are of especial value for those laboratories in which these types are used to supplement human material.

The unavoidable difficulties of the study of the nervous system are further increased by an unnecessarily cumbersome nomenclature. Ranson has followed in the main the B. N. A. system of terms, wisely using English forms of the names in most cases. This system has at least the merit that it is possible to find out exactly what its names mean. Like nearly all other recent anatomical writers, he departs from this system in some respects (*e.g.*, dorsal and ventral for posterior and anterior. Pending the international revision of the B. N. A., which is perhaps more urgently needed in neurology than elsewhere, it is desirable that certain other changes be widely adopted. The "pons" of the B. N. A. is a hybrid monster, for whose continued existence there is no justification, anatomical, physiological, embryological or comparative. Other similar infelicities might be mentioned.

As indicated at the beginning of this review, the serious study of the nervous system can not proceed far without practical work, and Ranson's book is so organized as to follow the natural sequence of laboratory study. A brief laboratory outline is included in the final 20 pages.

The author has attempted to include within the covers of one book all that the medical student requires for his guidance in a first course on the anatomy of the nervous system, and this task has been well done. That this plan is very acceptable to the student, there can be no question, but in the reviewer's experience this is not an unmixed benefit. With a manual of this sort in his hands it is the very exceptional student who can be induced to consult the atlases and larger works of reference and the periodical literature which he must learn to use if he would win an adequate preparation and the proper outlook for successful work in neurology. The question may be raised whether from the pedagogical standpoint the symmetry and completeness of this work are, after all, really advantageous.

C. JUDSON HERRICK

SPECIAL ARTICLES

A SIMPLE APPARATUS FOR MICRO-MANIPULATION UNDER THE HIGHEST MAGNIFICATIONS OF THE MICROSCOPE

THE microdissection and microinjection of marine ova and of animal and plant cells have hitherto been carried out by means of Barber's[1] pipette holder, an instrument primarily intended for the isolation of bacteria. Barber's instrument had the big advantage over other similar mechanisms in that it enabled one to manipulate needles in a drop hanging from a coverslip suspended over a moist chamber. This eliminated all obstacles between the objective and the coverslip, thereby permitting the use of high-power objectives.

The method of making the glass microneedles and pipettes is described in full in Barber's various papers dating from 1904 to 1914 and in a paper of mine[2] in which the application of the method to microdissection is given.

The principle involved in Barber's apparatus is a carrier pushed along a groove by a screw at one end. By having a series of three carriers built up on one another, each travelling in a different direction, movements in any one of three dimensions may be imparted to a needle clamped on the top carrier. It is difficult to construct this instrument in such a way that each movement can be maintained in a precise focal plane. Even when skilfully made, wear and tear in time renders the movements jerky and undependable.

The instrument described in this paper has the following advantages over Barber's: (*a*) simple construction, (*b*) absence of any lost motion no matter how long the device is used, (*c*) accurate and constant control of the movements of the needle or pipette tip

[1] Barber, M. A., 1904, "A new method of inoculating microorganisms," *Jour. Kans. Med. Soc.*, IV., 487; 1914, "The pipette method in the isolation of single microorganisms and in the inoculation of substances into living cells," *The Philip. Jour. Sc.*, Sec. B, Trop. Med., IX., 307.

[2] Chambers, R., 1918, "The microvivisection method," *Biol. Bull.*, XXXIV., 121.

under the highest magnification of the microscope, (*d*) maintenance of the needle tip in one focal plane while it is being moved back and forth in any of the three directions. The basic principle of the instrument consists of rigid bars which are screwed apart against springs. The movements imparted are in arcs of a circle having a radius of from three to four inches. The arcs produced by the two lateral movements lie in one horizontal plane so that the needle tip does not drop out of focus during these movements. The curvature of the arc is unnoticeable as the extreme range of movements of the fine adjustments is only 3 mm. In the microscopic field no movement over one millimeter is ever required.

A full description of this instrument with photographs and diagrams is being published in the *Anatomical Record* and, possibly, in the *Journal of Bacteriology*. The principle on which the instrument depends is in the process of being patented.

The principle is demonstrated on considering the mechanism for the movements in one plane only (Fig. 1). This consists of three

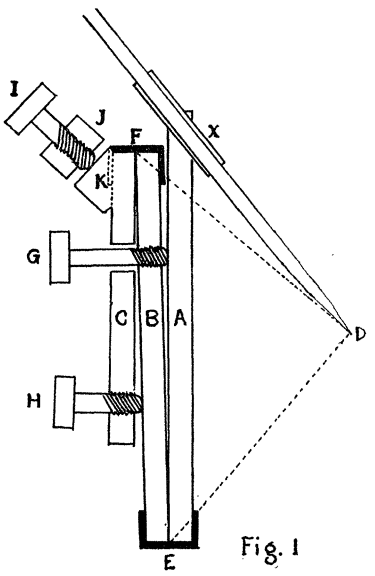

Fig. 1

bars of rigid metal connected at their ends to form a Z-like figure by resilient metal acting as a spring hinge.

