pollen will give a valuable clue to a plant's relationships, whilst at other times it will give no clue at all, or it points in various contrary directions. This is because plants have not descended one from another in a straight line, but possess complicated relationships with plants belonging to several different natural orders.—*The Gardeners' Chronicle*.

IV.—*Microscopy at the American Exhibition.*

By R. H. WARD, M.D.

IN briefly reviewing the microscopes exhibited at the American Centennial Exhibition, just closing at Philadelphia, it will be convenient to classify them in three more or less natural groups: the Continental, English, and American. All these classes are largely and characteristically represented by the most interesting and in many cases by the most distinguished examples of their kind, affording to microscopical students the best opportunity yet furnished in this country to study and compare the various types and qualities of tools available for their work.

It will be expedient to mention first, however, a few isolated and unclassifiable exhibits which are still of sufficient interest to demand a passing notice, such as a very small upright educational microscope of no well-marked character, from Switzerland; a small instrument from Tokio, Japan, which is evidently an early if not a first attempt, and a not unsuccessful one, though of unpretending form and crude workmanship, to imitate the instruments in vogue in this country a score of years ago; and a couple of large, clumsy instruments from Canada, one of them from Montreal and the other in the educational exhibit from Toronto, of which it can only be hoped that they do not fairly represent the science and art of our Canadian friends, since they are wholly devoid of any evidence of the spirit of that progress which has so fully and so fortunately changed the microscope from a piece of furniture to a tool for scientific work, and are in fact excellent illustrations of what a microscope ought not to be for educational purposes.

The Continental microscopes are chiefly represented by the exhibit of Nachet, of Paris, whose compact, ingenious, elaborate, and thoroughly built instruments are present in large numbers and great variety, constituting, with one exception perhaps, the most exhaustive exhibit in our department. Besides the familiar Nachet stands, large and small, monocular and binocular, for one observer and for more than one, and of course the inverted microscope of Professor J. L. Smith, which the manufacturer never should have

allowed to pass as his own, there are dainty pocket microscopes in cases of wood or nickel-plated metal, clinical, tank, and dissecting microscopes, and a few accessories, which, though not absolute novelties, are at least not usually seen on sale in this country. The most conspicuous and possibly the most worthless article in this exhibit is a huge inverted microscope, as big as a small stove-pipe, in which great amplification is gained by means of the great distance between the ocular and the objective.

Bardou and Son, of Paris, also exhibit, in connection with a large display of telescopes and other optical goods, one large instrument of the French style, having no important characteristics, and a few inferior instruments.

Austria is represented by S. Plossl and Co., of Vienna, whose little case contains a compact histological microscope of excellent design and attractive appearance. In place of a rack, a pair of arms attaches the body to the milled heads near their circumference, changing the rotary to a plunging motion, as if the driving wheel of a steam-engine moved the piston-rod, and giving a very delicate adjustment just as the body approaches a state of rest. Accompanying this instrument is a clinical one, of the German style, and far simpler than the French, English, or American forms.

The handsomest case of instruments in the English department, and indeed in the whole exhibition, is that contributed by the Ross house, of London. Less than this could hardly be true of a finely finished show-case well filled with their almost unequalled workmanship. With the exception of the new Wenham adaptation of the Jackson form of stand, and the series of new Wenham objectives which are understood to have been entered for competition and then permanently removed from the exhibition and the country, there is but little in the exhibit that would be called novel, most of the forms seen being the familiar and standard styles of several years past. No better commendation of the new stands, whose beauty is universally conceded, could be desired than is furnished by the old style Ross stands exhibited by their side. Notwithstanding the solid workmanship of the latter, and the care with which they were doubtless packed for transportation, the transverse bar which joins the body to the rack has in nearly every case given way under some unfortunate jar and become hopelessly though not conspicuously deformed. The untimely removal of the set of comparatively unfamiliar objectives from the exhibition could not have been an intentional breach of courtesy or propriety, but was certainly an unfortunate mistake on the part of both the proprietors who desired and the officials who permitted it.

R. and J. Beck's exhibit is perhaps the most complete in the exhibition, but is so badly displayed as to present a scarcely

attractive appearance. The large number of standard forms and the numerous and convenient accessories made by this firm have been so extensively exhibited and sold in this country that their peculiarities are well known. The chief novelties are a much-needed addition of centring and rotating adjustments to the sub-stage, and a showy introduction of aluminium mountings in some of the stands.

Henry Crouch, of London, also exhibits a full series of instruments characterized by a greatly improved quality of moderate-priced work, a class of work for which there is an increasing appreciation and a growing demand. His best stands of medium size lack scarcely any advantage as compared with far more clumsy and costly first-class stands. His variety of accessories is large and well selected, showing an earnest endeavour to adopt the best novelties from every source. His manufacture of a small histological instrument, with short body, low stage, and horse-shoe base, after the Continental method, is one more evidence of the growing favour with which such instruments are regarded in England and America, especially as it is sold at a price greatly disproportionate to its size and elegance.

Of Negretti and Zambra it need only be said that along with other goods they display a small variety of microscopes, of which but one, the largest, is notable, and that merely for its bigness. It belongs to the furniture style of instruments, and so does its large case of accessories. Precisely the same words may be applied, except as to numbers, to the two huge instruments of J. H. Dallmeyer, the smaller of which is, in the writer's judgment, too large for any known use.

