

ABSTRACTS OF PAPERS OF THE  
SPRING CONVENTION

AT

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*The Papers Committee submits the following abstracts of papers for the consideration of the membership. It is hoped that the publication of these abstracts will encourage attendance at the meeting and facilitate better discussion of the papers.*

PAPERS

G. E. MATTHEWS, *Chairman*

L. A. AICHOLTZ, *Chairman, West Coast*

P. ARNOLD	C. FLANNAGAN	F. H. RICHARDSON
M. C. BATSEL	L. D. GRIGNON	P. R. VON SCHROTT
L. N. BUSCH	E. W. KELLOGG	H. C. SILENT
O. O. CECCARINI	R. F. MITCHELL	H. G. TASKER
A. A. COOK	W. A. MUELLER	C. K. WILSON
L. J. J. DIDIEE		I. D. WRATTEN

**Report of the Progress Committee; J. G. Frayne, *Chairman*.**

The outstanding event in cinematography during the past year was the development of the high-speed panchromatic emulsions by the Agfa Ansco Corporation. Other interesting advances in the emulsion field are the development of two fine-grain duplicating film stocks by the Eastman Kodak Company. Of interest also is the new sound emulsion developed by Dupont in which the periodic variation in sensitivity brought about by the present emulsion-drying methods has been eliminated.

In the sound-recording field, items of interest are the introduction of linear decibel volume indicators by United Artists Studio and the introduction by RCA of the modulated high-frequency method of determining optimal processing conditions.

**"Sound Stages and Their Relation to Air-Conditioning"; C. M. Wert and L. L. Lewis, *Carrier Corp.*, Syracuse, N. Y.**

The development and growth of the modern motion picture sound stage has almost paralleled that of sound pictures. Weather and advancement of lighting technic undoubtedly brought about original need of enclosed stages. Advent of sound recording brought about requirements not originally considered. Modern sound stages have increased not only in quality but in size. The modern sound

stage must have structural strength to withstand the elements, including earthquakes. It must meet requirements of set construction, sound-proofing, and occupancy. Sound treatment makes necessary other treatment for satisfactory occupancy. Lighting on the sound stage is the greatest contributor of heat gain within the stage. Lighting is variable as to amount and duration, and must be controlled correctly. Size and number of sets are very variable and create their individual problems. Both the number and types of persons present on a sound stage play their parts in the relation between air-conditioning and the sound stage.

Construction that retards the flow of heat in either direction through walls necessitates the addition and removal of the heat. Lighting on a sound stage is of such magnitude that its effects must be removed. High-salaried personnel, often in costume, demand comfort while working. Management is obviously economically in better position if personnel is comfortable; less time is lost due to make-up retouching and less delay brought about by perspiration dampened costumes.

An air-conditioning system should have the ability to provide heating, cooling, ventilation, and cleaning. Heat in the air rising to the top of the stages should be removed by an exhaust system. Stages are generally maintained at 75°F and 50 per cent relative humidity, with temperature settings above and below at the option of the occupants. Floor distribution of air has the advantage of more economical removal of rising heat but has the practical disadvantage of placing set construction and personnel too near source of cooling. Overhead distribution has the advantage of better temperature distribution but is less economical in the removal of rising heat from lights.

Sound treatment of an air-conditioning installation is necessary for continuous operation of the system. If the system does not operate continuously the heat load builds up to the point where the system can not adequately regain comfortable conditions during non-shooting periods. Treatment is accomplished by both isolation and absorption of generated sound, and can be so accurately determined that a guarantee of the increase in noise level can be given in decibels and in relation to frequency ranges.

**"Motion Picture Projection from Metallic Film";** R. W. Carter, *Taylor-Sloane Corp.*, New York, N. Y.

A brief history is given of the various processes for putting photographic images on metallic surfaces and the evolution from flat surfaces to flexible metal ribbons is discussed. The subject of metal films is traced under the following headings: The physical and mechanical difficulties in the development of a metal strip suitable for projection. The physical, chemical, and mechanical properties necessary for the photographic emulsions and photographic developers. The effect of mechanical strain and the heat of the projection machine upon the metal film. The relative wearing quality of metal film as compared with that of cellulose film. The possibilities of coating both sides of the metal strip and the development of printing machines to print thereon. Making original master negatives on standard photographing equipment. Dubbing positive prints from the master metal negative. The optical system best adapted for getting the high-set possible reflection from the polished surface of the metal film. The comparison of light transmission from celluloid and metal films. The effect of heat upon the

image on a metal film. Can a metal film be joined rapidly if it comes apart? A comparison of shrinkage between metal film and cellulose film. What evidence have we of the permanence of metal film? Will it be possible to develop color on metal film, and will the use of prisms make it possible for successful projection? What changes will the operator have to make in technic and general practice? Why will the sound be more accurate from a reflected image? Will it be possible in the future to use a series of sound-tracks in various languages on the metal film? With the elimination of the fire hazard, shrinkage, and the introduction of less weight and positive permanence, what are the chief defects to be expected in metal film, and what is proposed to overcome these defects?

