More, presented at the joint session with Section L and the History of Science Society, will be published in full by the History of Science Society. Failure to mention this carefully prepared paper is the last serious omission.

P. F.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF MAKING TOPOGRAPHIC MODELS

RELIEF models have recognized advantages over other devices for representing topography. Teachers of physical geography, physiography or geography have found them especially valuable. Models of this type can be readily understood by children as well as by adults; hence their usefulness extends through the entire range of age groups.

One serious limitation in the use of such models is the difficulty of achieving detail and accuracy without spending an undue amount of time in their construction. To overcome these difficulties in part, a device was developed by the writer at Syracuse University when it was desired to prepare a model of the local area for the Natural Science Museum. With the aid of this device, nearly four thousand five hundred square miles of topography, representing central New York, have been completed. Both the accuracy and the amount of detail have proved satisfactory. Since the work was done during spare time, no accurate records were kept of the number of hours required. A fair estimate is that twenty-five square miles of topography of average difficulty may be completed in one hour, after a little experience.

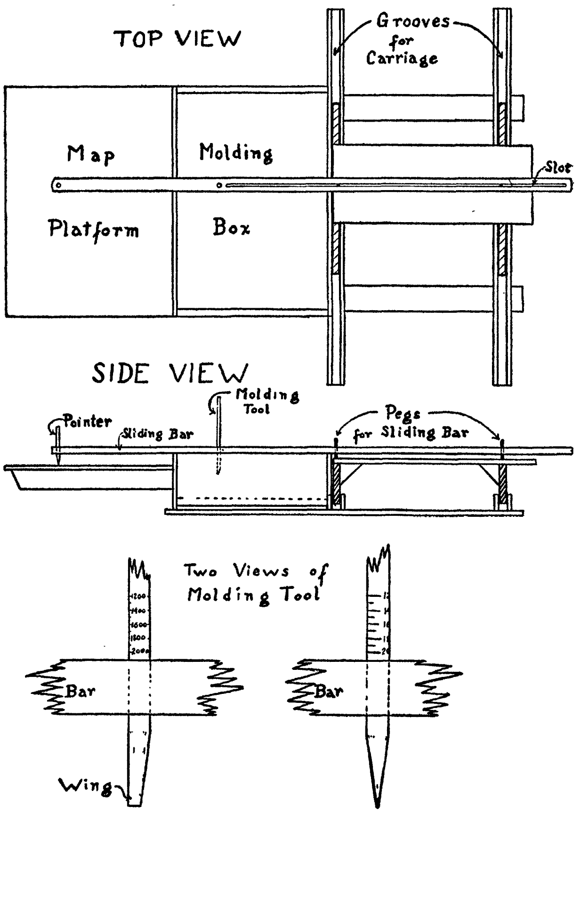
The method consists in making the relief first in molding sand, using a contour map as a guide. Plaster of Paris is then poured over the sand model, and the resulting plate used as a mold from which the permanent model, also of plaster, is cast.

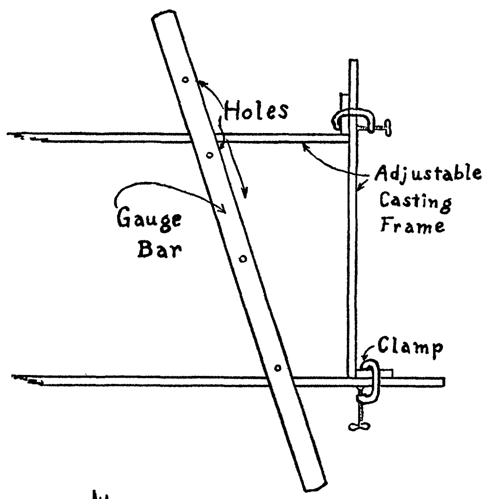
The central unit of the device for making the sand model consists of a box slightly longer and wider than the map, and about two inches deeper than is required for the maximum relief in the area to be represented. This box carries an attached platform at the left hand side on which the map is placed. A sliding carriage is mounted in grooves on the right hand side, free to move forward or backward as far as the limits of the box, but fitting closely in the grooves. This carriage supports a sliding bar which may be moved from side to side. The bar carries a molding tool near its center and a pointer at the left hand end by means of which map locations are transferred to the sand box. The vertical scale is marked on the molding tool. To facilitate the removal of the plaster plate from the sand box, the latter is provided with a false bottom which is lifted out by means of wires attached near each corner.

