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Science Education

ANOTHER VISUAL AID FOR BIOLOGY CLASSES

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OPTICAL INSTRUMENTS IN ELEMENTARY DEMONSTRATION

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Visual education seems to be in the foreground of discussion today. Due to the fact that the majority of people have an eidetic memory, visual aids are highly efficient in instruction. Disciplines of science especially are fortunate to have at their disposal not only movies, slides and tables but also experimental apparatus and laboratory work. There still is the argument whether a film strip actually has a greater value than the experiment itself. The author believes that any experiment properly prepared in the class, executed at the level of the students, and discussed in all implications (considering the capacity of the students) is more valuable than the best movie or slide series.

Often schools prefer to acquire films and slides and neglect the purchase of equipment for science classes. Many schools are reluctant to buy equipment for science classes because of the expenses. It is evident however that any neglect of equipment of science classes handicaps the teachers as well as the pupils. Fundamental concepts must be demonstrated by experiments, and if this is impossible by movies or slides.

The author wishes to state that the price of equipment does not necessarily vouch for its success in the class room; that sometimes equipment built in the school shop or basement serves the purpose better than fancy apparatus purchased from a supply house. In order to encourage science teachers to do their own designing and constructing this paper was presented.

The demonstration outfit described deals with experiments fundamental to geometrical optics and optical instruments. Due to the fact that already war surplus material is available for civilian use, this outfit requires an investment of only a few dollars. The author used optical elements which he obtained from the Edmund Salvage Company, 27 West Clinton Avenue, Audubon, New Jersey.

The demonstration outfit does not only enable the observation of light pencils and image formation of lenses and mirrors but also of its practical applications—the telescopes and microscopes. Of course the demonstration of the human eye as an optical instrument has to precede the discussion of more complicated optical instruments, like the photographic camera and the slide projector.

To facilitate the demonstration a trough was made of heavy sheet glass (3/16 inch thick) of the dimensions 5 in. x 5 in. x 30 in., and put together by means of adhesive tape, 2 in. wide. If a more permanent equipment is desired the glass plates can be cemented together with aquarium cement.

Into the trough optical elements are inserted by means of holders. The holders consist of 22 gauge sheet metal strips 0.5 in. wide, which, although small, hold the lenses and prisms quite firmly by virtue of their elasticity. The holders with their optical elements slide on the upper frame of the trough.

Since a projector is usually available in most of the schools this kind of equipment was considered as light source. However, even a strong flashlight can be used efficiently as light source with this outfit.

There also are diaphragms made of sheet metal to improve the visibility of coaxial and extra-axial rays as well as diaphragms to facilitate image tracing in optical instruments. Fig. 1* shows one-slit, two-slits, three-slits diaphragm to trace rays; Fig. 2 shows a diaphragm to trace the image in a telescope; Fig. 3 shows a diaphragm to trace the image in a microscope.

To demonstrate the existence of an image a ground glass or a No. 375 fluorescent glass, Corning Glass Works, Corning, N. Y., is used. The Corning Glass Works also make glass rods of fluorescent glass which can be used as pointers. A rod of this glass, 8 in. long makes an ideal pointer.

Fig. 4 shows the trough with light source, diaphragm, and lenses demonstrating the Dutch telescope and human eye. The advantage of this design of the trough is that the optical instrument can be tested not only for path of rays and image formation and location but also for direct observation. This means you can use it as an optical instrument as such, for you can place your eye at one end of the trough and the object of observation, either at the other end of the trough or outside of it, is visible through the glass wall of the trough.

To trace the rays and the image the simplest way is to blow smoke into the trough, and cover it with a glass plate, after the lenses or other elements necessary for demonstration are inserted. By moving the holders you can establish the conditions suitable for the use of the instrument. If a change of medium is desired (to show

* Footnote: The author apparently failed to include the figures of reference.

that the change of refractive index affects the focal length of lenses) water can be poured into the trough, and by the use of a few drops of milk sufficient turbidity is produced to trace the rays.

