high-school pupils in the Syracuse area, revealed excellent recorded sound but the reproduction equipment was wanting; and this was quarter-inch tape. So the comment does not wholly apply because there are good tape recorders and bad ones. And mind you the quality I heard out of these Eastman projectors was quite on a par with what I heard on those quarter-inch tape recorders in reproduction.

John A. Maurer (JM Developments, Inc., New York): Dr. Forsdale spoke of the need for low cost in film. Now the basic cost of film is the film itself. If we apply the maximum of ingenuity we can make the cost of printing and processing the film approach zero, but we cannot do away with the film itself. The question is, in the event that we could get the cost of 8mm sound film down to a quarter of the present 16mm cost, this being the ratio of the amounts of film stock consumed, would that be sufficient to free films for the uses that you have in mind in the schools — or ought we start thinking about something even more radical, say new methods of image duplication and new kinds of film?

Dr. Forsdale: My feeling is that if we were able to get 8mm down to one quarter the price of 16mm release prints of today, this would make a very big difference; but if we could drive the cost down to one tenth, that would very dramatically affect the whole film utilization problem.

Maxwell A. Kerr (Perkin-Elmer Corp., Norwalk, Conn.): In the education process there's frequent need for reference to a single frame for an indefinite time. Teaching machines and textbooks follow this principle. I am evolving different devices and need to see a proper relation between the need for still picture reference related to sound motion pictures.

Dr. Forsdale: Reference to a still picture is very desirable and the film strip has that advantage; however, if 8mm sound film does go down markedly in price then we could run the footage through for a sufficiently long time so that we have, in effect, a still picture on the screen for 30 sec or so, although not con rolled by the viewer, it's true. Secondly, there are many means of cuing motion-picture films to stop on demand for single-frame viewing.

Comment by mail — Mr. Kerr: It would be of decided help if Dr. Forsdale and others in educational pyschology would provide the motion-picture industry with some figures on the relative merit and time duration of classroom use of still pictures with accompanying sound as compared to sound motion pictures. If a major part of teaching needs can be handled by still pictures and closely related sound without the need for showing motion, then a sound filmstrip would be cheaper and more compact than the lowest cost 8mm sound picture. The sound filmstrip also offers more flexibility in the hands of the teacher since any picture can be held longer for pupil-teacher discussion and study.

As an example of size and cost reduction, I am developing a sound filmstrip (pictures and sound on the same filmstrip) which can reduce a 400 ft 16mm sound motion picture to a sound filmstrip a little over 11 ft long, and which can use the original soundtrack with little alteration. Estimated cost, in color, would be between $3.00 and $5.00. The usefulness of such a system of still pictures and closely related sound depends on the principle that the major need of the teaching situation can be met with still pictures instead of requiring motion pictures; and that it is more important to allow interruptions and discussions at frequent points during the film than to require continuous projection as in the case of motion pictures.

Can educators provide equipment developers with any figures on the relative merit of moving pictures with sound as compared to a series of still pictures with sound?

Dr. Forsdale: It is apparent that many educational jobs can be handled easily with a series of still pictures, and the mushrooming popularity of the filmstrip shows that teachers like the medium. On the other hand, it seems clear that certain problems require handling in motion, especially where motion is inherent in the subject matter. How the addition of motion helps or hinders where it is not inherent in the subject I cannot say at the moment, although studies have been made of the problem. It is true that we should look more deeply into these questions.

I have seen, heard and been impressed by the sound-on-filmstrip development The Kalart Company is demonstrating, to which your system seems to bear at least some resemblence. It should be an important contribution.

8mm and the Classroom Film Library: Potentials and Requirements

By STEVE KNUDSEN

Our present pattern of educational use of film involves film rentals, special projection rooms and passed-around projectors. Can 8mm serve as the agent to change this to a pattern in which an adequate library of films and the necessary projection facilities remain in, and are an integral part of, the classroom? If so, what will be the scope of such a shift? What are the requirements before such a shift can take place?

Many educators, including both teachers and administrators, look forward to the classroom film library as a simple and straight-forward answer to many of the ills now besetting the use of film in education. The prevailing pattern is based on a rental system which requires weeks and months of advance scheduling and includes the possibility of substituted titles, the moving of students to remote projection rooms and a system of passed-around projectors. Teachers would like to equip each classroom with its own projector in a ready-to-go status and with its own film library so the needed titles could be available at the precise teachable moment.