**"Documentary Film Study—a Supplementary Aid to Public Relations";** A. A. Mercey, *School of Public Affairs, The American University, Washington, D. C.*

Documentary films are proving of increased importance as a factor for informing and mobilizing opinion. The marked success of two U. S. documentary films, *The Plow That Broke the Plains* and *The River*, both written and directed by Pare Lorentz, has focused new attention upon this type of film. The school of Public Affairs of American University conducts an "in-service" training school for government employees whereby registrants obtain instruction in courses and subjects from experts in various Federal departments. Included in these curricula are a series of courses on public relations. The film as a factor in public relations is an important one. In answer to requests for some information and instruction in this new field, a course in "Documentary Films Today" was instituted.

The film course included an eight-week study with screenings, film analyses, and discussions conducted by visiting experts in film-making and film use. The subjects covered were: The newsreel as contemporary historian; the *March of Time* as a document; federal, educational, and scientific films; U. S. Government documentary films; documentary aspects of Hollywood films; foreign documentaries; industrial, sales, and domestic propaganda films. During the eight-week period, visiting experts included a government producer, an industrial film user, an educator, and others. Technical aspects with reference to advances in film production were discussed.

In addition to regular film discussion and study, a number of reports were made on documentary film activities. Among the most important was one on a federal film survey. For the first time, a complete survey of all U. S. government films is being made that will compile in one place the data on motion pictures. A standardized type of procedure was outlined.

**"The Determination of Correct Exposure in Photography";** L. A. Jones, *Kodak Research Laboratories, Rochester, N. Y.*

Many treatments of this subject, some dealing with certain specific phases, and some fairly complete, are to be found in various textbooks and scientific journals in the field of optics and photography. In spite of this, however, there seems to be some uncertainty in the minds of some relative to the correct manner of dealing with the problem. The present treatment is distinctly of a tutorial character, an endeavor being made to present the problem in a clear and systematic fashion. Much of the existing confusion is doubtless due to the multiplicity of photometric units found in the literature of photometry, and to a certain amount of ambiguity

in the current definitions relating to these units. An attempt is made to present a considerably simplified conception of the minimum number of photometric quantities required for dealing with the exposure problem. The relation between image illumination and object brightness is dependent upon several physical characteristics of the image-forming system. Quantitative information relating to specific image-forming systems and a general average image-forming system useful for computing the relation between object brightness and image illumination are given. The relation of the sensitivity of photographic materials to the problem is considered in some detail, as well as the photometric and contrast characteristics of various types of photographic subjects.

**"Latent-Image Theory and Its Application to Low-Intensity Photographic Exposures";** W. J. Albersheim, *Electrical Research Products, Inc.*, New York, N. Y.

In a previous paper by the writer, it was shown that the photographic exposure characteristics are in agreement with the assumption that a photographic grain must absorb two photons of visible light in order to become developable. In the present paper, this theory is compared with recent physical research by other authors. It is assumed that a film grain is "sensitized" by the first absorbed photon and fully "exposed" by the second absorbed photon.

Reciprocity-law failure at low-intensity exposures can be explained by the assumption that the sensitized state of film grains is unstable and that the number of sensitized grains decreases with time in an exponential manner unless fixed by activation. The half-time of this fading for certain emulsions is deduced from Kodak publications on reciprocity-failure characteristics.

Conclusions from this theory are drawn with regard to the contrast improvement for low-intensity photography, such as astronomical work or newsreel photography under unsatisfactory lighting conditions, by pre- or post-fogging. The theoretical conclusions are checked with test results.

**"Effect of Aeration on the Photographic Properties of Developers";** J. I. Crabtree and C. H. Schwingel, *Eastman Kodak Co.*, Rochester, New York.

Unseasoned elon-hydroquinone developers of relatively high alkalinity (pH 10.0 to 10.5) showed a rapid decrease in activity after aeration for 1½ hours while elon-hydroquinone-borax developers of low alkalinity (pH 8.4 to 8.8) showed increased activity (due to the liberation of alkali resulting from oxidation) which then remained constant for prolonged periods.

