character is. From the examination of some 1500 species I am convinced that the character of the medullary rays (which, by the way, are anything but medullary in the secondary wood) is the most constant feature and should form the basis of an artificial key, but it separates the genus Betula, the rays of which are but a millimetre high on a vertical section from Alnus, where they may run to inches, and it cuts the Leguminosæ into two halves, one of which has bold spindle-shaped rays in transverse section (Ulex, Cytisus, &c.), while in the other the rays seem to meander amongst the vessels like so many limp threads (Mimosa, Gleditschia, &c.).

Nevertheless, a useful key may be constructed by first distinguishing those woods with two kinds of rays (many Cupuliferæ) from those having but one. The latter then fall into two groups, one having rays which have intervals between them of not less than the transverse diameter of the largest pores present, the other conversely having the intervals between the rays never greater than the pore-diameter, *i.e.* the rays diverge and run round or avoid the pores. These two types of rays are very clearly marked and have quite different aspects. The arrangement of the vessels or pores can then be usefully employed, as the concentric radial, tree-like or undulating groups, or uniform distribution of the pores is very constant in many genera, as are

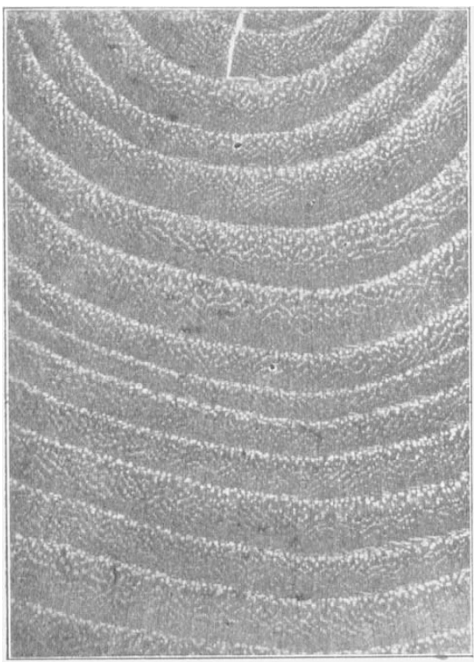

FIG. 2.—Common elm. Transverse section ×3½.

also the equally varied forms assumed by the soft-tissue (wood-parenchyma), which comes next in order of importance. It would be out of place here to go into further detail, and it need only be pointed out that by following this sequence all members of the same genus except the aberrant forms fall together into the same ultimate group, which is not the case with Nördlinger's or any other key that I have used.

Many groups, or even whole genera, are so similar in structure that their species can only be distinguished by long acquaintance, *e.g.* Fraxinus, Acer, &c., and it is then necessary to have recourse to other features, such as the specific gravity, colour, smell, taste, hardness, behaviour with certain reagents, colour of their solution with water and alcohol, &c. Frequently these are so pronounced that a single feature may be sufficient to describe a species, as, for example, the offensively powerful cheese-like smell of *Goupia tomentosa* and the flinty hardness of *Lignum vitae*, hence it has often been urged that if a wood can be so readily identified by such simple means, why employ a more complicated and less accessible method. No one underrates obvious characters, but there are thousands of species, hundreds of which are employed in the arts, that have no pronounced feature of this kind to distinguish them. The value of the anatomical characters to the systematic botanist and to the trader is, however, in inverse proportion. The closer the resemblance in structure between the members of the same group the stronger the claim for a place in classification. On the other hand, the greater the dissimilarity the easier becomes their discrimination for commercial purposes.

CONFERENCE ON SCHOOL GARDENS.

A CONFERENCE on school gardens was held under the auspices of the Berkshire County Technical Education Committee at Reading College on Saturday. Mr. T. G. Rooper, one of His Majesty's inspectors of schools, read a paper on "School Gardens in England and in Germany," giving an account of those he has helped to institute in this country and others which he visited on the Continent. He dwelt, too, upon the provision made in Germany at the Pomological Institute for training elementary teachers, and one of his most interesting points was with regard to them. They are not, as here in England, expected in return for tuition, maintenance and travelling expenses, to attend courses of instruction during well-earned holidays, but they have the additional privilege of working at the Institute during term time, a substitute being paid to take their duty.

