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The British Association and National Life.

WE published a fortnight ago (Sept. 2, p. 13) some observations made by Dr. R. V. Stanford, our local correspondent for the recent meeting of the British Association at Cardiff, upon "the apathy of local people of the educated classes to the presence of the Association" in the city, and the neglect of the opportunity which such a meeting may afford of stimulating public interest in scientific achievements and their applications. There is, we believe, a feeling among many members of the Association that efforts should be made to increase its usefulness by bringing it into closer contact with thoughtful members of all classes of the community and encouraging a fuller representation of the new generation of scientific workers. Institutions, like organisms, must be adapted to their circumstances, or suffer eventual extinction. The British Association is still in a state of strong vitality, but it is not making progress; and not to be in touch with advancing times signifies retrogression.

It is easy to be satisfied with this condition, and to consider that all is of the best in the best of all scientific organisations, but that is not the spirit of development. There is no need for scientific men now to work in secret cells, and carry on their discussions in conclaves; on the contrary, the world is more eager than ever it was to learn and to use the results of scientific research. Whatever apathy exists on the part of the general public as regards these advances is due largely to the neglect of national bodies like the British Association to adjust themselves to changing national needs. The public does not understand the Association, and the Association makes little endeavour to show the bearing of scientific methods and principles upon most subjects of vital importance in national polity and industrial affairs.

When the Association was founded, in 1831, one of its first purposes was stated to be "to obtain a greater degree of national attention to the objects of science"—a phrase which in the present rules reads "to obtain more general attention for the objects of science." Whether the change was deliberate or not we do not know, but we prefer to think that "national attention" is what was originally intended, and we desire to urge that this aspect of the Association's activities should be given more consideration than it now receives, instead of concentrating upon the work of the sections. There were no sections when the Association began its existence, but only committees upon various branches of science. At the Cambridge meeting in 1833 the sections were: (1) Mathematics and Physics; (2) Philosophical Instruments and Mechanical Arts; (3) Natural History, Anatomy, Physiology; (4) History of Science. Chemistry, with Mineralogy, became a section in the following year, and Statistics formed a sixth section. Then came in succession Geology and Geography, Zoology and Botany, Mechanical Science, and various other changes, leading to the present denomination of sections. Anthropology became a section in 1884, Physiology ten years later, Botany in 1895, Educational Science in 1901, Agriculture in 1912, and at the recent Cardiff meeting the General Committee recommended that Psychology be promoted from a sub-section to a section, making thirteen in all. Each section is autonomous, and there is no co-ordinating committee to make them part of a composite organisation, or suggest how they may combine their forces for the common good. The Association is like a great industrial works in which each shop produces what it pleases, and no one has the duty of building up a noble structure from the various parts.

Two separate functions may be distinguished in the work of each section. One is the presentation of papers for discussion by workers in the particular fields to which they refer, and half-a-dozen such allied workers gathered together can gain more from one another by informal conversation than can possibly be elicited when their remarks are addressed to an audience without special know-

ledge of the subjects under consideration. If, however, a section is to be regarded purely as an assembly of specialists, and papers read are prepared on this assumption, then fifty sections would not be sufficient to meet the present-day differentiation of scientific subjects. As such subdivision is impracticable, intensive discussion is usually impossible, and very few members of a section are able to make profitable comments upon papers of a specialised kind. Authors ought not, indeed, to assume that a section as a whole consists of specialists in their own minute fields, but should address themselves rather to workers generally in a broad department of scientific activity. Members who attend any particular section do not expect to learn much that is new of their own special subjects, but they do want to know the chief lines of progress in related branches of work. A section ought not, in fact, to be addressed as a scientific or technical society, but as a Royal Institution assembly. Its main function should not be technical discussion by specialists for specialists, but the enlightenment of an extensive group of workers as to main lines of advance in fields not specifically their own.

We know, of course, that there are practical difficulties in ensuring generally intelligible discourses from men whose main interest is in actual research. Genius for discovery is not often associated with the art of literary or of vocal expression, so that it is not uncommon to find readers of papers and openers of discussions in sections offending the most elementary principles of public speaking. They converse with themselves instead of addressing the back row of their audience; if they use a lantern their slides are often mixed, and are usually changed by the irritating instruction "Next, please," long ago discarded by every public lecturer of any reputation; and if they use a blackboard, what they scribble upon it can be read by the front row only. All these sins of commission, as well as others of omission, may be forgiven when a circle is small and those who compose it are familiar with the details of the subject, but an audience which fills a section room has a right to expect its interests to be considered, and not to leave the room with a feeling of disappointment or in a more confused state than when they entered it.

There would not be the slightest difficulty in securing large audiences for joint meetings of several sections, interested in different aspects of broad scientific subjects, provided that reasonable care were devoted to the selection of the subjects and the opening speakers. The success of the symposia arranged by the Faraday Society through Sir Robert Hadfield's enterprise shows how keen scientific workers are to occupy a common platform and understand each other's contribution to a common cause. The organising committees of related sections of the British Association would perform a much greater service to the scientific community by united action on these lines than by accepting as their separate programmes a variety of papers of which few are novel or of wide interest. The separate action of sections upon matters of common interest was exemplified by four resolutions brought before the General Committee at Cardiff. The Section of Zoology condemned the views of the "Investigators" of the Secondary Schools Examination Council of the Board of Education that zoology was not so suitable as botany as a school subject; the Section of Geography asked that geography should be recognised by the Board as a subject for advanced courses in secondary schools; and that of Anthropology urged that work of a regional survey type should receive official encouragement and anthropometric measurements should be made of pupils in continuation schools. There is an Educational Science Section of the Association where all these subjects could be considered appropriately in joint session with the sections which brought them forward, yet the action was taken independently and without consultation with the very members who are supposed to be concerned with the development along scientific lines of all schools and scholars. A joint meeting of several sections on "Science and the School," or similar subject, might have suggested a means of adjusting the various claims made upon the curriculum and the resources of schools, and such a meeting should obviously have been held before the Council was asked to father resolutions of individual sections upon subjects which concern other sections also.

We mention this episode merely as an example of the fissiparous tendency of the sections, and as a reason for more frequently dissolving the membrane which separates contiguous cells. When joint meetings are arranged, however, it should be remembered that the larger the intended appeal the more general must be the subject selected, and that the greatest common factor of knowledge possessed by the audience will be correspondingly lower. Huxley once said that in a public lecture he addressed himself to the least intelligent member of his audience, and though it may not

be essential for a speaker at a joint meeting of sections to accept this standard, yet if he wishes to claim the close attention of most of his hearers he should not soar so much above it as is commonly done.

What we have said as to the intensive and extensive functions of sections of the Association is on behalf of the general members, who are engaged in scientific education or research. No one waits for an annual meeting of the Association in order to describe a new discovery or announce a development, and as the Association does not publish papers, except by special resolution, there is nothing to induce authors, if they wish their work to be recorded, to make new communications to the sections. The chief aim should be, therefore, not a miscellany of papers of interest to a few specialists, but clear expositions of broad advances which appeal to the many. Beyond this duty of the Association to the general body of scientific workers is the even more important relation of the Association to national life and public interest. When the Association first met, and for many years afterwards, it was the only national peripatetic organisation of a scientific or technical kind. Now, however, the Institution of Naval Architects, Iron and Steel Institute, Royal Sanitary Institute, Society of Chemical Industry, Museums Association, Institute of Metals, and other bodies concerned with pure or applied science, hold their annual meetings at different places each year, and the Association no longer occupies a unique position in this respect. Notwithstanding this fact, the Association remains the only body which can represent the contributions of research to the whole field of progressive natural knowledge—whether applied or not—and we believe that a much larger public, in any place of meeting, would take active part in its work if greater consideration were given to wide national questions and the bearing of local conditions upon them.

The Association has come to be regarded as a technical or professional organisation, like the British Medical Association and similar bodies, with the result that the intelligent public in the locality where it meets takes little interest in it—at any rate, not so much as it did at one time. At the recent meeting in Cardiff, the total attendance was 1378; in 1891 it was 1497; and at almost every meeting in recent years the numbers have been less than at the previous meeting in the same place. Scientific workers are much more numerous than they were in the earlier years of the Association, and the fact that the attendance at meetings does not show a corresponding increase, but a decrease, is a sign that should not be disregarded by an organisation that desires to expand.

Unlike the other societies and institutions mentioned above, the British Association looks for members and support to the public in the locality in which its annual meeting is held. It cannot expect, however, to meet with the response desired unless it does much more to create and foster interest in local and national subjects with which science may be concerned, and by securing for the meetings the presence of prominent public men. Distinguished statesmen, great captains of industry, and leading representatives of labour should be approached, and we believe that many of them would be glad to range themselves on the side of scientific workers and testify to the national significance of contributions to national knowledge. There is no lack of subjects with which such men may be appropriately associated. What is lacking is the eloquent advocacy which well-known public men can give.

We are not alone in suggesting that a change of policy and of programme is needed to bring the Association into line with present conditions. Two of the technical journals—the *Electrician* and the *Chemical Age*—have each recently expressed regret that at the Cardiff meeting evidence of progress in electrical science, engineering, and chemistry was not prominently displayed by the papers presented to the sections devoted to these subjects; and they consider that the Association is now out of touch with the times. The former journal suggests that to make the annual meeting of greater interest to the public generally there should be a series of communications on the latest discoveries in physical science, the problems of electric traction, advances in wireless communication, domestic uses of electricity, and related matters in contact with daily life; and it remarks, "We do feel that at a time when electrical science is being more and more applied to the solution of industrial and domestic problems it is a pity that an opportunity such as the annual meeting of the British Association affords of placing what is being done in simple and, so far as possible, in non-technical language before the general public should have been so conspicuously missed."

Even technical men, therefore, do not look to the Association for specialised work, but for broad surveys of large regions and descriptions of outstanding peaks in scientific fields. Above all, they ask for attention to subjects of vital interest

to the community, and this plea is the main object of the present article. The Association should stand not for esoteric, but for exoteric, philosophy, and thus bring within its sphere all who believe that progressive thought, with accurate knowledge, form the only sure foundation upon which man can build a structure that will withstand the polemic storms of the present and the world shocks which promise to assail it in the future.

Ewing's "Thermodynamics."

Thermodynamics for Engineers. By Sir J. A. Ewing. Pp. xiii+383. (Cambridge: At the University Press, 1920.) Price 30*s.* net.

ONE of the chief fascinations of thermodynamics is the way in which it ramifies into other branches of science, following the manifold transformations of energy. The fundamental laws reappear in so many different aspects in relation to the quantities which are the subject of measurement in the different branches, such as chemistry, electricity, radiation, etc., that it affords one of the most interesting standpoints from which to view the growth of natural philosophy and to study the correlation of its parts. For the same reason it is difficult for the worker in any one branch to follow the applications of thermodynamics to other subjects with the principles of which he is unfamiliar; and he is apt to find that the discussion of his own subject in a general survey is necessarily lacking in the practical details and numerical data which would be required to enable him to make any use of it for his special purpose. Accordingly it is usual in treatises on special subjects, such as steam turbines, or petrol motors, or refrigerating machines, to include one or more chapters on the principles of thermodynamics in relation to the subject discussed. This is a very natural compromise, but involves a great deal of repetition of elementary principles, while it frequently fails, owing to limitations of space or lack of generality, in providing a sufficiently solid foundation for further research. So much effort has been wasted in the past, and is still being wasted, by inventors and experimentalists, in pursuit of fancied improvements which a wider knowledge of thermodynamics would have shown to be illusory, that such knowledge should be regarded as an essential part of the equipment of the scientific engineer, however abstract and theoretical it may appear to the practical man at first sight.

Among English treatises on thermodynamics, few, if any, appear to have been written primarily from the point of view of the engineer. We are therefore all the more disposed to welcome a book with this object from a master of clear exposition, whose books on kindred subjects are already so well known and appreciated by engineers. The method adopted by the author of the present work is to begin with the elementary notions and their interpretation in practice, and to defer the mathematical relations until the reader may be supposed to have become familiar with the fundamental ideas as physical realities, and is presumably able to apply them to practical problems.

In pursuance of this general scheme, the first six chapters of the book deal with general principles, explained in the first instance in relation to ideal gases, and then applied to practical problems in discussing the properties of actual fluids, the theory of the steam-engine and of refrigeration, jets and turbines, and internal-combustion engines. Since the general principles of thermodynamics have not changed in the last few years, it naturally follows that most of the material employed in this part of the work is the same as in the author's previous books on "The Steam-engine and Other Heat-engines" and on "The Mechanical Production of Cold." But the material has been rearranged as a connected exposition of the principles, and brought up to date in minor particulars, such as the adiabatic equation for dry steam, and the effect of supersaturation on the discharge through a nozzle. Most of the problems discussed are so well worked out that there is little room for difference of opinion, and so clearly explained that it would be difficult to suggest any improvement. It is only when we come to more recent or debatable problems, especially where the experimental data are still uncertain, that it becomes possible in a few cases to criticise the author's views.

The importance of devoting adequate consideration to the properties of the working fluid as affecting the operation of a heat-engine has been more fully recognised in recent years. Accordingly the author has included in the chapter on internal-combustion engines a discussion of the effect of increase of specific heat at high temperatures, and has added an appendix on the molecular theory of gases, which should serve as a useful introduction to the theory of the variation of specific heat. In discussing this subject the author naturally follows in the main the views of his successor at Cambridge, Prof. B. Hopkinson, whose work he did so much to inspire. Prof. Hopkinson's view that the loss of efficiency, as compared with the ideal air-standard for a given compression-ratio, could be attributed entirely to the increase of specific heat, provides an effective

working hypothesis, but the experiments of Sir Dugald Clerk on the variation of specific heat, and on the composition of the mixture shortly after the attainment of maximum pressure, appear to show that the question is not quite so simple. The later development of Hopkinson's own experiments on radiation in gaseous explosions by W. T. David indicates other factors which have to be considered in framing a complete theory, and may have an important influence on the design of engines for large units of power or for high speeds. The completeness or otherwise of combustion at the moment of maximum pressure may fairly be regarded as still an open question and a fit subject for further experiment.

In developing the general thermodynamic relations between the various properties of a substance, the chief difficulty is to make a selection among the many possible permutations. It need scarcely be said that the author makes a very judicious selection for the purpose in view, and develops chiefly those relations of the energy, entropy, and total heat, and of their coefficients, the specific heats and the cooling-effects, which are required in applying the principles of thermodynamics to the correlation of the properties of the working fluids employed in heat-engines. In the next chapter he proceeds to apply the general relations to particular fluids, defined by well-known forms of characteristic equation, showing how the equation selected determines the necessary relations between the coefficients. In this connection the author discusses the general properties of gases and vapours, as illustrated by Amagat's experiments at high pressures, and Van der Waals's equation for the critical state. But most of the numerical illustrations are drawn from the properties of steam at moderate pressures, as being the most important for engineering purposes and the most accurately determined by experiment. He shows how the formulæ employed secure exact thermodynamic consistency between the various properties, but he refrains from discussing the experimental evidence with regard to the particular values selected for the constants, because this is a separate question beyond the scope of pure thermodynamics.

At the same time the book is not without some bearing on physical experiment, because no modern experimentalist can afford to represent his results by purely empirical formulæ without inquiring how far they are consistent with other measurable properties of the substance investigated. This requires a knowledge of the thermodynamical relations, and the ability to apply them, which this book is intended to teach. Thus one of the practical uses of the thermodynamic relations is to find the form and slope of lines on diagrams, such as the Mollier diagram, which are becoming so popular among engineers. Mollier had great difficulty in constructing his diagram for carbonic acid near the critical point, owing to the scarcity and uncertainty of the experimental data. Most of the missing data have since been supplied by the experiments of Prof. Frewen Jenkin and Mr. D. R. Pye, who made great use of thermodynamic relations in constructing their diagram, and incidentally showed that some of Mollier's lines were of an impossible shape. They had some difficulty, however, in fixing the form of the saturation line for the liquid, which appeared to show a point of inflexion a few degrees below the critical point. The author suggests that the point of inflexion should be at the critical point itself. This is in some ways an attractive suggestion, but the proof does not seem to be quite conclusive, and would be difficult to reconcile with the orthodox view of the critical state, according to which the critical isothermal itself possesses this property. It is possible that the singularity at the critical point may be of a nature different from that commonly assumed. It would be difficult to decide such a point by experiment, but it is just in such cases where experiment fails that thermodynamics is most useful.

H. L. C.

Forensic Medicine.

A Handbook of Medical Jurisprudence and Toxicology for the Use of Students and Practitioners. By Dr. W. A. Brend. Third edition, revised. (Griffin's Medical Pocket-book Series.) Pp. xiii+317. (London: Charles Griffin and Co., Ltd., 1919.) Price 10*s.* 6*d.* net.

THIS edition has been revised and enlarged. The chapter on the legal relationships of insanity and other abnormal states of mind, which has been entirely rewritten, gives a very good account in a brief and concise form of a branch of forensic medicine which usually presents difficulties to the medical student and practitioner. Chap. xvii., dealing with "Medical Privileges and Obligations," is excellent, and gives in a collected form the duties and responsibilities which may devolve upon a medical practitioner as a result of his registration by the General Medical Council. This subject has been much neglected in most of the existing text-books on forensic medicine, and the present edition of this work supplies a much-needed want by providing valuable advice on the line of conduct to be adopted by medical men in the many difficult situations which are likely to arise in medical practice.

The various chapters on forensic medicine and toxicology are well written, but a few points need correction and revision in a future edition. For example, in reference to "exhumation" it is stated that disinfectants should be freely used. The use of disinfectants in exhumations should, on the contrary, always be avoided, since in suspected poisoning, which is a common reason for exhumation, the use of disinfectants is likely seriously to complicate the analysis. A classical example of this was the Crippen case, where the sprinkling of a disinfecting powder containing carbolic acid and traces of arsenic on the remains added considerably to the difficulties of the analysis.

In the chapter dealing with blood-stains reference should have been made to the benzidine test. Also sufficient importance is not attached to the serum test for human blood, which must now be regarded as being trustworthy, and one of the routine tests which should always be adopted in the examination of blood-stains in order to determine with certainty that they are those of human blood and not of other animals, such as sheep, horse, ox, etc.

We do not find any account of the influence of status lymphaticus in cases of sudden death. In the chapter on abortion there is no mention of the effect of quinine and pituitary extract, which are powerful abortifacients. Reference should have been made to the changes introduced during the war with regard to the procedure in coroners' courts. In the chapters on toxicology one would wish to have seen some description of the poisons, such as tetrachloroethane, trinitrotoluene, etc., which were responsible for so many cases of fatal jaundice amongst munition workers.

