed from theory and not from experiment. They made extended studies into the principles of equilibrium, and in this field made important scientific discoveries. Their mechanical means for carrying some of these principles into effect were patented, and the resulting litigation attracted so much attention as to cause the scientific work upon which the patents were based to go without notice. It was upon their own tables and other scientific work that the Wright Brothers built their first power machine.

These scientific experiments were made entirely at the expense of the Wright Brothers themselves, and with no thought or expectation of any other reward than the satisfaction of discovering things unknown before and the honour that naturally comes as a result. It was not until they attempted to build a power machine to carry this scientific knowledge into practical use, an expense too great for their small means, that they took out patents.

My address on the "Langley Machine and the Hammondsport Trials" was not a criticism of Langley nor of his scientific work. This was not a point at issue in my paper. But since the writer of the articles in NATURE now brings this into the discussion, I feel that some of his statements should not be allowed to pass uncorrected.

NATURE is in error in attributing the discovery to Langley of the inherent stability effect of the dihedral angle of the wings adopted by Langley in his models. This method of maintaining lateral stability in calm air was published by Sir George Cayley a hundred years ago, and was used by Penaud in his flying models in 1870 and 1871. It has never yet been solely relied on for lateral balance in actual human flight, having been always supplemented by aileron control.

The writer in NATURE says: "So far back as July 23, 1891, a paper on his (Langley's) experimental researches is to be found in NATURE, showing that the flight of a man-carrying aeroplane was possible, and enunciating the fundamental principles for obtaining a design." The demonstration referred to as "showing that the flight of a man-carrying aeroplane was possible," was stated on page 107, "Experiments in Aerodynamics," where Dr. Langley says, "such mechanical flight is possible with engines we now possess, since . . . one horse-power rightly applied, can sustain over 200 pounds in the air at a horizontal velocity of over 20 meters per second (about 45 miles an hour) and still more at still higher velocities." This statement was based upon the mistaken principle published by Sir George Cayley in Nicholson's *Philosophical Journal* of November, 1809, and accepted by most experimenters thereafter, that the pressures on a plane were normal to the surface of the plane, and that the drag was equal to the lift multiplied by the tangent of the angle of incidence. Langley's actual measurements did not confirm this theory, but he assumed (page 65, "Experiments in Aerodynamics") that if he had made certain modifications in the planes he was measuring other results would have been secured which would have confirmed it. It was this assumption that formed the basis of his demonstration that one horse-power would sustain 200 pounds at a speed of 45 miles an hour. As a matter of fact his actual measurements (page 64) showed that one horse-power could carry only 60 pounds at 45 miles an hour.

The other fundamental principle enunciated by Langley in 1891 was that known as the "Langley Law," which was that the faster an aeroplane be flown the less will be the power required to sustain it. The fallacy of this law is well known to all aeronautical engineers to-day, but up to 1910 this was generally considered as Langley's chief contribution to the science of aerodynamics. In that year when the Regents of the Smithsonian Institution decided upon the placing of a bronze tablet in the Institution commemorating Langley's work in aerodynamics, they ordered the following legend to be inscribed upon it:—

SAMUEL PIERPONT LANGLEY
1834–1906
SECRETARY OF THE SMITHSONIAN INSTITUTION
1888–1906.

AERONAUTICS:

LANGLEY LAW: "These new experiments show that if in such aerial motion there be given a plane of fixed size and weight, inclined at such an angle, and moved forward at such speed that it shall be sustained in horizontal flight, then the more rapid the motion is, the *less* will be the power required to support and advance it."—Langley, "Experiments in Aerodynamics," 1891, p. 3.

"I have brought to a close the portion of the work which seemed to be specially mine—the demonstration of the practicability of mechanical flight."—Langley Aerodrome, Smithsonian Report, 1900, p. 216.

FLIGHTS:

Steam model, May 6, and November 28, 1896.
Gasoline model, August 8, 1903.

Before the tablet was cast, the Wright Brothers were consulted as to the advisability of using this inscription and they, not wishing that anything discreditable to Langley should appear on the tablet, Mr. Wilbur Wright wrote a letter to Secretary Walcott, from which the following is quoted:—

"I have often remarked to my brother that Prof. Langley was ill-fated in that he had been especially criticised by his enemies for things which were deserving of highest praise and especially praised by his friends for things which were unfortunate lapses from scientific accuracy. I should consider it both unwise and unfair to him to specially rest his reputation in aerodynamics upon the so-called Langley Law, or upon the computation which gave rise to it, as they do not seem to represent his best work. The particular computations which led him to enunciate this law are found on pages 63-67, 'Experiments in Aerodynamics.' A careful reading shows that he never actually tried the experiments of which he professed to give the result. . . . It is clear from the Doctor's statement that he never demonstrated by direct experiment that weight could be carried at the rate of 200 pounds per horse-power at 20 meters per second, nor that the power consumed decreased with increase of speed up to some remote limit not attained in experiment. He merely assumed that he could have done it by varying the experiments a trifle and based the so-called Langley Law on this mistaken assumption."

The Regents of the Smithsonian Institution adopted this suggestion and the Langley Law was not inscribed on the tablet.

The article in NATURE of November 3 states that "the Wright Brothers are equally clear in their acknowledgment of Langley's work," and gives a quotation from them to support this idea. This quotation, taken in connection with the suggestion of the writer in NATURE, may have carried to some readers the erroneous impression that the Wright Brothers acknowledged an indebtness to Langley for his scientific work. This was not the fact. The quotation given makes no reference whatever to Langley's scientific work. It is simply a generous acknowledgment by the Wrights at the time of Langley's death for the inspiration received from his faith in the possibility of human flight, and containing an expression of gratitude for information as to books on the subject of flight other than those they had already read. The Wright Brothers have also acknowledged their indebtedness to Chanute, Mouillard and others, but have always made it clear that their greatest debt was to Lilienthal.

GRIFFITH BREWER.

33 Chancery Lane, London, W.C.2.

SOME difficulty is felt in continuing a discussion of the relative merits of the great pioneers in aviation, Prof. Langley and the Wright Brothers, since they are all entitled to our esteem, and comparison seems to be unnecessary. Mr. Griffith Brewer does not appear to dissent from such a general statement, but one suspects that his enthusiastic admiration for the work of the Wright Brothers has led him to make extravagant claims.

It is very surprising to hear that "the Wright Brothers first established a scientific basis for aeroplane design," and that their laboratory measurements "covered a field many times greater than had been covered by the work of all other experimenters together." The only publication cited in support of this contention occurs in two pages of the *Century Magazine* in 1908, and readers of scientific literature in aeronautics will realise that they do not know where to look for data based on the work of the Wright Brothers. Indeed, Mr. Brewer indicates that this must be so when he says, "While in Dayton (in 1914) I was allowed to examine, with the privilege of copying, much of the personal correspondence and diaries, as well as the records of the early purely scientific work of the Wright Brothers"; apparently the work was not publicly available. Is it then strange that one should look to Langley as the scientific pioneer, since he took the normal steps of a man of science and published complete accounts of his results as he obtained them?

Mr. Brewer refers to the "Langley Law" that the faster an aeroplane be flown the less will be the power required to sustain it. He says: "The fallacy of this law is well known to all aeronautical engineers to-day, but up to 1910 this was generally accepted as Langley's chief contribution to the science of aerodynamics." The inadequacy of the law is evident now, but it is still at least partly true; in the case of the most modern aeroplanes the horse-power for flight decreases as the speed increases from the least at which support can be obtained. The increase of power required to increase the speed of the modern aeroplane above a certain limit is due to the light-weight engine, a factor which did not come into consideration in early practice. The error of unsound extrapolation outside the experience of the day was made, but only superficial observers could regard the enunciation of the law as "Langley's chief contribution" to aeronautical research.

One can only disagree with Mr. Brewer in his review of the situation and regret that this aspect of pioneer work in aviation was introduced in the tone of the paper on "The Langley Machine and the Hammondsport Trials." The point of the paper was not so much missed, as suggested by Mr. Brewer, as countered owing to the fact that the statements therein did not carry conviction. One of the articles in NATURE intimated this in the suggestion that the Royal Aeronautical Society should take up the matter and after full investigation issue an official report. The views on the Langley aeroplane expressed by Mr. Brewer cannot be accepted as final although given in all good faith.

THE WRITER OF THE ARTICLES.

Some Biological Problems.

DR. CUNNINGHAM (NATURE, February 9, p. 173) cannot be more weary of this discussion than I. It is many years since I, becoming doubtful, first tried to discover the precise meaning of certain biological key-words. To this day I have not succeeded. It has been my misfortune to encounter authoritative people who, instead of perceiving that I was genuinely puzzled, thought I might do "much harm by leading many who have no special knowledge of heredity and evolution"—*e.g.* Professors Goodrich and Bayliss—"to distrust the work of those who are engaged in research on these subjects." May I suggest that in this matter authority and regard for public opinion are out of place. Most biologists profess to know the meanings of their terms; but there is no agreement, and no definitions can be framed which cover the whole of common and accepted usage. A science which lacks a precise and significant means of expression labours under paralysing difficulties.

Dr. Ruggles Gates thinks that a variation is a character. Surely he is mistaken. When one individual varies from another (*e.g.* child from parent) the difference is revealed in a character. If this new character becomes established in the species, it remains a character; but, even colloquially, it ceases to be a variation. How then can a variation be a character? A variation cannot be thought of without a comparison, explicit or implicit, between two separate individuals; a character can always be thought of without such comparison. Evidently, then, a variation is not a character, but an unlikeness between two individuals which is displayed in a character. When we say that a variation is innate *or* acquired we know exactly what is meant—*i.e.* that a difference between two individuals is germinal *or* somatic, a product of nature *or* nurture. For example, if B differs from A in that he has a sixth digit and a scar, he varies innately (not by acquirement) in the case of the digit, and by acquirement (not innately) in the case of the scar. But when we say that the digit itself is innate (not acquired) and the scar itself acquired (not innate) what can we mean? We are now comparing not separate individuals, but two characters of the same individual. Obviously the digit as such is no more germinal, no more a product of nature and evolution, no less somatic, no less a product of nurture than the scar. How then is the one more innate or acquired than the other? Our terms "innate" and "acquired" are now unmeaning or else they have new meanings. But, as I say, no new meanings can be thought of which cover the whole of established usage. All this would not matter were it not for its consequences.

When it is said that an innate variation is inheritable we know exactly what is meant—*e.g.* that the descendants of B will tend to reproduce the digit (will tend to differ from A) even when reared under the same influences as A. Again, when it is said that an acquired variation is not inheritable, we know exactly what is meant—that B's descendants will not reproduce his scar when reared under the same influences as A. But when it is said that innate characters are inheritable and that acquired characters are (or are not) inheritable, what is meant? Either the word inherit has now no meaning, or in this single sentence it has two directly contrary meanings—inherit when applied to innate characters, and non-inherit (*i.e.* vary) when applied to acquired characters. We are now fully immersed in that fog of words in which, except for a brief interlude in Darwin's time, biology has strayed for a century.

The trouble began in the popular notion that, like Topsy, some (*i.e.* innate) characters "just growed," while others are acquired through some influence or other and may become, through "centuries" or "generations" of experience, "innate" in the race. Lamarck formally introduced this popular notion to science. His second law has been disputed and shown to be inconsistent with the first, but the first has been accepted without question. Yet it is crammed with obviously erroneous assumptions. It is not true that "In every animal that has not passed beyond the term of its development, the frequent and sustained use of any organ strengthens it, develops it, increases its size, and gives it strength proportionate to the length of time of its employment. On the other hand, the continued lack of use of the same organ sensibly weakens it; it deteriorates, and its faculties diminish progressively, until at length it disappears." (1) No character is in any clear sense of the words more innate or acquired than any other. (2) In our own bodies are many characters—*e.g.* hair, teeth, external ears and genitals—which do not develop in the least in response to use, or atrophy in the lack of it. Only some characters develop in response to use, and only such characters atrophy in the lack of it. There is no evidence that the development of any characters in low animals is influenced by use. On the contrary, the power of so developing appears to be, relatively speaking, a late and a high product of evolution. But as to that I shall have something to say when trying to trace evolution from the physiological standpoint. (3) Lamarck's first law dimly implies that which is more clearly implied in the writings of succeeding biologists—that although all characters develop somewhat in response to use, no characters develop greatly in that way; the actual truth being that, from birth onwards, much the greater part of the growth of the higher animals is made in response to that influence.

For millions of years Nature fashions a species to develop in response to an influence (*e.g.* injury or use). The race persists because its individuals grow in that way when need arises. At long last a biologist observes such a character—*e.g.* scar, or blacksmith's muscles. For no particular reason he calls it "acquired," and supposes that evolution results from the "transmission" of such traits—a wonderful thought, for he must know that regeneration and use-acquirements are products of evolution. For half a century his fellows agree. Then some one denies not the fundamental error, not the special acquiredness of the character, but only its inheritability. Thereafter, controversy, founded in the best scholastic style on three misused words and a number of unverified assumptions, rages for half a century. Presently a majority are convinced that acquired characters are not transmissible. Thereupon some biologists devote their energies to discovering what characters are innate and therefore inheritable, and others to discovering what characters are inheritable and therefore innate. Hedged about by her extraordinary terminology, biology becomes isolated from a number of kindred sciences and studies—physiology, psychology, medicine, history, pedagogy, and the like. Of what use is it to the students of these studies to learn that a character is innate or acquired? They want to know what causes it to develop. Of what uses is it to the biologist to know how a character develops? He wants to know whether it is innate or acquired. Meanwhile many problems, mainly psychological, social, and medical, of vast importance, on which the whole future of the race depends, await solution and the driving home of the truth by the weight of scientific proof and united scientific conviction. But all these problems are too big for the subsidiary sciences. Their students are too few in number. Moreover, in every case the evidence is derived from more than one science. Only biology, which sits at the hub whence radiate all the studies that deal with life, is in a position to deal with them, and then only if it has a clear and precise medium of expression. I daresay many biologists think I am vapouring. But, if they wait, I think they may perceive a method in my madness. This much I will permit myself to say: that unless biology awakens from her long sleep, our modern civilisation is likely to smash, just as old Rome smashed and for the same reason—because there is not enough intelligence left to run a society grown very complex.

According to Dr. Cunningham, biologists bestow the descriptions "innate" and "acquired" on characters which develop in response to internal and external stimuli respectively. That is to say, "innate" and "acquired" are supposed by him to be technical terms which have meanings quite other than their ordinary dictionary meanings. But:—

(1) Before this discussion began no one ever thought of such technical meanings. On the contrary, as attested by all literature, biologists have genuinely believed that some characters are really innate and others really acquired. Hence the synonyms—germinal, blastogenic, plasmogenetic, somatic, somatogenetic, and the like—which were coined to give definition and emphasis to this belief.

(2) Light, heat, moisture, gravitation, food, injury, and the like are all external influences; and of them, the only one which is commonly regarded as evoking acquired characters is injury. On the other hand, hormones and functional activity (use) are internal influences; and since hormones act from outside the characters they influence, whereas use acts from within, the latter is the most internal of all stimuli. But use is supposed to be more especially *the* influence

which evokes acquired characters. Clearly internal, just as much as external, stimuli evoke what are called "acquired characters."

(3) As a fact, biologists when classifying characters as "innate" and "acquired" have not in practice been influenced by the kind of stimuli which have evoked them. As again all literature testifies, they have, in accordance with popular usage, called all characters which develop in response to any very glaringly obvious stimulus acquired. For example, they do not call the musculature of the child, the youth, and the ordinary man "acquired"; but they do bestow that name on the musculature of the blacksmith, though the latter develops in response to precisely the same influence. Any number of similar examples might be named.

