

It must be obvious that with the acquired ability to present such appropriate illustrations of a subject, the pupil's comprehension of it, and the clearness and accuracy of his description of it must be greatly assisted; and more than this, the plan calls for the exercise of originality and independent thinking which is the true solution of the problem of mental training.

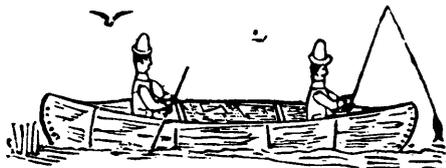


FIG. 9.—INDIAN CANOE, USED BY COLONISTS.

Fig. 3, for example, is one of a number of sketches to illustrate the resemblance, in outline, between bodies of land and water.

Figs. 4 to 9 belong to a series in one of the compositions on "Life in the Colonies." These sketches were as artistically placed in the writing of the composition as they would be in a page of print.

METALLO-CHROMES.

The production of Nobili's rings is a very simple and pleasing electro-chemical experiment which may be readily tried by any one having one or two batteries, or a small dynamo or magneto-electric machine, and figures of various kinds may be produced by the same process in brilliant colors.

To produce the rings, all that is required is a Bunsen or Grenet battery in good order, a strong solution of acetate of lead (sugar of lead) and a steel or nickel plated brass plate. The lead solution is placed in a common saucer, the steel or nickeled plate is placed in the bottom of the saucer and connected by a wire with the zinc pole of the battery, and the end of the wire, which is connected with the carbon pole of the battery, is held near the steel plate without touching it, as shown in Fig. 1. In a very short time a spot of color will ap-

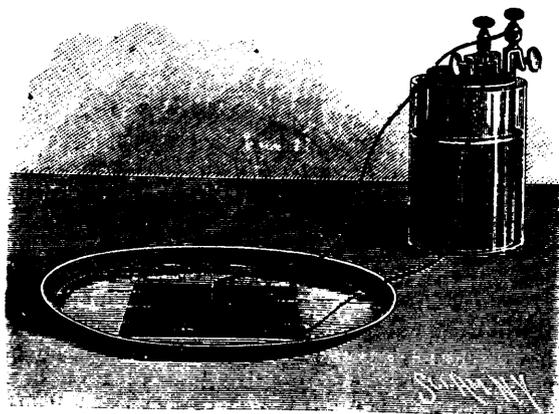


FIG. 1.—PRODUCTION OF NOBILI'S RINGS.

pear on the plate, and in a minute or so the spot will spread rapidly and form concentric rings of prismatic colors, as shown in Fig. 2. A few trials will enable the operator to determine the time required for the production of the best effects. When the operation has proceeded far enough, the plate is removed from the solution, washed in clean water and dried. The

beautiful color effect is due to the decomposition of the light by the exceedingly thin film of peroxide of lead deposited on the surface of the plate. It is quite permanent, and serves to protect the surface of the plate from oxidation.

To secure the best results, the plate should be highly polished and the lead solution should be filtered.

By providing anodes of different forms, various ornamental figures may be produced on the surface of the plate. For example, a wire bent into the form of a letter or figure of any form may be used as an anode for producing a figure of the same general form on the plate. As it is sometimes difficult to hold the anode in the proper position, ordinary insulated wire (magnet wire) may be used. This permits of placing the anode down upon the plate, the insulation serving to prevent direct electrical contact.

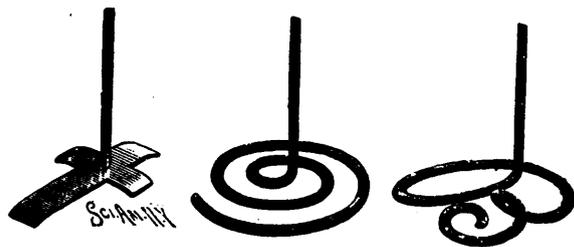
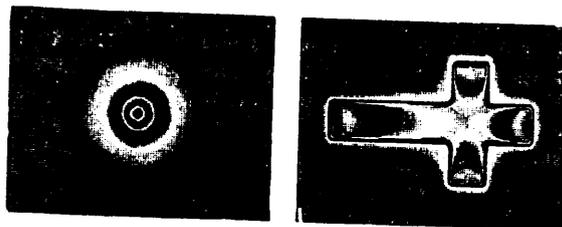


FIG. 2.—METALLO-CHROMES AND ANODES.

Very beautiful effects may be secured by cutting an anode of the desired shape from sheet copper and bending parts so as to vary their distance from the plate as in the case of the cross, Fig. 2. The result is that the film is deposited in beautifully graduated colors at the extremities of the figure, the arrangement of colors bearing some resemblance to those of a peacock feather.

The arrangement of the colors in these films is that of the solar spectrum. Nobili's rings resemble Newton's. The colors are fully as intense and more readily seen.

Nobili discovered this phenomenon in 1826. Since that time many modifications of the process have been devised, and some commercial applications have been made. It has been used to some extent in the ornamentation of small objects, such as buttons, articles of jewelry, etc., imparting to them an iridescence which cannot be imitated by any artificial coloring.

Becquerel suggested a solution for this purpose, the formula of which is as follows: "Dissolve 200 grammes of caustic potash in 2 quarts of distilled water, add 150 grammes of litharge, boil the mixture for a half hour, and allow it to settle. Then pour off the clear liquor and dilute with its own bulk of water."

This solution is adapted to other metals than those above mentioned, but the acetate of lead solution yields very satisfactory results and is sufficient for experimental demonstration. In conducting these experiments the poisonous nature of the solutions should be borne in mind.—By GEO. M. HOPKINS, in the *Scientific American*.