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level technical area and the pool of underemployed undereducated youth. A capsule history of vocational and technical education is followed by discussion of specifics in chapters headed, "Vocational and Technical Education in Secondary and Higher Education," "Other Opportunities for Vocational and Technical Education," "The Federal Government and Vocational and Technical Education," "Manpower Needs, Present and Future," and "Major Issues in Vocational and Technical Education."

The final, excellent, chapter offers conclusions and recommendations that stress the compelling need for the educational

system to concern itself with occupational education. Indeed, the report warns, if it does not, a separate system of education will emerge in the nation, and this will be unfortunate. Recommendations include vigorous urging that more research be done, that lines of co-operation be strengthened, that the offerings in technical and occupational education be greatly widened and deepened, that guidance be intensified, that the education system assume more responsibility for the "drop-out," and that interest, need, and ability be made the basis for enrollment in vocational and technical education, rather than financial capability.—*Ed.*

## CHEM Study Films to Improve High-School Chemistry Teaching

By DAVID W. RIDGWAY

*This report is an abridgment of a presentation made by David W. Ridgway, Director of Film Activities, Chemical Education Material Study, Lawrence Hall of Science, University of California, Berkeley, Calif. 94720, on March 31, 1965, at the Society's Technical Conference in Los Angeles.*

TWENTY-SIX motion pictures, averaging 20 min in length, produced by the Chemical Education Material Study (CHEM Study) are now being widely used by both secondary schools and colleges.

CHEM Study is the outcome of a recommendation of a committee of the American Chemical Society. The objective of CHEM Study was to improve the teaching of chemistry at the high-school level. CHEM Study, under the leadership of Glenn Seaborg, Chairman of the Atomic Energy Commission, in addition to the films, produced a textbook entitled *Chemistry—An Experimental Science*, a lab manual and a teachers guide. An unusual feature of the films is that they are directly integrated into the course. The production of all of the materials was made possible by a grant from the National Science Foundation. A new emphasis is placed on the experimental approach. Descriptive materials are de-emphasized and memorization and subsequent regurgitation are discouraged.

The films were designed to do those things which the teacher would find difficult or impossible to do in the classroom. The films concentrate on presenting experiments which teachers cannot do readily because of the expense of equipment, scarcity of chemicals or excessive setup time. The films also show experiments done with chemicals which would be too dangerous to handle in the average school classroom.

Animation plays an extremely important part because it can present effectively, in a few moments, abstract concepts and principles which the teacher could present only laboriously with words or ineffectively at the chalkboard.

Before the production of the film series was started, it had to be determined whether CHEM Study would set up its own studio and hire a production staff to do the films or whether it would be more practical to utilize already established commercial film production organizations.

While a certain unity and uniformity of product might be achieved by having one coordinated staff operating in a central headquarters, there seemed to be distinct advantages in utilizing already established commercial film production organizations. The established companies had competent staffs which had worked together effectively. Each one had special talents and provided some variety in presentation. Furthermore, CHEM Study used scientists at widely separated geographical points and it turned out to be possible, in every instance, to utilize a film production organization which was close to the collaborating scientist. Geographic proximity, too, made it possible for the scientist to work very closely with the script writer and with the entire film production operation. This proximity provided one of the essential ingredients without which it was found that good scientific films could not be produced.

Of the twenty-six films twenty four were made in color. For these, photography was done on commercial Ektachrome. Two of the films, where color was not essential, were made in 35mm black-and-white and release prints are made from a reduction dupe negative.

In addition to the normal 16mm release all the films have been adapted for use in an 8mm continuous cartridge sound projector. Half the films have been translated into Spanish. Translation of the remainder is in progress. Many of the films are being used on educational television.

### Discussion

*James A. Larsen (Academy Films):* Can you tell us what was the production cost of the films?

*Mr. Ridgway:* The production cost ranged from a low of \$11,300 to a high of \$29,800; the average cost was \$19,500.

*Mr. Larsen:* What was the average length, or were they all the same length?

*Mr. Ridgway:* The length varied from 13 to 24 minutes; the average length was 20 minutes.