G. ARCHDALL REID.

9 Victoria Rd. South, Southsea, Hants,
February 25, 1922.

A Rainbow Peculiarity.

EVERY one has observed a brilliantly coloured rainbow and also the secondary bow situated some distance on the outside of the primary. Is it a fact of general observation that the whole area of the inside of the primary bow is brighter than the region outside?

It was not until the winter of 1913 that this bright inner region was brought to my notice on a photograph I secured on December 1 of that year. On the morning of that day one or two heavy showers passed from S.W. to N.E., traversing the ground to the north of the Norman Lockyer Observatory. The primary bow in question was distant about one mile to the north of the observatory, as could be judged from the spot where the rainbow ended on the ground. An attempt was made to photograph the bow with a 4×5 screen focus Kodak using the ordinary Eastman film, and on development it was found that the light from the interior area of the bow had acted on the film in a much more actinic manner than that on the outside—or, in other words, the area inside the bow was brighter than that on the outside. The accompanying illustration (Fig. 1) gives a reproduction of the photograph.

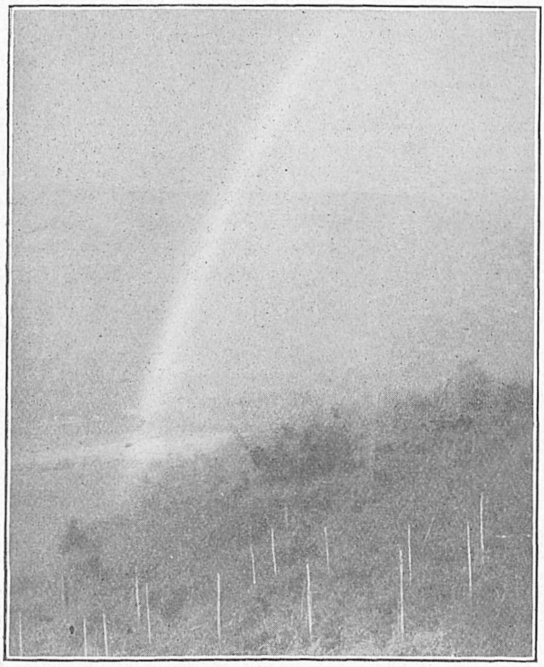

FIG. 1.—Rainbow photographed on December 1, 1913.

I somewhat doubted the reality of this appearance until I had taken another photograph of a similar nature, and an opportunity occurred in December of last year.

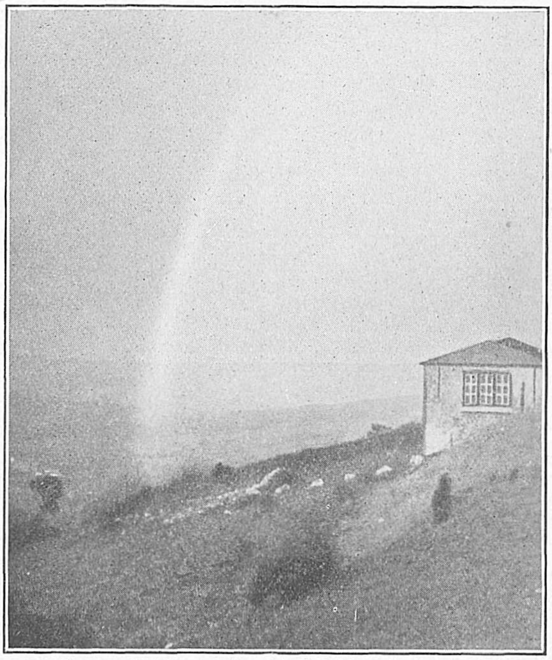

FIG. 2.—Rainbow photographed on December 22, 1921.

On December 22 numerous showers were passing to the northward of the observatory, and I photographed three different rainbows during the morning. They were not so brilliant as that photographed in 1913, but yet sufficiently bright to record the same phenomenon. One of these photographs is reproduced in Fig. 2, and a comparison of the intensity of the distant landscape inside and outside the primary bow corroborates the previous photograph.

These photographs thus establish a fact in Nature which appears to have been rarely noticed visually. Kämtz in his "Lehrbuch der Meteorologie" (vol. 3, p. 158), a book which was published so long ago as 1836, writes on the subject as follows:—"When a rainbow with very pronounced colours is projected against a dark cloud, the sky above the first bow is darker than that underneath. If we follow the path of light in our spherical drops and remember the limiting values which have been given above, we receive none of the inner surface reflected rays from any drops which lie higher than those in which we found the maximum and which form the bright bows; lower-lying drops also send out rays from the inner back surface, and, although these more or less diverge, they tend to produce an undoubted brightness under the bow. The drops lying above the bow also send out reflected rays from their near sides, while from the drops lying under the bow we receive rays from the far side."

Following this extract Kämtz states that he has to thank Brandes for directing his attention to this phenomenon, and gives a reference to Gehler's "Wörterbuch," *Nach. Astr.*, vol. 7, p. 1324.

WILLIAM J. S. LOCKYER.

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Flowering Dates of Trees.

Referring to Mr. J. E. Clark's interesting article on the above subject in Nature of February 16, I would suggest that a consideration of the different variations of temperature between Falmouth and London will help to solve the problem. From phenological observations I have made at Falmouth for many years past, it would appear that on an average this district is earlier than nearly all other parts of England in January and February by about a fortnight, but that after those months the lead is lost and the flowering and leafing of trees, etc., are retarded by our situation being near the coast line, where the waters of the European current play such an important part in lowering the land temperatures in summer and raising them in the winter. It is not always sufficiently realised how much longer the sea requires than the land to gain its summer heat and then to lose it again. Thus we find from the records of 41 years that the mean temperature of the sea in December is 50·1°, whilst in January, February, March, and April it is less, viz. 48·0°, 47·0°, 47·3°, and 49° respectively.

The following table (1920 being taken at random) shows that in January and February our mean temperature is higher than about London, but during March, April, and markedly in May, it falls behind and it is only natural that the effect on the flowering and leafing of trees, etc., should be as described by Mr. Clark.

	Falmouth.			Kew.	
1920.	Mean of daily Max. and Min.	Mean for 50 Years, 1871-1920.	Mean of daily Maxima.	Mean of daily Max. and Min.	Mean of daily Maxima.
	°	°	°	°	°
January	44·4	43·4	49·3	42·7	47·5
February	46·1	43·4	50·7	43·4	49·8
March	45·5	43·9	51·5	46·6	54·1
April	48·7	47·5	54·1	49·3	55·2
May	53·4	52·2	59·3	55·6	63·9

Wilson Lloyd Fox.

Falmouth, February 24, 1922.

Where did Terrestrial Life Begin?

In reference to Mr. Dines's letter in Nature of February 16, if the diurnal variations in temperature and humidity on a mountain summit in the early earth would have been smaller than at sea-level, my objection to Dr. Macfie's theory would certainly not hold. But Mr. Dines remarks that, assuming some stratification of the atmosphere, the stirring up of the lower levels might cause a temporary raising of the temperature at higher levels, which is the basis of my objection. Mr. Dines points out that if the early atmosphere had been homogeneous, mountain summits could not have been warmed by ascending air, while if the air had been stratified vertical movements would have been impossible; but that dilemma does not seem applicable to the conditions likely when the earth had just cooled down to a temperature at which life was possible.

My conception of the probable geographical conditions at the dawn of terrestrial life is that the seas would have been small, but were growing from water discharged from steam vents, which would have kept the lower air hot and saturated. Above the steam-charged layer the air temperature would have fallen quickly (as the surface would have received less heat from the interior and have lost more by radiation), so that the cooling by expansion of air rising up a mountain side would have been small and might have been largely counteracted by latent heat set forth by the condensation of moisture. Distrustful of my own capacity in thermodynamics, some years ago I asked an expert on that subject, in reference to another problem in primeval geography, whether the last condition was possible, and he replied that it was. The geographical conditions which would seem most favourable for spontaneous generation from some inorganically formed carbohydrate would be in a moist atmosphere in which the temperature would have been practically uniform. Unless those conditions held on a mountain summit, some lower position for the origin of life would seem more probable.

J. W. Gregory.

February 20, 1922.

The Name of the Gid Parasite.

In 1910 (U.S. Dept. of Agriculture, Bureau of Animal Industry, Bull. 125) Dr. Maurice C. Hall published a most interesting historical account of the gid parasite, a cestode worm which is exceedingly destructive to sheep. He showed that the first available specific name for the worm was *Taenia multiceps* of Leske, 1780. At the same time he rejected the familiar name *Coenurus* of Rudolphi because Goeze in 1782 had said that the parasite might be called "Vielkopf (*multiceps*)." I protested at the time to Dr. Hall that "multiceps" could scarcely be taken as a valid generic name. Goeze was not a binomial writer; he actually called the gid parasite Taenia *vesicularis cerebrina*. *Multiceps* seems to have been introduced simply as the Latin form of the common name proposed, *vielkopf*. Now, after the passage of years, I again have occasion to refer to the gid parasite and I find no ground for altering my opinion. Apparently the animal should be called *Coenurus multiceps* (Leske). The matter is important, on account of the injuries caused by the parasite, and consequent frequent references to it. I observe that Railliet and Henry (1915) and Railliet and Marullaz (1919) accept *multiceps* as a valid generic name.

T. D. A. Cockerell.

University of Colorado, Boulder, Colorado.

The Weathering of Mortar.

In regard to statements in Nature of June 23 and July 21, 1921 (vol. 107, pp. 523 and 652) to the effect that the curious ridges and furrows which occur in mortar in walls are due to the segregation of lime, I would invite attention to a note in Proc. Dorset Nat. Hist. and Antiq. Field Club, 1906, vol. xxvii. p. xxxii, giving an account of an exhibit of mine of a series of pieces of mortar from a wall showing the early stages of the development of this phenomenon. The appearance is caused by the growth of moss in minute shrinkage cracks in the mortar, the sides of the cracks being gradually disintegrated by the roots of the moss, until the final stage of ridge and furrow is reached and the moss, not having sufficient root-hold, falls out when dry.

I may add that since then I have tested the mortar in the ridges and also some from the general body below the surface, and can find no difference in the proportion of lime contained in the two.

Nelson M. Richardson.

Montevideo, near Weymouth, February 24.

Cancer Research.

By Dr. J. A. Murray.

DURING the last twenty or thirty years the above title has been very frequently the text for reviews, summaries and editorial articles, and might in other circumstances be regarded as covering an over-written subject. The wide interest taken in cancerous diseases—an interest stimulated by the apparently increasing toll of this malady which the mortality figures of the Registrar-General reveal—suggests that the editorial request for a further article on the same theme should not be neglected. Recently the general Press has contained the announcement of Lord Atholstan's offer under certain conditions of a prize of 22,000*l*. for the discovery of a medical cure for cancer, whilst this has been followed by Sir William Veno's prize of 10,000*l*. The final form in which these sums will be applied to the stimulation, and perhaps the subvention, of cancer research has probably not yet been definitely decided, but both gifts can be looked upon as concrete examples of the importance which men attach to a solution of the problem of cancer.

At the present time we have in this country two important and outstanding diseases, namely, cancer and tubercle, both of which are great destroyers of human life. The latter is certainly the more important in an economic and social sense for it attacks people at a much earlier age, but nevertheless it does not seem to have the same hold as cancer on the imagination of the public. It would almost seem as if the *spes phthisica*, the illusory hope of recovery often entertained by the almost moribund consumptive, had spread from the victim to his fellow-man. The prime cause of tuberculosis has been known for forty years, yet treatment is still very unsatisfactory; in cancer the cause is still unknown, and a wider field for investigation is presented, as well as one offering the attraction of the unknown.

Physicians and surgeons are not alone in entertaining the interest thus awakened, but share it with a wider army of pathologists, physiologists and biologists, who may regard cancer as a perverted form of growth perhaps induced by an aberrant type of metabolism. If we restrict our survey to the period of the war and the following years, we find that although research was greatly curtailed, especially in Europe, it did not cease entirely; since the war, work has been resumed and certain progress made. To-day, work is being done even in impoverished Austria, and from Japan in the East to the United States in the West, from Denmark to the Argentine Republic. Investigation into the nature of cancer is almost as widespread geographically as the disease itself.

It is at no time easy to formulate a working hypothesis for attacking a biological problem, and it is especially difficult in the case of the ill-defined one we are considering; but if the attempt be made to analyse the different lines of inquiry adopted, this might profitably be done by arranging them according to their bearing upon the theory that cancer is caused by an extraneous parasite. The parasitic theory has been in the field for many years, but from the opening of the present century it did not claim so many adherents until about ten years ago, when its advocates had their view strengthened by the discovery of a peculiar sarcoma in fowls which could be transmitted by a porcelain candle filtrate, and presumably contained one of the filterable viruses. The exact relation of this chicken sarcoma to the true neoplasms is still a matter of uncertainty, but the failure to repeat this experiment with tumours from other animals leads one to suppose that their nature is essentially different. A similar comment applies to the infective venereal tumour of dogs, a sarcoma-like growth transmitted by coitus, especially amongst bulldogs. Here, again, it is no easy matter to define the relationship with the infective granulomata on one hand, or with the true neoplasmata on the other.

A great many of the opponents of the parasitic theory of cancer believe in the efficiency of "chronic irritation" as an actual inducer of the cancerous transformation of a tissue. By chronic irritation they usually mean a prolonged succession of chemical or physical insults to a group of cells, these insults being of a degree which does not destroy the vitality of the cells but serves to excite their powers of growth and reproduction. That cancerous disease may supervene in tissues maltreated in this way is shown in a wide variety of cases, of which there may be cited chimney-sweeps' cancer, "kangri" cancer, the cancer of X-ray workers, and the cancer developing at the site of a long-standing ulceration.

All these instances lead directly to the attempt to produce cancer experimentally, but it is only within the last few years that any measure of success has attended the experiments. The production of cancer has been most successful in rabbits and mice in which a small skin area has been painted for a period of six to twelve months with coal tar. About half the animals thus treated show tumour growth at the treated site, and the method promises to be exceedingly useful for studying the conditions affecting tumour origin. Another method of producing cancer experimentally is less straightforward than the preceding, but about equally efficacious. In this a chemical or physical agent is not applied but the irritation produced by the presence of a gross parasite is employed. The artificial infection of rats by a species of nematode, *Gongylonema neoplastica*, leads to the overgrowth of the squamous portion of the stomach and in a fair percentage of cases to the development of cancer. Sarcoma of the liver of rats can also be produced with ease by the simple expedient of infecting the animal with ova of the cat tapeworm, *Taenia crassicollis*. All three methods seem likely to further our knowledge of the etiology of the disease.

The search for the cause of cancer in a developmental (embryonic) abnormality does not appear now to command many followers; it is at best a very fatalistic line of thought, and discouraging to all but the most robust-minded.

Starting from an already established tumour, much work has been done upon observing the characters of the growth exhibited and the nature of the differentiations displayed by the tumour cells. The discovery of the transplantability of tumours of the lower animals has provided much material for this line of research, but the many attempts made to fix on any one outstanding character of tumour cells differentiating them sharply from normal cells have been unsuccessful. As before, we are confronted with the unexplained and unco-ordinated powers of proliferation shown by the tumour cells. The discovery that animals could be rendered resistant to transplanted tumours raised hopes that it might be possible to elicit an immunity towards cancer in an animal affected spontaneously, but these hopes are now considerably abated.

A start has also been made to ascertain the food requirements, general and special, of the tumour cells, but these experiments are still too slightly advanced for us to know whether any result of positive value will be obtained.

