work done under the aegis of the foundation has been of real value and that the foundation, which is the only one in Canada lending its support to medical research, has proved a valuable aid and stimulus to such research in Canada. Like all such foundations, the depression has increased the demands upon it and a larger revenue could be expended with advantage.

VELYIEN E. HENDERSON
D. T. FRASER
Honorary Secretaries

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MICRO-MANIPULATOR FOR PURE CULTURE AND MICROCHEMICAL WORK

THE rapid selection of unicellular organisms for pure culture presents problems which differ so markedly from those involved in cell dissection, injection and aspiration that they require not only a different technique but, if a high ratio of success is to be achieved, changes from existing standards in the form and arrangement of parts of the manipulator itself.

To adapt my recently introduced micro-manipulator[1] to this line of work, I have made a number of changes in the standard form. The new instrument has proved in use not to be limited to the field of biology but to meet the demands of microchemical work. By the use of the pipette point as a test tube, it permits the rapid chemical analyses of particles of the order of 10^{-7} gm, and is therefore available for the convenient analysis of even the most valuable works of art.

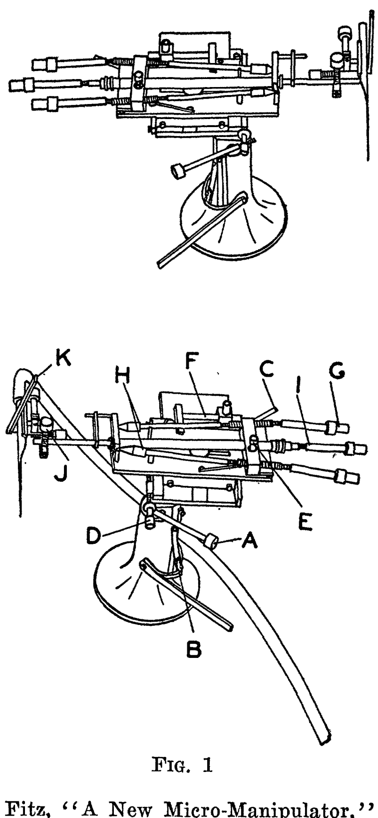

FIG. 1

The instruments as illustrated are arranged for the pipettes to enter the moist chamber from the front and to converge at the optical axis of the microscope. The pipettes are held at right angles to the MM shaft, that the grouped MM controls may be within instant grasp by the operator. When desired, the pipettes may be held parallel to the MM shaft, in which case the manipulators may be grouped on one side of the microscope.

The manipulator is supported by a pedestal and the vertical gross adjustment occurs within the hollow post of the pedestal through the up-and-down movement of the vertical stem of the supporting bracket. The bracket is set to the height of the microscope stage and its stem is grasped by a collar clamped by the long-stemmed screw A. The superimposed apparatus is raised and lowered through a range of one half inch by means of the lever B, which has a power ratio of 4 to 1. A coiled spring within the bracket stem supports the weight and permits a uniform control through the smooth resistance of polished metal on the graphite-lubricated felt friction rings of the bracket stem. The resistance is sufficient to hold any given position securely, yet instant adjustment may be made with smoothness and accuracy.

The shelf of the bracket supports a plate which glides between felt-lined guides attached to the bracket shelf, in the axial line of the pipette. It is actuated by lever C with a power ratio of 3 to 1 and has a range of 2 inches, that clearance may be given for the safe installation of the pipette. An adjustable stop D is attached to the shelf of the bracket and can be set when the point of the pipette is in the center of the field. When the pipette is moved away to install the moist chamber, its point can be instantly returned to its previous exact position in the field.

The plate in turn supports and controls the motion of a second plate by attached guides which permit said plate to move in the line of the axial shaft of the MM, *i.e.*, at right angles to the axial line of the pipette, through a range of 2 inches. This movement is directly actuated by pressure applied to stud E and can be limited in its centrally directed course by an adjustable stop F.

