

spectrum. There are evidently two quite different mechanisms of interaction possible between the atoms of the two gases—a problem I commend to the chemist for investigation.

But it is not necessary to mix one gas with another in order to produce the energy transfer. It can be achieved otherwise, as some further slides I have here will suffice to show. We have made many measurements of intensity, more especially in the spectrum of pure helium, of the lines from a pure gas as dependent on the part of the tube they arise from, and on the conditions of excitation. We shall only consider one or two of the more interesting results which arise from a comparison of three spectra of helium: (1) the "ordinary" spectrum, or the spectrum given by the capillary of a vacuum tube containing helium at about a millimetre pressure, excited by the discharge from an induction coil without capacity or spark-gap; (2) the bulb spectrum, obtained by putting a small condenser and a very small spark-gap in parallel in the circuit; (3) the capillary spectrum with a spark-gap and a strong condensed discharge. In both (2) and (3) the transfer of energy to the more refrangible members of a series takes place very strongly. In the diffuse series the transferred energy goes in (3) mainly towards increased breadth of the line, but in (2) mainly towards enhanced central intensity—two quite distinct effects. The sharp and principal series show the same transfer quite definitely, though on a smaller scale, and the effect is in these cases more closely confined to enhancement of the central intensity.

The most striking enhancements produced by the condensed discharge in helium occur with the lines $\lambda 4472$ and $\lambda 4388$, which are precisely the helium lines apt to be found abnormally strongly in the spectra of some of the planetary nebulae. Some other experiments we have made, on the spectrum of helium at very low pressure, indicate that these lines, together with the line $\lambda 5015$ more frequently quoted, are the strongly enhanced lines also in these circumstances. If the two sets of circumstances occur together, $\lambda 5015$ is not especially strong, but the others are enhanced for both reasons. We have, in fact, been able to demonstrate that the peculiar "nebular" spectrum of helium could be produced in the laboratory by a combination of the condensed discharge with an extremely low pressure.

I shall not discuss the spectra of gases as dependent, in their intensity relations, on pressure. The time required would be prohibitive, and my object is to indicate the range of work now open to precise investigation, rather than to give any complete account of the phenomena which the method has yet indicated or elucidated. One remark must, however, be made in connection with high-pressure spectra. We investigated the intensity distribution in a helium tube at the extraordinary pressure of 42 mm. Except for the trace of hydrogen which came out of the electrodes during the discharge, the helium was pure. Yet the hydrogen spectrum was nevertheless predominant on the plate, and fourteen members of the Balmer series, instead of the usual six or seven at most, could be seen visually as very sharp lines. This phenomenon incidentally cannot be reconciled with the current quantum theory of the hydrogen spectrum—perhaps not an unexpected fact to those conversant with the hydrogen spectrum. No atomic theory as yet has begun to interpret any of this spectrum except the Balmer series, and many have done this. No spectroscopist can, in fact, accept a theory which can give no hint of the origin of the so-called "secondary spectrum" of hydrogen, known to arise mainly from the atom, and, in the laboratory at least, the most important and extensive part of the spectrum. The elucidation of this spectrum is in many ways the most fundamental problem of

physics, and far more fundamental than the Balmer series problem.

Many of the problems of interest, which the possession of an accurate method of intensity determination in spectra enables us to attack, are mainly of astrophysical importance. There may be variations of intensity in the Fraunhofer lines accompanying other more readily perceived solar phenomena, for example, but of more urgent importance is the need for a series of photographic registers of the intensity across the whole spectrum of a new star at different stages of its history. It has not often been possible even to determine the actual number of component radiations, in an apparent broad band with a structure, emitted from such a star—at least with any real certainty. A method which automatically sifts out such bands and gives peaks on a photograph at all the maxima of intensity in the band may well be expected to contribute greatly to the elucidation of the phenomena taking place, which must in any case be totally different from anything known by our terrestrial experience.

The only other class of phenomenon depending for its elucidation on precise measures of intensity in spectrum lines, to which I shall refer with further illustrative slides, is the variation which takes place in the spectrum from a helium tube as we recede from the cathode. The slides serve to show the considerable differences which take place in the distribution of the various series, which are all emitted most strongly at unequal distances from the cathode. One very extraordinary result, shown clearly on the last slide, is the fact that there exists a narrow region of the tube in which the characteristic spark line $\lambda 4686$ is emitted simultaneously with the helium band spectrum—a circumstance which necessitates some readjustment of preconceived ideas.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. S. Lees, who was recently appointed University lecturer in thermodynamics, has been re-elected a fellow of St. John's College.

LONDON.—The following appointments have been made in connection with the newly instituted school of librarianship at University College, of which, as already stated, Dr. E. A. Baker is the director:—Bibliography, Mr. A. Esdaile; Cataloguing and Library Routine, Mr. W. R. B. Prideaux; Classification, Mr. W. C. B. Sayers; Public Library Law, Mr. H. W. Fovargue; Library Organisation, Mr. B. M. Headicar; Literary History, Dr. A. W. Chambers; Literary History and Book Selection, Dr. E. A. Baker; Palaeography and Archives, Mr. H. Jenkinson; assistant to the director, Mr. L. F. Newcombe. The work of the school is to begin on October 1, but the formal opening will take place on October 8, at 5 o'clock, at the hands of Sir F. G. Kenyon, the director and principal librarian of the British Museum.

DR. S. W. PATTERSON has been appointed director of the Eliza Hall Institute of Research, in connection with the Melbourne Hospital.

MR. W. H. N. JAMES has been appointed head of the electrical engineering department of the Bradford Municipal Technical College.

MR. J. A. R. MARRIOTT has intimated to the vice-chancellor of the University of Oxford his intention to resign the secretaryship to the University Extension Delegacy in March next.