The book claims to be a handbook of medical jurisprudence, and as such it has certainly justified its publication, for it will be most useful to students for examination in forensic medicine and to medical practitioners.

Industrial Administration.

Industrial Administration: A Series of Lectures. By A. E. Berriman and Others. (Publications of the University of Manchester. No. cxxxi.) Pp. vii + 203. (Manchester: At the University Press; London: Longmans, Green, and Co., 1920.) Price 7*s.* 6*d.* net.

THE lectures published in this volume were delivered in the department of industrial administration in the College of Technology, Manchester, during the session 1918–19, by various well-known authorities on subjects relating to industrial administration. Mr. Seebohm Rowntree discourses on the "Social Obligations of Industry to Labour," and endeavours to fix the minimum wage compatible with the maintenance of a working man and his family in decency and moderate comfort. In answer to the question: "Can industry afford to pay the minimum wages indicated?" he believes that the principal source to which we must look for increased wages is increased efficiency in the organisation and administration of industrial enterprises. Many British factories are run on very inefficient lines, with antiquated machinery and ill-trained staff and workers, and in such cases the profits are inconsiderable even when wages are low.

A most interesting and striking lecture on "Occupational Diseases" was given by Dr. T. M. Legge, who, in his capacity as Medical Inspector of Factories, has been largely responsible for the precautions taken to abate the evils of certain industrial processes. The success of the precautions may be judged from some of the figures he quotes. Whilst in 1900 there were 358 cases of lead poisoning among white-lead workers, and 200 among pottery workers, in 1913 the cases were reduced to 29 and 62 respectively. Of more recent interest are the cases of trinitrotoluol poisoning, which developed with alarming frequency in the latter half of 1916. There were 43 fatal cases in the six months, and another 32 fatal cases in the first six months of 1917, but by that time the chief cause of the poisoning—viz. absorption through the skin—was tracked down, and suitable precautions were taken. In the next six months fatal cases fell to 12, and in the following year to 10.

Other lectures deal with the applications of psychology to industry, industrial fatigue, and education in factory management and administration, whilst Dr. L. E. Hill gives an interesting account of his well-known investigations on "Atmospheric Conditions and Efficiency" by means of the katathermometer. Perhaps the lecture of most general interest is that on "Industrial Councils," by Mr. T. B. Johnston. The national council recently formed in the pottery industry is described in some detail, and it is to be hoped that in course of time similar councils will be formed in all the other staple industries. Equal numbers of representatives of the manufacturers and of the operatives sit on all committees, and they not only consider questions relating to wages, employment, and the conditions of production, but also encourage research into the industry, and consider inventions and improvements designed by the workpeople. Most important of all, the employers disclose full details of wages

and profits, so that the workpeople can determine whether they are being fairly treated or not, and at the same time the consumer can ascertain whether the prices he is charged are due in any degree to profiteering. As Mr. Johnston rightly points out, "the first essential to a better understanding between Capital and Labour is that all the cards should be laid on the table."

H. M. V.

Fuel Economy.

The Use of Low-grade and Waste Fuels for Power Generation. By John B. C. Kershaw. Pp. x+202. (London: Constable and Co., Ltd., 1920.) Price 17*s.* net.

THE great increase in the cost of coal has naturally directed the attention of users of fuel to the question of fuel economy, the possibilities of which lie in two directions—the utilisation of lower-grade fuels and waste combustible material, and the more efficient utilisation of all fuels. Mr. Kershaw's book deals adequately with both these aspects of this important question. His earlier chapters are devoted to the consideration of peat, wood waste, small coal and washery waste, and other minor combustibles. In his second section he deals with fuel sampling and analysis and with the scientific control of combustion in practice.

Mr. Kershaw defines low-grade solid fuel as containing more than 25 per cent. of ash and 10 per cent. of moisture, or, in all, 35 per cent. of incombustible material. The cynic may remark that such a definition covers most of the coal at present marketed! Small coal, however, no matter what its ash and moisture content, is also "low grade," and the author includes all coal and coke passing a $\frac{1}{4}$-in. mesh sieve.

Means are available, and Mr. Kershaw describes them clearly and discusses their merits lucidly, by which the lower-grade fuels may be utilised, but possibly, because of present economic conditions, the more general utilisation of low-grade coal and colliery refuse will be confined to the large, centralised power schemes which have been recommended, and individual consumers will more specifically seek economy in the better utilisation of the class of fuel they have been accustomed to use, and for which their plants can be adapted with but little expenditure. Mr. Kershaw's treatment of this side of the question is adequate and practical, and he is to be congratulated on producing this small volume at this opportune moment, for it is one to command the attention of all interested in the use of fuel for every industrial purpose.

Text-books of Chemistry.

(1) *An Introductory Course in Quantitative Chemical Analysis, with Explanatory Notes, Stoichiometrical Problems, and Questions.* By Prof. G. McPhail Smith. Pp. x+206. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 9*s.* net.

(2) *Quantitative Analysis by Electrolysis.* By A. Classen, with the co-operation of H. Cloeren. Revised, rearranged, and enlarged English edition by Prof. W. T. Hall. Pp. xiii+346. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 17*s.* 6*d.* net.

(3) *Industrial Organic Analysis: For the Use of Technical and Analytical Chemists and Students.* By Paul S. Arup. Second edition, revised and enlarged. Pp. xi+471. (London: J. and A. Churchill, 1920.) Price 12*s.* 6*d.* net.

(4) *A Foundation Course in Chemistry: For Students of Agriculture and Technology.* By J. W. Dodgson and J. Alan Murray. Second edition, thoroughly revised. Pp. xii+241. (London: Hodder and Stoughton, Ltd., 1920.) Price 6*s.* 6*d.* net.

(5) *Chemistry in Everyday Life: Opportunities in Chemistry.* By E. Hendrick. Pp. xii+102. (London: University of London Press, Ltd., 1919.) Price 3*s.* 6*d.* net.

IN the multiplicity of text-books one naturally looks for evidence of the trend of progress as demonstrated in new editions and new volumes. We want to find the aim of the author and why he has considered it desirable to add one more to the books that are already so many that the teacher and the student find it difficult to select the one that will suit them best.

(1) Prof. Smith says of his manual that it is for those who have completed courses in elementary chemistry and qualitative analysis and are beginning work in quantitative analysis. We are glad to see, so far as this is evidence of it, a return to the natural sequence of quantitative following qualitative work. The student at this stage ought to be able to appreciate the introductory section in which the author, after some excellent advice, proceeds to consider the balance, its use and care, methods of weighing, the calibration of weights, various errors and their elimination; the precipitation, filtering, and washing of precipitates, in which he uses the theories of modern physical chemistry; drying, ignition, evaporation, and the use and calibration of volumetric apparatus. The student is thus well prepared to work intelligently, but throughout the book, although the instructions are definite, almost every direction is accompanied with the

reason for the procedure. So the student is helped to study and not merely to perform. One evidence of progress is the appreciation of the filter-pump at its true value: "When paper filters are employed, the use of a vacuum pump to promote filtration is of doubtful advantage in quantitative analysis"; its disadvantages "more than offset the possible gain in time." While the volumetric section is more extended than usual, the number of gravimetric exercises of a simple kind seems to us unduly few. After the determination of chlorine, iron, and sulphuric acid in simple salts, we pass to sulphur in an ore, phosphoric anhydride in a phosphate rock, and so on. Still it is better to do little thoroughly than much superficially. The ten pages devoted to the electrolytic determination of copper (1) with stationary electrodes, (2) with a rotating anode, is a part in which we think a few more practical exercises might have been introduced with advantage, but perhaps time does not permit of this in the laboratories of the University of Illinois.

(2) Prof. Hall has prepared this edition of "Classen," from the translation made six years ago, without further reference to the German text. Some new procedures have been added, and the order and the theoretical explanations have been somewhat modified. He says: "A simple application of the modern electronic theory seems to clarify rather than befog the vision of the beginner. An attempt, therefore, has been made to apply this theory a little more closely than has been done in most of the other well-known books on the subject." After 100 pages of introductory matter which describes in general terms electrolysis and the various details that affect it and its applications in analysis, the practical methods of determining twenty-nine metals are described, then methods of separating thirteen of the commoner metals from great varieties of other metals, and finally the electrolytic analysis of a considerable number of industrial products. The comparisons of various methods of depositing the different metals are often tabulated, so that a great amount of information is given in a comparatively small space, and the references to original communications being numerous, the student can turn at once to the full accounts of investigations if he wishes to pursue any particular matter. This edition of an authoritative treatise will be welcomed by all who are interested in the subject.

(3) In preparing the second edition of "Industrial Organic Analysis" Mr. Arup has added a chapter on sugars, some recently published methods, and references to the literature of the subject-matter. This last is an especially valuable feature, because the author has prepared the volume for those who have had a "thorough training in chemistry and physics," and are therefore able to take full advantage of such assistance. The author not only gives methods of analysis, but also describes the details of manufacture or treatment of the material dealt with so far as is necessary to carry out with intelligence the analytical process and to interpret usefully the results. The subjects treated of are coal and coke, coal-tar and its distillation products, fatty oils and fats, soap, petroleum and its distillation products, milk and butter, starch and its decomposition products, flour, barley, and malt, sugars and alcohol, and preservatives and colouring matters in foods. These headings are interpreted liberally; for instance, we have under one or the other infants' foods, margarine, cocoa, the sterilising and pasteurising of milk, and so on. The author is eminently practical, but in no sense merely empirical.

(4) It will probably long remain a debatable matter whether a student's elementary course in chemistry should be pursued with a definite aim as to the use he is ultimately to make of it. This means more or less passing over subjects that appear to be of little or no importance to him, and expanding the treatment of matters that appear to bear specially upon his future work. But the future may bring into prominence the very subjects that are scantily treated. The authors in their "Foundation Course" include, besides general chemistry and a consideration of various inorganic materials, a little organic chemistry, devoting forty-four pages to aliphatic compounds and five pages to aromatic compounds. Physical chemistry is dealt with in twenty pages. To this extent the book provides a good general introduction to these subjects.

(5) Mr. Hendrick, with few exceptions, gives sound information and good advice in his little volume, but it is marred by a familiar style and such statements as "the temperature of the electric arc, which is about as hot as sizzling sinners getting their reward." C. J.

Oil Geology.

Popular Oil Geology. By Prof. Victor Ziegler. Pp. viii+149. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 11*s*. 6*d*. net.

TO render any scientific subject into easy reading, to make such reading void of technical details while keeping strictly within the limits of accuracy and precision, is a problem tackled by many, but overcome only by few. To this few we may add the name of Victor Ziegler, who, in his

"Popular Oil Geology," has produced a remarkably neat and illuminating little volume which may be confidently recommended to all interested in the subject of petroleum technology.

Prof. Ziegler has condensed a very large subject into a comparatively small space, and it must be admitted that in but few instances have the principles of the science suffered from this treatment. The author has the obvious knack of extracting the real substance of the various branches of oil geology, and of presenting this without unnecessary "padding," so that the book really achieves its purpose of being an introduction to larger volumes dealing in more detail with the principles of the subject.

The chapters on the laws of the migration and accumulation of oil and gas, on oil structures and oil fields, and on prospecting are particularly good, while the final remarks on oil investments, culminating in a parody of John Hammond's rules for investors, are quite as amusing as they are apposite.

The book is profusely illustrated, a great many of the maps and diagrams being taken from the U.S. Geological Survey publications, as acknowledged in the preface. While this practice of reproduction is useful within limits, it is one that can be very easily overdone. To say that it shows lack of originality is possibly an exaggeration, but when such diagrams as that included on p. 77 occur again and again in various American publications we have examined, it seems disappointing that a new rendering of the same subject cannot be invented. But for that and the price (which for a book of this description is rather excessive), this little volume deserves a place on the bookshelf of the layman, student, and expert alike.

H. B. MILNER.

Our Bookshelf.

Ozone. By Prof. E. K. Rideal. (A Treatise of Electro-chemistry.) Pp. ix + 198. (London: Constable and Co., Ltd., 1920.) Price 12*s.* net.

IN recent years ozone has attracted increasing interest on account both of its value as an aid to research in organic chemistry, and of its actual or possible applications on the industrial scale. The literature of the subject is, however, widely scattered, hence in compiling this monograph, which forms a section of the treatise on electrochemistry in course of production under the editorship of Mr. Bertram Blount, the author has done good service to chemists.

An interesting introductory portion, which deals with the early history, the general properties, and the occurrence of ozone, is followed by five chapters in which the methods of production—chemical, thermal, and electrolytic—and in particular production by means of ultra-violet radiations and of the silent electric discharge, are adequately described. These are succeeded by a summary of the principal investigations on the catalytic decomposition of ozone, and in the next chapter its more important industrial applications—*e.g.* in the sterilisation of water, the "purification" of air, the bleaching of oils and fats, and the manufacture of vanillin—are discussed in some detail. The last chapter contains an account of the methods of detecting and estimating ozone.

The author has been distinctly successful in his effort to collect and correlate the various references to ozone which occur in chemical literature, and his monograph will be welcomed if only for that reason. In addition, it contains a valuable summary of what is known—after all not very much—about ozone, and by indicating problems which remain to be solved should also serve to promote investigation. It is therefore all the more regrettable that several of the pages of an otherwise praiseworthy book are disfigured by grammatical errors, or by sentences so carelessly constructed as to be obscure in their meaning.

Microscopy: The Construction, Theory, and Use of the Microscope. By Edmund J. Spitta. Third edition. Pp. xxviii + 537 + xxviii plates. (London: John Murray, 1920.) Price 25*s.* net.

THE first edition of this work was reviewed in NATURE for February 6, 1908. The work has gained a well-deserved popularity, and two further editions have since been called for. In each of these the opportunity has been taken to bring the subject-matter so far as possible up to date, and to indicate important new developments. In the present edition may be noted especially the reference to low-power objectives designed to give great depth of focus and a flat field, valuable especially for the photography of relatively large specimens of appreciable thickness, where good definition has to be obtained of parts lying in different planes. To illustrate the use of these, a considerable number of new plates have been added, which include some admirable reproductions of photographs obtained with modern objectives of this type.

Mention must also be made of the photographs added to illustrate the use of the term "critical definition." Unfortunately, the term, though no doubt convenient, is not one to which a precise significance can be given, and it thus always presents difficulties to the learner, who comes to appreciate only by experience the sense in which it is employed.

The "Addenda," amounting to more than twenty pages, contain useful notes of some recent improvements, with a few convenient tables. Attention is directed especially to the use of the newer Kodak filters for obtaining blue light with a powerful illuminant, details being given. The index has been improved and additional references have been inserted, notably those to the pages of

the text in the descriptions of the plates, which are of material assistance. In short, the third edition exhibits throughout the same careful attention to detail as its predecessors, and the work fully maintains its position as the most valuable handbook to the practical use of the microscope as an optical instrument.

Oil-Finding: An Introduction to the Geological Study of Petroleum. By E. H. Cunningham Craig. Second edition. Pp. xi + 324 + xiii plates. (London: Edward Arnold, 1920.) Price 16*s.* net.

THE second edition of this work has been enlarged to nearly double the bulk of the first, the scheme remaining the same, and there is little to add to the review which appeared in NATURE of August 8, 1912, except to say that the revision of the work has distinctly improved its quality. The author is still insistent on the importance of the theory of the origin of petroleum, and for him that of vegetable origin and subsequent concentration, controlled by geological structure, is supreme. The treatment of this subject, regarded as of vital importance, is inadequate, in so far that less than six pages are devoted to theories of inorganic origin, and thirty-four to a polemical examination of the hypotheses of animal or vegetable origin; yet there are many facts in the known distribution of petroleum more easily explicable on the supposition of inorganic than on that of organic origin. At present there are grave difficulties in the way of regarding either as even approximately complete, and there is this to be said for the theory and principles of application advocated by the author, that they will lead to correct conclusions in about nine cases out of ten, and in the tenth success will depend mainly on luck, instinct, or intuition. The chapters on field-work are very distinctly improved, the approximate and imperfect methods indicated being relegated to their proper place, as expedients which may have to be resorted to by force of circumstances, and not, as inexperienced readers of the first edition might easily be led to believe, preferable to more exact and thorough methods.

Keys to the Orders of Insects. By Frank Balfour-Browne. Pp. vii + 58. (Cambridge: At the University Press, 1920.) Price 7*s.* 6*d.* net.

MR. BALFOUR-BROWNE has placed students under an obligation by publishing this useful series of tables, founded on notes drawn up for those who have the advantage of attending his courses of entomology at Cambridge. The twenty orders of insects recognised are first distinguished by means of a "key," and then the families of those six orders that may be regarded as of greatest economic importance—the Orthoptera, Rhynchota, Lepidoptera, Coleoptera, Diptera, and Hymenoptera—are further discriminated. The characters given are those of adults only; but in later editions the author proposes to deal with some of the larval forms. It is to be hoped that these tables will serve to familiarise the rising generation of entomologists with the Comstock system of nomenclature for wing nervuration, and to hasten its use—perhaps with the modifications rendered necessary by Dr. Tillyard's recent researches—among special students of all orders of insects. Some points of detail in the tables need correction. It is implied that all Thysanura have the jaws retracted within the head; this is not the case with the two most conspicuous families, Machilidæ and Lepismidæ. Palps are not present in the Anoplura and Rhynchota; probably "absent" was meant, but "present" has been printed. In a new edition it would be well, if possible, to break up the unnatural group "Polymorpha" among the beetles, and it is to be hoped that the sale of the book may enable the publishers to reduce the price, which must be considered high, although blank interleaved pages have been considerately provided for students' notes.

G. H. C.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Supplement. Vol. ii.: *Catalogue of the Lithosiadae (Arctianae) and Phalaenoididae in the Collection of the British Museum.* By Sir George F. Hampson. Plates xlii–lxxi. (London: British Museum (Natural History), 1920.) Price 32*s.* 6*d.*

THE present volume is supplementary to vol. iii. of the great Catalogue of Lepidoptera Phalænæ. Owing to the European War it has remained in manuscript since 1915, but has been brought up to date so far as possible. It includes no references to German publications which have appeared since August, 1914, for the reason just mentioned. Two families of Lepidoptera are dealt with—the Lithosiadæ (Arctianæ) and the Phalænoididæ. Of the former, vol. iii. included 147 genera and 845 species, and to these are added in the present work twenty-five genera and no fewer than 1215 species. Of the second family (Agaristidæ of many authors), the original numbers are increased by seven genera and eighty species. In his selection of family and generic names Sir George Hampson has adopted views on nomenclature which have been largely rejected by most systematists, but he has wisely adhered to the system utilised in the already issued volumes. We need only add that the book is well printed and up to the standard of the previous parts of the catalogue.

