give the gray background and ruled vertically every centimeter to give the amplitude scale. To illuminate this strip, light from a small intense source is focused to a point where it is periodically interrupted by a timing device; then its divergence is reduced by a lens, and the beam reflected by a plane mirror through a cylindrical lens (5 inches long, 4 inches focal length), thus producing a bright band on the upper edge of the strip.

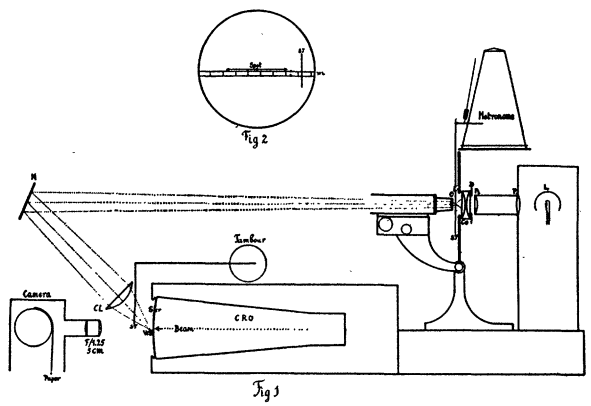

FIG. 1. Diagram of apparatus in side view. CRO = cathode ray oscillograph, Scr = its screen, L = light source, P_1 and P_2 = projecting lenses, D = diaphragm, Co = Abbe condenser of microscope, ST = time marking arm from metronome, O = low power objective of microscope, M = mirror, CL = cylindrical lens, WL = focal plane of washlight on horizontal strip across Scr, F/1.25, 5 cm = photographic lens of paper-camera. ST = stylet of tambour. FIG. 2. Diagram of front view of fluorescent screen with spot traveling horizontally across screen. WL = horizontal strip illuminated by washlight. ST = stylet of signal marker.

To record stimulus, response and other variables electromagnets, tambours or other devices interrupt the washlight by their vertical stylets, which travel horizontally between the cylindrical lens and the illuminated strip.

As the screen and the strip of paper are photographed simultaneously to produce the records described, the spot, being just above the strip, is recorded, at any speed of paper, a small constant distance (about .55 mm) ahead of the corresponding shadow record.

In practice a small projection lantern has proved a satisfactory source of washlight for records of speeds up to 4 inches per second. Its collimated beam is focused by the condenser of a microscope, in horizontal position, to a point between its stage and low power objective, which reduces the divergence of the beam. The intensity of the light is controlled by the diaphragm of the condenser, and inequalities in illumination of the strip of paper are reduced by a cardboard shield, cut to admit less light in the center and mounted against the cylindrical lens. In order to avoid possible electrical interference from synchronous motors used to drive tooth-wheel interrupters, the time record was obtained from a metronome, with a descending arm so placed that at the center of the swing it interrupts the beam at its focal point between the stage and objective of the microscope.

When necessary, simultaneous tracings (in black) from instruments with mirrors on moving elements can be superimposed upon these records by focusing the beam from the mirror to a spot, which moves horizontally on the strip.

W. S. MCCULLOCH
G. R. WENDT

PREPARATION OF TRANSPARENT SPECIMENS OF LEAVES, WORMS, BEES, BUTTERFLIES, ETC.

DURING the course of investigation of formic acid on plant and animal material[1] it was noted that this acid dissolves most plant pigments, starches, sugars, gums, dextrines, proteins, etc., but does not dissolve such framework material as cellulose, lignin or the chitin of animal tissues. These observations have been utilized recently for the preparation of transparent sections of vegetables, leaves, grasshoppers, worms, butterflies, etc. These specimens, in addition to being attractive in their transparent forms, which look somewhat like Cellophane wrappers covering the frames of grasshoppers, bees and worms, make it possible to study their structures without the interference of opaque substances.

METHOD OF PROCEDURE

The usual procedure has been to place the object or material in 95 per cent. ethyl or methyl alcohol, which dehydrates the tissues to a considerable extent and dissolves tannins, sugars, etc., and also prevents distortion through extensive swelling of tissues when formic acid is added. The samples are left in the alcohol for storage, 48 hours or more, until it is convenient to proceed with the preparation of transparent specimens. The alcohol solution is then decanted off and replaced with a 90 per cent. (1.2 sp gr) formic acid. This acid will dissolve about all that the alcohol will and much more; in fact, nearly the only parts about these specimens that do not dissolve are fat, carotin, lignin, cellulose and the chitinous material making up the framework of bugs, grasshoppers, etc.

The time the specimen needs to remain in the formic acid depends somewhat on the material. A week was necessary to dissolve all soluble material in some cases, but no harm seems to result when it is left longer, and in cases hard to clear the liquid may be drained off in a few days and replaced with fresh formic acid. In the case of grasshoppers, bees, etc., which are

[1] R. H. Carr, SCIENCE, 69: 1789, 1929.

more difficult to penetrate, more time is needed to remove resistant material.

