Adjustments are provided for bringing the second principal point of the lens under test on to the axis about which it is rotated by the bar, and also for bringing the centre of curvature of the mirror exactly on the axis of the roller above-mentioned and on the optical axis of the lens. The distance from the centre of the roller in the axial position to the axis of rotation of the lens is measured by a vernier. When all adjustments have been made, this vernier gives the focal length of the lens to an accuracy of about 0·001 in.

The apparatus measures the degree to which the wave-front, impressed by the lens on light from a distant point source, differs from a spherical wave-front. The indications are given in aberrations of wave-front to a scale of wave-lengths, the aberration shown being in every case twice that present in the once transmitted beam which normally forms the image of a distant point. The form in which the indications are presented is that of a series of interference fringes which are lines of equal aberration of wave-front. These interferometer pictures can be translated into terms of geometric optics by an observer who has had a little practice with the instrument. The various types of aberration and their chromatic variations produce characteristic interference patterns, and thus they can be readily differentiated and measured in terms of wave-length. By means of the pair of deflectors 011 a measurement of the distortion can also be obtained.

With a suitable source of light and a suitable camera the interference patterns can be photographed, and a complete photographic record can be obtained of the performance of any camera lens. Fig. 3 is a photographic reproduction of the interferograms of a well-known lens of high repute for the green mercury radiation (546$\mu\mu$) for the axial beam and for obliquities of 5°, 10° and 15°. It will be seen that even the best photographic lenses—of which this is a fair example—are very far indeed from perfection.

Mutations and Evolution.

IN the series of articles by Dr. Ruggles Gates appearing under the above title in a *New Phytologist* Reprint (No. 12), published by Messrs. Wheldon and Wesley, Ltd., we have the most recent attempt to present a reasoned and comprehensive statement of the problem of evolution. As the author tells us, his aim has been to show that though germinal (by which apparently we may understand chromosomal) changes are of importance in the evolutionary process, they cannot be considered as all-sufficing; that only from the Neo-Lamarckian point of view is it possible to explain a large class of organic phenomena. From this point he sets out to show how the Darwinian doctrine and Mendelian conceptions in combination may furnish us with a solution. To this end, however, it scarcely seems necessary to maintain, as the author is at pains to reiterate, that in the application of Mendelian principles we are merely putting into use a refinement of the theory of natural selection. Nor does any point appear to be gained by this insistence on accord, since, by the author's own showing, the underlying difference between Darwinism and Mendelism—the difference, namely, between the idea of continuity and discontinuity—is profound enough to have divided biologists into two opposite camps. One feels that what is common ground might more easily be made apparent if an attempt were made to define more strictly, or else to abandon, terms which are used to cover an ever-increasing complex of ideas. It will be obvious, for example, that a fresh analysis of evolutionary processes should be couched in terms which clearly differentiate the causes (=true factors) to which variation is presumably due from the mechanism by which variations, once having appeared, are perpetuated, and from conditions which permit or limit the occurrence of variation. That the author evidently has in mind the necessity for precision in this connection appears from the fact that he is careful to point out that isolation due to geographical barriers must be regarded as a *condition*, and not as a *factor*, yet he fails to draw this distinction when dealing with natural selection.

The important point which Dr. Gates seeks to establish is that a new character may arise in *two* different ways: (1) as the result of what we have still to term *spontaneous* nuclear (=karyogenetic) mutations; (2) from a so-called organismal change, *i.e.* a change due either to environmental effects on the cytoplasm or to the morphological principle known as orthogenesis. In the first case the mutation is perpetuated through the *whole* cell-lineage, and the associated character is inherited as a unit. In the second *a localised region or a particular stage in the life-cycle* only is usually affected. Perpetuation of an organismal modification connotes the inheritance of acquired characters.

Mutations.—The more striking observations of Morgan and other American workers on Drosophila and of de Vries, the author, and others on Œnothera, which indicate a direct relation between chromosomal behaviour and somatic appearance, are set forth. Definite zygote characters are shown to be constantly associated with definite irregularities in the meiotic division, as, *e.g.*, the *lata* habit in Œnothera with the presence of an extra chromosome. The author brings forward evidence of independent sporadic appearances of this form, and a parallel mutation has been obtained in cultures of other Œnothera species. In every case the number of chromosomes was found to be 15 instead of the typical complement 14. The occasional occurrence of an 8–6 instead of a 7–7 separation of the chromosomes in another mutant form supplied the clue to the mode of origin of these 15-chromosome forms. In another instance a particular strain of Drosophila, indistinguishable in general from the normal but showing an aberrant type of inheritance, led Bridges to infer the duplication of a sex-chromosome—a prediction which later investigation proved to be correct. These forms with an extra chromosome are found seldom, if ever, to breed true. Their importance, according to the author, lies in the support which they give to the conception of the origin of a zygotic character from a nuclear mutation rather than in their significance in evolution. It is held to be otherwise, however, when the whole chromosomal equipment is duplicated (tetraploidy) and associated with a characteristic giant habit as in Primula and Œnothera.

The separate class of Mendelian mutations is regarded as due also to a nuclear change (in this case possibly chemical) which is presumed, however, to affect only a particular locus or element in the chromosome. It is clear, however, from Bridges's observation cited above, and from Heribert-Nilsson's work on Salix (which the author does not discuss), that, on one hand, duplication of chromosomes *need not* be accompanied by any gross change in the organism, and, on

the other, that a Mendelian mutation *may* produce an alteration in habit as marked as that which characterises the Œnothera forms with an extra chromosome. This being so, what becomes of the author's scheme of classification?