Research into the treatment of cancer other than surgical has produced many empirical experiments and observations, but, apart from the extended knowledge of radio-therapy, nothing of importance has come to light. In the field of radio-therapy, the manner of action of the rays used, and the way in which they induce destruction of cancerous cells, still offers an unsolved problem of high importance. In conclusion, it may be predicted that progress in cancer research will in large measure be closely co-ordinated with that in the ancillary sciences.

The Mechanism of Heredity.[1]

By Prof. T. H. MORGAN, Columbia University, New York City, U.S.A.

III.

Further Relations between Chromosomes and Heredity.

IN examining the chromosomes for a stage when "crossing-over" might be possible, we turn naturally to the time when the members of each pair come together. This occurs once in the history of every germ-cell. In many accounts it has been shown that the members of each pair come to lie side by side throughout their length. Even more interesting is the fact that just prior to this union the chromosomes have spun out into long, thin threads. There are also

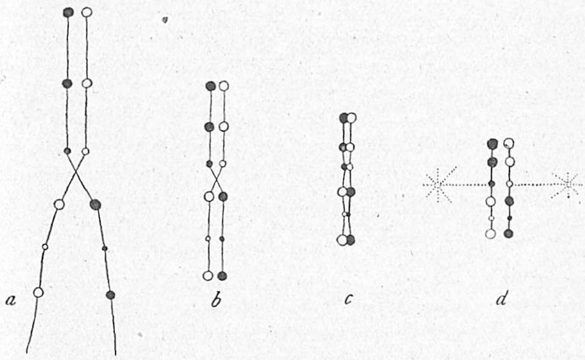

FIG. 16.

several detailed accounts showing that at this time the two chromosomes of each pair may actually twist about each other in one or more turns (Fig. 16). They then come to lie side by side and appear as a single thread that shortens preparatory to entering upon the first maturation division. Here, apparently, we find realised a condition that might make interchange possible between the members of a pair of chromosomes, for if the threads fuse where they cross each other and the ends on the same side unite, the interchange of pieces will be accomplished. From the nature of the case it would be almost impossible to demonstrate that the twisted threads do break and make new unions at the crossing point. It is true that there are certain later stages that lend, perhaps, some support to the view that breaking and reunion have occurred, as Janssens has pointed out, but it cannot be claimed that this evidence does more than give, on such an assumption, an account consistent with certain configurations he describes. Here the case must rest for the present. The genetic evidence is clear and far in advance of what the cytologist is able to supply. But, nevertheless, it is very important to find that, so far as the cytological evidence goes, it furnishes a great many of the facts essential to the kind of process that the genetic evidence calls for.

The Number of the Linkage Groups and the Number of the Chromosomes.

When Sutton in 1902 directed attention to the fact that in the behaviour of the chromosomes at maturation there was supplied a mechanism for Mendel's two laws, it was evident that the number of independently assorting hereditary characters would be limited to the number of the chromosome pairs characteristic of each species of animal and plant, provided the chromosomes remain intact from generation to generation. The integrity of the chromosome was held, in fact, by a few leading cytologists at that time, notably by Boveri, on evidence which, if not complete, was the best then obtainable. In the circumstances, the later discovery of the agreement between the number of chromosome *pairs* of *Drosophila melanogaster* and the number of its linkage groups was of paramount importance for the chromosome theory. In this species the number of known hereditary characters is so large (more than 300 in all) that this relation can scarcely be due to a coincidence, especially when the whole evidence concerning chromosomes and heredity is taken into account.

It is true, with the possible exception of the garden pea (where there appear to be as many independently

[1] Continued from p. 278.

Mendelising pairs as there are chromosome pairs, namely, seven), that this relation has as yet been established only for species of Drosophila. But it is also true that not a single animal or plant has yet been found in which the number of known hereditary groups of genes is greater than the number of chromosome pairs. It is to be anticipated that some one will before long announce such a discovery, for it is very probable that if two linked genes happen to be so far apart as to give 50 per cent. of crossing-over, they will appear to be in different groups. But such a situation need cause no alarm when (or if) it arises, and will not, of course, refute the correspondence of linkage and chromosomes, unless it can be shown that each such member belongs to a different linkage system. Furthermore, it is to be anticipated that where compound groups of chromosomes exist, such as have been described in some grasshoppers and bugs, peculiar relations are likely to be found.

The evidence from two species of Drosophila other than *D. melanogaster* should also be taken into account. In *D. obscura* Lancefield has shown that there are five pairs of independently assorting characters. There are also five pairs of chromosomes. In *D. virilis* Metz has found six pairs of chromosomes, and up to the present at least five independent loci. The fact that no crossing-over takes place in the male makes the evidence for the independence of the pairs practically certain.

Origin of Mendelian Genes.

Mendelian heredity is sometimes slightingly referred to as a particular kind of heredity dealing with characters that are due to losses of wild-type *characters*. This view ignores some significant facts and considerations. To argue that because a *character* is lost or modified there must be a corresponding loss in the *germ-plasm* is clearly a *non sequitur*. Each organ of the body is the end result of a long series of stages in embryonic development. Any change in any one of the stages would be expected to alter the end product. There are no grounds for assuming that such changes must necessarily be losses, although losses also might sometimes produce such effects. The argument has all the earmarks of reasoning by analogy.

However, the discussion need not rest any longer on philosophical grounds, since we have crucial experimental data which show that loss of a character is not necessarily due to loss of a gene. One case will suffice. In addition to the white-eyed mutant of Drosophila there are ten other eye colours that lie in the same locus. Obviously there cannot be ten kinds of absences. The only other possible explanation of ten absences would be that there were ten genes here so close together that crossing-over does not take place. Hence they appear to be in the same locus. Now, fortunately, the origin of these ten mutations is known, and shows—if they were really a closely linked nest of genes—that when the last one appeared there must have been at the same time mutation in nine other genes in order to get the results. The rareness of mutation precludes such an interpretation. Attempting to save the interpretation of recessive characters as due to absence of genes, it has been argued that perhaps only a part of the wild-type gene is *lost* when a new recessive character appears. It is, however, not obvious why the hypothesis needs to be saved. It is simpler and suffices to cover our ignorance to say that a change has taken place.

There is another question connected with these multiple allelomorphs—changes in the same locus—that is very important. Any given individual may normally have at most any two of the genes (one derived from the father, and one from the mother), but never more than two. When there are two such mutant genes present they behave towards each other in the same way as does any mutant gene towards its wild-type allelomorph. It follows that the Mendelian behaviour is not a peculiar relation of a mutant gene to a wild-type gene. It would seem, therefore, highly probable that wild-type genes behave in this way towards each other, and, in fact, where two wild types exist in Nature that differ in a single allelomorph, they are found to give a Mendelian segregation when brought together.

The discovery of a large number of mutants in the same species may be expected in time to furnish some idea of the number of hereditary genes that exist in a species, or, in other words, to tell us how many different kinds of genes *plus* the cytoplasm constitute a species. At present, even in the case of Drosophila, we are far from being able to make such a calculation. There are, however, one or two rough estimates which seem to indicate that the number of genes is more than several thousands. The upper probable limit cannot even be guessed.

How the genes bring about their effects, which are shown as modifications of the protoplasm (or by-products of it), is entirely unknown. If it seems desirable at present to limit the definition of heredity to cover only the distribution of the genes in successive generations, the result of their effects on the protoplasm becomes a problem of embryology. To many geneticists, however, no such limitation seems desirable, because it may appear that the ultimate constitution of the genes themselves can be discovered only by working backwards, through the effects produced, to the nature of the material that furnishes the first stage in the elaboration. With this pious hope I heartily agree, but in the meantime I do not think it desirable to let premature attempts in this direction interfere with clear-cut methods of research that Mendelian results supply.

Finally, the question as to whether all hereditary characters arise, or have arisen, through mutational changes in the germ-plasm similar to those found occurring to-day, can be settled only by future evidence. Guessing is scarcely worth while. One point, however, seems fairly well established—namely, that in several cases where differences in wild species have been subjected to the experimental analysis employed by geneticists for variation arising by mutation, they give the same kind of results.

Obituary.

Sir George Carter, K.B.E.

By the death of Sir George Carter, there passes one of the greatest figures in the shipbuilding industry of the last twenty years. He had been in ill-health for rather more than twelve months, but had not formally retired from his position of managing director of Messrs. Cammell Laird's famous shipbuilding and engineering works at Birkenhead. Sir George Carter was trained at the Royal Dockyard at Portsmouth, and furnishes another name on the list of great shipbuilders who have come from that excellent nursery, the Dockyard Schools.

Soon after completing his training at Portsmouth Sir George Carter proceeded to the well-known Tyneside firm of Messrs. Armstrong, Whitworth, and Co., where his uncle, Sir Philip Watts, was naval architect. A man of extraordinary vigour and of sound judgment, he was quickly given the important post of shipyard manager, and his tenure of this position for eighteen years witnessed the production of some very notable and epoch-making ships as well as a large extension of the firm's premises at their merchant shipyard at Walker.

Though always an important figure in the industry, it was during the last ten years that Sir George Carter came very prominently before the public, when in 1912 he became managing director of the Merseyside firm. He succeeded in extending the firm's business and premises in a remarkable manner, and when the war came in 1914 he was able to devote his whole energies to, and to utilise to the full the firm's great resources in the construction of warships.

Sir George Carter's activities were too numerous for mention in a short notice of his career, but reference must be made to the very important part he played as chairman of the Advisory Committee on Merchant Shipbuilding under the Shipping Controller in the fateful days of the early part of 1917. It was this committee that evolved the standard ship and made a supreme effort to organise the whole industry in order to simplify manufacture and increase output. Sir George also occupied many positions of importance, being a member of the council of the Institution of Naval Architects, of the Committee of Lloyd's Register of Shipping, of the Mersey Docks and Harbour Board, and of the Court of the University of Liverpool.

All those who knew Sir George Carter intimately and were familiar with his work during the war will agree that he spent himself in the service of his country and sacrificed some years of his life in its behalf.

T. B. A.

Dr. H. Lyster Jameson.

We regret to announce that Dr. Henry Lyster Jameson died at his home at West Mersea, Essex, on February 26, of hæmorrhage of the lungs, at forty-seven years of age. Dr. Jameson was educated at Trinity College, Dublin, where he took the degrees of B.A. and D.Sc. He spent a year at the Royal College of Science, London, and then worked at the University of Heidelberg, where he studied zoology under Bütschli. Afterwards he went to British New Guinea, where he had charge of a pearling station, and this gave him opportunities for research into the causes of pearl-formation, an investigation which he continued at the Lancashire Sea Fisheries Station in Piel, Barrow-in-Furness. There he established the parasitic theory of pearl-formation in the common sea mussel, and he extended the research later into a study of the various processes by which the orient pearl is formed, publishing a series of papers in the *Proceedings of the Zoological Society* and elsewhere. About this time his health broke down, and, threatened with pulmonary phthisis, he went to South Africa, where he was, for a time, on the staff of the Natal Education Department and, later, a lecturer at the Technical College in Johannesburg.

Some few years before the war Dr. Jameson returned to England and was appointed to a post in the Board of Education, becoming a Senior Examiner. At the outbreak of war in 1914 he was seconded for special service in the Ministry of Agriculture and Fisheries, and, later, became District Inspector for the South-Eastern Coast. At that time the slipper-limpet was becoming a pest to the oyster fisheries, and Dr. Jameson organised a system of collecting and disposing of this noxious mollusc. A very successful factory for the preparation of shell-grit from the limpets dredged up in the course of the oyster fishing was set up at West Mersea, and he was in charge of this up to the time of his death. In 1918 he became Adviser on Inshore Fisheries to the Development Commissioners and his work became largely administrative, but lately he was very active in the investigation of vitamins in molluscan shell-fish, working on this subject in collaboration with Prof. W. Bayliss.

Such was Dr. Jameson's persistent ill-health that any form of physical activity became impossible, but under this strain he developed a strong and most engaging personality and wide interests in social and economic reform movements. He was a man of great general culture, a very accomplished field zoologist, and a most lovable friend to those who knew him well. He leaves behind him a widow and two daughters.

Sir Edward Gonner, K.B.E.

We record with great regret the death, on February 24, in his sixtieth year, of Sir Edward C. K. Gonner, who was for more than thirty years the Professor of Economic Science in the University of Liverpool, and whose skill and power of organisation have done much to earn for that University the high position it holds as a centre of economic teaching. The view which he entertained of the difficulty and of the importance of economic study, and which inspired him in his work, is well expressed in the address he wrote for the Toronto meeting of the British Association in 1897, as President of Section F: "This is needed by all those who, either by action, word, or vote, have a part in the direction of the destinies of a country." Again appointed President of that Section at the Australian meeting in 1914, he enforced the same moral. He published some valuable text-books on economic subjects. He served on the Royal Commission on Shipping Conferences. As chairman of the War Savings Committee for Cheshire he also rendered public service, and was appointed a Companion of the Order of the British Empire. He was promoted to a knighthood of the same Order last year. Sir Edward Gonner's early death was due to an attack of influenza. At a time like the present when the inculcation of sound economic principles seems to be more than ever necessary, the loss of so good and practical a teacher as Sir Edward Gonner will be deeply felt.

MR. GEORGE CUSSONS.

IT is with regret that we record the death on February 10, at the age of seventy-five years, of Mr. George Cussons, the founder of the well-known firm of scientific apparatus makers of Lower Broughton, Manchester. Mr. Cussons in his early manhood gained a studentship at the Royal School of Mines, London, and upon the completion of the course became a drawing-master and also a teacher of geometry and mechanical subjects in evening classes in towns near Manchester. Having considerable mechanical skill, acquired in the course of his apprenticeship, he devised a variety of models and apparatus, which he employed effectively to demonstrate the problems arising in the course of his teaching. Finding great advantage accruing therefrom, he was induced to enter business life as a manufacturer of apparatus to be used in the demonstration of the subjects of geometry, theoretical and applied mechanics, and of physics. Among other excellent apparatus he designed and patented a much-improved Atwood's machine to demonstrate the laws of falling bodies. His firm gained well-deserved repute among Technical Institutions for the excellence and adaptability of its apparatus.

Mr. Cussons, whilst he was a student at the evening classes of the Owens College, Manchester, made the acquaintance of Osborne Reynolds, the eminent Professor of Engineering at the College, and brought to his notice certain models for use in Descriptive Geometry. He suggested various improvements which were adopted, and the models were exhibited at the National Health Exhibition of 1884, where they gained a medal for excellence. Since that time the firm has been awarded medals for the superior character of its apparatus at exhibitions held at home and abroad, and has supplied scientific equipment to practically every country in the world. It furnished a large number of models for geometrical and mechanical drawing, together with a considerable equipment, for the extensive mechanics laboratory of the Manchester College of Technology, which have proved of eminent service. Mr. Cussons was in close touch with all the principal science institutes, and was always ready to discuss any new suggestions for apparatus, and to place his practical training and his knowledge of the teaching of mechanical and physical science at the service of those concerned.

THE death occurred on January 28, in his 52nd year, of Dr. Charles Baskerville, who had been professor of chemistry at the College of the City of New York since 1904. Dr. Baskerville had previously occupied a similar post at the University of N. Carolina. He did notable work on the rare earths, and carried out many investigations in the chemistry of anæsthetics. His inventions included processes for refining oils, hydrogenation of oils, plastic compositions, reinforced lead, etc.

WE notice with much regret the announcement of the death on March 3, at fifty-five years of age, of Prof. Benjamin Moore, Whitley Professor of Chemistry in the University of Oxford.

THE *Chemiker Zeitung* reports the death on February 13 of Prof. Theodor Liebisch, of the University of Berlin, well known for his work on physical crystallography, especially in the department of crystal optics.

Current Topics and Events.

