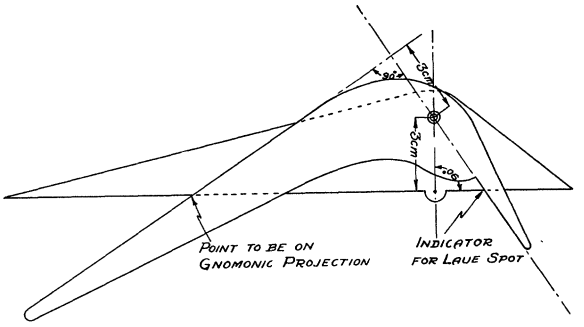

FIG. 1.

(C) in Fig. 2 is a small bearing holding a movable part, so designed that when one of its arms (CD) indicates the position of a Laue spot by its intersection with the straight edge, the other arm (AC) intersects with the straight edge at the correct position for the projected point.

To use the device, a pin is mounted through the small hole at (O) and through the center of the Laue pattern, which has previously been mounted on the sheet of paper intended for the gnomonic projection. The straight edge and the proper movable arm of the ruler are made to intersect at the position of the Laue spot and the corresponding point on the gnomonic projection is marked on the paper with the usual needle point. Rather complicated patterns can be transferred in this manner in a remarkably short time.

The theory is rather simple for the special case in which a definite distance, say c cm corresponds not only to the sample to film distance, but also to the radius of the fundamental circle of the gnomonic projection. Fig. 2 indicates the direction of the

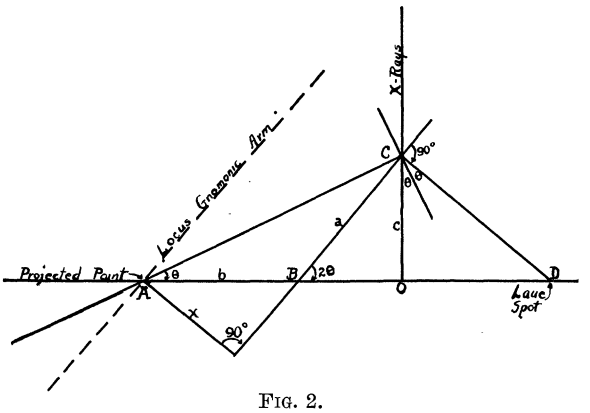

FIG. 2.

x-ray beam producing the Laue spot and shows where the gnomonic point for the same set of planes should lie. Since ABC is an isosceles triangle, $b = a$, but $\sin 2\theta = c/a = x/b$, so that $c = x$. It is evident that the arm intended to designate the position of the point on the gnomonic projection will be perpendicular to the indicating arm for the Laue spot, and at c cm above the bearing C. The bearing, of course, will lie c cm from the center of the Laue pattern at all times. Such a ruler as this can be made in a few moments from bristol board, using for the bearing a rather large eyelet, such as can be obtained from any stationery store. Suitable formulas can be derived for other more general cases, and the curve necessary for the gnomonic arm can be plotted on a piece of graph paper, and mounted on bristol board.

The necessary length of the indicating arms and of the straight edge depends upon the radius of the fundamental circle, and the size of the gnomonic projection desired. The accuracy with which points are located depends to a large extent upon the care used in properly placing the bearing.

Rulers such as this have been successfully employed in this laboratory, and make this type of projection a matter of only a few minutes rather than the somewhat tedious series of operations usually employed. For ordinary work we have found the special case at 3 cm to be very convenient.

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HYDROPONICS SOLUTION USED FOR DAPHNIA CULTURE

FOR the past year and a half we have had considerable success in raising *Daphnia* and other Crustacea and in maintaining cultures for long periods of time, using Gericke's hydroponics[1] solution as a culture medium. *Ankistrodesmus* developed rapidly in this solution and was consumed by the Crustacea. By employing the alternate aquarium method *Daphnia* cultures were kept going throughout the year. Besides *Daphnia pulex,* many other common aquarium forms have been successfully grown in this solution. The extremely common ostracods, *Cyprinotus incongruens* and *Cypridopsis vidua,* amphipods, copepods, planarians, snails and in fact all the usual inmates of aquaria thrive in this nutrient medium. Gericke's solution was also found to be excellent for growing *Elodea, Cabomba* and other aquatic plants to supply aquaria in our department. The added growth and vigor of the plants was noticeable within a day or two after transferring them to the culture medium. Recently, in order to show quantitatively the gain obtained by this method, we have made a series of controlled determinations of total organic matter, plankton counts and chemical changes, the results of which are given below.

