Scientific Apparatus in Meccano

Microscope Accessories made by Dr. Ernest Bade

This article is the third of a series in which we describe various uses that have been found for Meccano in the field of science. In the first two articles we described an instrument designed for electrocuting small equatic animals for microscopical study, an apparatus for photographing objects through the microscope, and a device for projecting microscope slides on to the screen. Below we deal with a Meccano microtome, a wonderful precision instrument for use in connection with the microscope. All the apparatus so far dealt with is the work of Dr. Ernest Bade.

III.—A REMARKABLY EFFICIENT MECCANO MICROTOME

IN describing a photo-micrographic device last month (see January issue, page 40) mention was made regarding an instrument known as a "microtome" used for cutting very thin slices of plant and animal tissue. The use of such an instrument will be unknown to many of our readers, although any who are particularly interested in microscopical study will know that without a microtome their field of experiment would be considerably limited. The reason for this is that although the student may obtain considerable information of a substance by examining its external appearance under the microscope, he must study its internal construction and the formation of the cells of which it is composed if he wishes to obtain a complete knowledge of the specimen.

This cannot, however, be carried out directly as in practically every case the substance that is to be examined will be of an opaque or semi-opaque nature. If on the other hand we had some means available whereby an extremely thin section could be obtained of the substance, it would become transparent and minute details of its structure would consequently be discernable. The photo-micrograph of a section of bulrush illustrated in the January issue obtained with the aid of this instrument demonstrates its extreme usefulness, and the way in which the tiny cells comprising the major portion of the bulrush have been severed, and so exposed to view, will be noted.

Naturally, very great precision is essential in the manufacture of an instrument of this type, and it is not therefore surprising that its cost varies between £5 and £20. It is therefore all the more remarkable, that an instrument capable of dividing a portion of matter into a number of very thin slices can be constructed with Meccano parts, and in addition to testifying to the system's adaptability, it also demonstrates the remarkable accuracy of each component part. We may mention also that while in most of the manufactured products the experimenter is required to manipulate the blade himself (an operation that requires a certain amount of skill), the action of the knife in the Meccano model is entirely automatic, the operator only having to push a framework up and down. By an ingenious arrangement of gearing, the knife, which consists of a razor blade, is given a lateral sliding action, in addition to its forward cutting motion, and consequently a very smooth cut is obtained.

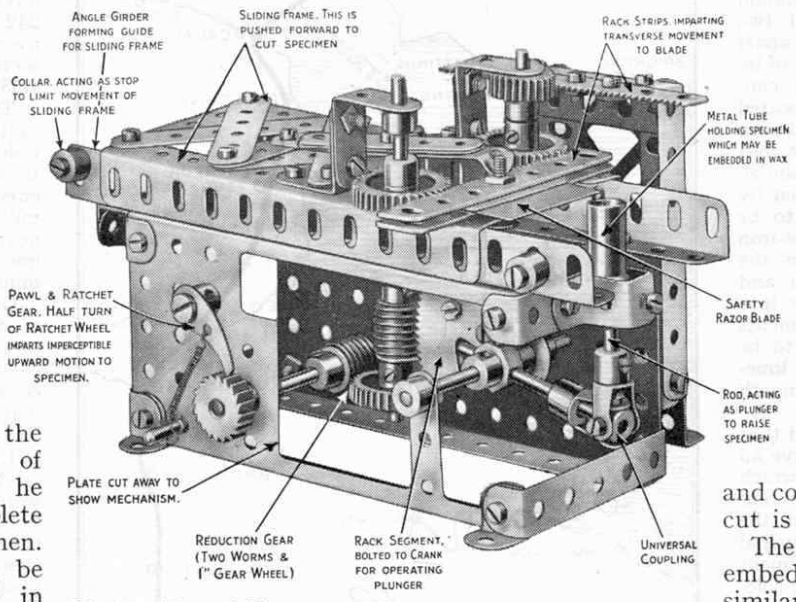

Fig. 1. View of Microtome with side Plate partly cut away to show the gearing operating the plunger, etc.

The object to be cut is embedded in paraffin wax or similar substance, and an ordinary safety blade, which moves forward with a sideways motion, cuts perfectly a section as amazingly thin as two thousandths of an inch! The only non-Meccano parts used in the model are the razor blade and the small metal tube for holding the specimen to be cut. (A Sleeve Piece would serve quite well in place of this tube).

The construction of the model is quite simple. The sides of the frame consist of $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates spaced apart by $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, and a $7\frac{1}{2}''$ Angle Girder is bolted to the top flange of each of the Plates, as shown in the illustrations.