Historical Geography of Britain and the British Empire. (In two books.) Book I. *The Making of England; The Making of Empire; The Establishment of Empire:* B.C. 55 *to* A.D. 1815. By T. Franklin. Pp. viii + 216. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd., n.d.) Price 2*s.* net.

BOOK I. is divided into three sections; the first deals with the growth of England from the time of the Roman invasion to the beginning of the sixteenth century, the second with the building-up of the British Empire during the two succeeding

centuries, and the third with the establishment and consolidation of the Empire. Geography plays a minor part in the book, and the title is therefore likely to be misleading. Nevertheless it is refreshing to find a school history in which the author has departed from the time-honoured custom of subdividing his work according to the number of monarchs with whom he intends to deal.

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.*]

"Spiranthes autumnalis" in Scotland.

GREAT is the debt which British botanists—experts and amateurs alike—owe to the authors of the "Handbook of the British Flora." It is scarcely possible to imagine a simpler or more convenient key to the natural orders. But a good deal has been added to our knowledge of British plants since the last revision of the work by Sir Joseph Hooker forty years ago, and it is to be regretted that before the latest edition was published in 1918 it was not passed through the hands of a competent editor to bring the work up to date. For instance, it is stated that the little orchid, *Spiranthes autumnalis*, is found nowhere north of Yorkshire and Westmorland. I had always accepted this as gospel until last August, when, while exploring a wood on Speyside for *Linnaea borealis*, I came upon a little colony of "lady's tresses." Since then I have received trustworthy information that Spiranthes grows in the valley of the Nairn.

I do not know whether this addition to our Scottish flora has been recorded hitherto.

HERBERT MAXWELL.

Monreith.

Associated Squares and Derived Simple Squares of Order 5.

THE six different types shown below are distinguished by the position of the complementary numbers (1, 25; 2, 24; 3, 23, etc.):

A					B					C				
25	10	3	9	18	20	11	5	22	7	6	4	21	19	15
11	20	5	22	7	10	25	3	9	18	22	20	5	11	7
2	14	13	12	24	14	2	13	12	24	12	14	13	2	24
19	4	21	6	15	4	19	21	6	15	9	10	3	25	18
8	17	23	16	1	17	8	23	16	1	16	17	23	8	1

D					E					F				
25	18	3	9	10	25	18	3	10	9	25	10	3	18	9
11	7	5	22	20	11	7	5	20	22	19	4	21	15	6
2	24	13	12	14	2	24	13	14	12	2	14	13	24	12
8	1	23	16	17	19	15	21	4	6	11	20	5	7	22
19	15	21	6	4	8	1	23	17	16	8	17	23	1	16

Constant 65.

A is an associated square, and by means of Dr. Planck's method of complementary differences it has been found that there are 3034 squares of this type, and each one can have sixteen inversions, making a total of 48,544 squares.

B. By exchanging the first and second numbers in both rows and columns of A, type B is obtained. There are thus 48,544 squares of type B.

C. By exchanging the first and fourth numbers in both rows and columns of A, type C is obtained. There are thus 48,544 squares of type C.

D. Every associated square cannot be converted into type D, but by means of Dr. Planck's method of complementary differences the number can be found. It is 972, and each one can have one inversion, making a total of 1944.

E. But 36 of these 972 can be converted into type E, and each one can have three inversions, making a total of 144.

F. Also the same 36 of type D can be converted into type F, and each one, again, can have three inversions, making a total of 144.

In the last three types, squares can be constructed for each type by taking the columns as the rows and *vice versa*, and I have included these in the totals. This obviates the necessity of including types of squares when these three types are turned round through a quarter of a circle.

Totals:

A	...	48,544
B	...	48,544
C	...	48,544
D	...	1,944
E	...	144
F	...	144
		147,864

These are only six out of thirty-four types of 5th order, making a total of nearly 700,000 squares.

J. C. BURNETT.

Barkston, near Grantham, Lincs.

The Spectrum of Nova Cygni III.

CLOUDY and hazy nights have seriously interfered with spectroscopic observations of this nova at Stonyhurst, but some good photographs of the spectrum were obtained with the Whitelow short-focus prismatic camera on the nights of August 29 and 30 and September 6 by Father J. Rowland. The spectrum, the bright band spectrum characteristic of the second stage in the progressive spectra of novæ, remained practically the same during that interval. The bright hydrogen bands extended, on the average, over 20 Å. units, and consisted each of two components. There was a bright extension on the violet edge of $H\zeta$, about λ 3870, which was possibly the first sign of the incoming of the nebular band.

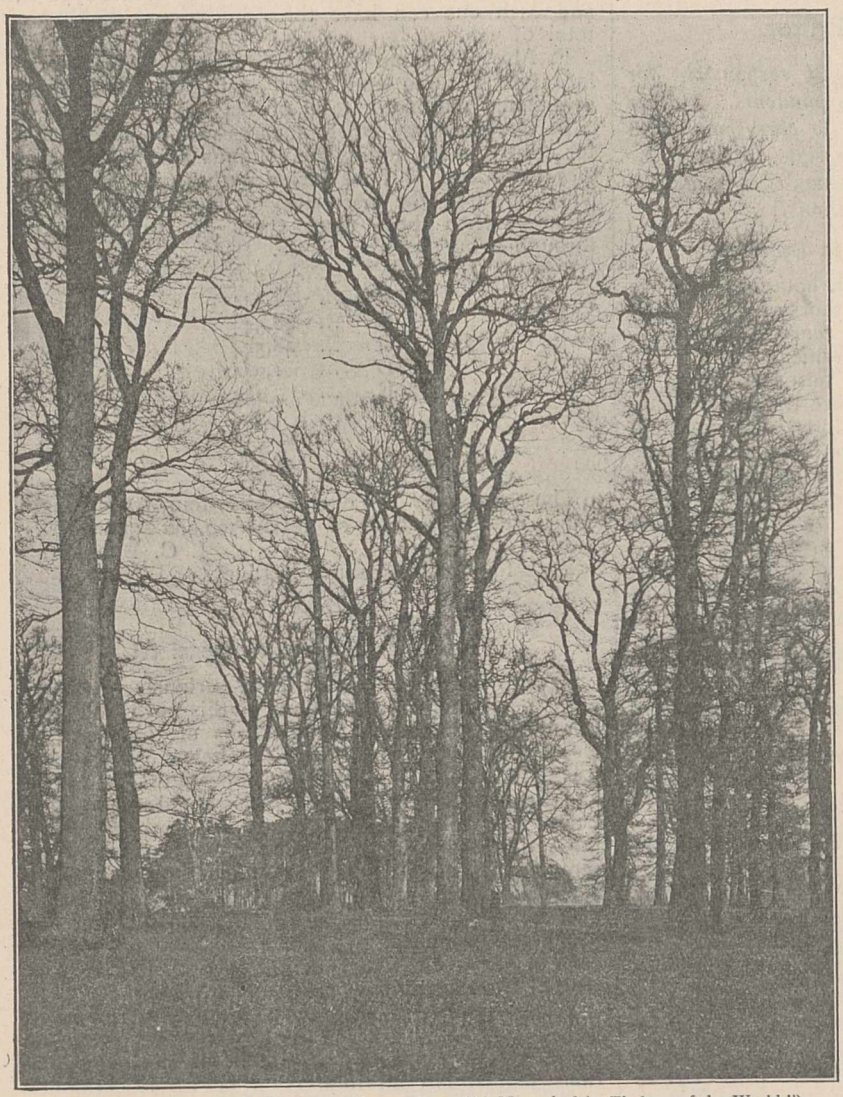
Besides hydrogen, the most prominent radiations were due to enhanced iron lines, 5316, 5169, 5019, and 4924. On September 6, 4924 alone of the four radiations named left an impression on an isochromatic plate. Between $H\beta$ and $H\gamma$ were two prominent and very broad bright bands, the first extending from λ 4703 to 4628, and the other marked by three maxima corresponding to the iron lines λ 4584, 4550, and 4516. Between $H\gamma$ and $H\delta$ were three very prominent radiations, λ 4303 iron, 4228, and 4170, the last being almost as intense as $H\delta$. The K calcium band was also doubled, and extended over about 15 Å. units. On August 29 the spectrum extended far into the violet. On September 6 the visual magnitude was estimated as lower than the fifth. No obvious change in the spectrum could be detected on a weak impression secured on September 10. The iron line 4924 was still present. $H\alpha$ was very brilliant.

A. L. CORTIE.

Stonyhurst College Observatory, Blackburn.

The Timbers of Commerce.[1]

A BOOK dealing with timbers in general is very welcome. The text-books in English on this subject give, as a rule, little information on the uses and commercial aspects of the numerous species which are imported into this country. There is one exception—Laslett's small book on "Timber and Timber Trees," which is still valuable, though in some respects out of date, the last edition having appeared in 1894. Other works, good as regards the microscopical structure of a considerable number of woods, fail to throw much light on their manifold uses and special properties.



Oak Grove, Kyre Park, Worcestershire. (From "A Manual of the Timbers of the World.")

Mr. Howard's work consists mainly of a descriptive account of the commercial uses of a great number of timbers, which are listed in alphabetical order, the botanical and vernacular names being indiscriminately used. This arrangement is open to criticism, as it occasionally mingles together species which have little in common but their trade name, and disjoins others which belong to the same genus—*e.g.* basswood (p. 23) and lime (p. 122), species of Tilia. Two indexes do away, however, with this difficulty. The title is somewhat misleading, as the timbers enumerated and described are not world-wide, but are practically confined to those imported into London and Liverpool. No attention is paid to any others. One fails to find, for example, an account of interesting woods like that of the nettle-tree (Celtis) in France, or of the sandarac wood (Tetraclinis) of Algeria, the latter remarkable for its subterranean burrs, out of which beautiful articles of cabinet-ware have been made from the time of the Cæsars to the present day.

Mr. Howard was, however, wise in limiting his subject to the timbers of which he has first-hand knowledge, and this inspires confidence in the facts that he discloses. With more than forty years of experience in the timber trade he is able to give his own personal opinion upon the merits and characteristics of a great number of species. The book, in short, is excellent on the commercial side. A scientific treatise on timbers in general has yet to be written. Such a work would contain a clear account of the structure of the woods concerned, and of their provenance, properties, and defects, and would point out how and why each species is adapted to the special purposes for which it is used. Mr. Howard's book is incomplete in these respects, and is, moreover, devoid of references to the numerous special papers and publications that have appeared on many species. Nevertheless, it is a valuable addition to the library of the merchant, the engineer, the architect, and the student at the present juncture. The British Empire Timber Exhibition, lately held, showed the wealth of timbers possessed by our Dominions, Colonies, and India, many of which are totally ignored by manufacturers and little known in the trade. Mr. Howard's book will awaken interest and disseminate valuable information.

"The Timbers of the World" is attractive in appearance, being illustrated by a series of repro-

[1] "A Manual of the Timbers of the World, their Characteristics and Uses." By A. L. Howard. Pp. xvi+446. (London: Macmillan and Co., Ltd., 1920.) Price 30*s.* net.

ductions from excellent photographs of timber operations and forest scenes in many parts of the British Empire. The inclusion in the work (pp. 328–84) of the tables of strengths of woods, which were published by Laslett, is probably justified by the fact that Laslett's book is out of print. These tables are of considerable value, but as Laslett had not at his disposal apparatus for determining the moisture contents of the woods examined, the figures are not so trustworthy as they seem. It would certainly be preferable in future, as Mr. Howard admits, to conduct experiments on woods "with some named and specific percentage of moisture." Moreover, we are now aware, thanks to the numerous tests carried out of late years at the Forest Products Laboratory, Madison (U.S.A.), that there is a remarkable variation in the properties of timbers of the same species from different logs and from different localities. That timbers are in no way comparable with metals in the uniformity of their physical characteristics is of course well known.

A chapter on the artificial seasoning of timber, with a note on laboratory and working tests, contributed by Mr. S. Fitzgerald, will prove useful.

There are errata and misstatements in this book, but they are not of a kind to detract much from its real value, which consists in the thoroughly practical nature of the information given on the uses, conversion, and utilisation of so many kinds of timber. Some of the inaccuracies may, however, be pointed out. It is, unfortunately, not true that, as stated on p. 118, "larch disease has practically disappeared." The explanation of the name "sycamore" on p. 266 is entirely erroneous, and is an instance of the strange fascination that wrong etymology has for many people. The word "sycamore" was originally applied in Greece to a species of Ficus, and is now transferred in England to the large-leaf maple, *Acer pseudoplatanus*, and in America to the Western plane, *Platanus occidentalis*. A whole page—p. 164—is devoted to the etymology of the term "wainscot oak," about which there is no doubt. It could have been expressed in three lines. "Wainscot" is derived from a Dutch word (fourteenth century) which means "oak wood with a wavy grain"; in other words, "wainscot oak" is "figured oak." Mr. Howard misquotes Skeat, who ("Concise Etymological Dictionary," p. 597) expressly warns the reader against the wrong derivation attributed to him by Mr. Howard. A regrettable error occurs on p. 211, where *Abies pectinata*, the European silver fir, is called "silver spruce." As is pointed out on pp. 262–63, the latter name can be applied only to the Sitka spruce (*Picea sitchensis*). Endless

Fine example of African mahogany curl. (From "A Manual of the Timbers of the World.")

embarrassment to the landowning class resulted during the war from the confusion between the names "silver spruce" and "silver fir."

The Structure of the Atom.[1]

By C. G. DARWIN.

II.—*Atomic Number (continued.)*

IT would involve very prolonged work to get the atomic numbers accurately by direct experiment with scattered α-particles. Fortunately, this is not necessary, as there exist much more convenient indirect means of determining them. The invention of a powerful method of studying X-ray spectra enabled Moseley to examine the spectra from a sequence of elements. Whereas visual spectra have a highly complicated structure, and exhibit the same periodicity as do chemical pro-

[1] Continued from p. 54.

perties, for the X-rays this periodicity disappears, and is replaced by a perfectly orderly progression from element to element. Each spectrum can be derived from the last by a reduction of the wave-lengths according to a simple rule. Thus an examination of a sequence of spectra reveals the true order of the elements, and gaps are shown by a missing term in the sequence. It will be seen that Moseley's method only gives differences of atomic number, and not the numbers themselves. To determine these we must find one of them in some other way. This is not difficult, for we know from observation on α-particles that helium must have atomic number 2; and though X-rays have not been observed for the sion of an α- or a β-particle from the nucleus, and this emission transmutes the atom into a new element. From a study of the chemical behaviour of these successive elements it was concluded that the emission of an α-ray shifts the element two places to the left in the periodic table, while the emission of a β-ray shifts it one place to the right. This fits in exactly with the conception of atomic number, for when the nucleus loses an α-particle (that is, a helium nucleus of atomic number 2) its own number must be reduced by two, whereas the loss of a β-particle out of the nucleus must raise the number by one, since the β-particle is an electron and has a negative charge. By a study of all the radio-elements we can work out

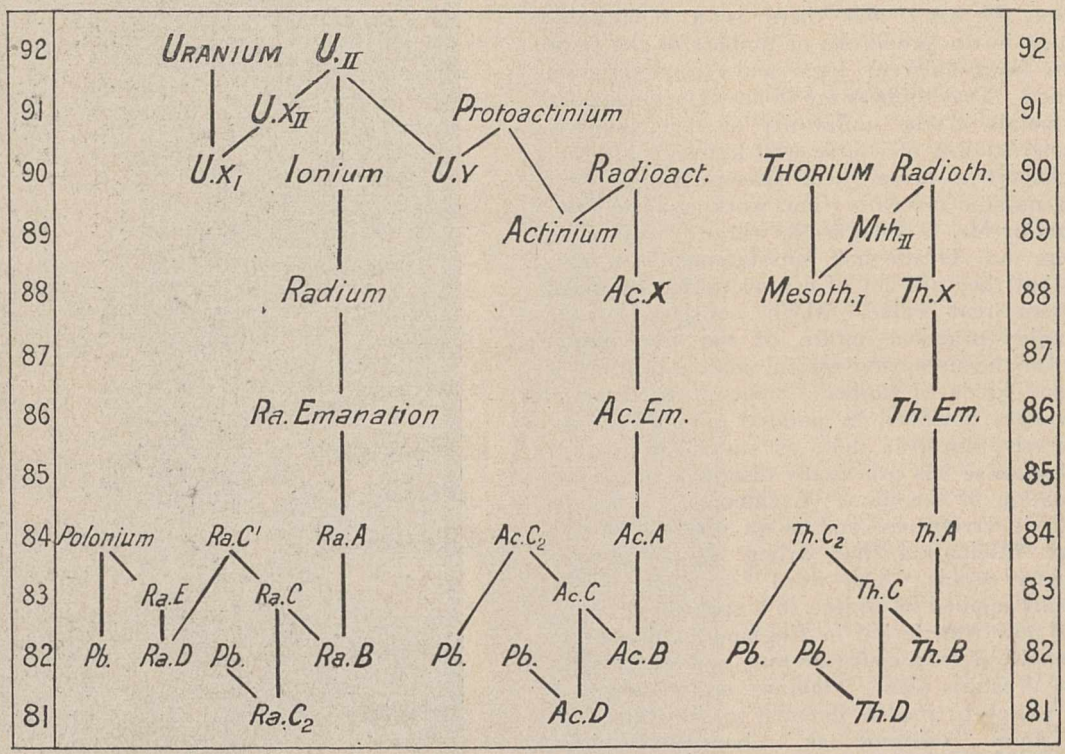


FIG. 1.—The Radio-active Transformations. In every case a step two downwards is accompanied by the emission of an α-particle, and one upwards by a β-particle. Actinium is derived from uranium or an isotope, but the connection shown is rather conjectural. Thorium C has a third branch about which little is known. The final products in all cases are believed to be lead, but as they are not radio-active it is uncertain how many of the isotopes are really different. In the Table of Atomic Numbers they were counted as all different, and one was added on to allow for the existence of common lead. One was also added there for 81 and 83 to represent the non-radio-active types of thallium and bismuth.

first dozen elements, the periodic table is perfectly regular in that region, and it is impossible to believe that it could contain any gaps. More remarkable still, if the formula for the wave-length of the X-ray spectrum is extrapolated right back to hydrogen, it reproduces the fundamental line of the famous Balmer series. The numbers which were given in the table are therefore certainly correct.

