The use of the shapometer is illustrated best by a study of Fig. 1 in which a pebble is shown in one of the three principal positions. The graduations on the scale are in millimeters. The following table shows the nature of the readings.

The junior writer has found that a smaller shapometer with a range of 75 mm instead of 150 mm is advantageous for measuring particles below 40 mm. The greater ease of handling the smaller instrument insures more accurate and rapid results.

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APPARATUS TO CIRCULATE LIQUID UNDER CONSTANT PRESSURE IN A CLOSED SYSTEM

THIS apparatus is designed to circulate a liquid and to maintain a constant pressure in a sterile system, without the use of joints or moving parts in contact with the circulating liquid.

The apparatus is a single piece of glass. Pressure is maintained by the head of liquid and the liquid is raised and kept in circulation by placing the apparatus on a tilted base which is given a circular motion without being permitted to rotate. This motion carries the liquid up the coil and into the top reservoir. Gases can be introduced through the tube half way up the coil, and an internal pressure can be maintained, if desired, by the displacement of water or other fluid by the exhaust gases.

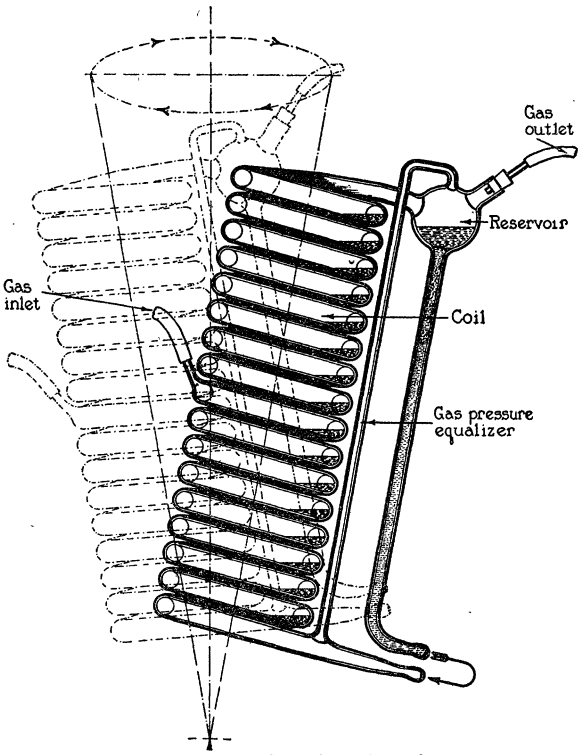

Diagram to show basic principles of apparatus.

DIVISION OF EXPERIMENTAL SURGERY,
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FOR MEDICAL RESEARCH

SPECIAL ARTICLES

GROWTH OF PLANTS UNDER CONTINUOUS LIGHT

STUDIES carried on by the writer since 1926 with plants illuminated both day and night seem of sufficient interest to report upon briefly at this time. Others who have tried somewhat similar although not exactly the same experiments[1] seem not to have secured just the results which have been so apparent in my work. Preliminary accounts of my studies were made at meetings of the Southwestern Division of the American Association for the Advancement of Science in Santa Fe, 1927, and in Flagstaff, 1928. The experiments are being continued, and a full account will be published at a later time.

Plants, chiefly annuals, have been grown in the greenhouse under natural light in the daytime and, in addition, during both day and night they have had the light of two 100-watt Mazda lamps suspended above the bench at a distance of four feet—the lamps provided with an overhead reflector. Controls, shielded from the artificial light, are growing in the same room of the greenhouse on the same bench at a distance of about ten feet. A total of nearly one hundred species have been worked with, some of them during two or more seasons if first results seemed doubtful. The list includes common garden vegetables, grains, weeds, native herbs and garden ornamentals.

In general, the experimental plants are taller than the controls at all times during the entire growth period, this increased height being due to elongation of internodes. Frequently the experimental plants are slender-stemmed and have a decumbent habit. Flowering is usually hastened under continuous light but in a few species is completely inhibited. Plants of some species reach full adult stature, come to blossom, and produce fruit and seed while the check plants are still in the rosette stage close to the ground.

The root system in plants of the experimental series is invariably less extensive than that of the controls; roots are smaller, shorter, and have fewer branches. Thickened taproots do not develop.

[1] J. Adams, *Amer. Jour. Bot.*, 12: 398, 1925. R. B. Harvey, *Bot. Gaz.*, 74: 447, 1922.