In these experiments two five-gallon glass battery jars were placed in a window with a southern exposure,

[1] W. F. Gericke, SCIENCE, 85: 177, 1937.

one containing ordinary tap water and the other the solution used in hydroponics; 100 cc of a culture of *Ankistrodesmus* was added to each jar. Weekly determinations were made on each aquarium, the water or solution taken out being replaced each time and the loss due to evaporation made good by the addition of the tap water. One liter was run through a Foerst centrifuge and the organic matter determined by loss on ignition; a half liter was centrifuged for plankton counts. Methyl orange alkalinity, free carbon dioxide dissolved oxygen and pH determinations were made. A 14.0 cm length of *Elodea* was placed in each aquarium and the gain in length determined weekly. At the conclusion of the experiment the plants were dried and ashed to determine the organic matter in each.

The results expressed graphically are shown in Fig. 1. The graphs show strikingly the comparatively

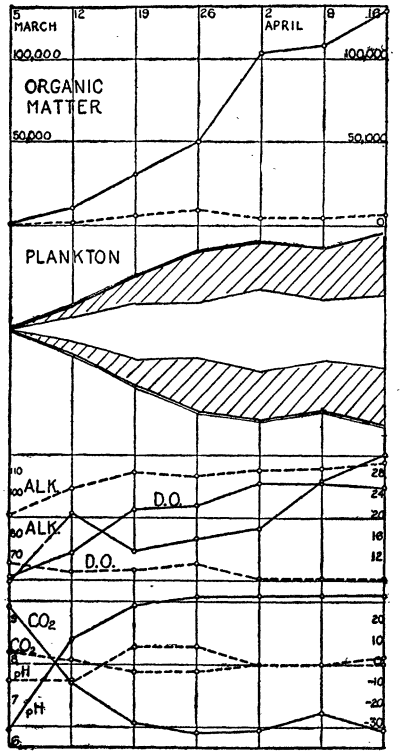

FIG. 1. Organic matter, plankton and chemical changes in aquaria containing hydroponics solution and control. Organic matter shown as milligrams per cubic meter; plankton as the number of individuals per liter, total vertical height represents fertilized aquarium, central unshaded portion the control; chemical figures in parts per million. Solid line represents fertilized aquarium, the broken line the control.

slight chemical changes in the control compared with the marked activity of the fertilized aquarium. In presenting the results of the plankton counts Lohman's spherical method was employed in order to bridge the extreme range between minimum and maximum numbers. The control ranged from 440,000 individuals per liter at the start to 440 million at its maximum, while the range in the fertilized aquarium was from 560,000 per liter to over 6 billion. *Daphnia* should be introduced after the first week or two or as soon as the culture becomes a decided green. In the present experiment the algae were allowed to multiply unchecked for six weeks, and at the end of that time, in fact long before it, the aquarium containing the culture medium was a very dark opaque green, while the control was barely tinged with a greenish color and perfectly transparent. The *Elodea* plants made their most rapid growth during the first part of the experiment due largely to the increasing green color in the culture solution and to the exhaustion of food from the control water. At the end of six weeks the plant in the culture was 32 cm in length and the control 25 cm; the condition of the two plants, however, showed great differences, the control being a sickly pale color with very short leaves on its terminal portion and no roots, while the other plant showed vigorous dark green leaves and numerous roots. The organic matter of the control amounted to 156.06 milligrams and that of the other plant 242.51 milligrams. It should be pointed out here that no soil was placed in either jar and this fact contributed to the very poor growth of the control plant.

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