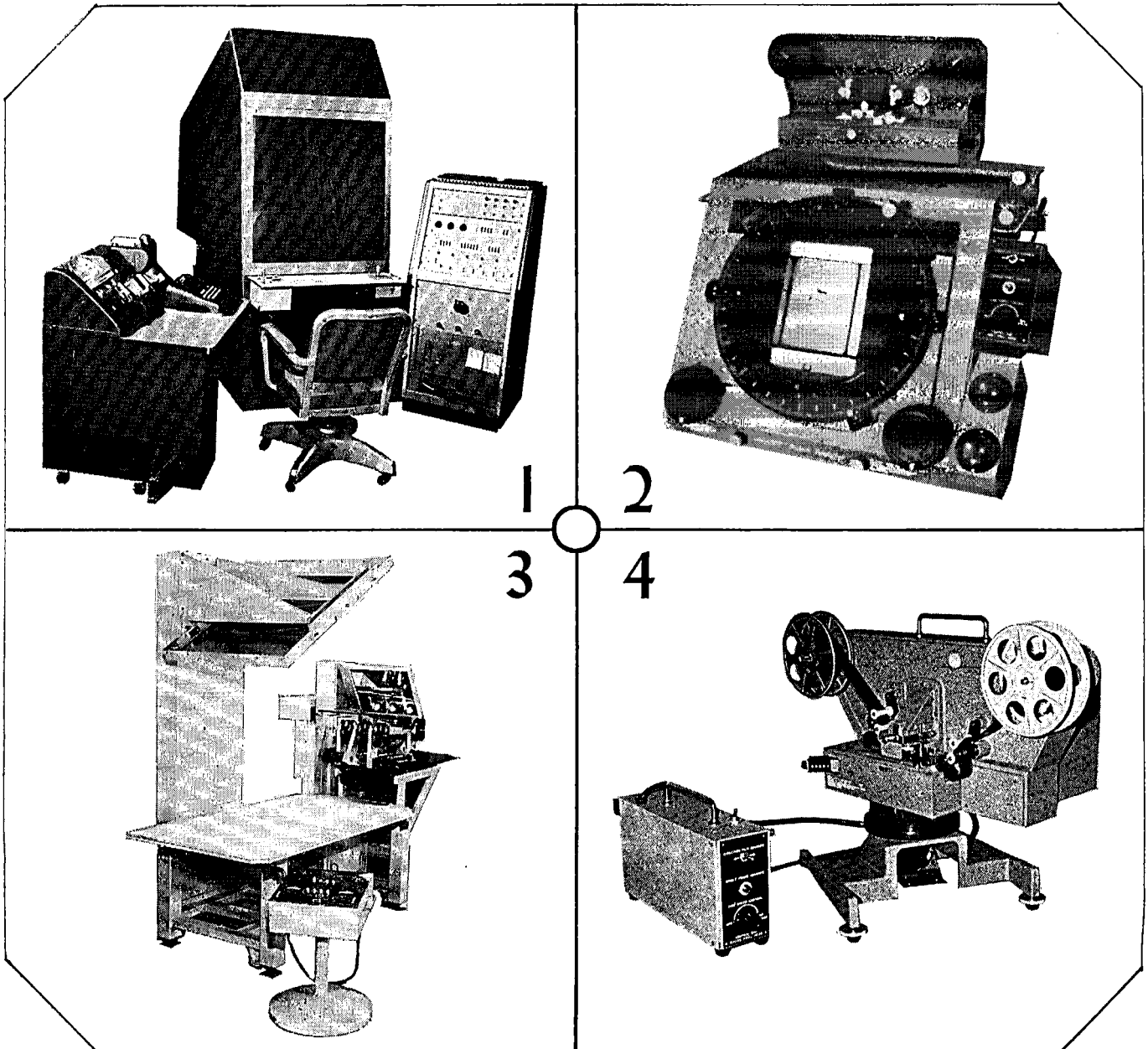
*Mr. Larsen:* And what was the selling price in color or black-and-white, or did you offer them in both forms?

*Mr. Ridgway:* Except for the two films that were photographed in black-and-white, they are all in color, and we are not offering black-and-white prints of the color subjects. The prices vary in accordance with length—which is common practice. The lowest priced one, 13-min, is \$105; and the highest, \$180.

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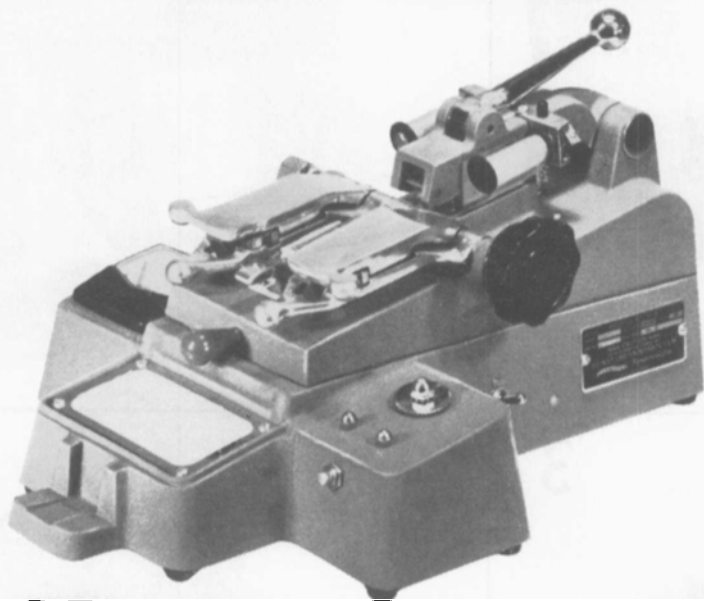
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*Mr. Larsen:* How was production cost financed?

