bodies of the specificity anti-*D* only. (2) The hidden saline antibodies are not measurably weakened by heating at 56° C. for two hours. (3) A hidden saline antibody of specificity anti-*D* will not agglutinate *D*-positive cells that have been blocked by an anti-*D* blocking antibody. (4) Not every serum that contains an albumin antibody will develop a hidden saline antibody when incubated with equal parts of an antibody-transforming serum. (5) In sera that do develop a hidden saline antibody, the titre of that antibody may be equal to, or less than, the original albumin titre. (6) The cord blood of a baby of a woman with both saline and albumin anti-*D* will not necessarily develop a hidden saline anti-*D* when incubated with an antibody-transforming serum.

It is our impression that antibody-transforming sera do not transform albumin antibodies into saline antibodies, but that the sera of some sensitized women and of their babies contain hidden saline antibodies which are made manifest by the addition of antibody-transforming serum. Our evidence so far does not indicate how this is brought about.

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A Simplified Micromanipulator

THIS communication describes a micromanipulator which is capable of the finest movements in three dimensions, and which can be constructed at negligible cost in a few minutes. The principle used is that a force applied by the hand, to move the micro-instrument against a resistance which can be made as large as needed, can produce a movement of the needle which may be controlled to within about a micron. The degree of control possible is already familiar in the ordinary microscope-stage movement. The delicacy of adjustment can be much improved by increasing the viscosity of the grease between the sliding surfaces.

The small movements are obtained by pushing, by hand, glass plates sliding over others and lubricated by 'Vaseline' of suitable viscosity. Two pieces of microscope slide are cemented at right angles with sealing wax, *W*, and the inverted T-shape so formed is placed on a drop of 'Vaseline' at one end of the slide holding the object which is to be manipulated. The microneedle is cemented with sealing wax *W* to another piece of microscope slide, and this is attached by 'Vaseline' to the vertical leg of the T (see Fig. 1).

The vertical fin is grasped by finger and thumb and the needle pushed in the desired direction. Vertical movement is produced by sliding the glass attached to the needle up and down with the thumb. A piece of sealing wax *W* cemented about 2 cm. above the needle assists gripping. It is difficult without practice to move the needle vertically without simultaneously altering the horizontal position. This can be obviated by first setting the needle at the desired height, and then moving it in the two horizontal dimensions by grasping the base of the T-holder instead of the vertical fin. By grasping a handle extending backwards a few inches along the needle axis, the finest movements in the vertical dimension can be made.

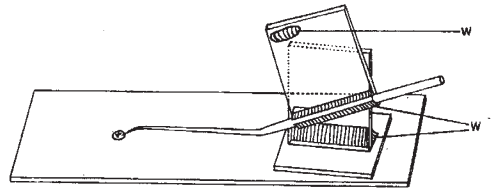

Fig. 1. Diagram of micromanipulator. Tip of needle and drop containing micro-organism are not drawn to scale. *W* = sealing wax

Ordinary 'Vaseline' is only sufficient to produce coarse movements; the whole success in producing fine movements is due to the use of lubricants of higher viscosity. These can be produced by melting together 'Vaseline' and paraffin wax in various proportions. A mixture containing about 60 per cent paraffin wax was found to permit control of the needle point to about 1 micron (though some experiment with the ratio is advisable owing to the different properties of various grades of paraffin wax and 'Vaseline', and their dependence on the operating temperature); backlash was found to be absent.

There is no drift in the two horizontal directions, and under gravity in the vertical direction with a light needle it is negligible (the tip not moving out of focus in half an hour) during the time of the experiment, since the weight of the moving part is small compared with the force exerted by the thumb to move it. Probably a slight thixotropy in the grease sets the needle in place once movement has stopped.

Movement of each instrument is controlled in three dimensions by one hand, and the effect is similar to that of the de Fonbrune instrument, except for the reversal in the microscope. With a little practice, skill in using it improves.

It is easy to see how this manipulator principle can be exploited to as many ends as the experiment demands. Two such instruments can be placed on one microscope slide, and others can be placed on the microscope stage itself, so as to move independently of the slide. Alternatively, by using a square glass plate instead of a slide, four or more instruments—hooks, needles, pipettes, electrodes—may be used at once. With microelectrodes, the problems of insulation are reduced through the complete absence of metal parts and the simplicity of the apparatus.

By tilting the needle slightly upwards, it can be used in a damp chamber on the under side of a coverslip so as to permit the high power of the microscope to be used. If a long-focus objective is used, the drop containing the organism may be simply covered with oil.

With this instrument various operations have been carried out: measurements of electrical potentials arising from various parts of the surface of the amœba; microinjection into the amœba; enucleation and various other microsurgical procedures; isolation of single cells into small drops; measurements of cell volume by sucking the cells into cylindrical tubes, etc.

Above all, this method of operation is useful where many different manipulators are required at once.

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