Organismal Characters.—The conception of organismal characters has been developed primarily, apparently, to account for the phenomenon known as recapitulation, *i.e.* the appearance in the individual of ancestral structures in a reduced or functionless form. In his treatment of this part of the subject the author is not easy to follow. Much of the argument advanced appears, and is admitted, to be inconclusive. The reader is left wondering why the "species cell" concept which has sufficed as a basis of explanation for karyogenetic mutations is here abandoned, and why physiological considerations are ignored. The essence of the conception of the "species cell" is, we are told, that when a new form arises it does so in consequence of some antecedent change in a (germ) cell unit. The individual derived from such a mutated germ-cell will exhibit the associated character in all its parts. The reasoning from this point onwards seems to be as follows:—If organisms were entirely composed of such cell units, then germinal mutations might supply the whole basis for evolution. But regions or structures occur in the organism in which the cell unit is ill-defined or non-existent, therefore some other type of evolution must take place [!] It does not appear, however, that it is in these regions or structures that the postulated environmental effect is felt. In fact, the line of argument now seems to lose touch with the cell altogether, and to work backwards from the other end, thus:—Recapitulation occurs, therefore at some point a lengthening of the life-cycle must have taken place. This can have come about only through additional cell-divisions taking place either at the end or in the course of the original cycle. Having laid it down that a *germinal* mutation is required to produce a new character, the author is driven to conclude that this extension of the life-cycle cannot be due to a change in a cell unit, "but must rather be the result of the organism, as it were, overcoming its cell-shackles and by its own energy [not, be it noted, through an environmental effect, as by the definition we are led to expect] producing new developments, though such novel additions are themselves cellular in structure." Somewhat earlier in his argument the author chides those who "desert science for obscurantism," but what are we to call this?

Though it may be that the reader will not feel that the author's conceptions of evolutionary processes materially advance the position, he will, nevertheless, find in these articles a useful collection of pertinent data.

University and Educational Intelligence.

LIVERPOOL.—Following the recent transfer of the Port Erin Biological Station to the University (Department of Oceanography), Mr. Herbert C. Chadwick, who has been curator under the Liverpool Marine Biology Committee for the last twenty-four years, has now resigned, but remains on the staff of the institution as research assistant. Mr. J. Ronald Bruce has been appointed naturalist-in-charge, and official letters should be sent to him.

ST. ANDREWS.—The following honorary degrees were conferred at the annual graduation ceremony on July 12:—*LL.D.*: Prof. W. M. Bayliss, professor of general physiology in University College, London; Sir William Henderson, chairman of Dundee Technical College; Emeritus Prof. D. MacEwen, Dundee; and Prof. A. N. Whitehead, professor of applied mathematics in the Imperial College of Science and Technology.

AMONG the bequests of the late Dr. H. Barnes, vice-president and a former president of the British Medical Association, are his medical books to the Royal Society of Medicine, and, conditionally, 2500*l.* to Edinburgh University for a scholarship for clinical medicine and 1500*l.* to Epsom College for a similar scholarship.

THE Paton-Figgis scholarship, value 50*l.* for a year and renewable, is being offered by the South-Eastern Agricultural College, Wye, Kent. Candidates must be reading for the B.Sc. (Agric.) degree, and reside outside the counties of Kent, Surrey, and Sussex. The latest date for applications to reach the Principal of the college is August 14.

THE following appointments have been made at the University College of Swansea:—Mr. F. A. Cavenagh to the chair of education; Dr. Florence A. Mockeridge, lecturer in botany and head of the department of biology; Mr. L. B. Pfeil, assistant lecturer in metallurgy; Mr. A. Stuart, assistant lecturer in geology; and Mr. J. S. Caswell, demonstrator in engineering for one year.

THE Ellen Richards research prize of 1000 dollars (200*l.*) is being offered by the Association to Aid Scientific Research by Women. Theses by women, based on independent laboratory research, are eligible for competition if received by the committee before February 25, 1922. Further information and application forms are obtainable from Dr. Lilian Welsh, Goucher College, Baltimore, Maryland. U.S.A.

TWO Royal School of Mines Frecheville research fellowships, in aid of research in connection with mining, mining geology, metallurgy, or the technology of oil, are being offered by the Imperial College of Science and Technology, South Kensington, S.W.7. The fellowships are of the annual value of 300*l.*, tenable for one year, with a possible renewal for a second year. Applications, giving particulars of the candidate's proposed investigation, his qualifications and references, must be sent to the Secretary of the college before September 1 next.

WE have received from Mr. G. D. Dunkerley, hon. secretary of the Secondary School Teachers' War Relief Fund, the report of the last year's working. The object of the fund is to supplement the pensions and allowances of soldiers, sailors, nurses, and their dependents, and to secure that the families of the fallen and disabled secondary-school teachers shall suffer to the least possible extent in material circumstances. A total of 9874*l.* has been collected, and allowances are now being made to the extent of 481*l.* per annum. Thus the present capital fully safeguards the present allowances, and leaves a margin for additional help. The committee has therefore decided to maintain the payments from capital and interest combined without appealing for further funds, the capital diminishing as the necessity for the allowances ceases. Every opportunity will be taken of helping the children of fallen teachers at future stages in their careers, and although it has been decided to close the subscription list in its present form, the committee will gratefully accept legacies or donations for this special purpose. The chairman of the committee is Mr. A. A. Somerville, of Eton College; the hon. treasurer is Mr. J. Hart-Smith, of the County Secondary School, Battersea, and donations should be sent to him, c/o Barclay's Bank, 835 Wandsworth Road, S.W.8.