MR. M. H. HADDOCK, of the Doncaster Technical College, has been appointed county mining organiser for Leicestershire, and to have charge of the new mining institute and technical school at Coalville.

It is proposed to erect a geological building in connection with the University of Wisconsin as a memorial to Dr. C. R. Van Hise, late president of the University, thus bringing together under one roof the departments of geology and mining engineering, and the State and Federal geological surveys.

IN connection with the New York Botanical Garden, which has well-equipped laboratories and an extensive horticultural library, a two-year course in practical gardening has been inaugurated for the purpose of providing careers for convalescent soldiers and sailors and to meet the increasing demand for trained gardeners.

THE following appointments to professorships in the University College of Wales, Aberystwyth, have been made:—*Physics*: Prof. G. Owen (University of New Zealand). *Mathematics*: Prof. W. H. Young (University of Liverpool). *Agriculture*: A. E. Jones (head of the Department of Agriculture, University of Wales) *Geology*: Capt. W. T. Pugh.

THE total number of higher education grants for ex-Service officers and men awarded by the Board of Education now amounts to 5400. The courses in respect of which grants have been awarded include more than 1000 for engineering and technological subjects, between 600 and 700 for classics, philosophy, and literature, and about an equal number for pure science and mathematics.

AN association has been formed in New York, called "The New York Association for the Advancement of Medical Education and Medical Science," the main objects of which are: To improve and amplify the methods of undergraduate teaching; to perfect plans for utilising the clinical material of the city for teaching purposes and to make use of teaching talent now unemployed; to bring about a working affiliation of the medical schools, hospitals, and laboratories, and the public health facilities of the city; and to initiate the establishment of a medical foundation in the city whereby funds may be secured to meet the financial requirements of all forms of medical education and investigation.

THE prospectus of the evening courses in technology at Leeds University for the session 1919-20 is now available. The arrangements announced are subject to revision in consequence of the special circumstances of the present time. Technological courses will be held, it is hoped, in the following departments of the University:—Civil, mechanical, and electrical engineering; coal-mining; textile and leather industries; colour chemistry and dyeing; and geology applied to sanitary and civil engineering. The evening courses in the department of textile industries, to refer in more detail to one department, are primarily designed to meet the requirements of persons who, having already passed through approved courses of study, wish to take up some particular line of research work, or to conduct trade investigations necessitating the use of special equipment.

THE Board of Agriculture and Fisheries announces that, as part of the Government schemes of higher education and training of ex-Service officers, provision is made by the Board for financial assistance for agricultural training by means of (a) grants for residential training with selected farmers in England and Wales, and (b) agricultural scholarships at approved universities or agricultural colleges in England or Wales. More than 1300 officers have now been approved for grants

under (a), of whom more than 1000 are actually in training on farms, whilst 65 out of the 100 scholarships available under (b) have been awarded. In view of the numerous applications which are still being received, the Board has decided that no application either for a grant for training on a farm or for a scholarship can be entertained by them (1) from any officer who has been demobilised by July 31, 1919, unless the application has been lodged at the appropriate district directorate of the Ministry of Labour on or before August 31, 1919; and (2) from any officer who has not been demobilised by July 31, 1919, unless it is received by December 31, 1919, except in any case in which it can be shown that for military reasons the application could not have been made by that date. All applications from non-demobilised officers should be made as soon as possible. Particulars of these farm-training grants and agricultural scholarships and of the manner of making application are given in the Board's booklet, "Land Settlement in the Mother Country" (L.S.9), which can be obtained either from the Board's offices at 72 Victoria Street, London, S.W.1, or from any district directorate of the Appointments Department, Ministry of Labour. The address of the appropriate district directorate can be ascertained at any post office. Non-demobilised officers should make their applications on Army form Z15 or Navy form S1299. Warrant officers, non-commissioned officers, and men in the ranks of suitable educational promise are also eligible for these grants.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 28.—M. Léon Guignard in the chair.—A. Laveran and G. Franchini: Some flagellæ of insects obtained in a pure culture, and in particular *Crithidia melophagi*. Details of the technique for obtaining pure cultures are given, and proof of the pathogenic action on mice.—A. Rateau: The theory of aeroplanes: application to an example.—R. de Forcrand and F. Taboury: The stability of the sulphones formed by the iodides of sodium, rubidium, and caesium. These compounds have the composition $MI+3SO_2$; their dissociation pressures have been measured at $-22.5^\circ C.$, $0^\circ C.$, $+9.65^\circ C.$, and at $15^\circ C.$, and the results are given in the form of curves.—N. E. Nörlund: The polynomials of Euler.—Ch. Platrier: The elastic equilibrium of a homogeneous isotropic body of revolution submitted to radial forces either proportional or inversely proportional to the radius.—H. Abraham and E. Bloch: Recording galvanometers with movable needle.—E. Brylinski: The induction reaction of alternators.—E. Poirson: A method of secret telephony. The telephonic currents are deformed by periodic interruptions by mechanical means, and the message cannot then be understood. The distorted currents can be rectified at the receiving end by a synchronised apparatus. Experiments have been carried out by this method with success over distances up to 600 km.—J. Lavaux: Electrolytic luminescence phenomena presented by certain metallic anodes.—Jh. Martinet: The indirubins.—Ch. Chavanne and L. J. Simon: The critical solution temperatures in aniline of mixtures of hydrocarbons. Application to the analyses of petrols.—H. Colin and O. Liévin: The spontaneous oxidation of complex organic compounds of cobalt. Alkaline solutions of glycerol or lactic acid containing cobalt absorb oxygen up to a maximum of one atom of oxygen for one atom of cobalt. Other substances, such as mannitol, erythritol, and glucose, under similar conditions absorb oxygen continuously beyond this limit.—P. Russo: The Eocene containing phos-