By the action of certain screws the bars can be forced apart; on reversing the screws the bars return to their original position owing to the spring action at the ends of the bars. By these means arc movements may be imparted to the tip of a needle when placed in the proper position, and these movements are fine and steady enough to be under perfect control when viewed under the highest powers of the microscope.

The needle or any instrument the tip of which is to be manipulated is held in a carrier fastened to the free end of a bar *A* at *X*. The needle is made to extend so that its tip is at the apex of an imaginary triangle at *D*.

In order to obtain two movements at right angles to one another in the horizontal plane the tip of the needle must be at the apex *D* of a right-angled isosceles triangle, the base of which is a straight line joining the centers *E* and *F* of the springs holding the three bars, *A*, *B* and *C*, together. The shank of screw *G* passes through a large hole in bar *C* and is screw-threaded in bar *B*. Turning screw *G* spreads bars *B* and *A* apart thus imparting an arc movement to the needle tip at *D*. The other screw *H* is screw-threaded in bar *C*. Turning it spreads apart bars *C* and *B* and imparts an arc movement to the needle tip at *D* at right angles to that procured by turning screw *G*.

The movement in the vertical plane at right angles to the afore-mentioned movements is procured by screw *I* (Fig. 2), which

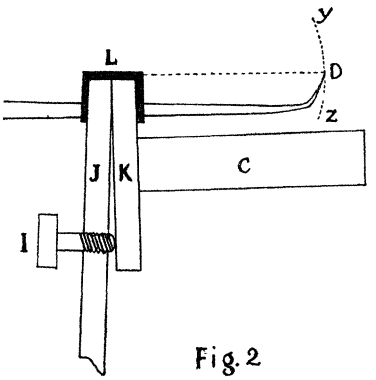

Fig. 2

is screw-threaded in a rigid vertical bar *J*

and abuts against a vertical extension K of the bar C. The extension K is parallel to the bar J and is connected to it at its top by means of a solid spring hinge. Turning screw I spreads apart bars J and K and lifts the whole combination (A, B and C) and imparts an arc movement in the vertical plane to the tip of the needle at D. To procure a vertical movement the tip of the needle at D must lie in the same horizontal plane L–D with the spring fastening K and J together. When screw I is turned the needle tip will then move in an arc Y to Z more nearly vertical than any other arc on the same circumference of which the point D is the center.

The rigid bar J can be attached directly to the stage of the microscope, or it may consist of a pillar rising from a metal base. In the latter case the microscope is clamped to the base alongside the pillar. In both cases the needle carrier X (Figs. 1 and 2) is arranged to allow the needle to project over the microscope stage with its tip in the field of the microscope objective.

This instrument can be used singly for one needle or with a companion when two needles or a needle and a pipette are to be used simultaneously. When a pair is to be used, one is a left-handed and the other a right-handed instrument.

There are two models of the micro-manipulator, a simple and a more elaborate form. Both are identical in the accuracy and extent of the fine movements. The advantages of the elaborate over the simple form are (1) great steadiness, (2) independence of the microscope from the apparatus and (3) special features for the preliminary adjustments of the needle or pipette.

In the elaborate form the manipulator is fastened on a pillar independent of the microscope. The pillar is screwed into a heavy base to which the microscope is clamped. This ensures great steadiness. The microscope can be removed at any time, thus facilitating greatly the exchange of needles and the preparation of the apparatus for micro-injection. Also the coarse adjustments are controlled by screws which aids greatly in the preliminary adjustments of the needle or pipette when bringing it into the focal field of the microscope.

The simple form is more compact and can be clamped directly to the stage of the microscope. Its steadiness, therefore, depends upon the steadiness of the microscope stand. The preliminary coarse adjustments of the needle depend upon sliding movements which are operated by hand. They are, therefore, less readily performed than in the case of the elaborate form. However, the essential feature of the instrument is in the fine adjustments and these are identical in their accuracy in both forms.

A very convenient combination is a left-handed needle manipulator of the elaborate type including the base and a right-handed manipulator of the simple type. On the other hand, the simple form either singly or with both a right- and a left-handed manipulator, is very serviceable.

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CHROMOSOME RELATIONSHIPS IN WHEAT

IN 1917 the writer found the chromosome number of *Triticum durum* to be 28 in the fertilized egg cell. Since the number of chromosomes in wheat had been previously reported as 8 by a number of other investigators a systematic study of the chromosome number of the species of wheat was undertaken, together with a study of sterility in interspecific crosses already in progress. This work has been interrupted and in the meantime Sakamura[1] and Kihara[2] have published short accounts of the chromosome numbers in wheat. Their work seems to have received little attention, possibly due to the lack of convincing illustrations.

The writer has found the same chromosome numbers as reported by Sakamura. Einkorn has 7 haploid chromosomes; the Emmer group, consisting of *T. dicoccum, T. durum, T. turgidum* and *T. polonicum,* has 14 haploid chro-

[1] *Bot. Mag. Tokyo,* Vol. 32, 1918.

[2] *Bot. Mag. Tokyo,* Vol. 33, 1919, and Vol. 35, 1921.