A NATIONAL tribute to the memory of Sir Ernest Shackleton took the form of a special service in St. Paul's Cathedral at noon on March 2. The service was conducted by Dean Inge and the Cathedral clergy and was short and simple but impressive and of great beauty. It included some sentences from the Burial Service, the twenty-third Psalm, the lesson from 1 Corinthians xv., the anthem "Thou wilt keep him in perfect peace," and two special hymns, "Eternal Father, strong to save" and "For all the saints who from their labours rest." The soft beauty of the perfect music was followed with striking effect by the shrill sounding of "The Last Post" by the boys of H.M.S. *Worcester*. It was impossible amid the splendour of the ceremonial and the distinguished congregation representative of the most refined civilisation not to picture in contrast the rough chapel on South Georgia and the toil-stained whalers who surrounded Sir Ernest Shackleton's grave, and the little *Quest* carrying on the mission on which he perished, tossing in the huge waves of the Southern Ocean or beset by the Antarctic ice. The congregation at St. Paul's included the widow and three children of the explorer, several of his sisters and other relatives, representatives of the King, Queen Alexandra, the Prince of Wales, the Duke of Connaught, the Colonial Secretary, the First Lord of the Admiralty, the Trinity House, and the diplomatic representatives of Norway, Denmark, Portugal, Argentina, and other countries. The Royal Geographical Society was represented by its President, a large number of the Council, and the principal officials, and many othei societies and institutions sent representatives. Amongst those with special interest in the Antarctic regions were Mr. John Q. Rowett, Sir John Scott Keltie, Dr. H. R. Mill, Dr. H. O. Forbes, and a strong muster of Sir Ernest's old comrades, including Captain C. W. R. Royds, R.N., and Mr. L. C. Bernacchi of the *Discovery* expedition, Capt. W. Colbeck of the *Morning*, Sir Philip Brocklehurst of the *Nimrod* expedition, Mr. J. M. Wordie, Mr. Greenstreet, and Mr. Rickenson of the *Endurance* expedition, and Mr. Mason, who had sailed on the *Quest*, but had to return on account of his health. No doubt others were present who were not recognized in the great congregation.

MR. CAMPBELL SWINTON gave some very interesting reminiscences at one of the meetings recently held to celebrate the Jubilee of the Institution of Electrical Engineers. In particular he recalled some of the experiments carried out in 1879 by David

Hughes, whose widow, who died recently in America, has bequeathed some of his notebooks to the British Museum. These have been examined by Mr. Swinton. They prove that Hughes undoubtedly noted some of the effects now known to be due to high-frequency waves. He used a small spark coil as a generator, and a Bell telephone and a battery generally connected in series with a microphone as a receiver. The microphone apparently acted sometimes as a coherer and possibly sometimes as a thermocouple rectifier. He received signals up to distances of about a hundred yards. He noted that the effects produced were very uncertain at the distance of half a mile. When he earthed one or both ends of his transmitting and receiving circuits he got enhanced results. It has to be remembered that all this was done about nine years before Hertz's memorable discoveries. Hughes, however, seems to have had no conception that he was dealing with electromagnetic waves. He thought that the effects were due to electric conduction through the air. In a letter to *The Electrician* on May 5, 1899 (vol. xliii. p. 40), Hughes himself describes his experiments. It appears that he showed his experiments to a number of leading men of science in 1879 and was profoundly discouraged by their comments on them. In particular Sir George Stokes stated that the effects were due to ordinary electro-magnetic induction. It would be interesting to speculate what might have happened had they encouraged him to proceed with his researches. But in any case a great deal of further experimental work would have had to be done before the art of radio-telegraphy was achieved.

SIR ROBERT HORNE, Chancellor of the Exchequer, in the House of Commons on March 1, surveyed the proposals put forward by the Geddes Committee on National Expenditure, and indicated the general views of the Government concerning some of them. The two items which in the main make up the "cut" of £18,000,000 recommended by the Committee as regards education are the reduction of teachers' salaries and the exclusion from school of children below the age of six years. The Government has decided that neither of these proposals can be put into operation. The reductions adopted amount to £6,500,000 instead of the £18,000,000 recommended by the Geddes Committee. It is proposed that teachers should contribute five per cent. of their salaries towards their superannuation fund, and this will bring in a sum of more than £2,000,000. The Department of Mines is to become an integral part of the Board of Trade, and the Minister who at present acts as secretary of the Department is to be one of the under-secretaries of the Board. The Forestry Department is to be carried on and will not be abolished as recommended by the Geddes Committee. As to agriculture, the Government has decided that the grant made available by the Corn Production Appeal Act cannot be used to make up the reduction upon education and research recommended by the Geddes Committee, but has to be additional to the amount already devoted to these purposes.

THE first Scientific Reunion of the Natural History Museum Staff Association for the current year, which took place on March 1, attracted an exceptionally large attendance. Many interesting exhibits were on view, among which may be mentioned the following: Fine group of Alaskan Bighorn Sheep, consisting of a male, female, and young, recently presented to the Museum by Mr. T. R. Hubbock; selection of the mammals, birds, and insects collected by the Mt. Everest Expedition in 1921; original plaster cast prepared by Mr. F. O. Barlow of the brain cavity of the Rhodesian Skull; model made by Mr. G. C. Robson of the curious triplicate respiratory mechanism in the Ampullariidæ; specimens and model of the gigantic frogs which swallow crabs and even small mammals whole; the flower-mimicking mantid from East Africa; Cichid fishes from Lake Victoria and certain Crustacea illustrating mutation; samples of wool treated with lichen dyes with or without mordants; specimen of *Orites excelsa* from Australia showing deposit of aluminium succinate in the cavities of the wood; a meteoric stone, weighing 4½ lbs., one of the hundred that fell on October 16, 1919, at Bur-Gheluai, Bur-Hagala District, Italian Somaliland; and a series of minerals from Zermatt. Messrs. Watson & Sons gave a demonstration of their most recent microscopes and ancillary apparatus.

THE Air Ministry announces that the Civil Aviation Advisory Board, the creation of which was announced by the Under-Secretary of State for Air at the recent Air Conference, has now been set up with the following terms of reference:—"To advise generally on the development of Civil Aviation and to report upon any specific point which may, from time to time, be referred to the Board by the Secretary of State for Air." The constitution of the Board is as follows:—The Under-Secretary of State for Air (Lord Gorell), chairman; The Controller-General of Civil Aviation, Air Ministry (Major-General Sir Frederick H. Sykes); The Director-General of Supply and Research, Air Ministry (Air Vice-Marshal Sir W. G. H. Salmond); representatives of General Post Office (Brigadier-General F. H. Williamson), Air League of the British Empire (Major-General Sir W. Sefton Brancker), Association of British Chambers of Commerce (Mr. Edward Manville), Federation of British Industries (Mr. H. James Yates), Lloyds (Lieut.-Colonel Sir Frederick Hall), Royal Aero Club (Brigadier-General Sir Capel Holden), Royal Aeronautical Society (Lieut.-Colonel Mervyn O'Gorman), Society of British Aircraft Constructors, Limited (Sir Henry White Smith). The secretary of the Board is Mr. F. G. L. Bertram, Air Ministry.

WE learn from *Science* that Dr. I. C. White—who has been State Geologist of West Virginia since 1897, and is distinguished for his contributions to the geology of coal and petroleum—and Mrs. White have given to the University of West Virginia and the city of Morgantown 1911 acres of Sewickley coal, situated in Marion County. It is estimated that the tonnage of the acreage will be approximately 15,000,000, and should yield at least 800,000*l.* over a period of years, of which the city and the University will have equal shares. The income which the University will derive from the gift is to be devoted solely for equipping and maintaining a geological department in the State University in the city of Morgantown, West Virginia. Western Reserve University has also received a noteworthy gift from Mr. Samuel Mather, of Cleveland, who has announced that he will provide funds for the erection of the new building of the School of Medicine. The estimated cost of this is about 506,000*l.*

AT a meeting of the council of the British Medical Association held on February 15, the gold medal of the association was awarded to Sir T. Clifford Allbutt, Regius Professor of Physic in the University of Cambridge, for his long and distinguished services to the profession and the association, and in commemoration of his five years' presidency of the association in the time of the great war, 1916–1921. In proposing the award, the Treasurer of the Association, Dr. G. E. Haslip, said that on all the three grounds for which the medal was customarily awarded no more fitting recipient could be found. Alike for his scientific attainments, for the measure in which he had enhanced the honour and dignity of the profession, and for his devoted services to the British Medical Association, Sir Clifford Allbutt richly merited this distinction. It was agreed that an engrossed testimonial, stating the grounds of the award, should be prepared and presented, together with the medal, at the Glasgow meeting in July next.

WE have received from The City Sale and Exchange, 81 Aldersgate Street, E.C., the sole British agents, the catalogue of microscopes and photomicrographic apparatus of the Koristka Optical Co., Milan. Koristka microscopes are obtainable for all classes of work; the objectives have a reputation for being of the highest quality, and are of the apochromatic, semi-apochromatic (fluorite), and achromatic types. A binocular form and a light aluminium travelling stand are supplied. The photomicrographic apparatus includes both vertical and horizontal forms, half-watt lamps of 100-300 candle-power constituting the illuminant. Dark-ground condensers, blood-counting apparatus, microtomes, hot and mechanical stages are also listed. The microscope stands included in the catalogue can be supplied from stock, and are approximately only half recent German prices for similar models.

THE Annual Conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, S.W., on Thursday, June 29.

THE Guthrie Lecture of the Physical Society will be delivered on March 24 at 5 o'clock, at the Imperial College of Science, by Prof. N. Bohr, who will take as his subject "The Effect of Electric and Magnetic Fields on Spectral Lines."

THE Chemical Manufacturers' Sub-Section of the London Chamber of Commerce, at a meeting held on February 28, unanimously adopted a resolution, "that this meeting is of opinion that the Safeguarding of Industries Act is of great potential value, and records its conviction that the establishment in this country of a Fine Chemical Industry is of the utmost national importance."

AT the meeting of the Royal Geographical Society on March 6 the president announced that all the members of the Mount Everest Expedition have now left England, and General Bruce with his two assistants from the Gurkha Regiments of the Indian Army, Captain Geoffrey Bruce and Captain Morris, must be by this time at Darjeeling making preparations for the start of the expedition at the end of this month. They will be especially concerned with the two most important matters, firstly, the organisation of the special corps of Himalayan coolies enlisted from Nepal, and the borders of Sikkim, and Tibet, and, secondly, with transport arrangements which will require very careful and methodical planning, for the expedition is larger this year than last, and is more fully equipped.

THE following were elected at the annual general meeting of the Geological Society on February 17:—*President*: Prof. A. C. Seward; *Vice-Presidents*: Prof. E. J. Garwood, Mr. R. D. Oldham, Dr. G. T. Prior, and Dr. H. H. Thomas; *Secretaries*: Mr. W. Campbell Smith and Mr. J. A. Douglas; *Foreign Secretary*: Sir Archibald Geikie; *Treasurer*: Mr. R. S. Herries; *Other Members of Council*: Mr. F. N. Ashcroft, Dr. F. A. Bather, Prof. P. G. H. Boswell, Prof. W. S. Boulton, Mr. T. C. Cantrill, Dr. J. S. Flett, Mr. J. F. N. Green, Dr. F. H. Hatch, Prof. O. T. Jones, Mr. W. B. R. King, Prof. S. H. Reynolds, Sir Aubrey Strahan, Prof. W. W. Watts, and Mr. H. Woods.

AT the annual general meeting of the Association of Economic Biologists held on February 24, the following officers and council were elected for the year 1922:—*President*: Prof. E. B. Poulton; *Vice-Presidents*: Prof. V. H. Blackman, Dr. G. A. K. Marshall; *Treasurer*: Dr. A. D. Imms; *Editors*: Dr. Wm. B. Brierley (Botany), Mr. D. Ward Cutler (Zoology); *Secretaries*: Dr. Wm. B. Brierley (General and Botanical), Dr. J. Waterston (Zoology); *Council*: Prof. V. H. Blackman, Dr. G. A. K. Marshall, Dr. S. A. Neave, Dr. W. Lawrence Balls, Mr. F. T. Brooks, Dr. E. J. Butler, Dr. E. J. Russell, Prof. J. Percival, Dr. W. F. Bewley, Mr. A. W. Bacot, Dr. J. W. Munro, Mr. A. B. Bruce.

ON Thursday, March 16, Dr. P. Chalmers Mitchell will begin a course of two lectures at the Royal Institution on "The Cinema as a Zoological Method." The Friday evening discourse on March 17 will be delivered by Prof. A. P. Laurie on "The Pigments and Mediums of Old Masters," and on March 24 by Prof. F. G. Donnan on "Auxiliary International Languages."

Our Astronomical Column.

SATURN.—This planet is now very favourably situated for telescopic study. The luminous rings are now only slightly inclined, as seen from the earth, and present but a small extent of surface and detail. The ball, however, with its various dusky bands and bright zones of different intensities, will furnish interesting features under high magnifying powers. Occasionally, white spots and other irregularities are to be seen in the belts, and markings of this kind are important and should be utilised for redetermining the rotation period. Mr. W. F. Denning points out that Saturn is akin to Jupiter in presenting a number of surface currents which differ considerably in their relative velocities. In 1903 a number of light and dark spots became visible in the north temperate region of the planet, and these indicated a rotation period of 10 hours 37 minutes and 52 seconds.

Saturn will be in opposition to the sun on March 25, and situated at a distance of 794 millions of miles from the earth.

METEORIC FIREBALLS.—A magnificent fireball is described as having passed over the southern hemisphere on January 11 last. Its flight was witnessed from the Liverpool liner *Vauban*, which arrived at New York on February 20. The fireball is described as being as large as the full moon and moving very slowly from 10 degrees above the western horizon to the eastern horizon. It occupied three and a half minutes in its flight and all the while emitted a blaze of light sufficiently powerful to illumine the sea and ship in an extraordinary degree.

On February 17, at 11·32, a brilliant meteor was observed from many places, including London, Barnet (Herts), Stowmarket, Droitwich, and Scunthorpe, Lincolnshire. As seen from places not remote from the object it appeared to be many times brighter than Venus, and its flight was fortunately witnessed by several observers who apply themselves to celestial studies, including Mr. A. King, Mr. J. P. M. Prentice, Mr. A. N. Brown, Mr. Gheury de Bray, and others. Computation shows that the meteor had a radiant at about $125° + 13°$ in Cancer, and that its height was from 62 to 29 miles from over Yarmouth to Winchester, Hants. Its luminous course extended over 41 miles and its velocity was 14 miles per second. It is remarkable how many fireballs displaying exceptional characteristics have appeared during the period from February 7 to 22 in different years.

COMPARISON OF SPEED OF BLUE AND YELLOW LIGHT.—*Harvard College Observatory Bull.* No. 763 contains an investigation of the difference in the times of the phases of the short-period variables in the globular cluster Messier 5 in Libra, as determined from photographic plates sensitised for blue and yellow light respectively. On the average the times were later in the blue light by 35 seconds, with a probable error of 70 seconds. The distance of the cluster was found by five different methods to be about forty thousand light-years, making it follow the Hercules cluster, Messier 13, as the second in nearness of those north of the equator. Accepting this distance, the speeds of blue and yellow light in the intermediate space do not differ by more than one part in ten thousand million as a maximum possible. Since any absorbing medium would cause the speeds to differ, this affords an upper limit to its amount.