English school gardens, though at present comparatively few in number, are on all sides acknowledged to be the most practical yet instituted. Except in the case of those attached to continuation schools, no attempt must be made to utilise them for the technical teaching of gardening or otherwise than as mere training, mental and manual. A point obvious enough that was touched upon was that inspectors of schools should know something of horticulture if they are to report on school gardens and these are to be instituted in larger numbers. The importance of it is that, with very few exceptions, the inspectors are not at all well versed in the subject. County Councils cannot spend money directly upon elementary schools, but training of teachers they can arrange for, they can hold conferences such as the one here discussed, and their horticultural instructors may, and do, without breaking the law, give advice on the laying out of school gardens. Mr. J. C. Medd, in the course of his remarks, alluded to the Nature-Study Exhibition, with a view to holding which in London during next summer an association has just been formed. At this, which if it comes about will be greatly due to Mr. Medd's efforts, garden produce that may be in the proper condition at the time will no doubt be welcomed. Sir John Cockburn, lately Premier and Minister for Education in South Australia, is the chairman of the executive committee. Sir John, speaking at the Conference, alluded to "Arbor Day," upon which everyone in the antipodes who can plants a tree. The idea, one might say, is borrowed from America and is a very good one.

The difficulty of getting proper time for practical work was also touched upon by Sir John Cockburn, who said that, although one hour was all he could obtain at first, nevertheless, before he left South Australia, schools had been started in which only half the time was devoted to theoretical instruction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At the 232nd meeting of the Junior Scientific Club on Wednesday, February 12, two papers were read, viz. "Colour and Chemical Composition," by Mr. S. A. Ionides, Balliol College, and "The Centrosome," by Mr. A. D. Darbishire, Balliol College.

By his will, Sir J. H. Gilbert, F.R.S., who was Sibthorpean professor of rural economy from 1884–90, and who died on December 23, 1901, bequeathed the portrait of himself by his brother, Josiah Gilbert, to the University of Oxford, to be placed in the library of the Sibthorpean professor of rural economy.

DR. F. T. TROUTON, F.R.S., of Trinity College, Dublin, has been appointed Quain professor of physics in University College, London, in succession to Prof. H. L. Callendar, F.R.S.

DR. W. H. WILLCOX has been appointed deputy lecturer in hygiene at Bedford College for Women, on the resignation of

Dr. W. C. C. Pakes, who has been appointed bacteriologist to the Transvaal Government. The council has resolved that, in order to keep a permanent record of the legacy left to the college by Mrs. Morton Sumner, the lecturer in geology be hereafter called the Morton Sumner lecturer in geology.

THE papers read at the recent conference of science teachers, arranged by the London Technical Education Board, are appearing in the *Technical Education Gazette*, with reports of some of the speeches. The January number of the *Gazette* contains addresses on the teaching of hygiene, by Miss A. Ravenhill; mental school hygiene, by Dr. F. Warner; and the teaching of natural history, by Mr. F. E. Beddard, F.R.S.

THE Technical Education Board of the London County Council report that the reorganisation of London University is already having a marked influence for good on the polytechnics and other institutions. The advanced classes in science and engineering are being revised and brought up to a higher standard, gaps in the curriculum are being filled up, and more students are being induced to enter upon systematic courses of study, extending over three or four years, instead of attending isolated classes. Complete degree courses, under teachers of the University, will shortly be available for evening students at several of the polytechnics. The due recognition of engineering and higher commercial subjects was provided for by the establishment of separate faculties, and the Senate has now approved courses of study in which students will proceed to the degrees of B.Sc. and D.Sc. The regulations for the economic or commercial degree enable it to be gained in such subjects as the history, principles and organisation of banking, insurance, railway and shipping transportation, international commerce, local government, statistics, &c. By means of the Council's aid, the Senate has now determined on (1) the organisation of an institute of advanced chemistry, both organic and inorganic, at one centre; (2) the provision of advanced teaching in engineering at two centres; (3) the systematic organisation of the teaching of modern languages at all the University centres, including the polytechnics, and beginning with German; (4) the provision of a professorship of education in connection with the Council's proposed day training college for teachers; and (5) the appointment of University teachers in economic history and theory, commercial geography and history, banking, statistics, foreign trade, &c.

SCIENTIFIC SERIAL.

