

which never flowered. Also, the tall and dwarfs could not always be distinguished by their heights. It was found that in each generation dense-eared plants (a safer character to deal with than dwarfness) gave (1) lax-eared, (2) dense-eared, (3) short plants with one stem and no ear, and (4) bushy pigmy plants with no ear. The last, when grown under special conditions, produced ears which were found to be denser than the normal dense-eared form. Dense-eared plants showed wide fluctuation in height, which made classification on a height basis impracticable. Usually, height and ear-density are inherited independently and are hence presumably determined by different chromosomes. It is therefore suggested that in this ever-splitting race there may have been a fusion of these two chromosome pairs, this being a part at least of the mutational change to which the dwarf form owed its origin. A number of ever-splitting races of cereals are discussed. It is hoped that a cytological investigation of this peculiar dwarf will be made, which may help to clear up the genetic peculiarities of such ever-splitting races.

In another paper in *Journ. Genetics*, vol. 16, No. 1, Messrs. Engledow and Hutchinson give some results of crossing between *Triticum turgidum* and *T. durum* or rivet and Kubanka wheat. Since these are both tetraploid species, there is no sterility in the hybrids. The F_1 plants from this cross showed the vigour of heterozygosis. In previous experiments with wheat the endosperm characters of the seed have appeared to show maternal inheritance, in spite of the fact that double fertilisation takes place, which might be expected to lead to the phenomena of xenia, or paternal

influence on the endosperm. In *T. turgidum* \times *T. durum* the grains were larger than in either parent, but while intermediate in certain features, the vitreous texture and extreme hardness of the durum endosperm were dominant. Moreover, the grains on each F_1 were uniform, although the endosperm really belongs to an F_2 generation and might be expected to show recombinations. In the F_2 plants the same condition held, but in addition to the plants with endosperm like *turgidum* or like *durum*, there were other plants in which the grain showed various mixtures of the two kinds of tissue. The striking difference between the phenomena of xenia in maize endosperm and maternal inheritance in wheat endosperm leads to the suggestion that since in wheat seeds the endosperm cells are already dead, the paternal character determined by the male nuclei has not had a chance to express itself. But the same conditions would appear to obtain in the maize seed, where xenia occurs.

In these crosses the inheritance of solidness of straw has also been studied. The "lodging" of cereals is believed to be due to lack of elasticity, rather than lack of strength, in the stems. Solid straw has greater elasticity. In different varieties of wheat various kinds of solidness were found, and these were in general unifactorial differences; but the results were influenced by other factors for size of straw.

From these crosses it should be possible to produce a rivet wheat with high yield, hard, 'baking' endosperm, and solid, non-lodging straw.

R. RUGGLES GATES.

Dielectric Constant and Molecular Structure.¹

THE physical methods for investigating the structure of molecules are principally five in number: (1) the ratio of the gaseous specific heats at constant pressure and constant volume; (2) the arrangement of atoms in crystals found by X-ray diffraction methods; (3) the molecular band spectra as interpreted by the quantum theory; (4) phenomena indicating strong fields of force around certain types of molecules; (5) refractivity and dielectric properties. The connexion between dielectric constant and molecular structure was to some extent realised by Faraday, but the theory has been developed by Lorentz, Debye, J. J. Thomson, Gans and Pauli. Recent tests have confirmed the basis of the theory.

The electrons in a molecule are displaced in an electric field, causing the appearance of an electric moment. Account must also be taken of the facts that not all electrons are similarly situated in the molecule and that an effect is produced on the field of its neighbours by the displacement of an electron. The effect produced on the displacement of any electron by that of other electrons in the same molecule must also be considered. If each molecule is a permanent electric doublet of moment μ , there is a tendency of molecules to orient themselves with their electric axes in the direction of the field. This is hindered by the thermal agitation and a statistical average degree of alignment results, depending on the moment of the doublet, the strength of the field and the temperature. All these factors are included in the equation of Debye:

$$\frac{\epsilon - 1}{\epsilon + 2} = 4\pi N \left(\frac{e^2 \sum_i v_i r_i^2 L_p}{3} + \frac{\mu^2}{9kT} \right) = \left(A + \frac{B}{T} \right) D.$$

¹ Abstract of an address by Prof. K. T. Compton, of Princeton University, retiring vice-president of Section B (Physics) of the American Association for the Advancement of Science, delivered at the Kansas City meeting on December 30, 1925.

In this ϵ is the dielectric constant; N the number of molecules per unit volume; e the electronic charge; v_p the number of electrons of type p in the molecule; r the binding constant; L_p a factor to take account of the effect produced on the displacement of any electron by that of other electrons in the same molecule; k Boltzmann's gas constant; T the absolute temperature; A , B are constants, and D is the density.

In the case of gases the equation has only recently been tested with sufficient accuracy; ϵ is very near unity. One of the experimental methods, used by Herweg and improved by Zahn, consists in amplifying the electrical beats between two differently tuned oscillating circuits, one of which contains the experimental condenser alternately filled and emptied of gas. The electrical beats are made audible by a telephone receiver and produce acoustical beats with the sound from an electrically driven tuning-fork. This method is capable of measuring a change in capacity of one part in two millions. By plotting $(\epsilon - 1)/vT$, where v is $1/D$, a straight line is obtained, from which A , the binding constant r and B , or the permanent electric moment μ of the molecule, may be computed. The values of μ so found vary from 1.03×10^{-18} for hydrogen chloride to 0.06×10^{-18} for carbon dioxide. In the case of liquids, the values vary from 0.20×10^{-18} for benzene to 2.15×10^{-18} for amyl alcohol; the value for water is 1.98×10^{-18} . The application to liquids is not very good, probably on account of the mutual actions between molecules not allowed for in Debye's formula, and Gans has derived a much more complicated formula. C. P. Smyth has shown that it may be combined with the Lorentz dispersion formula to permit at least an approximate calculation of the electric moment in many cases. In some cases the moment varies with temperature, apparently due to association.