Leaves of plants under continuous illumination often show no modification but in a considerable proportion of the species studied they have smaller, thinner blades, and often longer petioles. Leaves of monocotyledons tend to be very much lengthened as do the sinuately deeply-cleft leaves of certain Hydrophyllaceae. Reduction in leaf size is especially noticeable in certain members of the chickweed family, and this with the thin stems and greatly lengthened internodes and frequent paleness of color gives a suggestion of etiolation. But only a few species are sufficiently pale or show the leaves so much reduced as to make the similarity to etiolated plants very pronounced. The greatly lengthened internodes are, however, a practically constant feature.

Internally, the stems of plants grown under continuous light show a thinner cortex, less vascular tissue (especially phloem), and a relatively larger pith than the controls. Leaf-blades in cross-section look as if derived from plants grown in the shade, usually having a single layer of palisade and with more and larger intercellular spaces than the plants grown under ordinary greenhouse conditions. Leaf cells are smaller, hence the leaves are thinner. Roots of the plants of the experimental series show slight development of phloem but otherwise are of usual structure, except that as previously noted they are small and short and with few branches.

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A MAXIMUM POINT IN AN EFFECT OF PROLONGED X-RAY IRRADIATION UPON DROSOPHILA LARVAE

IN a previous report[1] from this laboratory certain effects of X-ray irradiation upon drosophila larvae have been presented. It was found that under the given conditions the mean duration of the prepupal period, φ, (the interval, expressed in days, between the laying of the egg and the formation of the pupa) was an increasing function of the period of irradiation, t. In the work referred to the maximum irradiation interval was six hours, which was taken as a limit to the time for subjection of the larvae to the unnatural environment as well as to the continuous operation of the X-ray tube. As has been stated, an increase of X-ray radiation power was not possible at that time. In view of these circumstances observations were made concerning the effect of radiations of longer wave length with the idea of obtaining more extensive changes. We do not assume, however, that effects of radiations of different wave length are the same. Accordingly, radiations filtered with only 3 mm of cardboard were employed, using a Coolidge air-cooled tube (tungsten target) impressed with a potential difference corresponding to a spark-gap reading (between 12.5 cm spheres) of 2.0 cm and a tube current of 8.0 M.A. with otherwise the same X-ray apparatus.

Larvae were prepared for irradiation and maintained in the same manner as in the work previously reported,[1] except that they were irradiated in wells in paraffin blocks 125 mm square by 35 mm in thickness. The wells were cylindrical (25 mm in diameter and 5 mm deep) and were situated with axis 25 mm from a corner on a diagonal of a square face of the block—one such well in each block. Just prior to irradiations approximately 200 larvae were placed in each of eight such wells and covered with perforated filter-paper permeated with paraffin as described in the earlier work.[1] Four of these blocks were then placed with wells uppermost upon the same plane with the adjacent corner at a point 30 cm vertically beneath the center of the target of the X-ray tube. Periods of irradiation were so chosen that the following scheme could be employed.

The irradiation intervals were seven successive multiples of 35 minutes up to 245 minutes; so that, with the exception of the last, they could be arranged in pairs whose sum was 245 minutes. Accordingly, with just four blocks in position at all times (as described above) it was possible by means of substitution at

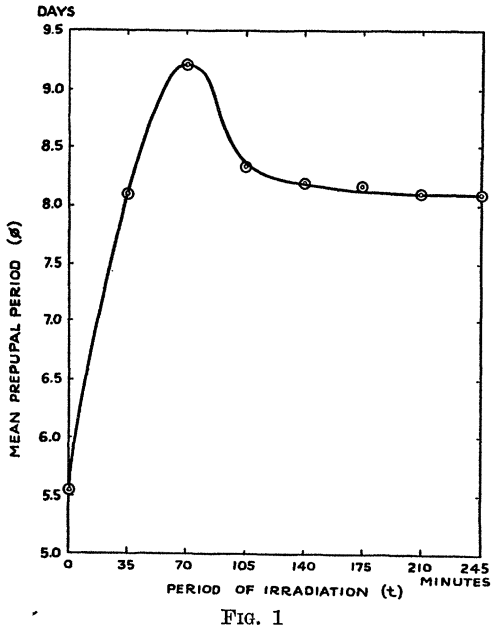

FIG. 1

the proper time of the other member of each pair to complete all the irradiations within the same interval employed for the longest. The eighth block was kept in the same room but shielded from the radiations, and thus corresponded to a zero irradiation interval or control.

[1] R. Hussey, W. R. Thompson and E. T. Calhoun, SCIENCE, 66: 65–66, 1927.