A Ratchet Wheel is secured to one end of a Rod that is journalled in the Flanged Plates and that also carries a Worm. The latter meshes with a 1" Gear on a vertical Rod to which is secured a second Worm meshing with a Rack Segment. The Rack Segment is bolted rigidly to a Crank which, in turn, is secured to a transverse shaft

Parts Required

The following is a complete list of parts required to build the Meccano Microtome :—

5 of No. 4	2 of No. 12B	40 of No. 37	1 of No. 97
4 " " 5	1 " " 16A	1 " " 45	3 " " 103G
2 " " 8B	2 " " 16B	4 " " 48A	3 " " 110
2 " " 9	2 " " 17	2 " " 52	2 " " 111C
2 " " 9B	2 " " 18A	2 " " 58	1 " " 115
4 " " 9E	1 " " 25	6 " " 59	1 " " 119
3 " " 12	3 " " 31	1 " " 62	1 " " 140
4 " " 12A	2 " " 32	1 " " 63	1 " " 147
1 Safety Razor Blade		1 Small Metal Tube	

comprising two short Rods joined together by an Octagonal Coupling. A Rod is held in the transverse bore of the Coupling and carries at its outer extremity a Universal Coupling, in the other portion of which is held a short Rod that passes upward through the centre of the tube 7 (Fig. 2). The top of this Rod is fitted with a Collar or similar part to fit the diameter of the tube. If the latter consists of a Sleeve Piece, the top end of the Rod may be equipped with a $\frac{1}{2}$" fast Pulley, which will be found to be a sliding fit in the bore of the Sleeve Piece. The specimen to be cut is retained in place on the top of the plunger by means of a small quantity of paraffin wax and lard, etc.

The method by which the slicing motion is given to the razor blade is very ingenious. A sliding frame comprising two $5\frac{1}{2}$" Angle Girders braced by $2\frac{1}{2}$" and 3" Strips, slides on the up-turned flanges of the $7\frac{1}{2}$" Girders that are bolted to the $5\frac{1}{2}$" $\times 2\frac{1}{2}$" Flanged Plates, and two 1" Gears are mounted on the front end of the sliding frame as shown in the illustrations. On the Rod of the far 1" Gear in Fig. 1 ; a $\frac{3}{4}$" Pinion is secured, and meshes with a portion of a Rack Strip 6 (Fig. 2) attached to a fixed portion of the frame of the model. In engagement with the 1" Gears are two Rack Strips 5 bolted face to face with the razor blade 4 clamped between them. They are held in mesh with the Gears by means of the Strips 8 pressing down on the upper one and a Spring attached to the lower one and to the sliding frame.

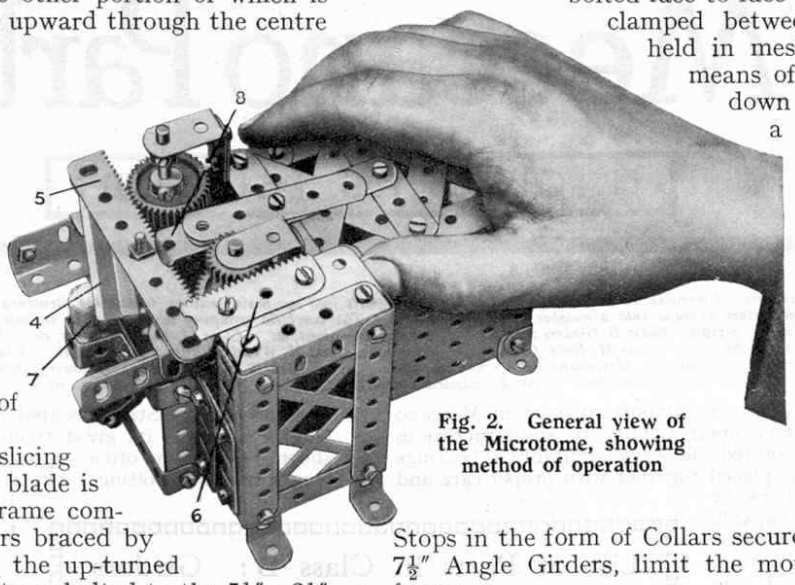

Fig. 2. General view of the Microtome, showing method of operation

When the frame is moved forward, the blade moves across the frame laterally at the same time, owing to motion imparted to the $\frac{3}{4}$" Pinion by the Rack Strip 6. Thus a perfectly clean cut is given to the specimen. Stops in the form of Collars secured to either end of the $7\frac{1}{2}$" Angle Girders, limit the movement of the sliding frame.

It will be seen that, by turning the Ratchet Wheel one or more teeth at a time, the thickness of the cut may be regulated to within very fine limits.