THE ILLUMINATION OF THE ECLIPSED MOON.—The *B.A.A. Journal* for January contains an important article by L. Richardson discussing the action of the terrestrial atmosphere in refracting sunlight on to the eclipsed moon. Tables and diagrams indicate the amount of refraction of light at various heights above the earth. The values at heights of 0 km., 10 km., 20 km., 30 km., are 68′, 22′, 5′, and 1′ respectively; thus to reach the centre of the shadow the sunlight has to pass fairly near the earth's surface, and high mountains or clouds would intercept a good deal of it; an irregularity in the outline of the shadow in the eclipse of 1888 was plausibly attributed to cloud in the Amazon basin, or else to the Andes. The strange distortion that the sun would undergo to an observer on the moon is described.

The author deduces from theory that the centre of the shadow should be slightly brighter than the surrounding regions, and finds some support in the observations of May 1920. He constructed a model lens of concave section in printers' roller composition, with an opaque disc in the middle; when this was placed over a source of light, the brilliant ring could be seen round the dark disc, also the increase of illumination near the centre of the shadow. The bluish or greenish fringe often seen in the outer parts of the shadow is explained by stating that the sunlight that has passed high above the earth's surface would be much less reddened than that which passed low down. It is also pointed out that the varying distance of the moon from the earth is an important factor in altering the illumination in different eclipses. When the moon is in apogee it is further from the earth's "black shadow," and gets more light. After allowing for these factors, and for the mountain ranges that lie along the earth's terminator, the illumination of the moon should afford a useful index of the clearness of the zone of atmosphere that lies near the terminator.

PARALLAXES AND PROPER MOTIONS.—Mr. Van Maanen deals with this subject in *Contributions from Mt. Wilson Observatory*. No. 204 contains two important investigations, the first being a set of parallax determinations of specimen objects of various types made with the 60-inch reflector. The terms to reduce to absolute parallax have been derived from comparison with the spectroscopic parallaxes of Adams, etc. The mean parallax of 11 planetary nebulæ is of the order of 0·01″, the mean absolute magnitude is 8·4, and the mean diameter 0·06 light-year. Two Cepheids give small parallaxes of the same order as those found by Shapley from the proper motions; T Cassiopeiae, a long-period variable, has the considerable parallax 0·027″; its absolute magnitude varies from 3·9 to 9·7; two stars, Boss 500 and RR Lyræ, are notable for their high velocities, each about 200 km./sec., their absolute magnitudes being near 0; the value 0·019″ found for Nova Aquilæ is nearly the same as the accepted value for Nova Persei, 1901, while Campbell's hydrogen-envelope star (type O) and Boss 3322 (type N) are assigned parallaxes of 0·005″ and −0·002″. The radial velocity of the double cluster in Perseus is found to be −40 km./sec. and its proper motion +0·003″ in R.A. and +0·003″ in Decl. These values are so small that it is impossible to pick out cluster stars with certainty unless they are bright enough to permit their radial velocity to be determined. Tables are given of the individual motions and magnitudes of over 1500 stars.

Research Items.

THE TABOO OF WOMEN AMONG GYPSIES.—The *Journal of the Gypsy Lore Society*, now happily revived with good prospects of success, publishes in its opening number an article by Mr. T. W. Thompson on "The Uncleanness of Women among English Gypsies," which brings us back, in this England of ours, to savage taboos which Sir James Frazer has copiously illustrated in the "Golden Bough," and reminds us that the Gypsies are a foreign, oriental race established in our midst. Women, not only at special periodical seasons, are treated as impure. Gypsies will destroy any piece of crockery or any cooking utensil touched by a woman's skirt: no woman may walk over a stream or spring from which drinking water is taken, lest it may become defiled: and this power of contamination without contact applies to things like crockery: "Suppose now," said a girl, "my mother or one'm the girls had stepped over the tea-things as we was getting our teas, d'ye think my father'd ha' eaten another bite?" Women engaged in cooking never touch "red meat" —beef, mutton, or liver—but roll up their sleeves and put the meat into the pot with a fork. Men object to women using for washing up the crockery the soap they use for washing themselves. The article deserves consideration as describing a remarkable survival of taboo among a civilised race.

THE TOMB OF CONFUCIUS.—The *Museum Journal*, issued by the University of Philadelphia (vol. xii., No. 2), is devoted to an article by Mr. C. W. Bishop on "Shantung, China's Holy Land," and the tomb of Confucius. The cult of T'ai Shan, holiest of mountains, belongs to Taoism, the real creed of the common people, contrasted with that of Confucius, whose teachings represent the ideals of character and conduct of the ancestor-worshipping feudal aristocracy to which he belonged. There is also a goddess of T'ai Shan, but the most striking fact about the religion of China in feudal times is the entire absence of female divinities. Some forty miles south of the holy mountain, at Chu'u-fu, is the tomb of Confucius, a splendid temple within which is the gigantic seated figure of the sage, arrayed in royal robes, and round him statues of his principal disciples. The cemetery, said to be thirteen miles in circumference, contains tens of thousands of the graves of his descendants, perhaps the most wonderful graveyard in the world, continuously occupied by the descendants of a single man for more than two thousand years. The excellent photographs accompanying the article enable us clearly to realise this Chinese Holy Land.

NATURALISTIC ART IN EGYPT.—Under the heading "A New Chapter in the History of Egyptian Art," in the February issue of *Discovery*, Dr. A. M. Blackmann describes a new development of naturalistic art found in the tombs of the barons of Cusae, the modern Kusiyeh, about 200 miles south of Cairo. It is possible that this school of art did not originate locally, but at Heracleopolis Magna, the capital during the Ninth and Tenth Dynasties, which lasted from about 2500 to 2220 B.C. There is nothing quite so realistic and vigorous in the art of Memphis as the Cusite sculptor's representations of the lion catching a bull by the muzzle, the hartbeests, antelopes, and gazelles pursued by the hounds, and, more wonderful still, the tense, nervous figure of the noble hunter, raising himself on the toes of his right foot as he leans forward to discharge an arrow from his bow at the flying deer. Equally remarkable are the figures of two fellahin binding a bundle of papyrus reeds, the typical hulking Upper Egyptian yokels, the butt of the town-bred clerk in a coffee-house. Dr. Blackmann's review of this notable chapter in the art of Egypt is in every way to be commended.

MOUNT EVEREST MAPS.—During the Mount Everest expedition of last year Major Morshead and his plane-tablers mapped the whole country traversed on a scale of 4 miles to 1 inch, with the exception of the area within 10 miles of Mount Everest, which was surveyed photographically by Major Wheeler. On the return of the expedition this map was rapidly reproduced in colours by the Survey of India. The *Geographical Journal* for February contains a reduced reproduction on a scale of 1 : 750,000 of Major Morshead's map in outline, time being insufficient for the preparation of a hill shaded or hachured plate which has now been taken in hand. On this sheet the area around Mount Everest has not been taken from Major Wheeler's photographic survey, which did not reach London in time, but has been filled in by a map constructed at the Royal Geographical Society from panorama photographs. The positions of certain stations east and west of the mountain were resected from the few peaks the positions of which had been triangulated from the plains of India. When these stations were fixed other points could be intersected, and a framework was thus constructed on which the topography was sketched from photographs. This map is also reproduced, but on a scale of 1 : 100,000.

NEW SURVEYS IN KERGUELEN.—Considerable additions to the chart of Kerguelen were the outcome of Capt. R. Rallier du Baty's expedition in the *Curieuse* in the southern summer of 1913–14. Previous surveys of the coasts were very incomplete in many parts and little of value had been done since the visit of the *Challenger* in 1873. Capt. du Baty's work, the publication of which was delayed by the war, now appears in *La Geographie* (January 1922) in a revised large-scale chart of Kerguelen, on which many new soundings appear, and two sheets of harbour plans. Six harbours were surveyed in detail, including Port Curieuse, an unexpected discovery on the smooth storm-beaten west coast. Three other harbours were partly surveyed. The charts are admirably reproduced in colour. Some meteorological data for six months are appended to the paper.

NUCLEAR DIVISION IN OPALINA.—Prof. R. W. Hegner and Dr. Wu (*American Naturalist*, vol. 55, pp. 335–46, 1921) have analysed the relation between growth and nuclear division in the well-known multinucleate ciliate Opalina, from the frog's rectum, based on the study and measurements of 455 specimens. The investigation was undertaken with the view of affording further evidence on the nucleo-cytoplasmic relation theory, according to which an increase in the amount of cytoplasm as compared with the amount of nuclear material furnishes the stimulus which initiates nuclear division. The multinucleate condition and the absence of cell-walls make Opalina a favourable object for such study. By comparing the area of specimens in various stages with the number, size, and state of division of the nuclei the authors have been able to determine approximately the amount of increase of cytoplasm which stimulates nuclear division in Opalina. Nuclear division in this multinucleate organism is not synchronous; one nucleus is usually stimulated to divide before the others, and this division is, for the time, sufficient to re-establish the normal relations between nuclei and cytoplasm.

VARIATIONS IN ORGANS OF AURELIA.—It has long been known that considerable variation occurs in the number of radial canals and tentaculocysts in Aurelia, but only recently has investigation been made as to whether the ephyræ produced by individual strobilæ were always normal, or, if abnormal, were similar in their abnormalities. Mr. J. W. Low has published (Proc. Roy. Phys. Soc. Edinburgh, vol. 20, pp. 226–35) an account of his observations on twenty-seven productive strobilæ, each of which was kept in sea-water in a separate vessel. The ephyræ were examined in the order in which they were produced. The largest number of ephyræ given off by one strobila was twenty-eight; the average production per strobila was about ten, and the total number of ephyræ examined was 278, of which 90 showed major or minor abnormalities. Six of the strobilæ produced only normal ephyræ having the usual eight arms and tentaculocysts, four pairs of gastric filaments, and four mouth-lappets. The remaining strobilæ produced ephyræ some or all of which exhibited departures from the normal. The same strobila may give rise to normal ephyræ and to ephyræ having more or less than the normal number of arms, and in particular cases there was found to be abrupt discontinuity, *e.g.* from a four-rayed to a twelve-rayed form. The extremes of variation were represented by three-rayed and fourteen-rayed examples.

MICROSCOPE OBJECTIVES.—The problem of improving the design of microscope objectives in the near future has been taken up seriously in the last few months, and three suggestions have been made for the more accurate measurement of the errors to which such objectives are subject. It is rightly felt that better methods of testing must be introduced before the objectives themselves can be improved. Mr. Martin at the November meeting of the Optical Society suggested a modification of the Hartman test by transmitting the beam from the objective through separate small holes in a screen; Mr. Twyman in the November number of the *Philosophical Magazine* suggested a modification of his interference method, and Dr. Hartridge in October showed to the Cambridge Philosophical Society the curves he had obtained by a third method. He restricts the beam entering the objective to a small area and determines by means of a micrometer the lateral change of position of the image of a small object. The change is reduced to unit magnification and plotted against the portion of the aperture used, expressed as a fraction of the numerical aperture of the objective. The shape of the curve obtained gives the curvature of the field, and the magnitude of the spherical and chromatic aberrations present.

TREATMENT OF SURRA IN CAMELS.—Antimony salts such as tartar emetic are frequently curative for diseases caused by protozoal and other animal parasites, *e.g.* in oriental sore and kala-azar caused by Leishmania, bilharziasis caused by a fluke (Schistosomum), etc. Capt. H. E. Cross finds that injections of tartar emetic cures camels affected with surra, a disease caused by a trypanosome. Different methods of administration were tried, and of 51 animals treated, 31 were cured (Dept. of Agriculture, Punjab, *Veter. Bull.* No. 2 of 1920).

ENZYME ACTION AND X-RAYS.—In the *Archives of Radiology and Electrotherapy* for January (No. 258) Mr. R. D. Lawrence records experiments on the effect of X-rays on enzyme action. The diastatic ferment of human blood and urine was chosen for the investigation. Radiation was performed with a Coolidge tube at 9 inches from the anticathode, with a 5½-inch gap and unfiltered radiation at 2 milliamperes in the secondary. The radiation was carried out for from 1 minute up to 20 minutes. In no case had the radiation any effect on the enzyme action.

ANTI-OXIDATION.—During the study of the changes undergone by acrolein on long standing, it was noted by C. Moureu and C. Dufraisse that the spontaneous oxidation of this substance by an "Autoxidation" was influenced in a very marked manner by traces of impurities. Further investigation of this process (*Comptes rendus*, January 30) led to the unexpected discovery that the autoxidation of a large number of substances is prevented by the presence of certain bodies, named by the authors anti-oxidisers (*anti-oxygènes*), and this property is connected with the presence of the phenol group. Thus, the oxidation of benzaldehyde is prevented by the addition of a twenty-thousandth part of hydroquinone. Hydroquinone, pyrocatechol, and pyrogallol are especially active in preventing oxidation; ordinary phenol, resorcinol, guaiacol and the naphthols also act as anti-oxidisers, but the proportions required differ in each case. As an exception, phloroglucinol is without action, and in this connection it is recalled that phloroglucinol often reacts as a ketone. In the presence of a suitable proportion of an anti-oxidiser, furfurol remains colourless, acrolein gives no precipitate of disacryl, styrolene gives no resin on standing, linseed oil exposed in thin layers to air retains its fluidity for three years, fats (including butter) do not go rancid. Mineral substances, such as sodium sulphite and hyposulphite, are sensitive to the action of anti-oxidisers. The authors also consider the bearing of these facts on biology: phenols are fairly common in plants, generally absent in animals. It was found that the action of haemoglobin was not affected by phenolic anti-oxidisers.

THE EFFECT OF MOISTURE CONTENT UPON THE EXPANSION OF CONCRETE.—Bulletin No. 126 of the University of Illinois contains the results of a series of experiments upon the expansion of concrete carried out by Mr. T. Matsumoto, who has had some years of experience on harbour works at Formosa. The temperature coefficient of expansion of concrete is about the same as that of steel, so that these materials expand or contract together on heating or cooling. Concrete expands when it absorbs moisture and contracts when it is dried; the contraction causes stress in the concrete unless it is permitted to take place freely, and this stress appears to be not as small as is generally supposed. In reinforced concrete, the contraction may set up stresses in the steel which may reach the usually accepted working stress of steel when the reinforcement is less than 1·5 per cent. With 1 : 2 : 4 concrete and reinforcement greater than 1·5 per cent., shrinkage may produce stresses in the concrete approximating to its ultimate tensile strength, and such concrete is liable to develop cracks unless proper provision is made. The author does not consider that reinforced concrete is likely to be a durable material in places where a corrosive influence on steel, such as sea air, is active, unless proper protection against shrinkage cracks is made.

Ewing's Theory of Magnetic Induction.

AT the Royal Society of Edinburgh on February 20, Sir J. Alfred Ewing read a paper on "Models of Ferromagnetic Induction," giving a detailed account of his most recent work in magnetism.

In this paper Sir Alfred Ewing develops the theory of magnetic induction put forward by him in 1890, and discusses the reasons which have led him to modify the theory in an important particular. The theory was based on Weber's conception that a substance capable of strong magnetisation, such as iron, owes its magnetic quality to the presence within it of ultimate magnetic particles capable of being turned, and that the process of magnetising consists in compelling these particles to face more or less completely in one direction. When all the Weber particles are facing one way the iron is magnetically saturated.

What the author showed in 1890 was that the control under which the Weber particles turned was a magnetic control, and that in turning they fell over from one position of stable equilibrium to another, through an unstable phase, thereby producing the phenomena of magnetic hysteresis. This fundamental feature of the theory is retained but the author has now abandoned his further idea that the control of the particles was due simply to their mutual magnetic forces, acting from atom to atom, because a quantitative examination of the forces produced in that way has convinced him that other forces are also involved. These other forces are those which exist within each individual atom, between the Weber particle and the rest of the atom. We now know the atom to be a very complex whole, comprising many moving electrons. In a substance such as iron each atom contains a Weber particle—a thing that turns under the influence of an external magnetising force. It is not the atom as a whole that turns, but only a part of it. According to the author's view there is magnetic control exerted between the part that turns and an outer shell which is held fixed in relation to neighbouring atoms. He now shows that all the characteristics of the magnetising process can be accounted for on this basis, and may be reproduced by means of illustrative models.