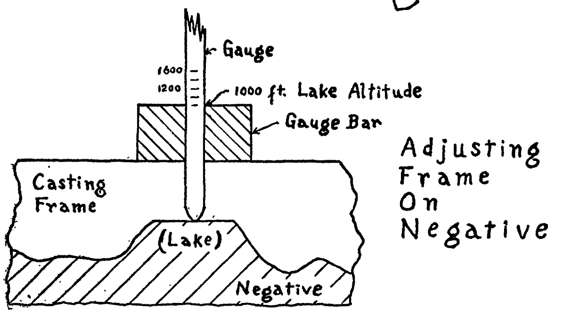
Much of the effectiveness of a relief model depends on a proper vertical scale. The vertical exaggeration employed on the Syracuse model is approximately 4 1/3. That is, with a horizontal scale from the map of 1/62500, the vertical scale is twelve hundred feet to the inch. This is enough to accentuate the low relief of the Ontario Plain north of Syracuse, and yet not too much for the dissected plateau country to the south.

Procedure: Fill the box nearly full of fine moist molding sand, tamped down firmly. Adjust the map so that when the pointer is moved around the map margin the molding tool will follow around the inside margin of the box. Secure the map in position with thumb tacks.

It has been found best to begin with that portion of the map nearest the operator. Place the pointer successively at each prominent hill top and set the tool each time at the corresponding level. Hold the tool and bar with the left hand, and grasp the carriage with the right. By moving the bar from side to side, and the carriage forward and backward, the excess sand is loosened and may be removed. A teaspoon and a soft brush have been found satisfactory for this purpose. Then select a contour line about a







hundred feet lower and set the tool to throw the sand away from the hill as the pointer follows along the line. It may be necessary to turn the tool as the direction of the line changes. Much care is required to avoid breaking down steep hillsides or narrow ridges. Experience will develop the proper technique. The minor ravines are best done free hand, using either the spoon or the molding tool after determining accurately their positions. If the sand becomes dry and crumbles it must be moistened by careful sprinkling. When the model has been formed, the loose sand grains at the surface should be pressed down with the fingers, being careful not to destroy any part of the work, or to leave concave finger imprints. A thin mixture of plaster of Paris may now be poured gently over the model to a depth of about an inch, or until the hill tops are well covered. The amount necessary will be governed to some extent by the nature of the relief. When it has set firmly it should be loosened from the sides of the box and removed by lifting out the false bottom. The sand may now be cleaned from it by scraping and brushing.

The final cast is made in an adjustable frame. The one used by the writer consists of four separate side pieces, each with a flange at one end by which they are clamped to each other with small clamps. This frame fits closely around the plate or negative, and is supported independently. A gauge is used to adjust the height of the frame. Test the adjustment by sighting across the edges. They must all be in the same plane else the completed cast will not rest on an even base. The surface of the mold must be coated with vaseline or similar substance to prevent the cast from sticking. Fill the frame with plaster of Paris mixed thin enough to fill readily the inequalities of the mold. Use a straight-edged board to smooth the top even with the edges of the frame. Oftentimes it will not be necessary to fill the center of the frame to this level. Use only enough plaster to insure adequate thickness and strength. When dry, the cast may be cleaned and painted in any desired manner.

An important feature of this device is that the completed model has the same horizontal scale as the map from which it is taken. If a pantograph is used to guide the molding tool, the model may be made either larger or smaller than the map, but it is not convenient to reproduce the same scale. The writer has used a large pantograph in this way to increase the scale of models made from maps. It is a satisfactory method, except that the enlarged model calls for a corresponding increase in detail not shown by the map.

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AN OSCILLATOR AND SYNCHRONOUS MOTOR FOR OBTAINING EXACT VARIABLE SPEEDS

Where it is desired to have a shaft or disc rotating at a single exact rate, the synchronous motor, following the oscillations of an alternating current, gives an extremely high degree of accuracy. The type of motor employed in electric clocks and that recently described by Wilkins[1] serve that purpose. However, it is often necessary to have the rate of rotation exact, but capable of rapid and convenient variation. The clock motor, though designed to operate on 60 cycle alternating current, can be made to run and vary its speed over a fairly wide range if operated from the output of an oscillator of variable frequency.

The construction of such an oscillator is shown in Fig. 1. A screen grid tube, Type UX-222, is employed as a dynatron in a circuit of the parallel tuned type. This kind of oscillating circuit has the advantage of stability greater than that afforded by the ordinary type of vacuum tube oscillator.[2] If the proper capacities and inductances are used variation of frequency over a wide range is possible. Small inductance, capacity, or both, yield high frequency; lower frequencies are obtainable by the use of larger

[1] H. S. Wilkins, *Gen. Rad. Experimenter*, 1930, 5, No. 5, 3–7.