Fifteen demonstrations have been worked out with this demonstration outfit:

1. Reflexion (one-slit diaphragm, plane mirror, fluorescent pointer)
2. Spherical Mirror (one-slit diaphragm, spherical mirror)
3. Refraction (one-slit diaphragm, flat) and (medium prism)
4. Refraction of curved surfaces (three-slits diaphragm, + lens /60mm f.l./, — lens / —125 mm f.l./)
5. Image Formation (L-diaphragm, + lens, — lens, ground glass)
6. Human Eye (see 5 but without — lens) / = photographic camera)
7. Magnifying Glass (Triangle —diaphragm, + lens and Human Eye)
8. Compound Microscope (Triangle —diaphragm, + lens/24 mm f.l./, + lens /60 mm f.l. and Human Eye)
9. Astronomical Telescope (L and three-slits diaphragm, + lens /180 mm f.l./, + lens /24 mm f.l./ and Human Eye)
10. Dutch Telescope (L and three-slits diaphragm, + lens /180 mm f.l./ —lens /—125 mm f.l./ and Human Eye)
11. Terrestial Telescope (L and three-slits diaphragm, + lens /180 mm f.l./, + lens /60 mm f.l./, + lens /24 mm f.l./ and Human Eye)
12. Total Reflexion (one-slit diaphragm, Porro Prism)
13. Compound Telescope (L and three-slits diaphragm, + lens /180 mm f.l./, —lens /—125 mm f.l./, + lens /24 mm f.l./)
14. Prism Telescope (L and three-slits diaphragm, + lens /180 mm f.l./ 2 Porro Prisms, + lens /24 mm f.l./ or Kellner Eye Piece)
15. Rifle Telescope (L and three-slits diaphragm, + lens /180 mm f.l./, cross-lines-reticle, Kellner Eye Piece)

The material for the trough consists of:

2 plates : 5 in. x 5 in.
1 plate : 6 in. x 31 in. (top plate)
1 plate : $4^{13}/_{16}$ in. x $29^{10}/_{16}$ in. (bottom)

if plate glass is $^{3}/_{16}$ in. thick.

If the lens formula is intended to be derived experimentally an inch scale is attached to the trough, and the different intersection points and lens positions are marked by a glass pencil (red wax). The positions of the elements can be established either by direct observation of the object through the optical system, or by ray tracing and denoting the position of the elements.

This demonstration outfit is a suggestion only. The teacher who wants to do his own designing can improve this outfit and adapt it to his special problems of instruction. The author wishes to remark that the outfit has been used in actual class work, as well as in laboratory work, and the students were very enthusiastic about it. As a matter of fact they tried to build it themselves.

CONCERNS OF B.A. CHEMIST, CITIZEN *

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PROBLEMS ENCOUNTERED IN PLANNING A MORE EFFECTIVE SCIENCE CURRICULUM

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ABSTRACT

The purpose of this paper is to question the worth of our traditional science curriculum and to ask that studies be undertaken to determine what improvement can be made within the physical limitations of the usual high school.

In order to focus attention, consideration is here given not to the pre-medic or pre-engineering student but to the future manager, lawyer, or salesman. The criticism is offered that while this student has a record of B's and A's in science courses, his behavior on graduation exhibits certain grave deficiencies. He is lacking in true interest in science and things scientific. He has a mere verbal, memorized idea of experimentation. He cannot easily use the simpler operations of arithmetic and algebra. In short, he is weak in functional knowledge that we might expect to acquire in science courses.

Where is the cause or causes of this situation? What do we do in our science programs? What do we need to do? These questions require both philosophic and scientific answers. The former is the easier, and since the current vogue demands that we formulate objectives first and develop our program afterward, we of the science faculty of the Rochester Schools have approached the problems from just that point.

As is usual in the field of education, the preliminary meetings at Rochester were consumed with definition of terminology. The time seemed wasted, but we did discover essential agreement. In teach-