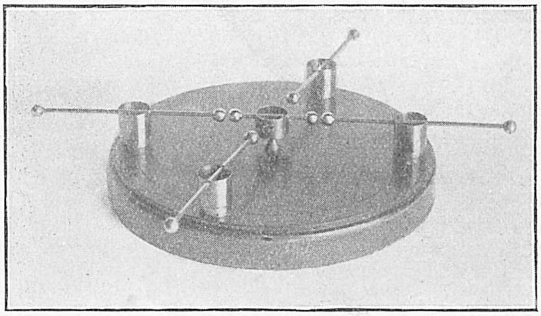

FIG. 1.

The first part of the paper is a study of the equilibrium of pivoted magnets, undertaken with reference to the author's model of 1890, in which the Weber particles were represented as rows of little magnets controlling one another by their mutual forces only. It is shown that this model fails quantitatively because when the magnets are placed near enough together to give the correct form to the curve of magnetisation, in its several stages, the deflecting force which is required to break up the row is enormously greater than that which suffices to produce strong magnetisation in iron. Iron acquires only about one per cent. of its magnetism of saturation during the first or quasi-elastic stage in the deflection of the Weber particles, before irreversible turning sets in. This means that the magnets of the old model had to be set with so small a clearance between them that the stability of the row was far too great. In the new model the stability can be reduced to any desired extent, for it depends on the balance of attracting and repelling forces due to the action of opposite portions of the outer shell of the atom on the Weber particle within.

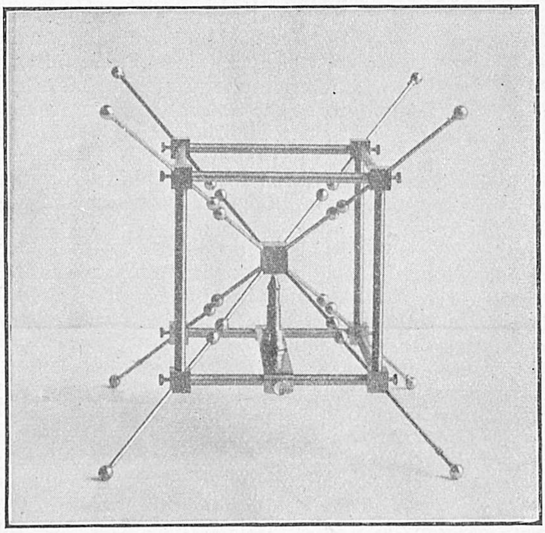

FIG. 2.

Several forms of the new model were exhibited, some with pivoted magnets to represent the Weber particles and fixed magnets to represent the controlling portions of the atomic shell. Thus in the model of Fig. 1 a pivoted magnet in the centre turns between four fixed magnets all of which present towards it poles of the same name. In the model which is shown in Fig. 2, the Weber particle is a group of eight magnetic poles, turning as a whole within a group of eight fixed magnets. The arrangement is a cubically symmetrical one appropriate to a metal such as iron, in the crystals of which the space-lattice is known to be the centred cube. In another model (Fig. 3) the Rutherford-Bohr conception of an atom with large electron orbits is realised. The orbits are represented by elliptically shaped coils with the nucleus of the atom at their

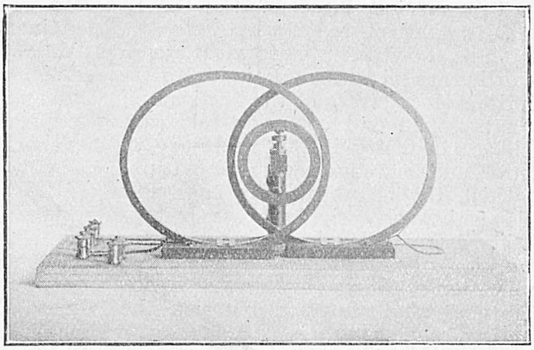

FIG. 3.

common focus: one of them is circular and turns under the control of the others, which are fixed.

Sir Alfred Ewing went on to show that with these models it is possible to imitate known features in the magnetic behaviour of metals, including effects of stress and temperature, and also effects due to the presence of non-magnetic atoms in a ferromagnetic substance, whether these were impurities or were present in combination with the metal. It was pointed out that the new model preserves all the advantages in this respect of his model of 1890 and at the same time escapes the quantitative discrepancy which had made it necessary to amend the former theory.

The Profession of Chemistry.

AT the forty-fourth annual general meeting of the Institute of Chemistry held on March 1 the president, Mr. A. Chaston Chapman, presented the first Meldola medal to Dr. Christopher Kelk Ingold. The medal, which is the gift of the Society of Maccabæans, has been instituted as a memorial to Prof. Raphael Meldola, a past-president of both the Institute and the Society, and is awarded for meritorious original work in chemistry conducted by British subjects under thirty years of age.

In the course of his presidential address Mr. Chaston Chapman said that owing to a variety of causes—foremost among which must be placed the intensive educational effect of the great war—the importance of chemistry to the national well-being was daily becoming more widely and more clearly recognised, and with that recognition had come a great development of the work of the Institute. The roll of members had increased during the past twelve months by 371 to more than 3540, and the students by 84 to 883. The organisation of the profession of chemistry was thus being steadily effected. The older members had the satisfaction of seeing the Institute placed on a sure foundation and its position as the body truly representing professional chemistry in this country, acknowledged alike by chemists, by the general public, and by the Government.

Referring to the scheme recently inaugurated under arrangements made with the Board of Education for the award of National Certificates in chemistry to students in technical schools in England and Wales, the president remarked on the advantage of bringing such students at an early age into touch with the professional qualifying body. Later, when the scheme was in operation, the council of the Institute would consider whether, and to what extent, the certificates should be allowed to rank towards the fulfilment of the conditions required for admission to the examination for the Associateship of the Institute.

In an open and comparatively young profession such as chemistry it was necessary that the public should understand clearly the nature of the work in which the members were engaged. He did not believe that any single cause had contributed so greatly to retarding in the past the progress of the profession of chemistry in this country as the misapplication of the word *chemist*. In no other country was there any confusion between the person who practised chemistry and the person who followed the profession of pharmacy, and continental chemists often expressed their inability to understand what they no doubt regarded as one of our many national peculiarities. For the present the members had to be content to express the hope that their friends the pharmacists, without relinquishing their rights, would, wherever possible, refer to their ancient, important, and very honourable calling by the word which more accurately defined and described it. The power—he might say the tyranny—of a word was often very great, and he appealed to the press, as a very important factor in the enlightenment of the general public, to assist, so far as it could, by employing the terms *chemist* and *pharmacist* respectively in the correct signification. It was to be deplored when such confusion was the unfortunate consequence of the poverty of a language; but, in this instance, the correct and distinctive words were readily available and the confusion was, therefore, easily avoidable. If chemists themselves used the word without qualifying adjectives, it would be an effective step towards establishing the proper meaning of the word.

The war had proved a very powerful factor in informing the public of the activities of the chemical profession, which occupied a position in the public esteem such as he (the president) would not have thought possible in his own lifetime; but every member should help to the best of his ability to consolidate the position they had gained, and to keep alive in the public mind the enormous national importance of the profession. Whether we regarded chemistry as a subject of study, essential to an understanding of the world in which we lived, as an agent which had done so much to transform the life of man, as one of the most powerful factors in the creation of material wealth, or, finally, as that department of natural knowledge on which our national prosperity and our national security so largely depended, its supreme importance was equally manifest.

Commenting on the production of British laboratory glassware, porcelain, and fine chemicals, the president said that the view taken by the council of the Institute and by many others who were desirous of seeing those industries firmly established in this country was that it would be a mistake of the first magnitude to revert to the position of dependence on foreign—and possibly enemy—nations. The whole chemical industry (including those essential to successful conduct of war), the prosecution of scientific research with all that it implies, and the practical teaching of science in schools and universities, all depended upon a supply of laboratory glassware, porcelain, and chemicals, adequate in quantity, suitable in quality, and reasonable in price. On national grounds, it was obviously desirable that the country should be ever directing its activities to production and to the increasing development of its internal resources. There was, moreover, the further consideration, which was much in the minds of the council, that the establishment of these essentially chemical industries demanded the services of properly qualified chemists. British manufacturers had made great progress under difficult circumstances, and there appeared to be no good reason why we should not be self-supporting in all the requirements of the profession.

After complimenting the local sections of the Institute on their activity and acknowledging the help they had given to the council in connection with the work of the Institute, the president commented on the fact that, at a time of almost unparalleled industrial depression, less than two per cent. of the members were without employment. He thought they might draw from this the comforting inference that employers were looking more and more to science to help them in overcoming technical difficulties and in improving their manufacturing operations. He concluded his address, however, with a note of warning. Many parents still retained the impression that chemistry afforded a rapid road, if not to wealth, at least to a comfortable competence, and that it involved a less expensive course of preparation than for other professions. A keen love of the subject was essential to success; but those who were attracted to chemistry should be prepared to face a great deal of hard and often unattractive work, and to make the very real sacrifice which a professional career inevitably involved. The course of training of the average chemical student was of a university character and made the same demands upon the financial resources of parents as that for medicine and the law.

The present position of the profession should inspire its members with feelings of pride and deep satisfaction, and should stimulate them to increased endeavours to raise it still higher towards that position of pre-eminence which it was surely destined to occupy.

There was scarcely a department of human activity which was not influenced more or less profoundly by the discoveries and developments of chemistry, nor was there a single individual in the community whose comfort had not been increased and whole daily life had not been made happier—or, at least, more tolerable—through the beneficent operations of that science. What discoveries in chemistry the future might hold, and in what way those discoveries might still further modify the material life of man, none could say, but it was not unlikely that if any distinctive term should be applied by the historian of the future to the era on which we were now entering, he would describe it as the "Age of Chemistry."

Biology of Mosquitoes and the Disappearance of Malaria in Denmark.

AN interesting memoir on the biology of Danish Culicidæ has recently been completed by Dr. C. Wesenberg-Lund (Mem. Acad. Roy. Sc. et Lettres de Danemark, Section des Sciences, Series 8, vol. 7, No. 1, 1921). Forty forest-ponds were subjected to regular fortnightly exploration for some years, and from them twenty-five species have been obtained, twenty of which have been reared from larvæ. Among these are four species of Ochlerotatus known from America, but not hitherto found in Europe. Observations on the habits of the larvæ lead the author to support the general conclusion reached by other recent workers that the anal gills are best developed in those larvæ which feed at the bottom of the water. The pupæ are, as every one knows, capable of movement, but they are much more stationary than is usually believed; indeed, the author goes so far as to say that usually there is no locomotion during the whole of the pupal stage. An attempt has been made to work out the life-history of each species of Culicine from the laying of the egg onwards, and the author records many interesting observations. For instance, *Ochlerotatus communis* was found to lay its eggs singly on withered leaves or on the ground underneath these; the eggs are hatched in midwinter or early spring—many of them in April—and the imagines emerge in the first half of May. Mating takes place shortly afterwards, but the craving for blood does not arise until the latter part of June. Eggs are deposited upon dry bottoms from August to December, but do not hatch until they have passed through a period of frost. The biology of *Taeniorhynchus Richardii* also presents features of special interest; the siphon of the larva pierces the submerged roots of aquatic plants and gains access to the air in the intercellular spaces; the siphons of the pupæ are brought into close apposition at their tips and are inserted into submerged roots.

In an important concluding chapter on the three species of Anopheles—*A. plumbeus, bifurcatus,* and *maculipennis*, the species found also in this country—the author deals especially with the biology of *A. maculipennis*, well known as the chief carrier of malaria in Europe. He states that in Denmark this species sucks blood from domestic animals—pigs, cattle, horses—that it is seldom seen in the open, but is found, often in incredible numbers, hanging, sluggish and blood-filled, from the ceilings of pigsties, cowsheds, and stables. Only exceptionally does it suck the blood of man, whereas in Mediterranean countries it is an outdoor species feeding largely on human blood. Dr. Wesenberg-Lund considers that in Denmark *A. maculipennis*, which is there living near the northern limit of the range of the species, has ceased to be an outdoor species sucking the blood of man, and has taken to an indoor life and restricted its attacks to farm animals. In his opinion, this change in habits has been the main factor in the disappearance of malaria, the last great epidemic of which took place in Denmark in 1831.

The change in the habits of the mosquito followed an alteration in agricultural methods about a hundred years ago. Whereas previously the swine had been driven to the woods to feed on mast, they and other farm animals were thenceforward housed. The stables, etc., form so many traps which attract mosquitoes by the odour and heat of the animals within, and once within the stable the mosquitoes find all they need until the time arrives for pairing and egg-laying. Thus the connection between man and *A. maculipennis* has been broken in Denmark, and malaria was therefore bound to disappear. The author remarks that if the measurements of the length of this mosquito given by Meigen (1818), when the species presumably fed in the open and largely on man, are correct, there has been an increase in size during the intervening century, though the species is there living near the northern limit of its range.

The Unity of Anthropology.

AT the annual meeting of the Royal Anthropological Institute on January 24 the president, Dr. W. H. R. Rivers, delivered the presidential address, taking as his subject "The Unity of Anthropology."

The aim of the address was to show the unity which underlies the apparently diverse interests of the various branches of anthropology. No student of simple societies can fail to recognise this unity, for the different aspects of culture which are readily distinguished from one another in advanced civilisations are in the simple societies so intertwined and interdependent that it is hopeless to understand any one aspect without studying the whole. It is from the students of more advanced forms of human society that we need a more complete recognition of the unity of anthropology.

The unity of ethnology and archæology was illustrated by means of recent discoveries of the Rev. C. E. Fox in the Solomon Islands, where after the bodies of the chiefs have been eviscerated they are interred within flat-topped pyramidal mounds, from the surface of which a shaft leads to the recess in which the body is placed. A dolmen is erected on the mound, by the side of which is placed an image in human form designed to receive the soul of the dead chief. These, together with other features, such as the belief in two souls, a cult of the sun with the idea of marriage with the sun, and a tradition of descent from an incestuous union, all connected especially with the chiefly clan, form a body of evidence which shows so many points of resemblance with ancient Egypt in detail that it cannot be neglected by the Egyptologist. It suggests that the rapidly increasing material provided by ethnographical research may help to elucidate some of his most difficult problems.

It was pointed out that it is only in such remote regions as Melanesia, which have not been overrun by later invasions, that we can expect to find survivals of the culture of early voyagers.

The relation between philology and ethnology was illustrated chiefly by reference to phonetics. It was pointed out that in such a region as Melanesia the philologist can now study living examples of transitions and interchanges for the existence of which in Europe his chief evidence is drawn from dead languages, impeded by the limitations which are the necessary result of fixation by means of writing. It was also shown by examples from Melanesia how features of grammar and syntax can be explained as the result of social interactions.

The present barren state of physical anthropology, in so far as it deals with living races, was ascribed to the neglect to utilise the findings of ethnology as working hypotheses and stimuli to new lines of research.

The address concluded with a consideration of the means whereby the Royal Anthropological Institute might promote the recognition of unity. It was pointed out that a scheme, already under consideration, whereby societies dealing with different aspects of human culture should be housed under one roof, with the common use of libraries and lecture-rooms, would contribute to this end; and it was suggested that the Institute itself might give much more attention than it does at present to papers and discussions which would bring out the common purpose of the more specialised studies.

Geology and the History of London.[1]

NUMEROUS small streams now "buried" under London are indicated on the new 6-in. Geological Survey Maps constructed by the author, and the historical research involved in tracing them has led to an appreciation of the connection between the geology and topography on one hand, and the original settlement and gradual growth of London on the other.