Can 8mm be the agent for changing from the rental system to a pattern built around the classroom film library?

Presented on May 9, 1961, at the Society's Convention in Toronto by Steve Knudsen, Film Production Unit, Iowa State University, Ames, Iowa.
(This paper was received on April 1, 1961.)

Acceptability of Technical Quality

There are many papers devoted to the aspects of 8mm sound film quality and its improvement. Two points not often included are pertinent here:

The capabilities of 8mm are related to audience size. The average elementary class in the United States today has 29.5 pupils; high-school classes are smaller. The rapidly growing school population and significant school district reorganizations into larger units are influences toward larger classes; countering this trend is a very prevalent feeling among the teachers that in a typical situation anything over 30 pupils per class approaches overloading.

The second pertinent consideration is the space for film storage within a classroom, which has to have blackboards and bulletin boards and natural light through windows, all requiring wall space. A wall cabinet to store an 8mm classroom film library needs a space no larger than 4 by 5 ft.

Scope and Economics

Suppose an elementary teacher had, right in her classroom, all the films which might be pertinent to her material. How many minutes of each day would that elementary teacher use in projection? The assumption is made here that the total time used per day would be a half hour. For convenience, we may divide the 30 minutes into three 10-minute periods, meaning for practical purposes three reels per day. The U.S. Office of Education gives a figure of 861,035 elementary teachers for the fall of 1960. Using a figure of 860,000 classrooms, each requiring 3 reels per day, gives us a daily requirement of 2,580,000 reels for the entire nation.

Similarly, we might anticipate the demand for secondary education — again assuming a classroom film library. A typical schedule for secondary pupils involves four subjects. Round off the number of secondary teachers to 549,000 (U.S. Office of Education figure, 548,-960) and assume that each teacher in each subject will use one 10-minute reel per day. However, the actual requirement will be less since a secondary teacher may have more than one class in History I or Algebra II or some other subject. To allow for this, a figure of 2.5 ten-minute reels per day is used here.

This gives a total of 1,372,500 reels per day for use in the secondary schools of the entire nation.

The figures for both elementary and secondary classrooms total 3,952,500, or just short of 4 million reels per day. There are 180 days in the school year. The product is a staggering total of 720 million reels per year. This roughly would be the requirement for classroom film libraries in our public schools across the nation.

Using $120 as the current price for a 10-minute 16mm reel in color and sound and assuming that each film will need replacement in six years, we find that the cost per year per reel would be $20. Hence the total yearly cost at present 16mm prices would be $20 times 720 million or $14,400,000,000 for the nation.

Dividing this 14-plus billion dollars by the number of classrooms in the United States would give us a figure for each classroom of $10,220, which would be almost enough to triple the number of teachers that we now have. It should be obvious to teachers and educators, who have long been asking for classroom film libraries, why, under out present system, such libraries are impractical.

Would economies resulting from the use of 8mm film be sufficient to make the classroom film library feasible?

The three major components of the final cost of a film are the cost of the print, the cost allocated to each print to amortize distribution, and the costs of merchandising. The relative importance under today's practices are (approximately):

	Cost	*Per Cent*
16mm Print, per reel...	$ 24	20
Amortization of Production and Merchandising	96	80
Total	$120	100

The costs for amortization and costs for merchandising appear to vary widely among distributors. Actually there is no point in disputing just what the proper figures for each might be. The total is known and the two combined do constitute a major share of the final price paid by the customer, our public schools.

What happens in 8mm? On the item of print costs, the laboratories are quoting figures varying between one-third and one-half of the present 16mm print costs. The lower figure is being used here for reasons which will be apparent later. Assume (optimistically) that other costs would continue their present ratios, then:

	Cost	*Per Cent*
8mm Print, per reel......	$ 8	20
Amoritization and Merchandising	32	80
Total	$40	100

To supply classroom film libraries over the entire nation at the $40 figure would still be the equivalent, costwise, of adding six new teachers for every ten we now have. The cost is still too high for "every-classroom" adoption although significantly lower for specialized situations.

What happens if we achieve *mass production* of 8mm prints? To approximate some end points of what might be a snowballing process will be easier than to trace a pattern of price reductions.