In formulating the principle of atomic number we said that it, and not the weight, completely determines the chemical character of the element. This statement is justified by a line of evidence which we must now consider. The process of radio-active transformation consists in the emis-

chains of transformations such as are shown in Fig. 1. These chains start at uranium 92 and thorium 90, and, so far as we know, all end at lead 82. It will be seen that most of the numbers are occupied several times over. For example, 90 has ionium, the parent of radium, as well as thorium and several others. It has been found that the spectra of ionium and thorium are exactly the same, and that all chemical methods are quite powerless to separate them from each other. They are chemically identical because they have the same atomic number, but they differ in the nature of their nuclei, as witnessed by the difference in their radio-active behaviour. Such substances are called *isotopes*.

The existence of isotopes was first proved from radio-active evidence. But besides possessing the radio-active characteristics of the atom, the nucleus also carries its mass, and this suggests that isotopes may differ in mass. The first evidence for this can be derived from the study of the figure. For example, uranium at 92 loses an α-particle and two β-particles, and thus returns to 92; and the loss of the particles must have reduced its weight from 238 to 234. The same principle has been experimentally verified by finding that the atomic weight of lead from radium is perceptibly different from that of ordinary lead. We shall see in the next article that ordinary elements also have isotopes; for convenience, these have been given in the table, in so far as they have been yet discovered. It should perhaps be here mentioned that the mere difference of atomic weight theoretically implies certain minute differences in chemical behaviour, but it can be shown that these are out of all proportion less than those between substances of different atomic number, so much so that it is an almost impossibly laborious task to separate isotopes by ordinary chemical or physical processes.

The general outcome of our argument has therefore been that atomic number, and not atomic weight, is the determining factor in the behaviour of an element. There are exceptions to this rule—for example, specific heat depends directly on the weight of the atom—but apart from these exceptions the importance which in the past the chemist and spectroscopist have given to atomic weight must in the future be attached to atomic number.

(*To be continued.*)

Obituary.

PROF. WILHELM WUNDT.

WITH the death on September 1, at the advanced age of eighty-eight years, of Prof. W. Wundt a remarkable and striking personality passes away from the scientific world. If, as a philosophic thinker, he did not possess either the speculative genius or the insight of a Herbart or a Lotze, he was yet a mind of extraordinary versatility, whose comprehensive acquaintance with vast fields of knowledge has rarely, if ever, been rivalled. His amazing activity as a writer has been for long a source of wonder to his contemporaries; year after year books, pamphlets, and articles have issued from his pen in steady succession, and there was no department of philosophy which he thus left untouched. Naturally, this tremendous literary output is not all of equal worth, but almost everything he wrote exhibits a surprising mastery of detail and power of turning it to account in reaching theoretical conclusions. As a teacher, too, his influence has been extremely wide and far-reaching; students from all parts of the world met in his class-room, and worked in the Institute of Experimental Psychology at Leipzig, the foundation of which was due to him.

Wilhelm Wundt was born on August 16, 1832, at Neckarau, near Mannheim. In 1851 he began the study of medicine at Heidelberg, and in subsequent semesters pursued his medical studies further in Tübingen and Berlin. Fr. Arnold and E. Hasse, of both of whom he always spoke with great respect, were his teachers in Heidelberg; while in Berlin Johannes Müller was then at the height of his fame, and in the great man's laboratory Wundt was for some time busily engaged. On the completion of his career as an undergraduate, he turned his attention first of all to pathological anatomy, and took his degree in Heidelberg in 1886, his *Arbeit* being a thesis on the condition of the nerves in inflamed and degenerated organs. In the following year he habilitated in the Faculty of Physiology of the same university, and remained in Heidelberg for some years as Helmholtz's assistant in the physiological laboratory. During that period he published two monographs on physiological subjects—the "Beiträge zur Lehre von den Muskelbewegungen" (1858) and the "Beiträge zur Theorie der Sinneswahrnehmung" (1859–62)—in the long Introduction to the latter of which he first outlined his conception of the scope of empirical psychology as a natural science, and insisted upon the necessity of using experimental methods in the observation of mental processes. It was in consequence of his being occupied with the problems of sense-perception that the young physiologist was induced to enter the domain of metaphysical inquiry, and started to read, "ziemlich ziel- und planlos," as he tells us, the works of Kant, Herbart, and Leibniz. The first fruits of these and of his more strictly psychological labours saw the light in the "Vorlesungen über Menschen- und Thierseele" of 1863—a volume in which, as he afterwards expressed it, he set about his task with more zeal than discretion, and which he came to look upon as containing the wild oats of his youthful days. There followed in 1865 a text-book of "Human Physiology" (which apparently had a large circulation, a fourth edition appearing in 1878), and in 1867, when he was already a professor in Heidelberg, a voluminous treatise on what he called "Medicinische Physik," intended to acquaint medical students with the exact physical methods needful in medical investigation. Probably the most elaborate piece of experimental research undertaken by himself was that of which account is given in his "Untersuchungen zur Mechanik der Nerven und Nervencentren," the first part of which was published in 1871 and the second in 1876. The bold and ingenious hypothesis, which he here

put forward, of reflex phenomena has not been sustained by later investigation, but it was a resolute effort to explain a large group of facts of which an adequate theory is still to be sought, and it led incidentally to not a few interesting observations, some of which are referred to by Sherrington in his book on the nervous system.

Wundt succeeded F. A. Lange as professor of "Inductive Philosophy" in Zürich in 1874. In the same year the "Grundzüge der physiologischen Psychologie" was published in two volumes (increased to three volumes of huge proportions in the fifth edition of 1902). His sojourn in Zürich, however, was of short duration. In 1875 he removed to Leipzig, on his appointment to one of the philosophical chairs in the university; and, despite several attempts on the part of other centres of learning to draw him away, Leipzig continued to be his home for the last forty-five years of his life.

In his "Antrittsreden" of 1874 and 1876 Wundt sketched the view which, as professor in Leipzig, he consistently maintained of the function of philosophy, and of the influence which philosophy, as he conceived it, should exert upon the empirical sciences. Philosophy, he contended, is based upon the results reached by the empirical sciences, and forms their necessary supplement and completion. It has for its main purpose to consolidate into a coherent system the generalisations of the special sciences and to trace back to their ultimate grounds the principles and presuppositions which the special sciences are compelled to use. But, he insisted, if philosophy is dependent for its material upon the special sciences, the latter are no less dependent upon philosophy for a justification of the fundamental concepts without which scientific explanation would be impossible. And great as had been the influence of Kant, Hegel, and even Schopenhauer upon the science of their time, he foresaw that the influence of exact philosophical thought upon the science of the future would be greater and more significant still. From this point of view it was natural that, as a philosophical inquirer, his attention should be directed at the outset to the problems of knowledge. His "Logik," the first volume of which was devoted to "Erkenntnislehre," was published in 1880, and the second, dealing with the methods of scientific investigation, in 1883 (in later editions the "Methodenlehre" expanded into two volumes), is undoubtedly a work of considerable importance, and may justly be said to occupy a distinct place in the history of logical science. In the first volume the author tries to steer a middle course between the purely formal view of logic on the one hand and the metaphysical view of it on the other, while in the second volume he undertakes by far the most accurate and detailed examination in existence of the principles, methods, and results of the special sciences. The study of logic in this country has suffered much through want of an English translation of a book which in its way is unique. The next of Wundt's larger works to be published was the "Ethik" (1886)—an investigation, as he described it, of the facts and laws of the moral life. Although not, I think, on the same level of value as the "Logik," it is a suggestive and stimulating treatise, basing an ethical system upon the doctrine of evolution, which here takes form for him especially in the ideas of human progress and of the "Gesamtwille." Finally, as the culmination of his attempt at philosophical construction, the "System der Philosophie" appeared in 1889, in many respects the most original of all his writings, and that by which his position in the development of philosophical thought is most definitely established.

The position is not one that can be indicated in a few words. Wundt took his departure from the point of view of what he called "immediate experience"—experience as he conceived it would be prior to the elaboration of it by reflective thought, which is itself evolved from it. The data of such primordial experience might be classified under the three heads of presentations, affective processes, and conative activities. Originally, presentations are, he insisted, for the experiencing subject not different from objects; they are *Vorstellungsobjecte*, wholes which contain the elements, as yet undifferentiated, which thought in the course of time distinguishes. The development of thought means that presentations come to be separated from the objects to which they are taken to refer; and, when the attempt is further made to conceive these objects as freed from contradiction, they have to be represented as destitute of such attributes as sense-qualities, which, as intuitively experienced, must belong to the subject. The world of physical science is, therefore, wholly conceptual in character; for physical science the ultimate constituents of objects are material points. On the other hand, a psychological treatment of the subjective factors leads to the notion of activity and passivity as mutually involved in every mental state. But we are compelled to conceive of activity as that which is essentially characteristic of our conscious being and to ascribe the passivity we experience to the objects which affect us and thereby counteract our activity. The pure activity which he thus took to be characteristic of the subject Wundt designated will; will he regarded as the essence of subjective existence. Ontologically, however, there was no stopping short of a monistic view of the universe. In the long run the concept of object rests upon an effect which the will experiences, and what thus limits the will is not in itself immediately known. We can only conclude, on the basis of our own experience, that what occasions passivity must in itself be active; and, since will is the only activity known to us, we are justified in ascribing our passivity to another will. Presentations, then, are to be traced back to the reciprocal action of different wills. A further step brought the author to his final contention. Our personal individual wills are not, he

argued, elementary will-units, but units of a higher order comprising many elementary will-units. And these units of higher order may be thought of as in turn uniting to form higher unities still (*e.g.* the collective will of society), until in the end we reach the thought of a world-will including within itself the multiplicity of individual wills.

Many of Wundt's psychological theories—such, for example, as his well-known doctrine of apperception—only become intelligible in the light of his general view of Nature. Emphatic as he was in claiming for psychology a position of its own as an empirical science, he never ceased to regard it as standing in the closest and most intimate relation with philosophy. Even in the "Grundzüge," which is a storehouse of facts largely accumulated in his own laboratory, he turns again and again to the discussion of problems essentially philosophical in character. That work has often been severely criticised, yet when all is said it remains one of the great and permanent contributions to the modern science. The Leipzig Institute was started in a humble way in 1878, but it grew by rapid strides, and Wundt lived to see one of his early desires realised—namely, that the time would come when in every German university a psychological laboratory would be deemed a part of the necessary equipment. The "Philosophische Studien," of which he was the editor, served as a medium of publication for the work of his pupils, and many valuable articles of his own are likewise contained in the twenty volumes that appeared from 1883 to 1903. The last years of his life saw also the realisation of another of his early dreams. In 1900 the first volume of his "Völkerpsychologie" was published, and five other bulky volumes followed. Here, again, to some extent he was breaking new ground, where, however, he was entirely dependent for his material upon the labours of others.

Wundt married shortly after leaving Heidelberg; his son is distinguished as an authority in Greek philosophy, and to his daughter, his companion "im Urwald der Mythen und Märchen," one of the volumes of the "Völkerpsychologie" is dedicated. In private life he was a man of many lovable qualities. His old students look back to many delightful hours spent with him in the midst of his family, and remember with gratitude his kindly interest in them and their work. Slender in build, never of strong physique, and troubled with failing eyesight, it seems well-nigh incredible that he got through the multitudinous labours of which I have spoken, and survived so many of his former pupils. He was wonderfully effective as a lecturer; without a note, and usually to audiences of more than three hundred students, he would handle in a concise and lucid manner themes of notorious difficulty. Absorbed in his scientific pursuits, allowing himself little leisure, but content and happy in his modest and simple home, his life was a rounded whole, the memory of which one would not willingly let die.

G. DAWES HICKS.

ARMAND GAUTIER.

BY the death of Emile Justin Armand Gautier, at Cannes, in his eighty-third year, France loses one of her most distinguished chemists. Born at Montpellier, the son of a medical man, Gautier appears to have been destined to follow his father's profession, and to his early training is to be attributed, in all probability, the direction of much of his subsequent life's work in science, notably in biological chemistry. As a youth he obtained a post, under the Faculty of Montpellier, first as *aide-préparateur* and then as *préparateur* in the chemical laboratory, where he remained five years, and where he acquired that power and facility of manipulation which characterised his experimental work. In the early 'sixties he seems definitely to have decided to attach himself to chemistry as a career. At that period the science was experiencing profound changes, and chemical theory was developing with remarkable rapidity, more particularly owing to the progress in organic chemistry. Wurtz was everywhere recognised as one of the pioneers and leaders of the new movement, and accordingly young Gautier repaired to Paris to work under his inspiration and direction. At Paris he remained, becoming, in 1869, a member of the Faculty of Medicine, in 1872 director of the first laboratory of biological chemistry instituted in France, and in 1884, on the death of Wurtz, professor of medical chemistry. He was elected a member of the Academy in 1889.

During the fifty years of his scientific activity Armand Gautier published an extraordinary number of memoirs—upwards of 600, it is said. They range over every department of the science and practically every sub-section of it. Many of them, of course, are not of first-rate importance, but, collectively, they serve to show his breadth of sympathy, his receptivity, his intellectual keenness, his versatility, and the many-sidedness of his interests.

Here we can deal only with his more noteworthy contributions to the literature of chemistry. The influence of Wurtz is stamped on the earliest of them—as in his work on cyanogen derivatives, on the nitriles and their isomerides, the carbylamines—which mostly appeared in the Bulletin of the French Chemical Society and served to establish Gautier's position as one of the foremost investigators of the new French school. His appointment as director of the laboratory of biological chemistry, already referred to, gave a fresh impetus and a new departure to his work as an investigator. In 1872 he signalised the existence of a class of cadaveric alkaloids, termed by Selmi *ptomaines*, and presumed to be products of putrefaction. Earlier investigators, such as Panum, Dupré and Bence Jones, Marquardt, Schmidt, Bergmann and Schmiedeberg, Zuelzer and Sonnenschein, had obtained so-called putrefaction bases which occasioned physiological effects similar to certain vegeto-alkaloids. Selmi's term was adopted by Gautier to denote alkaloidal sub-

stances formed in the putrefaction of proteins. The earlier literature relating to the ptomaines—a term now fallen into disuse in scientific nomenclature—is full of errors, and there is practically no evidence that what is called "ptomaine poisoning" is due to poisonous alkaloids: it is rather to be attributed to bacterial infection and is caused by bacterial toxins. Gautier found in fresh tissues a number of basic substances, related to uric acid and creatinine, which he regarded as the products of ordinary metabolism, and to which he gave the name of *leucomaines*, to distinguish them from the products of bacterial action.

A subject which engaged Gautier's attention for some time, and to which he occasionally returned, was the widespread diffusion of arsenic in the animal organism, which led to work on improved methods of detecting and estimating that element in micro-chemical quantities. His speculations concerning the *rôle* played by arsenic, as well as by iodine, in our organism may be said to be at the basis of modern therapeutics. The question of the influence of the infinitely little on hygiene had, in fact, a special attraction for him. It is seen in his work on the action of the impurities of the air of towns on the public health. He detected the constant presence in air of iodine, as well as of hydrogen; the former, he imagined, was due to the presence of microscopic algæ, the latter to emanations from primitive rocks, volcanoes, and thermal springs.

Gautier, as a biochemist, also engaged himself in questions of plant physiology and on the chemical transformations of various products in the life-history of vegetable organisms. These studies occasionally took a practical turn, as, for example, in his inquiries into the colouring matter of the grape and the detection of the fraudulent colouring and dilution of wine, and into the influence of "plastering," "collage," and fortifying on the weight of the dry extract. The nature of tobacco-smoke also attracted his attention. He found that when tobacco is smoked in a pipe the volatile liquid products consist mainly of basic compounds, among them nicotine, a higher homologue, $C_{11}H_{16}N_2$, which pre-exists in tobacco leaf, and a base, C_6H_9NO, which appears to be related to picoline. Hydropyridines and other alkaloids are also present, resulting from the decomposition at relatively low temperatures of the carbopyridic and carbohydropyridic acids present in the leaf.

Gautier was a fellow-worker with Maxwell Simpson in Wurtz's laboratory, and the two collaborated in the study of the action of hydrocyanic acid upon aldehyde. He was an occasional visitor to this country, and represented France at various academic gatherings in London. He was a genial soul, and, as was said of him by M. Deslandres, president of the Academy of Sciences, when pronouncing his *éloge*, remained young in spirit and young of heart until the end.

T. E. THORPE.

By the death of MR. HENRY BASSETT, F.I.C., at the age of eighty-three, on August 30, we have lost one of the few remaining survivors of that ardent band of young chemists who studied under Dr. A. W. Hofmann at the Royal College of Chemistry. Handicapped at the start by the death of his father when he was only nine years old, Mr. Bassett had an uphill fight all his life; but he was animated by the same spirit which often enables the poet and the artist to produce good work under most unfavourable conditions. For a time he acted as assistant to Brodie at Oxford, but most of the best years of his life were taken up in testing anthracene as assistant to Mr. F. A. Manning. In 1894, at an age when men more fortunately situated are thinking of retiring, he started a consulting practice of his own, first at St. Andrew's Hill and then at 104 Queen Victoria Street, specialising in non-ferrous alloy and anthracene work. Never lacking in ideas, Mr. Bassett always had some research work in hand, and at intervals, from 1863, he published some seventeen papers and short notes, mainly in the Journal of the Chemical Society or the *Chemical News*. Several of these had reference to anthracene testing, into which he introduced some improvements, and on which he was a recognised authority. His most important research was certainly that on ethyl orthocarbonate, which he prepared by the action of sodium on a mixture of chloropicrin and absolute alcohol. This was published in the Journal of the Chemical Society for 1864, and may give him a permanent place in chemical literature. Several short papers on chlorides of carbon and one on eulyte and dyslyte may also be mentioned. During the course of his consulting practice Mr. Bassett carried out a considerable amount of research work, notably on the corrosion of manganese and other bronzes by sea water, which was never intended for publication. Of recent years he had been doing some very interesting work on graphite, and until within a fortnight of his death had been trying to get his results into a form suitable for publication.

