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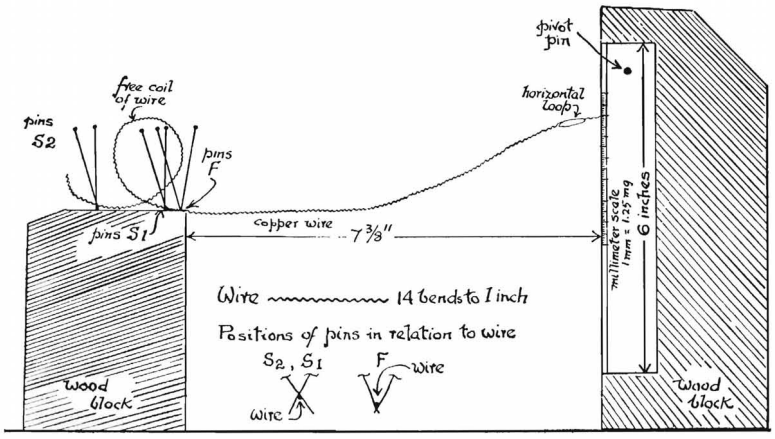
AN APPARATUS FOR WEIGHING SMALL INSECTS

by P. H. H. GRAY

The writer recently presented (1953) a short article pointing out the existence of correlations between the wing-radii and the weights of certain butterflies. Since weighing small butterflies such as *Pieris rapæ* L. on a beam balance is tedious, the apparatus described below was devised whereby each insect can be weighed in a few seconds. The apparatus is shown diagrammatically in the figure, at the scale of ½ inch to 1 inch.

Two separate wooden blocks form the framework of the apparatus; they are free to be moved for slight adjustments in distance or angle. A length of wire was removed from copper window-screening. The wire is about 15 inches long, half of it forming the balance wire and the remainder being coiled in a loop behind the fulcrum point shown on the left-hand block in the diagram. At the free end the wire was twisted through a right-angle and coiled in a small loop, as in the first stage of making a simple knot. The loop is about one-half of an inch is diameter, with the ultimate two or three bends serving as the pointer.

The fixed end of the wire, on the left-hand block, owes its stability to the manner in which the two pairs of pins, F and S-1 are placed, as shown at full scale in the sketch below the section of wire, also at full scale. The wire rests on the V-shaped fulcrum made by the pins F, which enter the wood below the wire, and is held down firmly by the pins S-1, about one quarter of an inch back from F. The free loop is prevented from twisting or springing by the pins S-2, which are fixed in the same way as the pins S-1.



The scale is a millimeter rule, 6 inches long, held on the right-hand block by a pivot-pin near the top; this pin allows the scale to be moved to the right or left in an arc to adjust the millimeter marks to coincide with the end of the pointer when in the "rest" position.

The utility and accuracy of the balance were tested by means of gram-weight fractions of analytical standard. The wire was adjusted in length from F so that 1 millimeter on the scale was equivalent to 1.25 milligram; further extension did not improve its capacity or relative value. It was at this point in the development of the apparatus that the pins were put firmly into their permanent positions. In order to make the tests a small piece of thin paper was placed on the horizontal loop at the front (pointer) end to receive the weights. Here is an example of the tests:

Weight fraction	*Pointer depressed*
One 10 milligram	8 millimeters
Two 10 "	16 "
One 20 "	16 "
One 20, one 10 mgm.	24 "
One 50 milligram	40 "

The same results were obtained on checking again during and after weighing about 150 *P. rapæ.*

When the pointer reaches its maximum depression, which should not, on this first model, exceed 60 millimeters, it fluctuates only slightly, and the weight can be read to the nearest 0.3 mm., or about 0.4 mgm. Reweighing the same insect several times brings the pointer down to the same position each time, and recovery is to the same starting point.

The following example should be of interest:

A dry specimen of *P. rapæ* was found to weigh 21.25 mgm. The two forewings were removed, and the weight was found to be 17.50 mgm. The two forewings were then placed on the balance; they depressed the pointer 3 mm., equivalent to 3.75 mgm. It is thus possible to weigh objects having a mass of less than 4 mgm.

A valid criticism of the reliability of the device can be made because the weighed butterflies were not also weighed on a real balance of acceptable accuracy. This may be adequately covered by the fact that gram fractions were used as checks. However, four *Pieris rapæ* which gave certain values in 1952, shortly after drying in the basement, were weighed again on the wire device and by means of a Mettler Gram-atic Balance. The present weights are a little lower than the former, probably because of the butterflies having dried a little more in the warmth from the house furnace. Other comparisons have been given elsewhere (Gray, 1954). Figures are milligrams.

	August 1952 Wire	*March 1953 Wire*	*March 1953 Gram-atic*
1	20.0	18.7	18.2
5	16.3	15.6	15.6
10	20.6	19.3	19.3
13	17.5	16.3	16.7

The advantages of such a device are as follows: (1) it takes only a few seconds to weigh one specimen; (2) it appears to be reliable within the limits of 75 to 5 mgm.; (3) the cost is considerably less than that of a torsion balance of similar capacity.

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