If assumptions are made as to the structure of molecular models, the consideration of dielectric constants will enable these to be tested, although of course it will not explicitly give us the structure of the molecule. Prof. Compton gives examples of the Lewis-Langmuir type and shows that the electric moments produced by the shifts of the electrons in the formation of molecules are reasonable values.

The binding constant may also be calculated from refractivity data, and the figures derived by Born and Heisenberg, Fajans and Jooz, Smyth and others indicate that the electrons are most easily shifted in ions with small central positive charges (cores) and also in large atoms, where they are far removed from the centre. The deformability of molecules thus indicated has an important bearing on the theory of spectra, and a difficulty in the Ritz formula may perhaps be resolved if it is assumed that the electron shell is distorted by the field of the valency electron rotating about the core of the atom. Prof. Compton indicated that numerous interesting problems still await investigation in other aspects of dielectric constants.

University and Educational Intelligence.

ABERDEEN.—The Senatus has resolved to confer the honorary degree of LL.D. on Prof. F. W. Oliver, professor of botany in University College, London; Dr. R. W. Reid, emeritus professor of anatomy in the University of Aberdeen; Prof. T. B. Wood, professor of agriculture in the University of Cambridge.

BIRMINGHAM.—The report of the Principal (Mr. C. Grant Robertson) presented to the annual meeting of the Court of Governors on February 25, shows that the number of students, which had been steadily diminishing since the abnormal period of inflation following the War, last year reached its minimum, and there are indications that recovery has already begun. The percentage of unmatriculated and part-time students continues to decrease.

The construction of the new block for the biological departments at Edgbaston is rapidly progressing, and it is expected that the building will be in use next session. The transfer of these departments, however, will raise a serious problem, in that the Harding Library in its present form will be quite inadequate to meet the consequent increase in the demands on its space.

The new building for the Department of Petroleum Mining is already occupied, and is shortly to be formally opened. In addition, a new laboratory has been erected for the Mining Department and equipped with large-scale experimental plant for the study of scientific and technical problems of coal treatment, the funds being provided by the Central Committee of the Miners' Welfare Fund. The Principal directs attention to the fact that the Mining Department now serves as the post-graduate mining school for the Universities of Oxford and Cambridge.

An appeal is made for more generous support of the University by the midland area generally. In particular, "What is needed to-day is the establishment, on an adequate scale, of post-graduate scholarships. Its absence is a cause of national waste; and no better service to the cause of true education and a heightened national efficiency could be rendered than by the creation of such an endowment."

CAMBRIDGE.—Mr. G. F. Shove, University lecturer in economics, has been elected to a fellowship at King's College. Mr. I. A. Richards and Mr. F. McD. C. Turner have been elected to fellowships at Magdalene College.

A slight change has been introduced into the regulations governing medical studies; it is now laid down that no student may attend any course of instruction for the third M.B. examination until he shall have passed the last part of the second examination (pharmacology and general pathology). Some 'young men in a hurry' may find this distasteful, but there is little doubt that the principle on which the change is founded is sound.

The Board of Research Studies is proposing that a summary of each successful thesis for a research degree shall be published in the *Reporter*. Such summaries would then be distributed to the universities from which non-graduate research students are drawn. The present practice is that dissertations are placed in the University Library; some of them never appear in print, and in this way good work is sometimes lost to sight and memory. It is thought that the present proposal would both obviate this possibility and also avoid overlapping in research work. Incidentally, the great increase in numbers of research students at Cambridge in recent years will become apparent.

The governing body of Emmanuel College is offering to a research student, commencing residence in October 1926, a studentship of the annual value of 150*l*. Preference will be given to a candidate who has already completed at least one but not more than two years of research. Applications should reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than June 30. Candidates should submit two certificates of good character, a statement of the proposed course of research, and evidence of general ability and of special fitness for the proposed course of research.

LONDON.—The offer of the Petrie Medal Committee, on behalf of the subscribers, of a Petrie Medal and Fund amounting to 75*l*. has been accepted. The Medal is to be awarded once in every three years for distinguished work in archaeology, preferably to a British subject.

Prof. C. A. Lovatt Evans has been appointed as from Aug. 1 to the Jodrell chair of physiology tenable at University College. Since March 1922 Prof. Lovatt Evans has been University professor of physiology at St. Bartholomew's Hospital Medical College. During this period he has published "Recent Advances in Physiology" (1925) and edited a new edition of Bainbridge and Menzies' "Essentials of Physiology" (1925).

Dr. G. V. Anrep has been appointed as from March 1, 1926, to the University readership in physiology tenable at University College. Dr. Anrep was educated at the University of Dorpat and at the Medical Faculty of the University of Leningrad. From 1912-14 he was engaged in research work at the University of Leningrad and at University College, London. From 1917 until 1920 he was senior assistant in physiology at the Institute of Experimental Medicine of Leningrad and in 1920 he was appointed assistant, and in 1923 senior assistant in physiology at University College, London. He obtained the D.Sc. degree in physiology in 1923 and has been awarded the Schäfer Prize and the Julius Mickle Fellowship (1924-25) for his research work in this University. His published work includes numerous articles in the *Journ. of Physiol.* (1912-25); *Proc. Roy. Soc.* (1923-25); and in *Heart*.

APPLICATIONS for the Beit fellowships for scientific research should be made upon a prescribed form and sent to reach the Rector, Imperial College of Science and Technology, South Kensington, S.W.7, by, at latest, April 19.