WE regret to note that the death of Mr. ISHAM RANDOLPH on August 2, at seventy-two years of age, is announced in the *Engineer* for September 10. Mr. Randolph's most prominent work was on the Chicago drainage canal, of which he was chief engineer from 1893 until 1907, and was thereafter its consulting engineer until 1912; this great work cost about 12,000,000*l*., and has a hydroelectric plant of 40,000 h.p. He was a member of the international board of consulting engineers for the Panama Canal, and occupied many other important public posts. Mr. Randolph was a member of many engineering societies, including the American Society of Civil Engineers. The Franklin Institute awarded him the Elliott Cresson Medal for distinguished achievements in civil engineering, and the University of Illinois conferred upon him the degree of Doctor of Engineering in 1910.

Notes.

THE earthquake felt on September 7 in the north of Tuscany proves to have been much more serious than the early accounts indicated. Many towns and villages are completely destroyed. The epicentre seems to have been near Fivizzano, a small town, now a heap of ruins, on the slope of the Apennines, and about twelve miles north of Carrara. The area within which buildings were damaged is evidently extensive, as it includes both Viareggio and Pistoia, the latter town being about forty-five miles south-east of Fivizzano. The number of deaths so far reported is 327, but the real number is probably much higher. The earthquake appears to be the most violent known in this part of Italy, which is fortunate in possessing a meagre seismic history. On April 11, 1837, an earthquake, with its centre about five miles south-east of Fivizzano, caused some damage in that town. On September 10, 1878, a strong shock, with its centre close to Fivizzano, again injured a few houses there. Indeed, the recent wholesale destruction of villages is evidence of their long immunity from violent earthquakes, for the buildings were not of that resisting type the construction of which is now enforced in the rebuilt towns of Italy.

IN the detailed exploration of the coasts of Greenland Danish explorers have taken a leading part. Plans of a new expedition under the leadership of Mr. Lauge Koch have been sent to us by Dr. M. P. Porsild, of the Danish Arctic Station in Disko, Greenland. In order to commemorate the voyage of Hans Egede to Greenland in 1721, which began the systematic settlement of the west coast by Denmark, Mr. Koch's expedition is known as the Bicentenary Expedition to the North of Greenland. The Danish Government has provided a vessel and part of the funds, the remainder of the cost being met by subscription in Denmark. The expedition left Copenhagen on July 15 for Robertson Bay in Inglefield Gulf, where a wintering station is to be established. From there a depôt is to be laid in Warming's Land. It is hoped that this will be done in the late summer with the help of motor-tractors. The journey to the depôt will be repeated next year with dog-sledges, and the main work of the expedition will then begin. This includes journeys to the interior of Peary Land and to the north of Adam Biering's Land, where an advanced base will be established. Independence Fjord, Böggild's Fjord, and the unknown parts of Wulff's Land and Warming's Land will be mapped. In the following spring the expedition will travel along the coast from its winter quarters through Kennedy and Robson Channels, round the north of Peary Land into Independence Fjord. The return journey will be made by the main depôt to Robertson Bay. Mr. Koch is accompanied by Mr. C. F. Slott and several Eskimo.

THE *British Medical Journal* for September 11 announces that the International Society of Surgery, at its recent meeting in Paris, elected Sir William Macewen, of Glasgow, as its president for the next congress, to be held in Great Britain—probably in London—during the summer of 1923.

THE British Launderers' Research Association has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of this association is Mr. J. J. Stark, 162–65 Bank Chambers, 329 High Holborn, W.C.1.

THE Royal Academy of Science of Turin has sent us a leaflet announcing the offer of two Bressa prizes of 9000 lire for the greatest work in almost any branch of science during the past four years. Candidates may submit printed (not written or typed) works to the Secretary before December 31, 1922. Members of the Turin Academy are not eligible to compete for the prizes.

THE eighth annual Indian Science Congress will be held in Calcutta from January 31 to February 5, 1921. His Excellency the Right Hon. the Earl of Ronaldshay has consented to be patron of the meeting, and Sir R. N. Mukerjee will be president. Members intending to read papers should send them, together with a short abstract, to Mr. P. S. MacMahon, Canning College, Lucknow, before November 30.

THE Secretary for Scotland has appointed an Advisory Committee to advise him on matters connected with the administration of the Wild Birds Protection Acts. The Committee consists of Mr. Hugh S. Gladstone (chairman), Dr. W. Eagle Clarke, Dr. Walter E. Collinge, Mr. H. M. Conacher (representing the Board of Agriculture for Scotland), Mr. H. J. Crowe (representing the Fishery Board for Scotland), and Prof. J. Arthur Thomson.

THE widespread, popular belief in the use and value of the divining rod gives considerable interest to a recent publication of the United States Geological Survey on the subject. "The Divining Rod," by Mr. A. J. Ellis (Water-supply Paper 416), is a condensed history of water-witching, to which is added a bibliography with many hundred entries. The origin of the divining rod is lost in antiquity, but a belief in its value for a variety of purposes besides water-finding has persisted until the present day. The U.S. Geological Survey considers that for all practical purposes the matter is thoroughly discredited and of no value whatever in locating either water or mineral ores. Mr. Ellis adds a note on various mechanical "water-finders," most of which are magnetic or electrical instruments. He dismisses the claims of all these contrivances as being purely speculative and quite unsound in principle.

THE *Geographical Journal* for July (vol. xvi., No. 1) gives a summary by Dr. Hamilton Rice of his recent expedition to the headwaters of the Orinoco. Dr. Rice's route was from the Amazon up the Rio Negro to the Orinoco. Esmeralda was reached at the end of last year. The Orinoco was then ascended to the rapids of Guaharibos, where Dr. Rice's party of ten was attacked by a big band of Guaharibos and compelled to fight. Material has been obtained for a map traverse on a scale of 1 : 125,000 of the route from Manáos to

the Guaharibos rapids. The traverse is checked by more than forty astronomical stations, where time was obtained by field wireless from Darien and Washington. Magnetic observations were taken at more than twenty of the stations. Meteorological readings were taken four times daily in conjunction with similar readings at the same hours at Para. Much attention was paid to geological research. Finally, Dr. Rice says that the survey of the diseases encountered will form one of the not least valuable results of the expedition.

THE problem of suitable maps for aviators continues to attract much attention and is far from being satisfactorily solved. In the *Geographical Journal* for August (vol. lvi., No. 2) Capt. H. A. Lloyd has a short paper, illustrated by many admirable photographs, on the classification of the ground from the air. Experience on the Western front during the war convinced Capt. Lloyd that the whole area could be divided into distinctive zones differentiated by the shapes of fields or by the industries carried on in particular localities. A recognition of these types of terrain was found to enable a pilot to determine his approximate position. This was particularly valuable in the case of a pilot losing his way owing to clouds or in flight over the country for the first time. Thirteen types of ground were recognised and taught to pilots in the area of the Western front between the sea and the River Oise. Under war conditions this classification had its limitations because the destructive effect of battle, as a rule, removed all features visible to the eye and generally to the camera. It is also noted that, under normal conditions, while the shape of the fields and other features remain constant, the height of the vegetation affects the appearance of the photograph. Thus a field of ripe corn may look almost as dark as a row of trees. These seasonal variations would need to be taken into account in making use of such a classification in map-construction. Capt. Lloyd also discusses the classification of landmarks, and insists that small-scale maps, such as are used in flying, should portray the chief features of towns so that a glimpse of a town would be enough for an aviator to locate his position. These considerations entail the omission of much of the detail shown on maps for land use, so that the features conspicuous from the air may stand out boldly.

A PROSTRATE variety of potato has been found in the breeding experiments of Messrs. R. N. Salaman and I. W. Lesley (*Journal of Genetics*, vol. x., No. 1), which, it is suggested, may be useful for potato-growers in semi-arid climates, since the foliage, lying on the ground, has a considerable effect in conserving the soil moisture. This variety breeds true, and is shown to differ from the upright type in a failure to form secondary xylem in the stem. A procumbent variety, the stems of which turn up at the end, has also appeared. Anatomically, it agrees with the prostrate variety. In both these types the crop of tubers is unaffected.

IN an interesting further study of melanism in moths, Mr. J. W. H. Harrison (*Journal of Genetics*, vol. x., No. 1) discusses crossing experiments with *Tephrosia bistortata, T. crepuscularia,* and their melanic varieties. The melanic variety of *T. crepuscularia* behaves as a simple Mendelian dominant to the type, and the same has been shown to be true of various other melanic varieties. But in crosses of *T. bistortata* with the melanic form of the other species a great range of colour forms was obtained in F_2 and F_3, with no indication of Mendelian segregation. The results are interpreted as showing that the unit factor for melanism has been modified, and in some cases broken up so that it has practically disappeared.

As a first study of inheritance of egg-weight in fowls, Philip Hadley and Dorothy Caldwell (Bull. 181, Rhode Island Agr. Expt. Station) make an analysis of the normal distribution of egg-weight in White Plymouth Rocks. Egg records from a flock of thirty-nine hens through eight years showed that individual hens differed markedly in the weight of eggs laid in any period. The first eggs of any year are smaller, increasing to a maximum in April, then falling to a minimum in July or August, followed by another maximum and minimum in September and November respectively. After the second laying year these maxima appear less clearly, and after the fourth there is a progressive decrease in the weight of eggs produced each year. There appears to be a slight tendency for heavier hens to lay larger eggs.

THE attention of workers on Diptera is directed to Mr. E. Brunetti's catalogue of Oriental and South Asiatic Nemocera, which has been published as vol. xvii. (300 pp., June, 1920) of the Records of the Indian Museum. Mr. Brunetti states that he has included in his catalogue all the names of species available up to the middle of 1919. In nomenclature his policy has been to retain the names employed by the principal dipterologists of the last century; he believes in "continuity before priority," and does not agree with the general overturning of generic and specific names, suggested by strict priorists, which arises out of the much discussed "1800 paper" of Meigen. For each species the author gives the essential bibliographical references and synonyms, and indicates the distribution. The location of the type-specimen, where this is known, is stated. The Culicidæ (mosquitoes) receive careful consideration, and the list of these extends over ninety-six pages of the catalogue.

IN view of the present scarcity in the supply of cotton, the attempts now being made to establish cotton-growing on a large scale in Mesopotamia are of particular interest. Cotton has been grown in Mesopotamia from very ancient times, and is still cultivated in small quantities by the Arabs in conjunction with food-crops along the banks of both the Tigris and Euphrates. The fibre is used locally for spinning and as a stuffing material for pillows and mattresses. The country possesses a soil and climate

favourable to the production of large yields of excellent cotton, and in course of time it should add materially to the world's supply. Since 1917 experiments have been conducted by an expert from the Indian Agricultural Service with the view of discovering the most suitable kinds to grow, and the results of the work done in this connection and the prospects of establishing a cotton-growing industry are fully dealt with in the current number of the Bulletin of the Imperial Institute. So far, American types of cotton seem to be the most suitable for cultivation in Mesopotamia. The members of a deputation of the British Cotton Growing Association which visited the country towards the end of last year were very favourably impressed with its possibilities for cotton production.

THE July–August issue of the *Scottish Naturalist* (Nos. 103 and 104, pp. 99–144) is devoted to a report on Scottish ornithology in 1919 by Miss Leonora Jeffrey Rintoul and Miss Evelyn V. Baxter—a careful piece of work in which many contributors have assisted. The most interesting feature of 1919 is the extension of the breeding range of certain species. Of these the most important is the reappearance of the Whooper swan as a Scottish breeding species. Migration ran a fairly normal course; the cold spring seemed to have no effect on the arrivals of summer visitors. A very large movement took place in the first half of May, but no very big migrations are recorded in autumn, the only one of any magnitude being a weather movement in mid-November caused by the very hard frost and snow at that time. No new birds were added to the Scottish list, but a good many uncommon visitors and new records for particular faunal areas are noted, *e.g.* a blue-headed wagtail at Fair Isle, a red-backed shrike in Moray, two reed-warblers from Lerwick, a bee-eater at Lentran, two American widgeon from Tay and Clyde, and a spotted crake from Ross-shire. The garden-warbler and the pied flycatcher were both found nesting in the Moray area. The report deals also with the decrease of certain species in various areas, with varieties of plumage, with the noteworthy phenomena of the various seasons, and with peculiarities of habit, such as carrion-crows acting as foster-parents. It is cheering to read that on October 5, at Swordale, East Ross, a golden eagle, two buzzards, and a peregrine falcon were all seen in the air together. The authors are to be congratulated on the continuation of their valuable series of annual reports.

IN Professional Paper 98–L of the U.S. Geological Survey, Messrs. G. C. Matson and E. W. Berry provide the first description of a North American Pliocene flora. This comes from the Citronelle formation of the Gulf coastal plain, extending from western Florida to eastern Texas, and indicates climatic conditions in late Pliocene time similar to those of the present day. The modern forest flora is well illustrated in its habit as it lives, to furnish a picture of the Pliocene period.

MR. JOHN PARKINSON introduces the term "lak" into geography in his "Report on the Geology and Geography of the Northern Part of the East Africa Protectorate" (Colonial Reports—Miscellaneous, No. 91, 1920). A lak is a drainage-channel that may carry water periodically; it is often a guide to the capacity of an area for development. On the banks of some laks in East Africa the abundance of molluscan shells indicates the former existence of extensive lakes, and the water-supply found in the wells may be a relic of these lakes in a region that has clearly suffered from desiccation.

DRUMLINS, kames, and eskers play a large part in the topography of northern temperate lands in Europe and America, and their relations are well illustrated in maps and landscapes in Mr. W. C. Alden's important memoir on "The Quaternary Geology of South-eastern Wisconsin" (U.S. Geol. Surv., Prof. Paper 106, 1918). The distribution of the drumlins of the Green Bay glacier west of Lake Michigan, and of the subglacial eskers, is a very striking feature of the large "surficial" map. Would the U.S. Survey consider the folding of its maps with the printed side outwards, as is done by the Ordnance Survey of the British Isles, following the plan adopted by so many travellers in their field-work?

A CATALOGUE of the Mesozoic and Cenozoic Plants of North America, by F. H. Knowlton, has been issued as Bulletin 696 of the United States Geological Survey. It contains 815 pages, and should form a useful work of reference. The catalogue is an alphabetically arranged list of the genera and species that have been described. For each American form that is known only in a fossil state the original date and place of publication are given; then follow all or the most important references, especially such as refer to descriptions and figures. For each Old World form that is recognised in North American strata the original date and place of publication are given; a reference to the publication in which the form is first recorded as American follows, and then in chronological order the American references. For living species found fossil only the authority is given, followed by the first reference to the species in a fossil state, and then by other important references. The synonymy is placed under the species to which it belongs, but each synonym occurs in its proper alphabetical place with a reference to the form to which it is now referred. The catalogue is supplemented by a systematic arrangement of the genera and an index of genera and families. There are also a list of the North American Mesozoic and Cenozoic plant-bearing formations, with the plants found in each alphabetically arranged, and a bibliography.

THE Report issued by the United States Geological Survey of the world's production of copper in 1917 has recently been published. For many years the U.S.A. has been the largest producer of this metal. In 1913 its production was about 57 per cent. of the world's output of just under one million tons. During the war there was a greatly increased use of this metal, and the demand of the belligerent countries was satisfied principally by a very large increase in Ameri-

can production. The high-water mark was reached in 1917, when a grand total of 1·454 million tons was extracted. Of this the U.S.A. produced 0·855 million tons. Japan and Chile also increased their smelter production to a little more than 100,000 tons. Then follow Canada, Mexico, and Peru. It will be seen, therefore, that by far the greater part of the world's copper was derived from the western hemisphere. It is evident that the U.S.A. is the largest single factor in nearly every phase of the industry. At present it is not only much the largest producer and consumer, but it also excels in both imports and exports. At the beginning of 1917 the producing capacity was the largest in the history of the industry, and was almost wholly utilised. The principal producing State was Arizona, followed by Montana, Michigan, and Utah. These four States provided 79 per cent. of the total American output in 1917.

MR. T. SHEPPARD, whose careful record of William Smith's maps and memoirs has just been published by Messrs. Brown and Sons of Hull, chose "The Evolution of Topographical and Geological Maps" as the subject of his address to the Delegates of Corresponding Societies at the British Association meeting in Cardiff. He showed how incomplete our collections are of county maps, while such publications are occasionally used by dealers for the wrapping of book-parcels. Great credit is very properly assigned to John Cary's work in England from 1787 to 1832; his large road-map, with the coach-roads coloured in blue, is on the scale of five miles to one inch, not ten as stated, and, with its index of every village, is still of great value in a private library. In citing maps published after the initiation of the Ordnance Survey, those of Scotland by Faden and Wyld, on the basis of surveys by General Roy and John Ainslie (1839), and by Arrowsmith, scale four miles to one inch (1840), used as the basis of MacCulloch's fine geological map, are worthy of mention. MacCulloch seems to have completed his share in this map in 1834. The second and most authoritative edition of Griffith's map of Ireland was issued in 1855, not 1853, as given in the address. Attention is well directed to the "soil-maps," in reality precursors of our "drift-maps," published in connection with agricultural and statistical surveys about the beginning of the nineteenth century. That of Londonderry by Sampson in 1802, with its blue boulder-clay and pink sands and gravels, interestingly anticipates our modern colouring. Mr. Sheppard's address as now printed is a welcome work of reference.

MONTHLY results of magnetical, meteorological, and seismological observations at the Royal Alfred Observatory, Mauritius, to April, 1920, have been received. Hourly observations of the magnetic declination, horizontal force, and vertical force are given from the photographic records. There are similar observations for each hour of atmospheric pressure, direction and velocity of wind, temperature of the air and evaporation, amount of cloud, duration of bright sunshine, and rainfall, most of which are from self-registering instruments. Monthly rainfall totals are given for about 100 stations in Mauritius, grouped according to the river systems. The monthly and yearly means and extremes of the meteorological elements at the Royal Alfred Observatory for 1919 are tabulated. July had the highest mean atmospheric pressure, and February and March the lowest. The absolute highest temperature was 34·9° C. in January, and the lowest night minimum 13·0° C. in August. The mean of the daily maxima was highest, 32·1° C., in January, and lowest, 23·4° C., in July. The mean of the night minima was lowest, 16·3° C., in August, and highest, 23·3° C., in February. The degree of humidity, saturation 100, was highest, 78, in March, and lowest, 69, in November. The amount of rain was greatest, 202·7 mm., in March, and least, 24·3 mm., in May, the total for the year being 1001·6 mm.