The estimate for an end point in print costs is based on a ratio between finished-print and raw-stock costs. The $24 cost of a one-reel color positive print in 16mm is approximately three times the cost of the raw stock (about 0.06 cents/ft finished compared with about 0.02 cents/ft raw). Our laboratories are working on about a 3:1 ratio. As an end point under mass production in 8mm, let us assume this is improved to a 2:1 ratio. This would make the print cost for a single 8mm reel $4.00.

The amortization costs can be more drastically reduced than the other major costs. Savings will be possible if significant increases in production volume bring increased efficiency. But more significantly, the amortization can be based on a much greater anticipated demand. It should be possible for this figure to go as low as $1.00 per reel.

The estimate of an end point in merchandising costs is based on information from the related field of textbook publication. In that field a rule of thumb gives a selling price of 2.5 times the manufacturing price. Based on these estimates, the figures would be as follows:

8mm Print cost in mass production	$ 4.00
Amortization..................	1.00
	5.00
Merchandising...............	× 2½
Total	$12.50

Even with a total figure of $12.50 per single reel, the cost per classroom would amount to $1,125 per year for elementary grades and to $937.50 for secondary grades. However, all the above figures are based on the use of sound color prints. The use of black-and-white as well as the use of silent films could materially reduce these figures.

The Process of Adoption

However, cost alone will not ensure that 8mm film will serve to change our pattern of the use of educational film. There are other factors to consider.

George Beal and Joe Bohlen* have summarized the findings of 35 research studies and have constructed frameworks useful in studying the problems of diffusing new ideas and practices. One of these frameworks is concerned with the relative complexity of an anticipated change and four categories are named: (1) a change in materials and equipment, (2) an improved practice, (3) an innovation and (4) a change in enterprise.

A straightforward change to 8mm where 16mm is now used would be a simple change in materials and equipment; but a change from film rentals to a classroom library would rank as an innovation. The summary mentioned above describes an innovation as "... a change which involves not only a change in materials, but also a complex of changes with regard to their use."

Changing to a classroom film library pattern will mean that the film will no longer be regarded as something which must be projected during class time. Home viewing, the use of film viewers in library cubicles and the application of 8mm films in teaching machines will almost certainly come into use. These uses will enable the film to contribute to what teachers call "outside preparation."

Using film for outside preparation will in turn affect those films which are reserved for showing during class time periods. Use of the long, comprehensive film will probably diminish inside the classroom; but there will be increasing use of the short, single-concept film, the problem or situtation film and the summary film.

The single-concept film will be very short — perhaps 3 min long; it will deal with a single major point. It may be animation visualizing the deflection of alpha and beta particles by a magnet; it may be photomicrography of a biological form function; or it may be a time-lapse record of an experiment which can thus be reduced from hours to seconds. Very short films of this type are not being distributed today because of the economics involved.

When a film is used to set a problem or pose a situation, it can add a new dimension to that problem. Not only is the student required to take the data given and to make computations, but he can be required to make the observations as well.

The summary film will continue to be effective during class time because of its ability to confine the class to the topic, because the graphic information assists in the recall and because distractions by questions from the class are eliminated.

The danger in the process of adoption in this situation is that the lay teacher will identify 8mm as a change in materials only and will fail to see the possibilities and the implications of its potential to bring about a classroom library. Furthermore, even if the teacher recognizes the possibilities, evaluation will be very difficult because so few films of the proper type exist. From a more positive point of view, the production of films designed specifically for the classroom library will

* George M. Beal and Joe M. Bohlen, "The Diffusion Process," Special Report #8, Agricultural Extension Service, Iowa State Univ., Ames, Iowa.

in turn provide some impetus to this snowballing effect.

Summary

A pattern of utilization of educational film based on a classroom film library is much more feasible with 8mm than with 16mm. But 8mm does not guarantee, in and of itself, that a classroom film library pattern will develop. There are collateral requirements which must be met — requirements in terms of film design and of making the educators aware of the possibilities. Organized effort is needed and can do much at this stage of development.