This second plate is the base of the MM proper

[1] G. W. Fitz, "A New Micro-Manipulator," SCIENCE, January 15, 1931, 72–5.

and carries its fine adjustments G 1, 2, 3 as in the standard form. The cones of the fine adjustments for the transverse and vertical movements H, have, however, steeper pitches which increase their rapidity of action threefold. The speed of control in the axial line is also increased threefold by change of the actuating screw I. Long use has shown that these changes give the additional speed needed for pure culture work with no sacrifice of accuracy.

The adoption of felt linings for the adjustable guides of moving parts insures sufficient friction to maintain the parts in any desired position without special clamping, yet permits by its smooth resistance accurately controlled movement. The parts are thus always ready for the instant response required by this type of work. All jamming and uncertainty of control are eliminated. So smooth and accurate is the control that, for low powers, the coarse adjustments frequently suffice.

A special form of pipette holder J, which makes possible the quick change of pipettes, has been designed for this instrument. The pipette is held between two jaws. One is movable, is opened by lever K and is automatically closed by an adjustable spring. The other jaw is fixed but can be adjusted by means of a clamp to receive pipettes varying in diameter from 2 mm to 10 mm. The pipette holder is adjustably clamped to the end of the MM shaft; it can therefore be inclined from the horizontal to any desired angle.

The grouping of all controls, as in my standard MM, has been adhered to throughout. The direct correlation between the control movement and the apparent movement of the operating point in the field of the microscope, as well as the bilateral symmetry between the right- and left-hand instruments of the double assembly, are also that of the standard form. Reports from the instrument in use show that this convenience of construction and arrangement makes it possible to prepare and put away a mount of ten culture selections in 5 to 6 minutes. Of this time 2 minutes are required for the spreading of the cells.

A total weight of less than nine pounds for the double micro-manipulator, inclusive of its mahogany base, insures easy portability, even in a suitcase.

For valuable assistance in the clear definition of the requirements exacted by pure culture and micro-chemical work and in the testing out of the working models submitted by me I acknowledge my indebtedness to Dr. Morton C. Kahn, of the Cornell Medical Center, and to Mr. F. R. Swift, of the Fleischmann Laboratories, New York City.

G. W. FITZ

PECONIC, L. I., N. Y.

SPECIAL ARTICLES

ARTIFICIAL PRODUCTION OF RADIO-ACTIVE SUBSTANCES

CURIE and Joliot[1] have recently observed the emission of positive electrons from boron, magnesium and aluminum, for a considerable length of time after exposure to α particle bombardment. They suppose that in the case of boron, the boron nucleus captures the α particle and emits a neutron, leaving as the product nitrogen 13, which is radioactive, and subsequently emits a positive electron, becoming carbon 13. They suggest analogous processes for magnesium and aluminum, and point out that, if the process is of this nature, it should be possible to produce the unstable nitrogen 13 by bombarding carbon with deutons.

In order to investigate carbon and other elements under deuton bombardment, we constructed a disk, around which was fixed targets of a number of substances. The disk could be rotated inside the vacuum by means of a shaft so that it was possible to bring any one of the targets first into the ion beam for bombardment, and then into view of a Geiger counter having a thin window for recording the delayed emission of particles or gamma rays. Targets of LiF, Be, H_3BO_3, C, Mg and Al were subjected to bombardment, each for about 15 minutes with 5 microamperes deuton current, at 900,000 volts, and immediately rotated into view of the Geiger counter. In the case of boron and carbon, a large number of counts was recorded during the first few minutes after bombardment. Carbon gave the largest effect; several hundred counts per second (calculated for the total solid angle) and decreased at a rate corresponding to a half life of about 10 minutes. The effect from boron was somewhat less intense, and the half life was about 20 minutes. Other substances bombarded gave effects which were appreciable, but which might have been caused by carbon contamination on the surface of the targets. In the case of these small effects an investigation of the rates of decay will decide whether or not they are to be attributed to carbon.

To determine the nature of this delayed activity Dr. Carl D. Anderson and Seth H. Neddermyer placed a piece of freshly bombarded carbon in a Wilson cloud chamber and took a series of photographs, extending over a period of about two hours after bombardment. During the first hour each expansion revealed a number of electron tracks, nearly all of which were of positive polarity. In addition, a few short tracks ap-

[1] *Comptes Rendus*, 198, 254 (1934).