A Run on the "*Twentieth Century Limited*"

(*Continued from page* 99)

" thrashed " to her utmost limit.

Upward we go until at last, after 62 miles' continuous climbing, we reach the summit of Mount Washington. From here after a sharp drop to Pittsfield, where we may touch 70 to 80 m.p.h. the scenery is just one beautiful panorama after another.

Through sleepy towns and villages we tear, the speedometer hanging steadily on at the 72 mark, until, as we start to cross the historic Hudson River we commence to decelerate in readiness for our entry into the great Union Station at Albany, N.Y. Here, two minutes to the good, we detach our train, leaving it to be taken forward to Chicago by one of the new " Hudson Speed " type of engines of the New York Central. Recrossing the Hudson River we reach our resting place where " 596 " will be thoroughly inspected and washed in preparation for the return on the morrow.

No doubt you feel ready now for a wash and a sleep but that does not prevent tongues from chattering. How, asks somebody, would that great " Hudson Speed " or even our gallant " 596 " look at the head of the " *Cornish Riviera* " express ! That reminds me of an amusing little incident that occurred to me quite recently. That day I was driving " 598 " on the " *South Western Limited.*" We rolled into the terminal station of Boston and a few minutes later as I was looking over the engine a young fellow addressed me. It did my heart good to hear him speak. I am from England myself, you know, and he was from good old Lancashire ! He was greatly interested in the engine and after a few moments' conversation he mentioned that he was an ex-Lancashire and Yorkshire Railwayman. I asked him how the engine would look running into Exchange Station, Liverpool. " By gum ! " he replied, " I don't believe the beggar could get in ! "

Famous Trains—

(*continued from page* 109)

the first trough we have seen all the way from Liverpool !—and mount the $2\frac{1}{2}$ miles at 1 in 125 to Belstead Signalbox. A quick run down to the Stour Valley, with a last " 60 " maximum, precedes a severe slowing over the North curve at Manningtree, which takes us on to the Harwich branch. Sharp ups-and-downs along the right bank of the Stour estuary have to be negotiated with our heavy load, and then, as we run down the final incline from Wrabness, the lights of our arrival being timed at 9.18 p.m. Parkeston Quay bear into view dead ahead,

We are not allowed to stand at the long platform any longer than is necessary to unload passengers and luggage, as the " *Esbjerg Continental* " is due from Liverpool Street at 9.31 p.m., the "*Hook Continental* " 11 min. after that, and the "*Antwerp Continental* " 10 min. later still. This is one of the reasons why our timings have been on the leisurely side, as punctuality of arrival at Parkeston is of vital importance, and there is ample margin for recovery of lost time should one of our many connections put in a late appearance *en route*. After leaving Parkeston Quay we have but another two miles to run, calling on the way at Dovercourt Bay, ere we " make the port of Harwich " at 9.31 p.m. We have had, as I am sure you will agree, a most interesting day.

The New Channel Tunnel—

(*Continued from page* 131)

each dining car would be 55 tons in weight. A train unloaded would weigh 505 tons, and would consist of three first-class corridor coaches, each accommodating 100 passengers ; two third-class corridor coaches seating 132 passengers each ; one dining car ; one luggage van and one locomotive. The passengers and luggage represent an additional 45 tons, so that a loaded train would weigh 550 tons.

The estimated total cost of the project is £189,177,094. Of this enormous sum the English " overland " section is estimated to cost £58,529,345, the Channel Tunnel £30,811,200, and the French " overland " section £99,836,549. It is calculated that the fare for the entire journey would be approximately £2 ; that for the journey to Boulogne £1, and the shorter journey from Ashford to Boulogne 10/–. Based on these figures, the gross receipts are estimated at £35,166,664 per annum, of which £23,209,998 would be required to meet working expenses, leaving a net profit of £11,956,666.

The interesting details of the proposed high-speed railway given in our article were published exclusively by " *Modern Transport.*" We have been able to reproduce them through the courtesy of the Editor of that paper.

How to Use Meccano Parts

(*Continued from page* 135)

Another important function of the Circular Girders is illustrated in the Steam Shovel (Model No. 7.7, Special Instruction Leaflet No. 19,) where it is used as the upper guide rail of a built-up roller bearing unit (see also Standard Mechanism No. 106). The part is invaluable in building models of large cement-mixing machines, wagon tipplers, and similar models where circular structures are necessary.

Channel Segments (part No. 119), which resemble curved channel girders, are dealt with in Class N (Wheels, Pulleys, etc.), as also are Ring Frames (No. 167B), which resemble the Circular Girder. Girder Brackets and Channel Bearings, which might be compared with very small girders, are included under Class C (Brackets, Trunnions, etc.).