"NOTES on the Ground Day Visibility at Cranwell, Lincolnshire," by Capt. W. H. Pick, published by the Meteorological Office as Professional Notes No. 11, is an attempt to find the relations existing between visibility and wind direction, wind velocity, and distribution of pressure. The period dealt with is from February 1 to April 8, 1920, and for hourly observations from 9h. to 17h. G.M.T. It is shown that winds in the south-west quadrant brought the best visibility, winds between west and east through north a considerably lower degree, and winds in the south-east quadrant the lowest degree. It is pointed out that visibility with winds greater than 12 m.p.h. was much higher than it was with winds less than or equal to 12 m.p.h. Classification according to pressure distribution shows that the mean visibility in front of a depression is 5·1 of visibility-scale (0–9), in the rear of a depression 5·0, and in a secondary depression 4·9. In an anticyclone or wedge it is 3·9 of scale, in a col 4·7, and with straight isobars south to north 3·2, west to east and south-west to north-east 5·5. The period of observation discussed—sixty-eight days of nine consecutive hours each—is far too short. The situation of Cranwell and its proximity to hills would render the conditions found quite different from those in many other parts of the British Isles, or on the open sea contiguous to our coasts. The relations between visibility and pressure distribution seem open to doubt. No attempt has been made to ascertain the relation of visibility to time of day.

THE August issue of the Journal of the Society of Glass Technology contains the paper on the properties of the raw fireclays found in this country which was communicated to the meeting of the society in April by Miss E. M. Firth, Mr. F. W. Hodkin, and Dr. W. E. S. Turner. Twenty-seven clays were examined, only five of them falling within the specification of the Refractories Research Committee of the society as suitable for glass-furnaces. The results show no correlation between the physical properties and chemical compositions of the clays, and the authors conclude that the classification of clays according to chemical composition is premature, and

should be replaced by one according to their shrinkage and porosity. Most of the clays tested show expansion at some part of the firing range, owing probably to the allotropic changes in the silica present. In general, clays with high alumina content show a wide range of porosity, but there are notable exceptions. From the tables of the properties of the various clays given by the authors it is possible to calculate the properties of a mixture of them when fired to a given temperature.

CONTINUING his researches on the alloys of iron with chromium and tungsten, Prof. Honda has recently published in the Science Reports of the Tôhoku Imperial University an investigation on the structural constitution of high-speed steels containing these elements. He concludes that in an annealed steel containing 5 per cent. of chromium, 18 per cent. of tungsten, and 0·6 per cent. of carbon the alloy consists of a solution of iron tungstide in iron, together with free tungstide and the carbides Cr_4C and WC. On heating such a steel above Ac_1 the carbides dissolve, and the chromium carbide Cr_4C is converted into Cr_3C_2 and metallic chromium. The higher the temperature, the more the change proceeds in this direction. On cooling, the reverse change takes place only slightly, and the result is that at the ordinary temperature a steel is produced containing the carbides, chromium, and the tungstide all in solid solution. This, according to him, is the constitution of the hardened steel. The self-hardening property is conveniently studied by the temperatures of the transformations, while the degree of tempering on later heating is best studied by means of magnetic heating curves. The tempering takes place in two steps—one at about 400° and the other above 700°. Prof. Honda concludes that self-hardening and resistance to tempering depend primarily on the quantity of Cr_3C_2 dissolved in iron containing chromium and tungstide. These properties increase both with chromium and carbon and with rise of temperature. The function of tungsten appears to consist in lowering the temperature, at which self-hardening begins to be manifest. When this element exceeds 12 per cent. it exists as fine globules of tungstide Fe_2W, and these are directly related to the cutting efficiency of the tool.

WE have just received from W. Heffer and Sons, Ltd., of Cambridge, a catalogue of their library of second-hand books. Science and mathematics are well represented by a number of the bigger text-books, and several collections of bound volumes of scientific journals are also offered for sale.

THROUGH the omission of the word "hundred" from line 28 of the first column of page 38 of last week's NATURE, the annual production of coal in Great Britain was erroneously stated to approach "three million" instead of "three hundred million" tons. It is shown in the article upon the proceedings of the Section of Economics and Statistics of the British Association, printed elsewhere in this issue, that the output in 1913 was 287,000,000 tons.

Our Astronomical Column.

TEMPEL'S COMET.—This comet is now fading, but may still be visible for some weeks. The following ephemeris, for Greenwich midnight, is by M. Ebell:

	R.A. h. m. s.	S. Decl. ° ′		R.A. h. m. s.	S. Decl. ° ′
Sept. 17 ...	3 1 5	8 27	Oct. 3 ...	2 51 44	10 53
21 ...	2 59 45	9 8	7 ...	2 47 59	11 21
25 ...	2 57 42	9 46	11 ...	2 43 50	11 44
29 ...	2 55 0	10 22	15 ...	2 39 24	12 1

Values of log r, log Δ: September 21, 0·2364, 9·9411; October 15, 0·2737, 9·9730.

A photograph obtained at Bergedorf on August 15 showed a well-defined nucleus and a fan-shaped tail which could be traced for about 1′. The corrections indicated to Ebell's ephemeris were +23s., S. 3·0′.

NOVA CYGNI.—The position of this star referred to the equinox of 1920·0 is R.A. 19h. 56m. 24·77s., N. decl. 53° 24′ 1·3″; annual precession, +1·50s., +9·7″. Examination of past photographs shows no trace of a star in this place on plates taken by Dr. Wolf and Mr. Franklin Adams some fifteen and twelve years ago. They go down to mag. 17 and 15 respectively. Two plates taken at Harvard on 1920 August 9 with a 1-in. lens fail to show it, and it must have been fainter than 9·5. A plate taken by Mr. Nils Tamm in Sweden on August 16 shows it of mag. 7, and a Harvard one of August 19 indicates mag. 4·8. Since the maximum was not reached until August 24, the rise in light occupied more than a week. The total increase in light was at least 15 magnitudes, while that of Nova Aquilæ 1918 was only 11 magnitudes (Harvard Bulletin, 729; *Astr. Nachr.*, 5060).

THE PERTH SECTION OF THE ASTROGRAPHIC CATALOGUE.—The publication of the great Astrographic Catalogue has fallen far behind the expectations that were formed when the scheme was initiated some thirty years ago, but many new observatories have stepped in to fill gaps left in the zones, and these are showing much energy in pushing on their share of the work. The Perth Observatory, under the direction of Mr. N. B. Curlewis, undertook the region from −31° to −41°. The Catalogue will be completed in thirty-six volumes, each containing six hours of R.A. in a single degree of declination. Vols. xvii. to xxiv. have recently been issued. The following table gives the number of stars in each volume and the ratio to the number in C.P.D.:

Plate centre	R.A. 0h.–6h. No. of stars	Ratio	R.A. 6h.–12h. No. of stars	Ratio	R.A. 12h.–18h. No. of stars	Ratio	R.A. 18h.–24h. No. of stars	Ratio.
−36°	7,740	4·7	21,923	2·5	20,766	4·1	19,832	5·0
−37°	7,664	4·4	21,883	2·6	20,667	3·5	14,562	3·8

It will be seen that the ratio varies considerably, being, on the whole, lowest where the star-density is greatest.

The radius of the image is given for stars not fainter than magnitude 8. The fainter stars have their magnitudes indicated by a letter (from A to L) referring to a specially constructed scale; approximately A is of magnitude 8½, and the letters are half-magnitudes apart, so that L is 13½.

The *étoiles de repère*, of which there are about fifteen on each plate, have recently been re-observed with the Perth meridian-circle, and proper motions deduced where necessary. The measured rectangular co-ordinates of all the stars are given to 0·001 of a *réseau* interval. The usual plate-constants and tables for reduction to R.A. and declination are also given, with a note that the constants are deduced on a somewhat different plan from that followed at Greenwich.

Geographers and the Reconstruction of Europe.*

By JOHN MCFARLANE, M.A.

IN the rearrangement of European States which has taken place geographical conditions have, perhaps, not always had the consideration which they deserve, but in an inquiry such as that upon which we are engaged they naturally occupy the first place. It is to the land within the frontier, and not to the frontier itself, that our main consideration should be given. The factors which we have to take into account are those which enable a people to lead a common national life, to develop the economic resources of the region within which they dwell, to communicate freely with other peoples, and to provide not only for the needs of the moment, but so far as possible for those arising out of the natural increase of the population. The principle of self-determination has likewise played an important, if not always a well-defined, part in the rearrangement of Europe. The basis upon which the new nationalities have been constituted is, on the whole, ethnical, though it is true that within the main ethnical divisions advantage has been taken of the further differentiation in racial characteristics arising out of differences in geographical environment, history, language, and religion. But no more striking illustration could be adduced of the strength of ethnic relationships at the present time than the union of the Czechs with the Slovaks, or of the Serbs with the Croats and the Slovenes. Economic considerations, of course, played a great part in the settlement arrived at with Germany, but, on the whole, less weight has been attached to them than to ethnic conditions.

When we come to examine the application of the principles which I have indicated to the settlement of Europe we shall, I think, find that the promise of stability is greatest in those cases where geographical and ethnical conditions are most in harmony, and least where undue weight has been given to conditions which are neither geographical nor ethnical.

The restoration of Alsace-Lorraine to France had always been treated as a foregone conclusion in the event of a successful termination of the war against Germany. From the geographical point of view, however, there are certainly objections to the inclusion of Alsace within French territory. From the economic point of view, however, the great deposits of iron ore in Lorraine constitute its chief attraction for France to-day, just as they appear to have constituted its chief attraction for Germany half a century ago. But the transfer of the province from Germany, which has built up a great industry on the exploitation of its mines, to France, which does not possess in sufficient abundance coal for smelting purposes, together with other arrangements of a territorial or quasi-territorial nature made partly at least in consequence of this transfer, at once raises questions as to the extent to which the economic stability of Germany is threatened. In regard to coal the position is serious. We need not, perhaps, be unduly impressed by the somewhat alarmist attitude of Mr. Keynes, who estimates that on the basis of the 1913 figures Germany, as she is now constituted, will require for the pre-war efficiency of her railways and industries an annual output of 110,000,000 tons, and that instead she will have in future only 100,000,000 tons, of which 40,000,000 tons will be mortgaged to the Allies. In arriving at these figures Mr. Keynes has made an allowance of 18,000,000 tons for decreased production, one-half of which is caused by the German miner having shortened his shift from eight and a half to seven hours per day. This is certainly a deduction which we need not take into account. Mr. Keynes also leaves out of his calculation the fact that previous to the war about 10,000,000 tons per year were sent from Upper Silesia to other parts of Germany, and there is no reason to suppose that this amount need be greatly reduced, especially in view of article 90 of the Treaty of Versailles, which provides that "for a period of fifteen years Poland will permit the produce of the mines of Upper Silesia to be available for sale to purchasers in Germany on terms as favourable as are applicable to like products sold under similar conditions in Poland or in any other country." We have further to take into account the opportunities for economy in the use of coal, the reduction in the amount which will be required for bunkers, the possibility of renewing imports from abroad—to a very limited extent indeed, but still to some extent—and the fact that the French mines are being restored more rapidly than at one time appeared possible. (On the basis of the production of the first four months of 1920 Germany could already reduce her treaty obligations to France by 1,000,000 tons per year.) Taking all these facts into account, it is probably correct to say that when Germany can restore the output of the mines left to her to the 1913 figure, she will, as regards her coal supply for industrial purposes, be in a position not very far removed from that in which she was in 1910, when her total consumption, apart from that at the mines, was about 100,000,000 tons. Our general conclusion, then, is that the territorial arrangements which have been made do not necessarily imperil the economic stability of Germany. The economic consequences of the war are really much more serious than the economic consequences of the peace. Germany has for ten years to make good the difference between the actual and the pre-war production of the French mines which she destroyed. Her own miners are working shorter hours, and as a result her own production is reduced, and as British miners are doing the same she is unable to import from this country. For some years these deductions will represent a loss to her of about 40,000,000 tons per annum, and will undoubtedly make her position a serious one. But to give her either the Saar or the Upper Silesian coalfields would be to enable her to pass on to others the debt which she herself has incurred. The reduction of her annual deliveries of coal to France, Belgium, and Italy was, indeed, the best way in which to show mercy to her.

The position of Poland is geographically weak, partly because its surface features are such that the land has no well-marked individuality, and partly because there are on the east and west no natural boundaries to prevent invasion or to restrain the Poles from wandering far beyond the extreme limits of their State. Polish geographers themselves appear to be conscious of this geographical infirmity. It is, then, to racial feeling rather than to geographical environment that we must look for the basis of the new Polish State, but the intensity with which this feeling is likely to operate varies considerably in different parts of the region which it is proposed to include. The population is sufficiently large and the

* From the opening address of the President of Section E (Geography) delivered at the Cardiff meeting of the British Association on August 24.

Polish element within it sufficiently strong to justify its independence on ethnical grounds. Moreover, the alien elements which it contains are united neither by racial ties nor by contiguity of settlement. Considered as a whole, Poland is at least as pure racially as the United States. When we consider the economic resources of Poland we see that they also make for a strong and united State. It is true that in the past the country has failed to develop as an economic unit, but this is a natural result of the partitions and of the different economic systems which have prevailed in different regions. Even now, however, we can trace the growth of two belts of industrial activity which will eventually unite these different regions. One is situated on the coalfield running from Oppeln in Silesia by Cracow and Lemberg, and is engaged in mining, agriculture, and forestry; while the other extends from Posen by Lodz to Warsaw, and has much agricultural wealth and an important textile industry. Moreover, the conditions, geographical and economic, are favourable to the growth of international trade. If Poland obtains Upper Silesia she will have more coal than she requires, and the Upper Silesian fields will, as in the past, export their surplus produce to the surrounding countries, while the manufacturing districts will continue to find their best markets in the Russian area to the east. The outlets of the State are good, for not only has it for all practical purposes control of the port of Danzig, but it is able to share in the navigation of the Oder and it has easy access to the south by way of the Moravian Gap. It seems obvious, therefore, that Poland can best seek compensation for the weakness of her geographical position by developing the natural resources which lie within her ethnic frontiers. By such a policy the different parts of the country will be more closely bound to one another than it is possible to bind them on a basis of racial affinity and national sentiment alone. Moreover, Poland is essentially the land of the Vistula, and whatever is done to improve navigation on that river will similarly tend to have a unifying effect upon the country as a whole. The mention of the Vistula, however, raises one point where geographical and ethnical conditions stand in marked antagonism to one another. The Poles have naturally tried to move down-stream to the mouth of the river which gives their country what little geographical individuality it possesses, and the Polish corridor is the expression of that movement. On the other hand, the peoples of East and West Prussia are one and the same. The geographical reasons for giving Poland access to the sea are no doubt stronger than the historical reasons for leaving East Prussia united to the remainder of Germany, but strategically the position of the corridor is as bad as it can be, and the solution arrived at may not be accepted as final. Lastly, we may consider the case of East Galicia, which the Poles claim not on geographical grounds, because it is in reality part of the Ukraine, and not on ethnical grounds, because the great majority of the inhabitants are Little Russians, but on the ground that they are, and have for long been, the ruling race in the land. It may also be that they are not uninfluenced by the fact that the region contains considerable stores of mineral oil.

Czecho-Slovakia is in various ways the most interesting country in the reconstructed Europe. Both geographically and ethnically it is marked by some features of great strength, and by others which are a source of considerable weakness to it. Bohemia by its physical structure and its strategic position seems designed by Nature to be the home of a strong and homogeneous people. Moravia attaches itself more or less naturally to it, since it belongs in part to the Bohemian massif, and is in part a dependency of that massif. Slovakia is Carpathian country, with a strip of the Hungarian plain. Thus, while Bohemia possesses great geographical individuality, and Slovakia is at least strategically strong, Czecho-Slovakia as a whole does not possess geographical unity, and is in a sense strategically weak, since Moravia, which unites the two upland wings of the State, lies across the great route which leads from the Adriatic to the plains of Northern Europe. The country might easily, therefore, be cut in two as the result of a successful attack, either from the north or from the south. Later I shall endeavour to indicate certain compensations arising out of this diversity of geographical features, but, for the moment at least, they do not affect our argument. We have, further, to note that the geographical and ethnical conditions are not altogether concordant. In Bohemia we feel justified in arguing that here at least the governing factors are and must be geographical. To partition a country which seems predestined by its geographical features to be united and independent would give rise to an intolerable sense of injustice. In Slovakia also there are racial differences. Within the mountain area the Slovaks form the great majority of the population, but in the valleys and on the plains of the Danube, to which the valleys open out, the Magyar element predominates. Moreover, it is the Magyar element which is racially the stronger, and before which the Slovaks are gradually retiring. Geographical and ethnical conditions, therefore, unite in fixing the political frontier between Magyar and Slovak at the meeting place of hill and plain. But on the west such a frontier would have been politically inexpedient because of its length and irregularity, and economically disadvantageous because the river valleys, of which there are about a dozen, would have had no easy means of communication with one another or with the outside world. Hence the frontier was carried south to the Danube, and about 1,000,000 Magyars were included in the total population of 3,500,000. The danger of transferring territory not on geographical or ethnical, but on economic, grounds could not be more strikingly illustrated. With regard to economic development, the future of the new State would appear to be well assured. Bohemia and Moravia were the most important industrial areas in the old Austrian Empire, and Slovakia, in addition to much good agricultural land, contains considerable stores of coal and iron. But if Czecho-Slovakia is to be knit together into a political and economic unit, its communications will have to be developed. We have already suggested that the geographical diversity of the country offers certain compensations for its lack of unity, but these cannot be taken advantage of until its different regions are more closely knit together than they are at present. The north of Bohemia finds its natural outlet both by rail and water through German ports. The south-east of Bohemia and Moravia look towards Vienna. In Slovakia the railways, with only one important exception, converge upon Budapest. The people appear to be alive to the necessity of remedying this state of affairs, and no fewer than fifteen new railways have been projected which, when completed, will unite Bohemia and Moravia more closely to one another and to Slovakia. Moreover, it is proposed to develop the waterways of the country by constructing a canal from the Danube at Pressburg to the Oder. If these improvements are carried out the position of Czecho-Slovakia will, for an inland State, be remarkably strong. It will have through communication by

water with the Black Sea, the North Sea, and the Baltic, and some of the most important land routes of the Continent already run through it. On the other hand, its access to the Adriatic is handicapped by the fact that in order to reach that sea its goods will have to pass through the territory of two, if not three, other States, and however well the doctrine of economic rights of way may sound in theory there are undoubted drawbacks to it in practice. It is probable, therefore, that the development of internal communications will in the end be to the advantage of the German ports, and more especially of Hamburg. But the other outlets of the State will certainly tend towards the preservation of its economic independence.