Bulletin de l'Académie de Sciences de St. Pétersbourg, 5th series, vol. xii.—On the compound (so-called stationary) radiants of shooting stars, by Th. Bredikhine (in French). The supposed existence of stationary radiant points (or radiant points of long duration) is an obstacle against all more or less admissible theories of shooting stars. Taking advantage of the 918 meteoric orbits calculated by J. Kleiber in 1891, and of subsequent data, the author concludes that each stationary (or long duration) radiant consists of several individual radiants, even when these radiants do not much differ from each other in their dates; this means that each stationary radiant is a compound radiant which originates from several individual radiants, each of which has its own position in space and its own origin, and all of which are intersected by the orbit of earth. Thus, in the well-known radiant of β Persei he finds "thirteen or fourteen different orbits, *i.e.* as many different streams" (p. 102). The author examines next the theories of Profs. H. H. Turner and A. S. Herschel, and concludes that "the deductions of Prof. Turner are only admissible under the impossible supposition that the earth moves with a uniform speed along a straight line. But if the theory itself is inconsistent, its secondary complications, such as the spinning of the meteoritic stream, the resisting medium, &c., have no more signification" (p. 115). Applying his explanation next to the polar stationary radiants of Mr. Denning, the author shows that in the radiant ζ Draconis (No. 36 of catalogue A), one may recognise "twelve different individual streams (twelve comets) apparently composing one single stationary radiant." The author's final conclusion is:—"A stationary radiant does not originate from a single individual stream or from one single comet; it must be named a compound radiant, because it is produced by several comets or independent streams. The phenomenon is so simple that all complicated and artificial theories are useless and superfluous. . . . Thanks to the numerous and careful observations of Mr. Denning, the phenomenon has lost its supposed individuality and has become decomposable and explicable."—On photographic observations of the satellite of Neptune at Pulkova, by S. Kostinsky (Russian; with a plate).—Report on zoological researches at Sebastopol in 1899, by A. Kovalevsky: hypodermal fertilisation with the leeches; on *Batracobdella latastii*; on *Hedyle Tyrtowii* (n.sp.); on *Pseudovermis paradoxus*, Periasl.—On faint lines in stellar spectragrams, by A. Belopolsky.—On a MS. in Coptish language attributed to Dionysius Areopagita, by Oscar Lemm.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"Mathematical Contributions to the Theory of Evolution. XI.—On the Influence of Natural Selection on the Variability and Correlation of Organs." By Karl Pearson, F.R.S.

The influence of directed—natural or artificial—selection on the characters of a race is one which it is fundamental for the purposes of evolution to appreciate quantitatively. I have already shown in an earlier memoir of this series the effect of random selection, or what it is better to term random sampling, on the characters of a population. Isolation of a few individuals who form a random sample may produce very sensible modifications of race characters, but it is to directed selection that we must look for changes on the largest scale. The subject is a very broad and complex one—no less than the total effect upon a population containing individuals at all ages of a selective death-rate applied for a long period and a function not only of the organs of each individual, but of the relationship of these organs to each other, and of the stage of growth of the individual. In the present memoir, attention is confined to the influence of selection in altering a complex of organs, no reproduction taking place during the selection.

A very definite distinction is at once reached, namely, that between directly and indirectly selected organs. It may be said that, although it is possible for the recruiting sergeant to select stature, and in so doing differentiate the arm-length of his troop from that of the general population, yet that in natural selection we are given only the modified organs, and so we cannot tell which of them have been directly and which indirectly selected. Both are changed; how discover which was the source of the change? The answer is: In the same manner as we could distinguish between two recruiting sergeants, one of whom selected his troop from the general population by stature, and the other by cubit; in either case the stature and cubit would be both modified, but the mathematical theory of regression would enable us to distinguish between the methods of operating of the two men, and even between them and one who selected by *both* stature and cubit at once. The mathematical theory as developed in this paper shows us that, although the whole complex of characters may have been changed, still, if direct selection has only occurred in p out of n possible cases, there will be certain of the partial regression coefficients which remain unmodified and which will theoretically enable us to distinguish among the whole group of differentiated organs, between those directly selected and those modified only because they happen to be correlated with the directly selected organs. Thus the distinction becomes one of singular importance, for though the selection of a few organs modifies the means, variabilities and correlations possibly of the whole complex of characters, certain functions of those quantities remain constant, and such constants ought to be discoverable, at any rate in theory, and should serve as the criterion of a common origin, when we deal with local races as having been subjected only to a selection *directly* differentiating a comparatively few characters.

If selection has changed a race from a condition A to a condition B, it becomes of much interest to determine the nature of the selective death-rate by which the process has been carried on, and it is found that this death-rate as represented in the surface of survival rates enables us to distinguish two kinds of selection, termed in the memoir positive and negative selection. In the first case, a race is modified, because the nearer its members are to having their organs with a certain system of values, the better fitted they are to survive; in the second case, the nearer the individuals are to this system the less fitted they