*Mr. Ridgway:* The money for it came originally from the National Science Foundation — then we had competitive bidding for the distribution contract — the lowest — or rather the best bidder — because there are a lot of factors involved, service and that sort of thing — turned out to be Modern Learning Aids.

*Mr. Larsen:* How many different commercial producers were involved in the production of these 26 films?

*Mr. Ridgway:* Seven.

*Robert V. Webber (Parks Photographic Lab., USAF):* Does the Chem Study plan to go into any of the other sciences, such as physics, or physiology or biology; or are you going to stay just in chemistry?

*Mr. Ridgway:* Chem Study was set up just for chemistry. There is a parallel course in physics which is PSSC; there is BSCS in biology; there are several mathematics operations — all of which are supported by the National Science Foundation.

*Charles A. Palmer (Parthenon Pictures):* Does your production cost include an allocation of your own overhead, your own salary, your staff, etc.?

*Mr. Ridgway:* No. The prices I gave were the actual contract cost of making the films, so there would be quite legitimate additional costs for those items that you mentioned.

*Mr. Larsen:* Do you contemplate further films in the same series or is your project essentially completed?

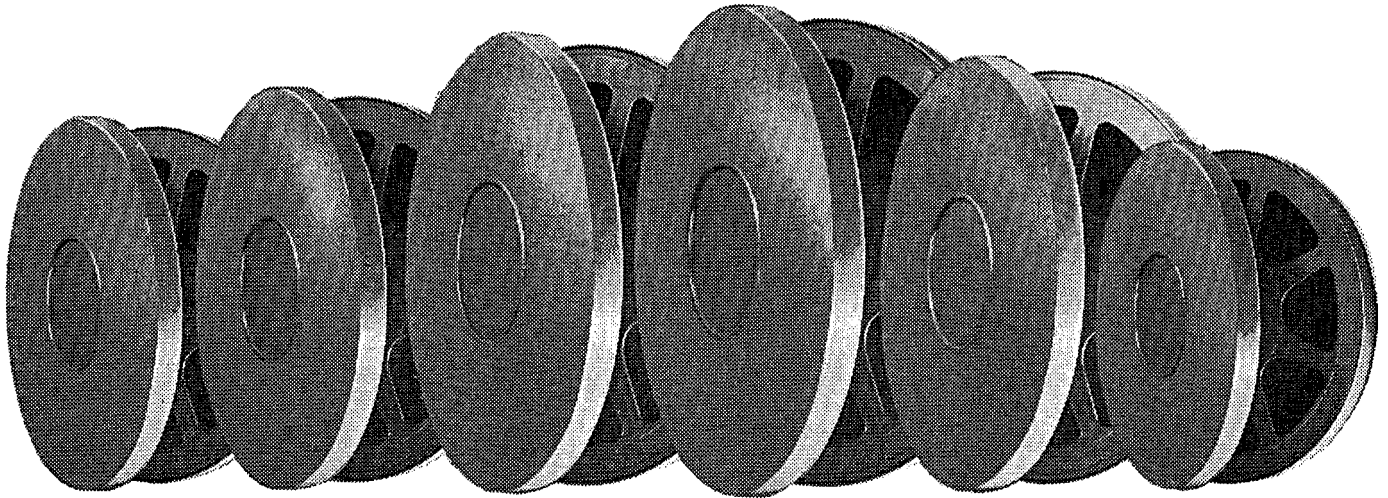
*Mr. Ridgway:* We have provision for two more films a year for a couple of years; however, now we are making adaptations like filmstrips and 8mm cartridge loops. Also we are making foreign versions, etc. However, our basic program is completed.

*Mauro H. Zambuto (Newark College of Engineering):* Has any effort been put into generating a unity, a logical unity in the development of different chemical concepts? In other words, have you considered these pictures as single units or have you tried to generate a logical flow? — from the first picture to the last one; and, if so, is there any order in this?

*Mr. Ridgway:* There is no flow from one film to another but the films are integrated into the course. There are a text, a laboratory manual and a teacher's guide, and there is a progression of pictures with the course. What we attempted with the films was to do those things which the teacher would find difficult or impossible to do in the classroom and we tried, as far as we could, to confine our filmmaking to that. Actually, we have found that the films are also useful in conventional chemistry teaching, but they all anticipate a certain amount of chemistry before you see the films.

*Stanley Gerstein (Parthenon Pictures):* What do you feel is the future for 8mm sound in this area? What do you think is holding up the possible wider use of 8mm sound in classrooms?

*Mr. Ridgway:* I think there is no doubt but that there will be increased distribution in 8mm. We have, at present, all of our films on 8mm and they are all available for the Fairchild projector which is sound and picture with a cartridge which will take a 22-min film. But the distribution in 8mm so far has been very limited, probably for two reasons: (1) few people have Fairchild projectors and (2) the cost of the films in 8mm at the present time is just about as high — it's only 15% less than 16mm. But I think that a smaller format, whatever it may be, will in time be more economical and that it is coming.



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