The exent to which Rumania has improved her position as a result of the war is for the present a matter of speculation. On one hand she has added greatly to the territory which she previously held, and superficially she has rendered it more compact; but on the other she has lost her unity of outlook, and strategically at least weakened her position by the abandonment of the Carpathians as her frontier. Again, whereas before the war she had a fairly homogeneous population—probably from 90 to 95 per cent. of the 7,250,000 people in the country being of Rumanian stock—she has, by the annexation of Transylvania, added an area of 22,000 square miles of territory, in which the Rumanians number less than one and a half millions out of a total of two and two-third millions. In that part of the Banat which she has obtained there is also a considerable alien element. It is in this combination of geographical division and ethnic intermixture that we may foresee a danger to Rumanian unity. The position in the Dobruja is also open to criticism. Geographically the region belongs to Bulgaria, and the Danube will always be regarded as their true frontier by the Bulgarian people. Ethnically its composition is very mixed, and, whatever it was originally, it certainly was not a Rumanian land. But after the Rumanians had rather unwillingly been compelled to accept it in exchange for Bessarabia, filched from them by the Russians, their numbers increased and their economic development of the region, and more especially of the port of Constanza, undoubtedly gave them some claims to the northern part of it. As so often happens, however, when a country receives part of a natural region beyond its former boundaries, Rumania is fertile in excuses for annexing more of the Dobruja. To the southern part, which she received after the Balkan wars, and in the possession of which she has been confirmed by the peace terms with Bulgaria, she has neither ethnically nor economically any manner of right. Her occupation of it will inevitably draw Rumania on to further intervention in Bulgarian affairs. The arrangements which have been made with regard to the Banat must be considered in relation to the Magyar position in the Hungarian plain. The eastern country of the Banat, Krasso-Szörény, has a population which is in the main Rumanian, and as it belongs to the Carpathian area it is rightly included with Transylvania in Rumanian territory. In the remainder of the Banat, including Arad, the Rumanians form less than one-third of the total population, which also comprises Magyars, Germans, and Serbs. But Rumania has been permitted to descend from the mountains and Jugo-Slavia to cross the great river which forms her natural boundary, and both have obtained a foothold on the plain, where it may be only too easy for them to seek occasion for further advances. For the extension of Jugo-Slavia beyond the Danube two pleas have been advanced, one ethnical and the other strategic. Neither is really valid. The Danube is certainly a better defensive frontier than the somewhat arbitrary line which the Supreme Council has drawn across the Hungarian plain.

In fact, it is in the treatment of the Hungarian plain that we feel most disposed to criticise the territorial settlements of the Peace Treaties. Geographical principles have been violated by the dismemberment of a region in which the Magyars were in a majority, and in which they were steadily improving their position. Ethnical principles have been violated, both in the north, where a distinctly Magyar region has been added to Slovakia, and in the south, where the western part of the Banat and Bačka have been divided between the Rumanians and the Jugo-Slavs, who together form a minority of the total population. For the transfer of Arad to Rumania and of the Burgenland to Austria more is to be said, but the position as a whole is one of unstable equilibrium, and can only be maintained by support from without. In this part of Europe at least a League of Nations will not have to seek for its troubles.

When we turn to Austria we are confronted with the great tragedy in the reconstruction of Europe. Of that country it could once be said, "Bella gerant alii, tu felix Austria nube," but to-day, when dynastic bonds have been loosened, the constituent parts of the great but heterogeneous empire which she thus built up have each gone its own way. And for that result Austria herself is to blame. She failed to realise that an empire such as hers could only be permanently retained on a basis of common political and economic interest. Instead of adopting such a policy, however, she exploited rather than developed the subject nationalities, and to-day their economic, no less than their political, independence of her is vital to their existence. The entire political reorientation of Austria is necessary if she is to emerge successfully from her present trials, and such a reorientation must be brought about with due regard to geographical and ethnical conditions. The two courses which are open to her lead in opposite directions. On one hand she may become a member of a Danubian confederation, on the other she may throw in her lot with the German people. The first would really imply an attempt to restore the economic position which she held before the war, but it is questionable whether it is either possible or expedient for her to make such an attempt. A Danubian confederation will inevitably be of slow growth, as it is only under the pressure of economic necessity that it will be joined by the various nationalities of south-eastern Europe. Moreover, Austria has in the past shown little capacity to understand the Slav peoples, and in any case her position in what would primarily be a Slav confederation would be an invidious one. For these reasons we turn to the suggestion that Austria should enter the German Empire, which, both on geographical and on ethnical grounds, would appear to be her proper place. Geographically she is German, because the bulk of the territory left to her belongs either to the Alpine range or to the Alpine foreland. Ethnically, of course, she is essentially German. Now, although my argument hitherto has rather endeavoured to show that the transfer of territory from one State to another on purely economic grounds is seldom to be justified, it is equally indefensible to argue that two States which are geographically and ethnically related are not to be allowed to unite their fortunes because it would be to their interest to do so. And that it would be to

their interest there seems little doubt. Austria would still be able to derive some of her raw materials and foodstuffs from the Succession States, and she would have, in addition, a great German area in which she would find scope for her commercial and financial activities. Not only would Austria find a market for her industrial products in Germany, but she would also become the great trading centre between Germany and south-east Europe.

The absorption of Austria in Germany is opposed by France, mainly because she cannot conceive that her great secular struggle with the people on the other side of the Rhine will ever come to an end, and she fears the addition of 6,500,000 to the population of her ancient enemy. But quite apart from the fact that Germany and Austria cannot permanently be prevented from following a common destiny if they so desire, and apart from the fact that politically it is desirable they should do so with at least the tacit assent of the Allied Powers rather than in face of their avowed hostility, there are reasons for thinking that any danger to which France might be exposed by the additional man-power given to Germany would be more than compensated for by the altered political condition in Germany herself. Vienna would form an effective counterpoise to Berlin, and all the more so because she is a great geographical centre, while Berlin is more or less a political creation. The South German people have never loved the latter city, and to-day they love her less than ever. In Vienna they would find not only a kindred civilisation with which they would be in sympathy, but also a political leadership to which they would readily give heed. In such a Germany, divided in its allegiance between Berlin and Vienna, Prussian animosity to France would be more or less neutralised. Nor would Germany suffer disproportionately to her gain, since in the intermingling of northern efficiency with southern culture she would find a remedy for much of the present discontents. When the time comes, and Austria seeks to ally herself with her kin, we hope that no impassable obstacle will be placed in her way.

The long and as yet unsettled controversy on the limits of the Italian kingdom illustrates very well the difficulties which may arise when geographical and ethnical conditions are subordinated to considerations of military strategy, history, and sentiment in the determination of national boundaries. The annexation of the Alto Adige has been generally accepted as inevitable. It is true that the population is German, but here, as in Bohemia, geographical conditions appear to speak the final word. Strategically also the frontier is good, and will do much to allay Italian anxiety with regard to the future. Hence, although ethnical conditions are to some extent ignored, the settlement which has been made will probably be a lasting one.

On the east the natural frontier of Italy obviously runs across the uplands from some point near the eastern extremity of the Carnic Alps to the Adriatic. The pre-war frontier was unsatisfactory for one reason, because it assigned to Austria the essentially Italian region of the Lower Isonzo. But once the lowlands are left on the west, the uplands which border them on the east, whether Alpine or Karst, mark the natural limits of the Italian kingdom, and beyond a position on them for strategic reasons the Italians have no claims in this direction except what they can establish on ethnical grounds. In Carniola the Slovenes are in a large majority, and in Gorizia they also form the bulk of the population. On the other hand, in the town and district of Trieste the Italians predominate, and they also form a solid block on the west coast of Istria, though the rest of that country is peopled mainly by Slovenes. It seems to follow, therefore, that the plains of the Isonzo, the district of Trieste, and the west coast of Istria, with as much of the neighbouring upland as is necessary to secure their safety and communications, should be Italian, and that the remainder should pass to the Jugo-Slavs. The so-called Wilson line, which runs from the neighbourhood of Tarvis to the mouth of the Arsa, met these requirements fairly well, though it placed from 300,000 to 400,000 Jugo-Slavs under Italian rule to less than 50,000 Italians, half of whom are in Fiume itself, transferred to the Jugo-Slavs. Any additional territory must, by incorporating a larger alien element, be a source of weakness and not of strength to Italy. To Fiume the Italians have no claim beyond the fact that in the town itself they slightly outnumber the Croats, though in the double town of Fiume-Sushak there is a large Slav majority. Beyond the sentimental reasons which they urge in public, however, there is the economic argument, which, perhaps wisely, they keep in the background. So long as Trieste and Fiume belonged to the same empire the limits within which each operated were fairly well defined, but if Fiume becomes Jugo-Slav it will not only prove a serious rival to Trieste, but will prevent Italy from exercising absolute control over much of the trade of Central Europe. Its development is more fully assured as the one great port of Jugo-Slavia than under any other form of government. With regard to Italian claims in the Adriatic little need be said. To the Dalmatian coast Italy has no right either on geographical or on ethnical grounds, and the possession of Pola, Valona, and some of the islands gives her all the strategic advantages which she has reason to demand.

Of the prospects of Jugo-Slavia it is hard to speak with any feeling of certainty. With the exception of parts of Croatia-Slavonia and of southern Hungary, the country is from the physical point of view essentially Balkan, and diversity rather than unity is its most pronounced characteristic. Ethnic affinity forms the real basis of union, but whether that union implies unity is another matter. It is arguable that repulsion from the various peoples—Magyars, Turks, and Austrians—by whom they have been oppressed, rather than the attraction of kinship, is the force which has brought the Jugo-Slavs together. In any case, the obstacles in the way of the growth of a strong national feeling are many. Religious differences are not wanting, and cultural conditions show a wide range. To build up out of elements in many respects so diverse a common nationality without destroying what is best in each will be a long and laborious task. Economic conditions are not likely to be of much assistance. It is true that they are fairly uniform throughout Jugo-Slavia, and it is improbable that the economic interests of different regions will conflict to any great extent. On the other hand, since each region is more or less self-supporting, they will naturally unite into an economic whole less easily than if there had been greater diversity. What the future holds for Jugo-Slavia it is as yet impossible to say; but the country is one of great potentialities, and a long period of political rest might render possible the development of an important State.

This brings me to my conclusion. I have endeavoured to consider the great changes which have been made in Europe, not in regard to the extent to which they do or do not comply with the canons of

boundary-making—for, after all, there are no frontiers in Europe which can in these days of modern warfare be considered as providing a sure defence—but in regard rather to the stability of the States concerned. A great experiment has been made in the new settlement of Europe, and an experiment which contains at least the germs of success. But in many ways it falls far short of perfection, and even if it were perfect it could not be permanent. The methods which ought to be adopted to render it more equable and to adapt it to changing needs it is not for us to discuss here. But as geographers engaged in the study of the ever-changing relations of man to his environment we can play an important part in the formation of that enlightened public opinion upon which alone a society of nations can be established.

Economics and Statistics at the British Association.

THE meetings of Section F (Economics and Statistics) at the recent meeting of the British Association at Cardiff were characterised by the greater part taken in the programme by the younger students of economics, and the result augurs well for the future of the science. What some of the readers of papers may have lacked in experience and authority they gained in freshness of outlook, in readiness to face the new facts of the post-war situation, and in refusal to be bound by the views of the older generation. It would have been interesting had some of the older representatives of the science been present to see the clash of the old ideas and the new; in their absence some of the less orthodox views went almost unchallenged.

In the first meeting of the Section the application of the co-operative method to economic life was urged in two connections. Mr. L. Smith Gordon (arguing from his experience of Irish conditions, in which he has been associated with Sir Horace Plunkett) dwelt on the necessity of treating agriculture as an industry to be organised on a scientific basis if its psychological and economic demands were to be reconciled with modern conditions. Such a scientific basis could only be found in co-operation. In his view, the undoubted advantages of large-scale farming lay not in the actual work of production, but in the handling and sale of the goods produced; and this thesis he maintained in an examination of the economies open to agriculture. But such advantages do not necessitate the existence of large farmers; the same results can be obtained through the adoption by small men of the co-operative methods already applied in Denmark, Belgium, and Germany, and this has the further advantage of building up a numerous race of independent, prosperous small farmers.

Mr. J. Lassen, a Dane, with twenty years' experience of England, argued for the introduction into this country of the Danish system of credit corporations, and supported his case by a detailed examination of the Danish method. The unique point of the system is that, whereas most financing is usually carried out through corporations of lenders (banks, trust companies, etc.), the Danish system begins with a corporation of borrowers. The borrowers, mainly belonging to one locality, and being known to each other, give joint security for loans, and the general public are asked to lend on this first-class mortgage security. That the system has worked well in Denmark was obvious from its history, but the writer was unable entirely to satisfy the sceptics on two points: first, how, if the system were introduced here, the hard-headed Englishman could be induced to accept unlimited liability; and, secondly, how the public could be induced to subscribe to bonds which are liable to depreciation and do not yield an abnormally high rate of interest. There seemed to be some subtle difference in the psychology of the Dane and the Englishman which remained unexplained.

From co-operation the Section passed to the consideration of coal. Mr. J. O. Cheetham analysed the present coal situation with special reference to its effects on the shipping interests of Cardiff. His main subject was the falling output, an examination of its causes and results, and suggestions for increasing production. In 1913 the coal produced in the United Kingdom amounted to 287,000,000 tons, in 1919 to 229,000,000 tons—a fall of 58,000,000 tons. In the same period the numbers employed in the industry increased from 1,128,000 by 63,000 to 1,191,000; and the output per person employed in the industry fell from 262 tons to 193 tons per annum. Thus an increase of 6 per cent. in the numbers employed synchronised with a decrease of 20 per cent. in total output. The writer also estimated (though from an *ex parte* statement by employers) that labour costs had increased from 63 per cent. of selling price in 1914 to 75 per cent. of selling price in 1919. Thus the period of Government control of the coal industry was also the period of the decline in total production and in production per head, and of increase in relative labour costs of production. The special causes to which the decline in output was attributed were the introduction of the seven-hours' day and the failure of transport to convey the coal from the pit-head owing to the lack of trucks. In addition, the employers accused the miners of restricted production, and the employees in turn accused the owners of a deliberate holding-up of the development of mines. Mr. Cheetham seemed to hold both charges well grounded, but to think that what was a sin against the community on the part of the miners was natural and justifiable on the part of the owners—a distinction in which it was difficult to follow him. The president of the Section, Dr. Clapham, directed attention to the necessity of discovering to what extent the decreased output was attributable to the employment of a large amount of labour, not in getting coal, but in improving the state of the mines which had been inevitably neglected during the war period.

Mr. R. F. Adgie, in a paper entitled "The Conduct of the Mining Industry," distinguished between the economic and the psychological aspects of the problem of nationalisation. His thesis was that while from the purely economic point of view the argument for nationalisation was inconclusive, from the psychological viewpoint the balance of evidence pointed to the necessity of social ownership and control. On the economic side he pointed out that there had been an undefined amount of waste connected with the conduct of the industry under private ownership in the past. There was a good deal in distribution, since coal sold at the pit-head for 23*s.* 5*d.* was sold to the London consumer at 44*s.*, the distribution charges thus amounting to 47 per cent. This leakage, however, could be stopped by large-scale or unified distribution. In some other directions the economic defects of the industry in recent years (reduced output, inefficient working, etc.) were exigencies of the war period, and were rapidly disappearing; and in others uncoordinated effort and inadequate capital resources had

been at fault. But on the economic ground alone the analysis of the existing system had not revealed any advantages arising from social ownership and control which could not be achieved under capitalism. From the psychological point of view the case was different. While granting that the best organising ability might not be forthcoming in a socialised mining industry, he contended that in coal-mining the absence of the best trained direction was of less importance than in other industries. On the other hand, the technical staffs were willing to work under a socialised industry, and the miners would co-operate in no other. Without the technical staffs and the manual workers the industry could not function at all, and therefore, on the balance, the introduction of socialised ownership and control was, from the psychological aspect, inevitable.

The third sitting of the Section was devoted to financial problems. The address of Mr. A. H. Gibson covered a wide field, and was mainly historical in its treatment of its subject, "Credit: Inflation and Prices." After a survey of the development of credit institutions, Mr. Gibson pointed out that banks having by common consent collectively become custodians of the available purchasing power, this imposed on them the duty of not expanding credit at a rate proportionately greater than the increasing supplies of commodities, otherwise inflation would necessarily follow. In theory there was no limit to the expansion of bank credit, subject to the banks being able to obtain sufficient legal tender to meet current demands. He explained that "ways and means advances" by the Bank of England had had the effect of increasing the cash reserves of the banks during the war, and therefore banks were compelled to stop expansion of credit. He expressed the opinion that the banks would meet all the demands made on them for legitimate trade requirements. Traders would find that after a time the restriction of credit would enable them (by causing a fall in prices) to conduct their businesses on a lesser amount of floating capital than at present. He reviewed the necessary steps to be taken for deflation, the chief of which, he maintained, was the increase of production without a further increase in wages or profits. Other remedies were the reduction in the purchasing power of the community, the funding of the present floating debt by direct subscriptions from the public and not from the banks, and further retrenchment in public expenditure. The purchasing power of the community was now 1,800,000,000*l.* greater than before the war, and 85 per cent. of this represented bank credit expansion.

One of the worst evils of inflation was that it considerably reduced the export trade of the country because of higher costs of production. Under these conditions high prices would remain, for this country would have little to offer in exchange for imports of foodstuffs and raw materials from foreign countries. Thus the inflation, which appeared of little consequence to the Government during the war, had all the seeds of disruptive forces within it in the case of a country situated like the United Kingdom, dependent for its existence on foreign trade. It had been a suicidal policy, and the harvest was yet to be reaped. High prices, discontent, labour troubles, and the probable loss in the future of a considerable part of our former volume of export trade were some of the fruits of this monetary inflation policy. The Government and the banks would make every effort to make the deflation as gradual as possible, but the process was bound to be accompanied by severe labour troubles and social discontent. He held, however, that however bitter the pill might be, it would be to the ultimate benefit of Labour to accept the inevitable reduction of wages and exert the maximum combined effort with Capital to increase production. A considerable increase in production might even allow the present level of wages to remain. Labour consumed probably 90 per cent. of the fruits of production, and had everything to gain by intensified output and everything to lose by wilfully diminished production.