A Self-Contained Recorder for Motion-Picture Sound

By WILLIAM V. STANCIL

New techniques in motion-picture production now require compact camera and sound equipment. A self-contained, battery-operated and transistorized tape recorder is described which provides synchronization with both spring-driven and motor-driven cameras. The 13-lb recorder may be used in conjunction with 35mm, 16mm or 8mm cameras, and the resultant sound may be transferred to sprocketed film for editing and subsequent release, or it may be synchronized with projectors for double-system viewing.

When sound was originally introduced to motion pictures, it created tremendous interest, and the public accepted the relatively static performances. Through the intervening years, both the producers and directors have sought more compact equipment to free them from fixed locations and confined areas. While the cameras have remained approximately the same size, new acoustical housings are available which greatly reduce their bulkiness. The sound equipment has made tremendous strides in departing from the original telephone company concept of centralized transmission racks down to hand-carried, self-contained units.

The volume of program material demanded for television has somewhat reduced the production standards that motion pictures have always tried to achieve. The sheer bulk of television productions precluded the many dramatic techniques and the excellent quality which motion-picture people had come to expect. Since now more people see television than ever before witnessed theater motion pictures, perhaps the public's viewing standards are somewhat lower. With this transition of both techniques and standards has come the increased demand for mobility involving the documentary type of dramatic presentations.

A number of evolutions had to transpire to permit a fluid type of motion-picture production, whether it be for theater or television release. The feeling has always been that since 35mm cameras were large and heavy, there was little incentive to reduce the motor-drive systems and power supplies. Hence, with heavy and large camera equipment, not too much concern was felt about the size and efficiency of the accompanying sound equipment. All the technicians associated in the editing and processing of both the sound and pictures felt no urgency to depart from their recognized procedures. With the excellent progress made in Europe in the tape-recording field, some of the motion-picture studios worked out methods of synchronizing nonsprocketed tape with standard motion-picture film. Outgrowths of this work appeared in the United States in the form of a 60-cycle signal recorded transversely in the center of $\frac{1}{4}$-in. tape. The 60 cycles which was recorded was the same as used to drive the synchronous motor on the camera so that on reproduction the 60 cycles was "resolved" and used to control the transfer from tape to magnetic film. Through the years this system has proved very satisfactory, and in the United States and in Canada a number of motion pictures have been and are being produced by this system. Other systems were subsequently employed in the United States wherein a carrier frequency recorded on the same track with the normal audiofrequency was modulated by 60 cycles, and again this signal was used for subsequent transfer. Two of the well-known magnetic recorder manufacturers in the United States employ this system.

These several systems did prove that synchronized tape could be successfully handled with the sprocket hole film. Perhaps the approach of directly recording 60 cycles has proved slightly more satisfactory because of the ease in recording and reproducing 60 cycles. High-frequency carrier signals have often been subject to dropouts and other interferences resulting from poor tape contact or foreign material which ultimately accumulated on the tape surface.

Experience With Miniature Tubes

The flexibility and broad requirements of the electronic systems in motion-picture recorders held back any major reduction in size until the advent of transistors. The Stancil-Hoffman Corp. of Hollywood, Calif., introduced the self-contained Minitape in 1949, and it was its intention to furnish a synchronized soundtrack for motion-picture production. The original recorder used miniature vacuum tubes with a preset recording level. A small d-c motor was speed-regulated by a tuned vibrator to realize high efficiency. It was planned to record two tracks on $\frac{1}{4}$-in. tape using one track for the audio and the second track for a synchronized signal. The state of the art at that time indicated a carrier frequency lower than had been used and yet modulated by 60 cycles. A frequency of 3000 cycles was chosen as this represented the maximum unequalized tape output. The program was not particularly stressed as either microphone mixing facilities had to be provided or automatic volume control incorporated as a means of holding the proper recording level. Extensive work was performed on subminiature tubes, but the inherent noise and "microphonics" of these tubes in high-gain audio circuits proved very discouraging. The corporation established the requirement and program for both a better mechanical system and improved electronics. Fortunately, at this time information was released on the new world of transistors. Projects were then established to design audio circuits with automatic-gain controls for miniature packaging. As a result, Stancil-Hoffman announced, and had in production, one of the first completely transistorized magnetic recorders available.

Presented on May 9, 1961, at the Society's Convention in Toronto by M. M. Elliott for the author, William V. Stancil, Stancil-Hoffman Corp., 921 N. Highland Ave., Hollywood 38. (This paper was received on June 26, 1961.)