The reasons for the first selection of the site have been dealt with by several writers: below London the wide alluvial marshes formed an impassable obstacle; traffic from the Continent came by the ports of Kent, and, if destined for the north or east of Britain, sought the lowest possible crossing of the Thames. This was near old London Bridge, where the low-level gravel on the south and the Middle Terrace deposits on the north approached close to the river-bank. A settlement was obviously required here, and the northern side was chosen as the higher ground. The gravels provided a dry, healthy soil and an easily accessible water-supply; they crowned twin hills separated by the deep valley of the Walbrook, bounded on the east by the low ground near the Tower and the Lea with its marshes, and on the west by the steep descent to the Fleet; the site was, therefore, easily defensible. The river-face of the hills was, naturally, more abrupt than it is now, owing to the reclamation of ground from the river; the most ancient embankment lay 60 ft. north of the northern side of Thames Street.

The first definite evidence of a permanent settlement is the reference in Tacitus. The early Roman encampment lay east of the Walbrook, and the brick-earth on the west around St. Paul's was worked. Later the city expanded until the St. Paul's hill was included, the wall being built in the second half of the fourth century. The great Roman road from Kent (Watling Street) avoided London, and utilised the next ford upstream—at Westminster—on its way to Verulamium and the north-west. The earliest Westminster was a Roman settlement beside the ford, built on a small island of gravel and sand between two mouths of the Tyburn. This settlement could not grow, as did London, since the area of the island, known to the Saxons as Thorney, was small. The road from London to the west joined the St. Albans road at Hyde Park Corner, running along the "Strand," where the gravel came close to the river; a spring thrown out from this gravel by the London Clay was utilised for the Roman Bath in Strand Lane.

Throughout medieval times London was practically confined to the walled city, a defensible position being essential. The forests of the London-Clay belt on the north are indicated in Domesday Book and referred to by several writers, notably Fitzstephen, whose Chronicle also mentions many of the springs and wells and the marsh of Moorfields, produced largely by the damming of the Walbrook by the Wall. The same writer mentions that London and Westminster are "connected by a suburb." This was along the "Strand," and consisted first of great noblemen's houses facing the river and a row of cottages along the north side of the road; this link grew northwards, at first slowly, but in the second half of the seventeenth century with great rapidity. By the end of that period the whole of the area covered by the Middle-Terrace Gravel was built over, but the northern margin of the gravel was also that of the town for one hundred years, the London-Clay belt remaining unoccupied.

The reason for this arrested development was that the gravel provided the water-supply. In early days the City was dependent on many wells sunk through the gravel, some of which were famous, such as Clerkenwell, Holywell, and St. Clement's. In the same way the outlying hamlets (for instance, Putney, Roehampton, Clapham, Brixton, Ealing, Acton, Paddington, Kensington, Islington, etc.) started on the gravel, but later outgrew it. In the City the supply soon became inadequate, or, as Stow says, "decayed," and sundry means were adopted to supplement it. The conduit system, bringing water in pipes from distant springs, began in 1236; London Bridge Waterworks pumped water from the Thames by water-wheels from 1582 to 1817, while the New River was constructed in 1613, and is still in use. It was not until the nineteenth century that steam-pumps and iron pipes made it possible for the clay area to be occupied, thus linking together the various hamlets that now form the metropolitan boroughs of Greater London.

[1] From a lecture delivered before the Geological Society of London on February 1 by C. E. N. Bromehead.

University and Educational Intelligence.

Manchester.—Prof. H. R. Dean, having been appointed to the Chair of Bacteriology in the University of London, has resigned his appointment as Proctor Professor of Pathology.

The University Colston Society has decided to establish, with the aid of industrial firms, a number of Colston Research Fellowships in the faculties of arts, science, medicine and engineering of the University of Bristol. It is proposed to approach firms in the area served by the University with the view of obtaining support for fellowships by the payment of yearly sums of 150*l.*, in return for which it would be possible for the donor to earmark the award for a particular branch of study, subject, or person, subject to the approval of the University faculty involved. These fellowships, which will be of the annual value of 150*l.*, will be awarded to graduates of the University of Bristol and be tenable for one year. Should no suitable graduate of the University present himself a fellowship may be awarded to a graduate of another university or to any approved person. This scheme comes as an addition to the numerous grants which for many years past have been made by the Colston Society for the encouragement of research in the University of Bristol.

The Association of University Teachers, the president of which is Prof. J. Strong, of the University of Leeds, has issued the first number of a publication, the *University Bulletin* (6*d.*), which it is intended to produce terminally. Its primary object is to serve as the organ of the association, and an editing committee, composed of Prof. J. Strong, Mr. R. D. Laurie, and Mr. F. Smith, is in charge. In an editorial note in the issue before us it is stated that the *Bulletin* will bring to the notice of its readers the doings and policy of the council of the association, and will endeavour to foster the effort to extend the influence of the universities in the life of the nation. Other items which the first issue contains are by Sir Michael Sadler on the threefold allegiance of university teachers to their institution, to the university life of the nation and of the world; an article by Prof. Strong on the aims and activities of the Association of University Teachers; and an historical sketch by Mr. Laurie of the movement which led to the formation of the association. There are also critical notes on the University Grants Committee's Report, Parliamentary representation of teachers, superannuation for university teachers, and similar topics.

Following the lines of previous years, Mr. F. S. Marvin has arranged, in conjunction with Dr. Charles Singer, a course of lectures on "Science and Social Progress," for the Unity History School, to be held at Woodbrooke, Birmingham, from Thursday, July 27, to Friday, August 4. A sketch in broad outline will be given of the history of science, especially in its relation to the contemporary social evolution, and this will be followed, in the latter half, by discourses on the problems that are being raised to-day by the growth of science. First the historical retrospect, then the living problem, and the whole looked at from the completely human point of view. The lecturers will be Prof. J. L. Myres, Dr. J. L. E. Dreyer, Prof. J. A. Platt, Dr. C. Singer, Prof. A. N. Whitehead, Prof. C. H. Desch, Prof. J. A. Thomson, Mr. Julian Huxley, Mr. A. E. Heath, Prof. F. G. Donnan, and Mr. F. S. Marvin. Communications concerning this holiday school should be addressed to Mr. Edwin Gilbert, 78 Mutley Plain, Plymouth. All letters requiring reply should contain stamps covering the necessary postage.

Calendar of Industrial Pioneers.

March 9, 1908. Henry Clifton Sorby died.—Sorby came of an old Sheffield family of cutlers. He was of independent means. Devoting himself to scientific investigations, he became known among geologists as the father of microscopical petrology, while his microscopic study of iron and steel opened out a field of research of immense importance to the metallurgist.

March 10, 1874. Moritz Hermann Jacobi died.—German by birth, Jacobi became a professor at Dorpat and St. Petersburg, where in 1837 he discovered the art of electrotyping. He also improved the voltaic battery, and made a trial on the Neva of a boat driven by an electro motor.

March 10, 1902. Charles Yelverton O'Connor died.—An eminent civil engineer, O'Connor held important positions in New Zealand, and in 1891 became engineer-in-chief to Western Australia. He constructed the harbour at Fremantle, and was responsible for the Coolgardie Water Supply Scheme, in which water is conveyed 328 miles through 30-inch steel pipes, an undertaking costing 2,660,000*l.*

March 11, 1916. Erasmus Darwin Leavitt died.—Trained as a mechanical engineer, Leavitt served in the United States Navy during the Civil War, and afterwards as a consulting engineer was responsible for many of the most important steam-engine installations in America. He was a founder of the American Society of Mechanical Engineers, and in 1883 served as its president.

March 12, 1898. Ferdinand Hurter died.—After serving an apprenticeship to a Swiss dyer, Hurter studied chemistry under Bunsen, and in 1867 settled in England, finally becoming principal chemist to the United Alkali Company. He was a pioneer in the application of mathematics to technological chemistry, and with Driffield carried out a long and fruitful investigation of the chemistry and physics of photography.

March 12, 1914. George Westinghouse died.—A great industrialist, the president of no less than thirty companies, Westinghouse first gained a reputation by his invention of the compressed-air brake for railway trains. Tried in 1868, the brake was made automatic in 1872, and has been universally adopted. Westinghouse was a pioneer in the development of alternating current electric machinery, he assisted Tesla in his work on the induction motor, and made the first ten generators for Niagara.

March 13, 1719. Johann Friedrich Böttger died.—The discoverer of the method of making porcelain from the reddish clays found in the neighbourhood of Meissen, Böttger began life as an apothecary's apprentice in Berlin, but his discovery was largely the outcome of his alchemical experiments. For many years he was maintained as a sort of prisoner by the Elector of Dresden.

March 15, 1898. Sir Henry Bessemer died.—The greatest metallurgist of the nineteenth century, Bessemer, by the invention in 1856 of his direct process of converting pig-iron into malleable iron or mild steel, provided mankind with abundant supplies of a superior structural material at a diminished cost. Several notable metallurgists contributed to the success of the process, which reached its perfection in 1879 by the discoveries of Sidney Gilchrist Thomas.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, March 2.—Sir Charles Sherrington, president, in the chair.—L. N. G. **Filon** and H. T. **Jessop**: On the stress-optical effect in transparent solids strained beyond the elastic limit. The stress-optical effect in glass under simple pressure exhibits no time-effect at ordinary temperatures, but in celluloid under simple tension there is a marked creep in both stress-optical effect and strain even under very moderate loads. The observations can be explained on the assumption that celluloid consists of a mixture of two constituents having different elastic and plastic properties and different stress-optical coefficients, the optical-effect in each being strictly proportional to the stress.—W. E. **Curtis**: The structure of the band spectrum of helium. Measurements of grating photographs of three of the principal helium bands show that the chief features of their structure are accounted for by the quantum theory of band spectra. In each of the three bands a new type of series is found. The spectrum is considered to be due to an unstable helium molecule, having a moment of inertia of about $1 \cdot 8 \times 10^{-40}$ gm.cm.^{2}.—S. **Datta**: The spectrum of beryllium fluoride. The spectrum of beryllium fluoride consists of six groups of bands, all in the ultra-violet between λ 2800 and λ 3400, and all fading off towards the red. The strongest band at λ 3009 includes three series of lines, which depart considerably from the usual type of formula. The groups of bands are similar to one of the groups given by magnesium fluoride.—W. G. **Palmer**: The catalytic activity of copper. Pt. III. The effect upon the catalytic (dehydrogenating) activity of copper of adding to the metal varying proportions of weak dehydrogenating catalysts, ferric, manganous, zinc, and magnesium oxides, is described. Magnesium and manganous oxides enhance the activity of the copper, if present in quantity greater than 1 to 2 per cent., while zinc and ferric oxides reduce the activity. It is considered that small proportions of oxide (less than 1 to 2 per cent.) destroy the activity of the copper, owing to solution in the metal leading to diminished adsorption of the alcohol attacked.—G. B. **Jeffery**: (1) The motion of ellipsoidal particles immersed in a viscous fluid. (2) The rotation of two circular cylinders in a viscous fluid. (1) Einstein has shown that the viscosity of a fluid containing solid spherical particles in suspension is given by μ $(1+2 \cdot 5\ V)$, where μ is the viscosity of the pure fluid and V is the total volume of the particles per unit volume of the suspension. This result is extended to ellipsoidal particles and it is shown that the factor 2·5 is *reduced* but always lies between 2 and 2·5 and depends upon the shape of the particles. (2) The problem of the rotation of a circular cylinder in a fluid contained in a non-concentric cylindrical vessel which may itself rotate about its axis can be solved in finite terms; that of the rotation of two parallel cylinders in an infinite fluid is in general insoluble; *i.e.* there is no steady motion for which the fluid is at rest at infinity.

PARIS.

Academy of Sciences, February 13.—M. Emile Bertin in the chair.—Maurice **Janet**: The characters of the moduli of forms and systems of partial differential equations.—Witold **Wilkosz**: A fundamental point in the theory of potential.—E. **Cartan**: A geometrical definition of the energy tensor of Einstein.—M. **Auric**: The resolution of an indeterminate linear equation.—V. **Dolejsek**: The Kα lines of the lighter elements. The Kα lines have been measured for thirteen elements, ranging between chlorine and zinc.—A. **Dauvillier**: The complexity of the K series of the light elements and its theoretical interpretation. Results and details of measurements in the K series of copper and molybdenum.—C. E. **Guye**: The extension of the law of Paschen to polarised fluids.—M. **Mercier**: Harmonic synchronisation of electrical oscillators.—R. **Bouloch**: Calculation of the elements which determine a centred system formed by any number of surfaces.—A. **Zimmern**: The influence of temperature on the sensibility of emulsions in radiography. Over the range 15° to 80° C. the sensibility of a photographic plate to light varies slightly, if at all. With X-rays, on the other hand, the sensibility increases with rise of temperature, and this effect can in some cases be utilised with advantage. It would appear that the actions of light and X-rays on the silver salt are dissimilar.—C. **Matignon** and M. **Fréjacques**: The transformation of ammonia into urea. Quantitative study of the conversion of ammonium carbamate into urea, alone or in presence of catalysts.—Paul **Pascal**: The magneto-chemical investigation of constitution in mineral chemistry. The phosphoric acids. Measurements of the magnetic susceptibilities are given, and constants deduced for the groups, P, PO_2, PO_3, PO, and PO_4. The results agree with the rational formulæ $PO(OH)_3$ and $RPO(OH)_2$ for the phosphonic and phosphoric acids, and are opposed to $H_2PO(OH)$ for hypophosphorous acid and $HPO(OH)_2$ for phosphorous acid.—E. **Decarrière**: The *rôle* of gaseous impurities in the catalytic oxidation of ammonia. The influence of hydrogen phosphide. Phosphoretted hydrogen poisons the catalyst (platinum) in ammonia oxidation, even in a proportion as low as 0·00002 per cent.—Marcel **Godehot** and Pierre **Bédos**: The oxide of cyclohexene and ortho-methylcyclohexanol. The ether oxide of cyclohexanol is obtained in quantitative yield by the oxidation of cyclohexene with perbenzoic acid. Methylmagnesium iodide reacts with the ether oxide giving *o*-methylcyclohexanol.—V. **Thomas**: A mixed organometallic compound of aluminium. Methylene iodide reacts slowly with aluminium at the ordinary temperature, no gas being evolved.—Alphonse **Mailhe**: A new preparation of amino-naphthenes. Cyclohexanone or its alkyl derivatives are converted into ketazines by reaction with hydrazine hydrate and these reduced to amines by catalytic reduction with nickel. The main product consists of primary amines, with a small proportion of secondary amines as a bye-product.—G. **Meunier**: The action of mineral acids on crude celluloses: the formation and destruction of reducing substances. The utilisation of the bye-products of this destruction. Dilute mineral acids at a high temperature attack the ligno-celluloses as vigorously as strong acids, used cold, with economy of acid. The bye-products include fatty acids, furfurol, acetone, and methyl alcohol, and suggestions are made for their utilisation.—Charles **Jacob**: The structure of southern Tonkin. Except for small differences in detail, the geological structure of southern Tonkin is the same as that of North Annam.—Mlle. Yvonne **Boisse de Black**: Rissian erosion in the high valleys of the Cère and the Goul (Cantal).—P. **Monnet**: The Italian earthquake of September 7, 1920. A slight shock on September 6 was followed on the 7th by a disastrous earthquake by reason of which 250 lives were lost. The seismic zone is a rough oval the major axis of which is S.E.–N.W. and about 50 kilometres long.—C. and M. **Schlumberger**: Electrical phenomena produced by metallic deposits. It has been shown in an earlier communication that deposits of pyrites produce spontaneously differences of potential with the surrounding layers. The phenomenon appears to be general and the presence of pyrites is not indispensable, similar effects being traced to the presence of galena, mispickel, sulphides of copper, pyrolusite, and other minerals. The effect can be reproduced in the laboratory.—Paul **Guérin**: The mucilage of the Urticaceæ. Mucilage is widely distributed in this order, and its presence in the various organs of these plants constitutes a character of real value, and should be taken into account along with other anatomical peculiarities.—H. **Jumelle**: The Neophloga, Madagascan palm trees.—A. **Guilliermond** and G. **Mangenot**: The signification of Holmgren's canals.—Eugène **Bonnet**: The action of soluble salts of lead on plants. The plants studied included wheat, peas, and beans, and the lead solution surrounding the rootlet between one-thousandth normal and half that amount of lead. Lead arrests the growth of the stem and diminishes the length of the roots.—Gabriel **Bertrand** and Mme. M. **Rosenblatt**: The variations in the proportions of manganese in leaves with age.—Gustave **Rivière** and Georges **Pichard**: The partial sterilisation of the soil. Experiments on the use of sodium arsenate for the partial sterilisation of the soil. Used in the proportion of between 21 and 42 kilograms per hectare the protozoa are destroyed and the useful bacteria multiply. This indirect fertilising action is shown by increased yields, which on the large scale have been shown to be 20 per cent. to 50 per cent.—Auguste **Lumière** and Henri **Couturier**: The resistance of females during pregnancy to anaphylactic and anaphylactoid shock. Female guinea-pigs during pregnancy are immune from shock caused either by the injection of serum or of flocculent inert material. The cause of the immunity has been traced to the increase in the volume of the blood: the immunity could be destroyed in females by bleeding and conferred on males by injecting physiological serum.—M. **Champy**: The conditions of the genesis of the sexual harmozone in Batrachians.—Henri Jean **Frossard**: Respiratory gymnastics and the tests of Valsalva and of Muller.—Foveau de **Courmelles**: Combined radiotherapy of the breast and the ovaries against tumours of the breast.