CLARIFICATION OF SPECIMENS

After the soluble material has been removed most specimens are far from clear or transparent. These pigments may usually be cleared by the addition to formic acid liquid of 3 per cent. hydrogen peroxide in amounts of about 5 ml at a time until it is cleared. The hydrogen peroxide is usually added when the second formic acid treatment is made. This bleaching effect may be accomplished also by the addition of chlorine water in the case of plant tissues, but this is not permissible with bees, grasshoppers or other forms of animal life composed of chitin in place of cellulose for their framework, as chitin is dissolved by use of chlorine water and the structure of the specimen is then destroyed. These reactions should go on at room temperature and should not be hurried by the aid of heat as the heat weakens the framework and leaves the material in a somewhat disintegrated condition.

TRANSPARENT SPECIMENS REVEAL COMPOSITION

The transparent specimens are not only of interest because they reveal parts which were hidden in the original material, but they call attention by the varying solubilities of the different materials to the differences in composition of the body parts as only cellulose, fat, lignin, carotin, chitin, etc., escape solution. Thus, a separation is made in the cold of materials which could not be removed except by methods which would destroy the specimen for purpose of study and examination. A large quantity of transparent plant and animal material has been prepared by this method. A few specimens have been photographed and one is shown in Fig. 1.

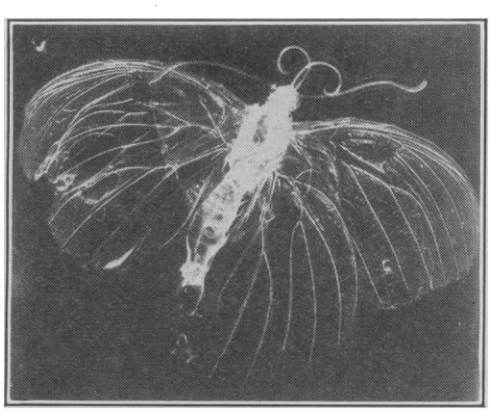

FIG. 1

The completed specimens are often so delicate and flimsy that they are difficult to handle out of water or to be prepared for photographing; they tend to tear or roll out of shape as soon as taken out of the water in which they may be kept in storage for a few days.

It was found that glass crystalizing dishes covered with watch glasses were convenient to use in preparing the specimens, as the delicate tissues, especially such as those of butterfly wings, could be held in place by watch glasses or lantern slides and thus be protected until the treatment is completed. This method of preparing transparent specimens is given with the hope that those who are working with plant and animal materials may find it useful in making more detailed examination of the whole bee or worm, etc., than was previously possible with the small sections for microscopic work. In addition, they form an attractive exhibit for the show window, especially when the specimen is held between two watch glasses (in 2 per cent. formic acid water, or other preservatives) and the edges waxed or taped to retain the liquid and so placed as to permit light from an electric light bulb to penetrate through the transparent specimen.

R. H. CARR

PURDUE UNIVERSITY

BOOKS RECEIVED

DUBLIN, LOUIS I. and ALFRED J. LOTKA. *Length of Life: A Study of the Life Table.* Pp. xxii + 400. 53 figures. Ronald Press. $5.00.

EWING, SIR J. A. *Thermodynamics for Engineers.* Second Edition. Pp. xv + 389. 100 figures. Cambridge University Press, Macmillan. $6.00.

GLADSTONE, SIDNEY A. *Cardiac Output and Arterial Hypertension.* Pp. 56. The Author, New York. $1.00.

Guide to the Exhibition Galleries of Geology and Palaeontology of the British Museum (Natural History). Second Edition. Pp. vii + 74. 15 figures. 2 plates. The Museum, London.

HEITLER, W. *The Quantum Theory of Radiation.* Pp. xi + 252. 26 figures. Oxford University Press. $6.00.

LANDSTEINER, KARL. *The Specificity of Serological Reactions.* Pp. vii + 178. Charles C. Thomas. $4.00.

RAMSEY, A. S. *Hydrostatics.* Pp. viii + 169. Illustrated. Cambridge University Press, Macmillan. $2.35.

Records of the South Australian Museum. Vol. V, No. 3. Edited by HERBERT M. HALE. Pp. 255–394. Illustrated. The Board of Governors, Adelaide. 10s. 6d.

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga. June–October, 1933. Section II, Part II. Pp. 58. Illustrated. Waseda University, Tokyo.

Scientific Reports of the Great Barrier Reef Expedition, 1928–29: Vol. I, No. 11. By C. M. YONGE. *Mode of Life, Feeding, Digestion and Symbiosis with Zooxanthellae in the Tridacnidae.* Pp. 283–321. 10 figures. 5 plates. Vol. 5, No. 2. By L. M. I. MACFADYEN. *Alcyonaria. (Stolonifera, Alcyonacea, Telestacea and Gorgonacea).* Pp. 19–71. 11 figures. 5 plates. British Museum, London. 5/- each.

The South African Journal of Science: Being the Report of the South African Association for the Advancement of Science. 1935 Paarl. Vol. XXXII, November, 1935. Pp. xlvi + 711. Illustrated. The Association, Johannesburg. 30s net.

ZIMMER, ERNST. *The Revolution in Physics.* Pp. xiv + 240. 58 figures. Harcourt, Brace. $3.75.