At the last sitting of the Section the chief contribution was a paper by Mrs. Wooton on "The Future of Earning." Mrs. Wooton's thesis was that there is nothing inherently sacred in the notion of earning; that in recent times the payment of subsidies which had no relation to the value of work done had taken an increasing part in the remuneration of the worker; and that the time had come to recognise the new ground of remuneration and to pay subsidies avowedly as such and not disguised as wages. As evidence of the tendency she pointed to the increased acceptance of the idea of a minimum wage and the growing favour of time- as distinguished from piece-wages. When the minimum wage paid exceeded the value of the work done for which it was paid, then it was no longer earned, but it was really a subsidy to the worker, and it was incompatible with the continuance of payment of a wage.

In the course of the last two or three years research has been carried on by sub-committees of the Section into problems of credit and currency and into the place taken by women in industry during the war. Already several printed reports have been issued by these committees. The Committee on Women in Industry will probably issue a final report, and the Committee on Credit and Currency has been continued for another year and will issue its report in the summer of 1921.

The International Congress of Physiologists.

AMONGST the results of the outbreak of war in 1914 was the making of it impossible for physiologists to assemble together as was their wont every three years. But now that Europe is recovering from the conflict, physiologists from different countries have been able to assemble, and they did so in Paris on July 15–20.

The congress was under the presidency of Prof. Richet, of the chair of physiology at the Sorbonne, who was assisted by the vice-president, Prof. Gley, of the chair of general biology at the Collège de France. It was informally opened on the evening of Wednesday, July 14, by a *réunion amicale* in the laboratories of physiology at the Sorbonne. This conversazione gave opportunities for old friends to forgather and to make arrangements for the congress-week.

At ten o'clock on the following morning the congress was formally opened by a convocation in the great lecture-hall of chemistry at the Sorbonne. The amphitheatre had been transformed by means of crimson curtains and gilded chairs into a *salle d'honneur* for the occasion. Prof. Richet occupied the chair, and was supported by the Minister of Public Instruction, Prof. Gley, Prof. Fano, Prof. Fredericq of Liége, Profs. Sir E. Sharpey Schafer, Langley, Sherrington, Waller, and others.

The presidential address was simple, dignified, and impressive. The president began by recalling the names of those physiologists who had passed away

from their labours since the last congress at Groningen in 1913. No sooner had he finished this part of his discourse than the whole assembly rose to their feet and remained standing in silence for some short time. It was quite spontaneous, so French, so exactly the thing to do at the moment, yet without a trace of anything theatrical or insincere.

The latter part of the address was an interesting survey of such advances in physiology since 1913 as have necessitated changes in our views regarding certain problems. In particular, reference was made to the value of the researches of the American physiologists under Benedict into metabolic exchanges at rest—the so-called "basal metabolism." Prof. Fano, the new occupant of Luciani's chair at Rome, was the next speaker, the subject of his discourse being the two cerebral attributes of volition and inhibition. He made use of data obtained through injuries to the human brain in the late war.

The afternoon was devoted to the reading of papers and to witnessing demonstrations, for which purposes the congress was divided up into five sections, which had to meet simultaneously.

At half-past eight the members were invited to witness a display of scientific kinematography at the Institute of Oceanography in the Rue St. Jacques. At this *séance* the Prince of Monaco and his suite were present. The demonstrations were exceedingly interesting, those of the amœboid movements of the leucocytes in frog's and in human blood being particularly instructive. The rate of reproduction of the films had been accelerated to sixty or eighty times the normal, so that, instead of seeing leucocytes advance on bacilli in the leisurely fashion of their own positive chemiotaxis, they appeared to bolt in and out amongst the *rouleaux* of red discs like so many rabbits amongst the bracken of a warren. Another set of illustrations was equally remarkable: men and animals had been photographed walking, running, and leaping, not only at the rate necessary for the normal reproduction of these movements, but also so rapidly that the transit of the pictures could be brought down to a very slow rate without, however, producing any flicker.

The illusion in the artificially retarded series was very curious; one saw, for instance, a man with a pole in his hand approach a high gate, slowly place the pole on the ground, rise leisurely into the air, float slowly over the gate, and then, having left the pole upright behind him, sink slowly down on the other side. The pole meanwhile fell on one side with a dignity and grace that would not have shamed a Vere de Vere. As a physiological study of the various groups of muscles co-ordinated in actions of this kind, the demonstrations were very valuable. Other series were: the cure of avian beri-beri; the heart and lungs in action in the opened thorax of the cat; hydromedusæ in their tanks; a cat let fall back downwards rotating itself so as to alight on the ground on all fours; and the flying of birds and butterflies in artificially retarded action.

The secretion of pancreatic juice after the injection of secretin into a dog was clearly demonstrated, as also the artificial digestion of a cube of albumen by activated pancreatic juice in presence of the necessary controls. This last demonstration was very remarkable, for in a few moments we were shown the chemical disintegration of the protein into soluble substances, which in reality occupies more than nine hours.

Saturday, July 17, until six o'clock, was given up to the scientific work of the congress. At nine in the evening Prof. and Mme. Richet received the members in their large and handsome house in the Rue de l'Université. It was fortunately a fine, warm evening, so that we were able to stroll about the illuminated garden, where the conversations were not exclusively on scientific subjects.

On the Sunday no scientific work was undertaken, but an excursion was made to the park and château at Chantilly, a place best known to many Englishmen as the site of a racecourse. This proved a very enjoyable visit; the interior of the château is decorated in the stately and gorgeous style of the Renaissance, and the house contains some fine paintings, besides miniatures, valuable gems, and other treasures.

Monday, July 19, saw the congress busily at work again until five o'clock, when there was a large reception at the Hôtel de Ville. This was given by the Mayor of Paris and the City Council; it was a full-dress affair, as might be inferred from the costumes of the ladies and from the uniforms and cocked hats of the attendants by whom we were ushered up marble staircases to painted halls. There were speeches of welcome and speeches of thanks in response, as well as generous entertainment.

At nine o'clock the same evening a *soirée* was given by the Club de la Renaissance française in the Rue de Poitiers. This consisted of a concert of chamber music, in which piano, 'cello, and harp all took part. Not for long had some members of the congress, they said, enjoyed an evening so much, for they were enabled for an hour or two to escape from the auditory discords of the streets and to live in an atmosphere of pleasing sounds.

On Tuesday, July 20, the congress was at its work again until half-past two, when the *séance de clôture* took place. At nine o'clock the same evening the Rector of the University of Paris gave a formal reception to the congress in the magnificent salons of the Sorbonne. This was a full-dress conversazione, the entertainment provided, besides some singing, being a recitation by a young actor of one of Alfred de Musset's poems.

During the week several dinner-parties and lunches were given, both the president and Prof. Gley acting frequently as hosts. The number of ladies who as physiologists participated in the congress was larger than at any previous meeting, Great Britain being particularly well represented in this respect.

Not many American or Canadian physiologists attended the congress. American physiology was, however, represented by Prof. Neil Stewart, of Cleveland University, Ohio; Prof. Frederick S. Lee, of Columbia University, New York; Prof. Graham Lusk, of Cornell University, New York; and Dr. L. G. Henderson, of Harvard University.

From Canada there were only Prof. J. J. R. Macleod, of Toronto University, and Prof. Fraser Harris, of Dalhousie University, Halifax, N.S.

The subjects discussed at the congress are too numerous to be dealt with in the detail they deserve. The physiology of adrenalin was the subject of prolonged debate. In particular, doubt was cast upon the trustworthiness of some of the methods for the detection of that hormone in the blood and upon the alleged rapidity with which adrenalin is increased in a very large number of different conditions, some accompanied and some not by emotional factors.

The topics of diabetes, the psycho-galvanic phenomenon of Waller, human calorimetry, the transport of carbon dioxide in the blood, and the condition of the respiratory centre in shock were all discussed at as great length as the overloaded state of the programme permitted.

The congress was too short to deal adequately with all the difficult problems presented for solution. Some of us were just beginning to know one another and

to discuss subjects of mutual interest when it was time to part. It was all too short for any lover of Paris, for no lover of brightness and beauty leaves Paris without regret. Some departed for the shell-scarred battlefields of the greatest war in history; others, ere they returned to the routine of their lives, gave one more glance at the gardens of the Tuileries lying in the golden sunshine of the perfect July afternoon as it brought out all the vivid colours of the flowers grouped with such unerring taste.

Memories of the past had been crowding in all that week; did not the word "Sorbonne" at one time import everything that strove against scientific enlightenment, and connote everything that stood for the obscurantism of the Middle Ages?

The historically minded could not but recall that it was in the gardens of the Tuileries one day in 1819 that Laennec devised the first stethoscope. He had been watching some children place their ears on logs of wood to hear sounds conveyed through them, and, seizing on the principle underlying the children's play, he soon invented the stethoscope, one of the earliest instruments of modern medicine.

As we strolled across the gardens we gave a parting glance at the sun-bathed roofs of the Louvre, the most magnificent palace in Europe, a building the history of which is an epitome of the wonderful story of France herself—of her glories, her triumphs, her crimes, and her sorrows. D. FRASER HARRIS.

University and Educational Intelligence.

THE Patent Office Library is open to the public daily except on Sundays, Good Friday, Christmas Day, Whitsun Eve, and Bank Holidays. On and after October 1 the hours of opening will be from 10 a.m. to 9 p.m., except on Christmas Eve and Easter Eve, when the library is closed at 4 p.m.

DR. R. M. CAVEN has been appointed to the chair of inorganic and analytical chemistry in the Royal Technical College, Glasgow. This vacancy was caused by the transfer of Dr. F. J. Wilson to the chair of organic chemistry in succession to Dr. I. M. Heilbron, who was recently appointed professor of organic chemistry in the University of Liverpool. Dr. Caven was for many years lecturer in chemistry at University College, Nottingham, a position he resigned to become Principal of the Darlington Technical College.

THE new session of the Battersea Polytechnic opens on Tuesday, September 21. A general introductory course has been arranged for students desiring either to qualify for the scholarship or entrance examinations of any of the diploma courses, or to take the Matriculation Examination of London University before taking up a science or engineering degree course. Day and evening courses are provided for those desirous of taking the Intermediate and Final Examinations of London University in science (pure and applied) and in music. Day courses are also available in engineering and other technical subjects, including teachers' courses in sanitary and domestic science. Evening courses are wider in scope; engineering, physics, photography, languages, music and domestic science are among the subjects with which the lectures will deal. Full particulars of all the courses will be found in the Polytechnic Calendar, which can be obtained from the secretary.

A COMBINED effort is at present being made by students and friends of the City and Guilds Engineering College, the Royal School of Mines, and the Royal College of Science in support of the Imperial College War Memorial scheme. The first object in view is the erection in the college buildings of simple memorial tablets bearing the names of the old students—some three hundred in all—who fell in the war. Closely connected with this purpose, and arising out of the desire of ex-Service men and relatives of the fallen to do something of permanent practical value for the students of the college, is the scheme for the acquisition of a sports field. This particular provision for physical development has hitherto been lacking at the Imperial College, and the enterprise now on foot aims at supplying what is generally admitted to be an essential part of the equipment of an educational institution. In response to an appeal issued in May last for 12,000*l.* to enable the scheme to be carried out in its entirety, a sum of more than 6000*l.* has already been subscribed or promised. This has been considered sufficiently encouraging to warrant the acquisition of a suitable ground over which an option had been secured, and the committee is now appealing to all old students and other friends of the Imperial College who have not so far subscribed to take their share in providing the balance of the purchase price and the cost of equipment.

Societies and Academies.

PARIS.

Academy of Sciences, August 17.—M. Henri Deslandres in the chair.—G. **Humbert**: The expression of a non-Euclidean area of the fundamental domain related to an indefinite Hermite form.—T. **Carleman**: Singular integral equations with a real and symmetrical nucleus.—M. **Galbrun**: The deformation of a helical spring the extremities of which are constrained.—L. **Barbillion** and M. **Dugit**: A new class of measuring apparatus for the direct evaluation of magnitudes which are functions of two variables. Forms of apparatus now in use, based on the determination of the position of intersection of two rectilinear needles with reference to a curve, are liable to errors of parallax which are difficult to reduce. The type now described is based on the use of a rectilinear needle and a curved needle rotating on a common axis. Two examples of application of the method are suggested: speed indicators for aeroplanes and control of carburettor in internal-combustion motors.—C. **Nordmann**: The absorbing powers of the atmospheres of stars. A method of comparing them and of determining the minimum numerical values.—H. **Gault** and R. **Weick**: A case of isomerism in the series of the aromatic α-keto-acids. In addition to the two isomers of phenylpyruvic acid described by the authors in a recent paper, a third isomer has now been isolated, and the conditions under which these isomers can be transformed into the other forms have been worked out. A study of the reactions of these three compounds leads to the conclusion that two are stereo-isomers possessing the enolic form, and the third is the ketone.—R. **Fosse**: The synthesis of a second diamide, oxamide, by the oxidation of sugar and ammonia. Oxamide has been isolated as one of the products of oxidation of cane-sugar in presence of ammonia by calcium permanganate.—MM. **Tiffeneau** and **Orékhoff**: The hydrobenzoin transformation. The influence of the nature of the reagent. With the exception of the case of triphenylglycol, which reacts in the same manner with different dehydrating agents, according as strong or dilute sulphuric acid is employed, the dehydration of the alkylhydrobenzoins may take place in various ways.—H. A. **Brouwer**: The nature of the diamond-bearing conglomerate of Diamantina, Brazil.—P. W. **Stuart-Menteath**: The tectonic of the Western Pyrenees.—J. **Kunstler**: A treatment preventive of

oidium. A handful of sulphur is distributed round the roots of the vine at a depth of 10 to 20 cm.—P. **Wintrebert**: The time of appearance and mode of extension of the sensibility at the surface of the tegument in fishes and amphibians.—C. **Levaditi**: An attempt at the culture of the organism of syphilis in symbiosis with the cellular elements. The culture *in vitro*, in contrast with the virus of poliomyelitis and rabies, not only did not grow, but rapidly lost its vitality and virulence.—F. **Grenet**: The appearance of alcoholic yeast in vineyards. It was noted by Pasteur in 1878 that although mould-spores could be found on the stems of the vines and in the soil at all periods of the year, alcoholic yeast appeared only at the time the grape ripened. The cause of this has now been traced to the fly, *Drosophila melanogaster*, which carries the yeast-spores, and appears in the vineyards only when the grapes are ripe. The origin of the fly has not been traced, nor is it known whence it obtains the yeast-spores.—E. **Joltrain**: The value of Bordst's fixation reaction in the diagnosis of plague. This reaction has rendered great service in cases of doubt in convalescents, and when search for the bacillus has given negative results.—C. **Gessard**: Sub-races of the pyocyanoid bacilli.—L. **Scheffler**, A. **Sartory**, and P. **Pellissier**: The use of silicate of soda in intravenous injections: physiological and therapeutical effects. Sodium silicate solutions may be utilised for intravenous injection in doses worked out empirically. The treatment is beneficial in cases of arterio-sclerosis, in cardio-renal troubles, and in chronic rheumatism. The treatment of tuberculosis by this method is under consideration.

ROME.

Reale Accademia dei Lincei, May 2.—A. Róiti, vice-president, in the chair.—S. **Pincherle**: Complete iteration of x^2-2. The problem has not been resolved for a non-linear function except in very limited cases, of which this is an example.—O. **Tedone**: Some other formulæ of inversion connected with Riemann's method of integration. These formulæ have applications to certain mechanical problems, such as finite wave-motion in an elastic fluid.—F. **Millosevich**: Blödite and other minerals of the saline deposits of Monte Sambuco, in the territory of Calascibetta, Sicily. The salt deposits on the southern face of the mountain, which is in the province of Caltanisetta, are worked by three tunnels, of which the upper cuts through a deposit of hard salt containing local aggregates of the present mineral, which is synonymous with astrakanite, and occurs in two forms, one of which is coloured by iron oxide. The crystallographic data are given, and the analysis indicates the composition $Na_2SO_4.MgSO_4.4H_2O$.—E. **Bompiani**: Point transformations between varieties which satisfy Levi-Civita's parallelism.—R. **Raineri**: Tripoli Corallinaceæ, iii. The species dealt with are *Corallina officinalis*, L., *C. mediterranea*, Areschoug, and *Peyssonelia rubra*, Grev.—Anna **Foà**: Excretory system of the silkworm. The peri- and endo-cardiac and peritracheal glands form a system for the excretion of certain substances probably having an acid reaction. A figure is given of a silkworm injected with carmine and Chinese ink.—A. **Pais**: Convalescence of chronic malaria by X-rays.—Commenting on the foregoing paper, Prof. B. **Grassi** concludes that in the sequelæ of malaria these rays, when opportunely used, have an almost marvellous curative effect, when other remedies, such as quinine, arsenic, iron, diet, and change of air, are much more tardy and uncertain in their action. On the other hand, these remedies can be usefully employed, especially in rebellious cases, in conjunction with ray treatment, but the latter has been shown to be suitable for adoption in every malarial district.—G. **Amantea**. Spermatic secretion, x. The elimination of the sperm in the cavy and rat.—Profs. **Róiti** and **Castelnuovo** referred to the deaths of Theodore Reye, Zeuthen, and Hurwitz; and Prof. Levi-Civita presented reports by C. **Guidi** on the strength of dykes, and by M. **Panetti** on the aerodynamic laboratory adjoining the Polytechnic of Turin.

May 16.—F. D'Ovidio, president, in the chair.—A. **Angeli**: Reactions of some ortho- and para-substitute derivatives of benzol.—Anna **Foà**: Excretory system of the silkworm, ii. The rectal portions of the Malpighian tubes (with three illustrations).—G. **Cotronei**: Identity of metamorphoses of Amphibia anura and urodela.

Books Received.

A Geographical Bibliography of British Ornithology from the Earliest Times to the End of 1918. Part 6. Pp. viii+481–558. (London: Witherby and Co.) 6s. net.

Lead: Including Lead Pigments and the Desilverisation of Lead. By Dr. J. A. Smythe. Pp. vii+120. (London: Sir I. Pitman and Sons, Ltd.) 3s. net.

Athena: A Year-Book of the Learned World. (The English Speaking Races.) Edited by C. A. Ealand. Pp. viii+392. (London: A. and C. Black.) 15s. net.

Handbook of Patent Law of all Countries. By W. P. Thompson. Eighteenth edition, completely revised. Pp. vii+157. (London: Stevens and Sons, Ltd.) 6s.

Ancient Egypt. Part iii., 1920. (London: Macmillan and Co., Ltd.) 2s. net.

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