Official Publications Received.

Meddelanden från Statens Skogsförsöksanstalt. Hälfte 18, Nr. 4: Stamforms-Undersökningar en Sammanfattande Analys av Norrländskt Tallmaterial med Avseende på de Faktorer som Bestämma Noggrannheten vid Aptering på Rot. (Stem Form Investigations: Accuracy of Yield Estimation of Standing Trees.) By Sven Petrini. Pp. 165-220. Hälfte 18, Nr. 5: Till Kannedomen om Förhallandet mellan Solbladens och Skuggbladens Kolhydratsproduktion. By M. G. Stålfelt. Pp. 221-280. Hälfte 18, Nr. 6-9: Skogsinsekternas Skadegorelse under 1918, die Beschädigungen der Forstinsekten im Jahre 1918. By Ivar Trägårdh. Bidrag Till Kännedomen om Splintborrarnas Näringsgnag: Beitrag zur Kenntnis des Ernährungsfrasses bei den europäischen Splintkäfern. By Paul Spessivtseff. Årsberättelser 1920. Årsberättelser 1921. Pp. 281-352. (Stockholm.)

I.—1922. Ceylon. Report of the Industries Commission. Pp. 91. (Colombo: Government Record Office.) 2.75 rupees.

Nigeria. Annual Report on the Forest Administration for the Year 1920 and period 1st January to 31st March 1921. Pp. 24. (Ibadan: Forestry Department.)

Bulletin of the American Museum of Natural History. Vol. 45. I.: On the Distribution of the Ants of the Ethiopian and Malagasy Regions. By Wm. M. Wheeler. II.: The Ants collected by the American Museum Congo Expedition. By Wm. M. Wheeler. Pp. 13-269+plates 2-23. (New York.)

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 45: A Biological Survey of Alabama. By Arthur H. Howell. 1: Physiography and Life Zones. 2: The Mammals. Pp. 88+11 plates. (Washington: Government Printing Office.)

The Carnegie Foundation for the Advancement of Teaching. Sixteenth Annual Report of the President and of the Treasurer. Pp. vi+205. (New York City.)

Hydro-Electric Survey of India. Vol. 3: Triennial Report, with a Preliminary Forecast of the Water Power Resources of India, 1919 to 1921. By J. W. Meares. Pp. ix+199. (Calcutta: Government Printing Office.) 4 rupees.

Ministry of Agriculture, Egypt. Report on the Motor Tractor Trials organized by the Ministry of Agriculture. Part A: At Kafr Bata—December 1920. Part B: At Damanhur—April 1921. Pp. iv+55+plates. (Cairo: Government Press.) P.T. 15.

Department of Agriculture, Mysore. Mysore Agricultural Calendar 1922. Pp. iii+56. (Bangalore: Government Press.) 1 anna.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1920. Pp. iv+28. (Barbados.) 6*d*.

Trinidad and Tobago. Council Paper No. 100 of 1921. Department of Agriculture. Administration Reports of the Director of Agriculture for the Years 1919 and 1920. Pp. 84. (Port of Spain: Government Printing Office.) 2*s*. 3*d*.

Department of the Interior: Bureau of Education. Bulletin, 1920, No. 39: Facilities for Foreign Students in American Colleges and Universities. By Samuel P. Capen. Pp. 269. (Washington: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 459: Surface Water Supply of the United States, 1917. Part IX.: Colorado River Basin. Pp. 192+xxxiii. Water-Supply Paper 460: Surface Water Supply of the United States, 1917. Part X.: The Great Basin. Pp. 277+xl. Water-Supply Paper 475: Surface Water Supply of the United States, 1918. Part V.: Hudson Bay and Upper Mississippi River Basins. Pp. 153+xxx. (Washington: Government Printing Office.)

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the Year ending June 30, 1919. (Publication 2590.) Pp. xii+557. (Washington.)

Diary of Societies.

FRIDAY, MARCH 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—R. L. Smith-Rose: The Electromagnetic Screening of a Triode Oscillator.—Dr. H. P. Waran: A New Form of High Vacuum Automatic Mercury Pump.—W. N. Bond: Viscosity Determination by means of Orifices and Short Tubes.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—Prof. H. Maclean and Dr. I. Jones: Some Observations on the Production of Lactic Acid in Stomach Diseases.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—C. H. Plant: Friction.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—P. G. Doyne: Coloured Vision.—R. A. Greeves: A Series of Sympathising Eyes examined Microscopically.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. T. R. Merton: Problems in the Variability of Spectra.

SATURDAY, MARCH 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Radioactivity (2).

MONDAY, MARCH 13.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore, S.W.7), at 5.—C. C. Fagg: A Description of the Regional Survey of the Croydon Natural History and Scientific Society.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.—Squadron Leader H. E. Whittingham: Observations on Sandfly Fever in Malta.

INSTITUTE OF TRANSPORT (at Institution of Civil Engineers), at 5.30.—T. R. Johnson: Railway Problems in China and Australia.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.—Dr. E. W. Goodall: The Differential Diagnosis of the Common Exanthemata.

TUESDAY, MARCH 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Arthur Keith: Anthropological Problems of the British Empire. Series I. Racial Problems in Asia and Australasia (4).

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (at University College), at 4.30.

EUGENICS EDUCATION SOCIETY (at Royal Society), at 5.—H. Cox: The Reduction of the Birth Rate as a Necessary Instrument for the Improvement of the Race.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Greenwood: The Influence of Industrial Employment on General Health (Milroy Lectures) (2).

ROYAL SANITARY INSTITUTE (90 Buckingham Palace Road, S.W.1), at 5.30.—A. H. Barker, and others: Central Heating in Relation to Domestic and other Buildings.

WOMEN'S ENGINEERING SOCIETY (at 26 George Street, W.1), at 6.15.—F. S. Button: Women's Place in Industry.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 6.30.—Prof. J. S. S. Brame: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—B. S. Curwen: Mounting in Glycerine with Wax Seals, with Special Reference to Entomostraca.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—J. P. Mills: The Lhota Nagas.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Adjourned Discussion on the Ideal Clinic for Nervous and Borderland Cases.

WEDNESDAY, MARCH 15.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—F. Romer: A Short History of Bonesetting.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—G. FitzGibbon: The Great Ship-Canals of the World (Vernon Harcourt Lectures) (1).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. E. M. Wedderburn: Seiches; and the effect of Wind and Atmospheric Pressure on Inland Lakes.

ROYAL SOCIETY OF ARTS, at 8.—O. T. Falk: Certain Aspects of the Problem of Exchange Stabilisation.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: The Future of the Microscope in Medical Research.—Dr. H. Hartridge: Monochromatic Illumination. A Low-Power Eyepiece with Large Field.

THURSDAY, MARCH 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. P. C. Mitchell: The Cinema as a Zoological Method (1).
ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Dr. H. H. Dale and C. H. Kellaway: Anaphylaxis and Anaphylatoxins.—J. C. Bramwell and Prof. A. V. Hill: The Velocity of the Pulse Wave in Man.—A. Fleming: A New Bacteriolytic Element found in Tissues and Secretions.—Dr. J. W. Pickering and Dr. J. A. Hewitt: The Action of "Peptone" on Blood and Immunity thereto.
LINNEAN SOCIETY OF LONDON, at 5.—B. M. Griffiths: The Heleoplankton of Three Berkshire Pools.—C. E. Salmon: Three British Plants.—Rev. F. C. R. Jourdain: Bear Island and Spitzbergen, with especial regard to their Bird-life.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Greenwood: The Influence of Industrial Employment on General Health (3).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Dr. V. E. Pullin: Radiological Examination of Materials.
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—L. C. Stuckey: Notes on the Valuation of Ores, Concentrates and Smelter Products.—L. H. Cooke: Methods of Measuring Horizontal Angles involving Steep or Precipitous Sights.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. G. Hill: Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits worked at Audio Frequencies.
CHEMICAL SOCIETY, at 8.—H. B. Baker: Change of Properties of Substances on Drying.—H. Burton and J. Kenner: The Influence of Nitro-Groups on the Reactivity of Substituents in the Benzene Nucleus. Part VI. The Elimination of Halogen during the Reduction of Halogenated Nitro-Compounds.
SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street, W.C.2), at 8.—Open Meeting.
ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 8.30.—Dr. J. Darier: Des cancers épithéliaux de la peau.

FRIDAY, MARCH 17.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 5.
INSTITUTE OF TRANSPORT (at Royal Society of Arts), at 5.—F. Pick: The Operation of an Omnibus Company, with reference to Capacity and Cost under Given Conditions.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—P. C. Dewhurst: British and American Locomotive Design and Practice.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.—C. C. H. Wade: The Electron Theory.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—G. H. Ayres: Power Factor Improvement.
ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section), at 8.30.—Dr. M. Legge and others: Discussion on the Pathological Changes produced in Subjects rendered Unconscious by Electric Shock, and the Treatment.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Principal A. P. Laurie: The Pigments and Mediums of the Old Masters.

SATURDAY, MARCH 18.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Radioactivity (3).
PHYSIOLOGICAL SOCIETY (at University College).

PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a series.*)

FRIDAY, MARCH 10.

METEOROLOGICAL OFFICE (South Kensington, S.W.7), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (8).
TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at Mary Ward Settlement, Tavistock Place, W.C.1), at 5.30.—Dr. H. C. Miller: The New Psychology and its Bearing on Education (7).

SATURDAY, MARCH 11.

LONDON DAY TRAINING COLLEGE, at 11.—Prof. J. Adams: The School Class (8).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Cleopatra's Needle and Sun-worship.

TUESDAY, MARCH 14.

IMPERIAL COLLEGE (Royal School of Mines), at 5.30.—Col. N. T. Belaiew: The Crystallisation of Metals (4).

WEDNESDAY, MARCH 15.

EAST LONDON COLLEGE, at 4.—Prof. F. E. Fritch: Certain Aspects of Freshwater Algal Biology (5).
LONDON (R.F.H.) SCHOOL OF MEDICINE FOR WOMEN (Hunter Street, W.C.1), at 5.—Dr. H. H. Dale: Some Recent Developments in Pharmacology (4).
KING'S COLLEGE, at 5.15.—Prof. N. Bohr: The Quantum Theory of Radiation and the Constitution of the Atom (2).
HORNIMAN MUSEUM (Forest Hill), at 6.—W. W. Skeat: The Living Past in Britain (8).
UNIVERSITY COLLEGE, at 8.—The Current Work of the Biometric and Eugenics Laboratories (5). Julia Bell: The Inheritance of certain Types of Blindness.

THURSDAY, MARCH 16.

SCHOOL OF ORIENTAL STUDIES, at 5.—Dr. L. D. Barnett: The Hindu Culture of India (3).
UNIVERSITY COLLEGE, at 5.15.—Prof. J. E. G. de Montmorency: Welsh and Irish Tribal Customs (6).
KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (9).
LONDON DAY TRAINING COLLEGE, at 6.—Dr. W. Rosenhain: Aluminium and its Alloys.

FRIDAY, MARCH 17.

METEOROLOGICAL OFFICE (South Kensington), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (9).
KING'S COLLEGE, at 5.—Prof. R. Robinson: Orientation and Conjugation in Organic Chemistry from the Standpoint of the Theories of Partial Valency and of Latent Polarity of Atoms (3).
TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at Mary Ward Settlement, Tavistock Place, W.C.1), at 5.30.—Dr. H. C. Miller: The New Psychology and its Bearing on Education (8).

SATURDAY, MARCH 18.

THE POLYTECHNIC (Regent Street, W.1), at 10.30 A.M.—P. A. Best: The Romance of Commerce.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Natural History of Elephants.

CONTENTS.

	PAGE
Awards for Discovery and Invention	293
Principles and Problems of Aeronautics. By Prof. G. H. Bryan, F.R.S.	296
The History of Whaling	298
Inorganic Chemistry as a Science. By Prof. F. G. Donnan, F.R.S.	300
Cloud-Forms. By Sir Napier Shaw, F.R.S.	301
Prehistoric Western Europe. By H. J. F.	302
Rosenbusch's Petrology. By Dr. J. W. Evans, F.R.S.	303
Our Bookshelf	304
Letters to the Editor:—	
The Langley Machine and the Hammondsport Trials.—Griffith Brewer; The Writer of the Articles	305
Some Biological Problems.—Sir G. Archdall Reid, K.B.E.	307
A Rainbow Peculiarity. (*Illustrated.*)—Major William J. S. Lockyer	309
Flowering Dates of Trees.—Wilson Lloyd Fox	310
Where did Terrestrial Life Begin?—Prof. J. W. Gregory, F.R.S.	310
The Name of the Gid Parasite.—Prof. T. D. A. Cockerell	310
The Weathering of Mortar.—Nelson M. Richardson	310
Cancer Research. By Dr. J. A. Murray	311
The Mechanism of Heredity.—III. (*With diagrams.*) By Prof. T. H. Morgan	312
Obituary:—	
Sir George Carter, K.B.E. By T. B. A.	314
Dr. H. Lyster Jameson	314
Sir E. C. K. Gonner, K.B.E.	314
Mr. George Cussons	315
Current Topics and Events	315
Our Astronomical Column:—	
Saturn	318
Meteoric Fireballs	318
Comparison of Speed of Blue and Yellow Light	318
The Illumination of the Eclipsed Moon	318
Parallaxes and Proper Motions	318
Research Items	319
Ewing's Theory of Magnetic Induction. (*Illustrated*)	321
The Profession of Chemistry	322
Biology of Mosquitoes and the Disappearance of Malaria in Denmark	323
The Unity of Anthropology	323
Geology and the History of London	324
University and Educational Intelligence	325
Calendar of Industrial Pioneers	325
Societies and Academies	326
Official Publications Received	327
Diary of Societies	327