sciences have been set forth, based more or less upon a philosophical concept of the theory of knowledge. The attempt here is to define knowledge in two broad categories—theoretical and practical. Space does not permit a critical discussion of this study of the science of sciences, important as it is from the standpoints of the methodology and history of science.

Dr. Libby evidently recognizes the fact that a good index greatly increases the practical efficiency of a text-book, for his book contains a much larger analytical index than is usually found in books of this size, and its content is as carefully worked out as that of the rest of the volume.

Dr. Libby's book will be also a most inspiring and useful one in the field of adult education and a good guide and source book for purposes of self-education. Therefore college students, laymen and librarians will do well to keep this volume on their shelves.

FREDERICK E. BRASCH
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

PRESERVING CERTAIN GREEN ALGAE IN NATURAL COLORS

PERMANENT slide mounts of the green alga Chara made as described below were very instructive. The natural colors of orange, brown and green were preserved as well as a fine sharpness of detail. The preservation of the sexual organs and thallus was better than in material preserved by usual methods. Two species of Chara were used, both heavily encrusted with lime.

The process is a modification of a method published in 1897[1] and in 1921[2] by Dr. A. F. Woods. Deviations from the schedule might be made to suit different materials. Preparations made as described were not injured by long exposure to the brightest sunlight. Thirty per cent. nitric acid did not change the colors for a remarkably long time.

Copper is employed to fix the chlorophyll, forming a light-fast compound very similar in color and shading to natural chlorophyll. Acetic acid removes the lime. A salt of copper is mixed with the acid so that the two processes go on simultaneously. Of several schedules the following was most successful for lime-encrusted Chara.

(1) Soak plants in cool tap water two days to partly remove lime.

(2) Remove air by soaking in cool boiled water or in an aspirator.

(3) Fix about four hours in a solution containing 4 per cent. acetic acid and ½ per cent. C. P. copper acetate (sulphate may be used). Use 50 volumes of solution to one of material. Agitate material occasionally to remove CO_2 bubbles.

(4) Pour off the blue solution and add to it just enough concentrated ammonia to give it a marked purple tint. The purple is due to the formation of complex copper-ammonia ions. Pour the basic solution back on the material and let stand for an hour or until the thallus shows a marked blue-green color.

(5) Wash in tap-water ten minutes. Soak in 50 volumes distilled water for five minutes. Material should now show thallus bluish green, antheridia orange and oogonia brown and green. Transfer to a 5 per cent. glycerine solution in distilled water. If 5 per cent. glycerine causes plasmolysis omit wash in tap water using 5 per cent. glycerine instead.

(6) In order to preserve the orange and brown pigments the following schedule must be rigorously observed. Pieces of smooth glass should be cleaned and the material placed on them in lots of the size desired in the permanent glycerine jelly mounts. Cover each bunch of material with thin glasses. Start artificial evaporation at once. If available use hot sunlight and air. The following was used with success. Slides were placed on an asbestos board and heat projected upon them from a regular electric heater. Adjust so water evaporates steadily but not suddenly from under the cover-glasses; add 5 per cent. or 10 per cent. glycerine as needed. Toward the end more concentrated solutions may be used to advantage. Occasional examination should be made to guard against plasmolysis or swelling. Practice is necessary. Not more than ten or twelve hours should be employed in evaporation if the orange and brown are to be preserved.

(7) When nearly the consistency of pure glycerine, remove the glasses and mount on clean new slides in Kaiser's gelatin. Allow to harden for at least a week before sealing two or three times with balsam. The formula for Kaiser's gelatin may be obtained from Lee's "Microtomist's Vade-Mecum" or other text of histology.

The method outlined above is difficult but it is possible to make some beautiful preparations. It is a modification of an old process employing well-known principles. Such a procedure has been applied to plants other than the algae with success.

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[1] A. F. Woods, "Method of Preserving the Green Color of Plants for Exhibition Purposes," *Bot. Gaz.*, 24: 206, 1897.

[2] A. F. Woods, "Preserving the Green Color of Algae, Protonema, etc.," *Quar. Jour. Mic. Science*, 14: 225–228, 1921.