The class of American instruments, though not as distinct a group as the other two, is mentioned separately for local reasons as well as on account of some peculiarities which its members have in common. Certainly first among these is the exhibit of Joseph Zentmayer, of Philadelphia, who offers the most elaborate and elegant instruments as well as the largest variety of different forms. His ingenious contrivances and excellent brasswork are too familiar to need description. He shows the large American, intermediate, hospital, and clinical stands, and the new student's, introduced a few years ago to meet the demand for histological instruments; also a material modification of the American, introduced this summer and known as the model, having the three new features of a fine adjustment by a long slide close behind the rack and moved by a screw and lever nearly in the Ross position, an interchangeable stage which can be almost instantly removed and replaced by an extremely thin diatom stage, and a bar, which carries the sub-stage and mirror, hinged at the level of the plane of the stage so as to enable the illuminating apparatus to revolve with

facility and in an easily measured position around the object as a centre. He also exhibits a new pocket microscope of neat and apparently serviceable construction.

T. H. McAllister's case, in the photographic building, exhibits his two or three grades of instruments, with chain movements, thin stages, and often iron bases, built with a view to both economy and excellence; and also a new-model physician's microscope, which is literally a charming little instrument, very portable and handsome, and combining with most of the excellences of the maker's former work the Zentmayer glass sliding stage and the diaphragm in the stage close to the object. The objectives furnished with it vary from fair to the best, according to the pecuniary views of the purchaser. The accessories are of the usual forms.

Bausch and Lomb, of Rochester, who have lately added to the province of the Vulcanite Optical Instrument Company, of that city, a microscopical department, under charge of E. Gundlach, formerly of Germany and late of Hackensack, N.J., exhibit a large series of entirely new designs. These are all of excellent workmanship, though of low or medium grade as to size, complexity, and cost. By simplifying the designs, introducing vulcanite into the mountings where it can be done to advantage, and introducing the business principle of attempting to create a large demand by production at a very low cost, the experiment of offering good instruments at a very low rate is being tried on a scale and with facilities unprecedented in this country. The special peculiarities of these stands, aside from the vulcanite mountings, are the hinging of the sub-stage bar at the level of the object, contesting in this respect the priority with Zentmayer's new stand; a new object carrier, which with some improvements may be convenient; a new fine adjustment, by means of a screw acting on the body, which is supported at the end of two parallel horizontal springs, which allow a peculiarly smooth motion practically incapable of deterioration from wear or any other probable cause; and a coarse adjustment, consisting of a slide at the upper part of its course, and, below, a rapid screw which prevents pushing the body suddenly through the slide, and, without interfering with a prompt adjustment of low powers by sliding, gives a delicate adjustment for higher powers by screwing. This method is evidently a modification of Wale's oblique slot.

George Wale's new student's microscope is exhibited by the Stevens Institute of Technology. This is indeed an educational microscope, and not a burlesque on the claim of the instrument to educational value. It is a small and compact stand, of the Continental style, with horse-shoe base and low stage, of most substantial workmanship, adopting the Zentmayer glass stage, and introducing an original coarse adjustment by means of a sliding

tube with the addition of a pin moving in an oblique slot and giving a rapid and very steady and safe adjustment by means of a screwing movement, and an iris diaphragm capable of being used after the Continental plan close to the object slide, consisting of a thin split tube whose blades are overlapped and gradually closed by being screwed up into a dome-shaped cavity in the bottom of the stage plate. The instrument is furnished with Wale's excellent lenses.

James W. Queen and Co. exhibit their instruments, which are of the English type, reduced and adapted to the student's microscope grade, and aim rather to combine well-known excellences into a good and popular instrument, than to introduce novelties of construction.

The instruments by W. Y. McAllister, in the Pennsylvania State Educational Exhibit, do not seem to suggest any of the progress of recent years.

A set of William Wale's exquisite lenses was exhibited by Mr. Zentmayer, but was unfortunately allowed to be prematurely removed from the case.

Several makers are conspicuous by their absence. All visitors to this department would have been glad to see Hartnack, and Powell and Lealand, and the German makers, well represented; and many felt disappointed at the absence of Spencer, of Tolles, and of Grunow, having very reasonably expected that such prominent American makers would, from motives of fitness and courtesy, if not of interest, contribute their share to the completeness of the International Exhibition. It would have been peculiarly appropriate, in view of their undisputed excellence and their high claims, that the new duplex-front objectives of Tolles should have been placed in comparison with the world's other lenses, while the unhandsome insinuation which is being extensively printed in advertisements, that they are not at the exhibition because they would not be properly examined there, must have been authorized without serious thought by the persons responsible for it. It is well known that President F. A. P. Barnard, who was associated with such judges in this group as Professors Joseph Henry, J. E. Hilgard, and others scarcely less distinguished, gave his personal attention to the examination of the exhibits in this department.

Among the objects, other than microscopes, of special interest to microscopists, may be classed the double-stained vegetable preparations by Dr. Beatty, the large series of fine mounted objects by W. H. Walmsley, and the far from equal set of imported objects, both exhibited by James W. Queen and Co., and the more limited series of pathological specimens, by Dr. H. N. Krasinski, in the Russian department; the already famous machine for micro-ruling

on glass, by Professor Rogers; the hitherto unequalled photomicrographs, by Dr. J. J. Woodward, exhibited by the Army Medical Museum, and the good though less pretending attempts in the same direction, by Dr. Carl Seiler, in the photographic building; and the large, interesting, and carefully prepared series of minute fungi, with tinted drawings of the same, contributed by Mr. Thomas Taylor to the exhibit of the department of agriculture in that most creditable portion of the whole exhibition, the United States Government Building.—*American Naturalist*, December 1876.