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THE TEACHING OF PHYSIOLOGY[1]

By Professor AUGUST KROGH

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I HAVE been engaged in physiological research and in teaching human physiology for about forty years during a period in which the most astounding progress has been made, and the subject from being of mainly academic interest has developed into being of deep significance for the welfare of mankind.

I wish to contend that the teaching of this branch of natural science has not kept pace with its increasing significance, that it should be taught to a larger number of people and in a more effective way than is usual at present.

I am not now concerned with the teaching of physiology to the small number of students who are going to engage in physiological research; they can pick up their factual knowledge during their apprenticeship, but I am thinking of all those people who need some knowledge of physiology to order their own lives and in their respective trades and professions, and my major contention is that this knowledge should be imparted mainly in a utilitarian way without any attempt to cover the whole subject as academically defined and delimited, but stressing definitely those parts of it which are most useful from the point of view of the pupils and therefore most likely to catch and hold their interest. I am convinced that at all stages the active cooperation of the pupils in the acquisition of this knowledge should be obtained.

Adopting this as my guiding principle, I would like to have the fundamentals of nutrition introduced as a subject in all lower schools—at least in the cities. While it is no doubt true that the instincts of children could guide them to a right selection of natural foods, this does not hold at all in the highly artificial environment in which most children are brought up; and they

[1] An address delivered before the American Academy of Arts and Sciences, Boston, on May 10, 1939.

erence or other notation concerning the source of the material and descriptive information. The subject headings of the index are patterned after the bibliographic indices of those using the material. Colored cards are used for indexing colored slides, white cards for those in black and white.

Any one wishing a certain slide or one on a specific subject turns to that subject in the card index and chooses, on the basis of the picture and attached information, the slide he wants. He may then quickly draw the slide of that number from the slide file.

The slide file is a numerical arrangement of the slides in each major subject. The file of this department is divided into twelve such major fields. As in the card index the subjects are indicated by letters, the slides by numbers. To find slide G-253 one opens the "genetics" drawer and removes the slide bearing that number on the "thumb mark" placed on the upper right-hand corner of the slide as it goes into the projector.

The slides are filed on edge with the numbers toward the front of the drawer, in wooden troughs 2 inches wide by 1½ inches deep inside. A white card which projects slightly above the slides is placed at intervals of 25 slides and bears the number of the series at that point. The troughs are made in units of two, which fit into a 3×5 inch card compartment. Four rows of more than 100 slides each can thus be filed in each of the lower drawers of the cabinet holding the subject index. The bottoms of the troughs are raised above the bottom of the drawer sufficiently to raise the slides to the top of the 3×5 inch compartment. To facilitate removal and handling of slides the inside depth of the trough is one-half inch less than the height of a slide.

The negative file is a comparatively inactive file, since it is likely to be used only for duplication of slides or for making prints of the slide subject. Various methods of filing may be utilized.[1] A convenient one has been to cut the film into strips of three negatives each and place them in 3×4⅞ inch kraft paper coin envelopes ("bags") which are numbered serially. These envelopes are durable and can be filed in a drawer of the cabinet containing the subject index and slides. (Use of the short length of film has not appeared inconvenient in the enlarger or contact printer used, and when a certain negative is required, unnecessary handling of other negatives is avoided.)

The clerical labor and the printing of photographs necessary for the subject index is well repaid in a large collection by the later saving in time required for finding desired slides and by the fact that several individuals can use the same collection effectively and without confusion. Moreover, the experience in this department shows that slides thus catalogued are more extensively used because of the ease with which the desired material can be found.

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LANTERN SLIDES FROM TYPEWRITTEN MATERIAL

THE recent note of Carpenter,[1] under the present title, on typing or drawing through white carbon paper onto black paper, to eliminate one step in the photographic process of making white-background slides is useful for certain work, but we have found that another step—that of retyping text material and retracing diagrams through white carbon paper—can be avoided by photographing the material from which slides are to be made onto a contrast grade direct positive film of the type supplied by the Eastman Kodak Company in their "high contrast direct positive film." The result of using this is a positive film (without having to prepare a negative) which can be bound between two standard size slide glasses with a slide mask as usual, effecting a saving in time of preparation.

CHARLES G. MILLER
BERKELEY, CALIF.

[1] SCIENCE, 89: 372, 1939.

BOOKS RECEIVED

American Philosophical Society: *Year Book, 1938.* Pp. 407. The Society, Philadelphia.

BERNAL, J. D. *The Social Function of Science.* Pp. xvi + 482. Macmillan. $3.50.

CHIBNALL, ALBERT C. *Protein Metabolism in the Plant.* Pp. xiii + 306. Yale University Press. $4.00.

FALES, HAROLD A. and FREDERIC KENNY. *Inorganic Quantitative Analysis.* Pp. xiii + 713. 132 figures. Appleton-Century. $4.00.

HEISKANEN, W. *Catalogue of the Isostatically Reduced Gravity Stations.* Pp. 140. Publication No. 5, Isostatic Institute of the International Institute of Geodesy.

HOLMES, HARRY N. *Introductory College Chemistry.* Third edition. Pp. viii + 619. 171 figures. Macmillan. $3.50.

MARSLAND, DOUGLAS and PAUL F. BRANDWEIN. *Manual of Biology; Part One, the Protozoa and the Plant.* Pp. ix + 176. 85 figures. *Part Two, the Metazoan Animals.* Pp. ix + 211. 83 figures. Holt. $1.20 each.

MELHUS, IRVING E. and GEORGE C. KENT. *Elements of Plant Pathology.* Pp. x + 493. 259 figures. Macmillan. $4.00.

MEYER, BERNARD S. and DONALD B. ANDERSON. *Plant Physiology; A Textbook for Colleges and Universities.* Pp. x + 696. 151 figures. Van Nostrand. $4.50.

Ruwenzori Expedition, 1934–5; Vol. I, No. 1, Introduction; No. 2–3, Simuliidae, by E. G. GIBBINS; *Mosquitoes,* by F. W. EDWARDS and E. G. GIBBINS; *Vol. I, No. 4, Psychodidae,* by A. A. TONNOIR; *Vol. I, No. 5, Ceratopogonidae,* by J. W. S. MACFIE; *Vol. III, No. 1, Trichoptera,* by M. E. MOSELY; *Vol. III, No. 2, Siphonaptera,* by K. JORDAN; *Vol. III, No. 3, Rhopalocera,* by A. G. GABRIEL; *Vol. III, No. 4, Lymantriidae,* by C. L. COLLENETTE; *Vol. III, No. 5, Ephemeroptera and Neuroptera,* by D. E. KIMMINS. British Museum (Natural History), London.

TAYLOR, F. SHERWOOD. *The March of Mind; a Short History of Science.* Pp. xiv + 320. 36 figures. 14 plates. Macmillan. $3.00.