In general, the alkalinity of developers containing hydroquinone increased on aeration, while those containing only elon showed little change.

Practical tests with processing machines equipped with air agitation devices have shown that very constant developing conditions can be maintained with both positive and negative types of developers.

**"Solution Agitation by Means of Compressed Air";** C. E. Ives and C. J. Kunz, *Eastman Kodak Co.*, Rochester, N. Y.

In the development of motion picture film, the developer in the emulsion undergoes exhaustion and thereby loses activity. Agitation of the developing solution in the vicinity of the film is required to assure sufficiently rapid and uniform re-

newal by relatively fresh developer brought from the remainder of the bath.

The present work is concerned with a method of bringing about this agitation by means of compressed air which is released at one or more points in the developer, through which it rises to the upper surface creating a generally turbulent condition and setting up rapid streaming effects.

The effectiveness of the stirring is limited by the tendency of the induced stream to form a narrow channel in one portion of the tank with relatively low velocity in the remainder of the tank.

Various means have been tried in an effort to direct the rapidly moving stream along the film surface, and this was accomplished by means of a gridwork of conducting pipes extending from top to bottom of the rack and parallel to the sides of the racks. Tests for uniformity of development made by means of uniformly flashed film showed the benefit conferred by the various improvements in control of the agitation. Dimensions and details of construction are given for making up the distributing grid.

**"Maintenance of a Developer by Continuous Replenishment";** R. M. Evans, *Kodak Research Laboratories*, Rochester, N. Y.

By a series of simple assumptions that do not depart appreciably from current practice it is shown that the concentration of any ingredient in a developer solution that is continuously replenished during use may readily be calculated. The equations for the equilibria and rates of growth of the various substances are derived and application is made to a practical case. The benefits of chemical analyses for developer constituents both for maintenance of quality and for economy are pointed out, and the analytical methods published by Lehmann and Tausch are briefly outlined.

**"The Effect of pH upon the Washing of Processed Films";** S. E. Sheppard and R. C. Houck, *Kodak Research Laboratories*, Rochester, N. Y.

Advantages stated to be obtained by adjusting fixing baths and wash-water to the isoelectric point of gelatin have been claimed. The advantages are said to be shorter washing time, less swelling and retention of water, with consequent improvement in the jelly strength of the wet emulsion, and reduced drying time. In the present investigation the conditions as to pH of the solutions, and wash-water, rate of flow of water, residual thiosulfate, *etc.*, were controlled accurately. The results indicate that with a regular acid fixing and hardening bath (*F-25*) there is no advantage, but rather a disadvantage in washing at the isoelectric point (ca pH 4.9) rather than at pH 7 to 8, since the time required to remove hypo to the same degree is increased, nor is less water retained. In a non-hardening acid fixing bath, there was little difference in washing time, but some gain in drying time for the isoelectric wash because of reduced water absorption.

**"A New Densitometer";** H. Neumann, *Klangfilm G. m. b. H.*, Germany.

Density measurements of variable-width sound records should cover a large range of densities, and the measuring area should be as small as possible, so as to make it easy to find a suitable area on normal sound records.

The densitometer described, which is intended mainly for use in studios and laboratories but which is so accurate that it may be used also for scientific

research, is capable of measuring densities of 0.01 to 2.5 of areas 2.5 mm. long and 0.03 mm. wide, limited by a mechanical slit. The absorption of light by the object is determined by means of the current set up in a blocking layer photoelectric cell which is measured by a very sensitive galvanometer giving direct density readings. The calibration of the light-source can be checked very simply by a separate light path without making necessary removal of the object during the check. A special arrangement is provided for visual observation of the measuring area under the slit.

The density values are determined with parallel light, and from these data the values for diffuse light may be easily calculated.

**"The Transmission of Motion Pictures over a Coaxial Cable";** H. E. Ives, *Bell Telephone Laboratories*, New York, N. Y.

The transmission of television signals over wire lines a number of years ago used signals corresponding to images of coarse detail, and required frequency bands accommodated by existing types of circuits. The television images now considered necessary correspond to frequency bands of greatly increased width, and will require special wire networks and transmission means.

The coaxial conductor recently in operation for experimental purposes between New York and Philadelphia can transmit a band of frequencies of approximately 1000 kc. While designed primarily for multiple telephone channels, it offered the possibility of transmitting a single wide band as required for television.

The experiment consisted in providing television-type terminal apparatus for producing signals falling within the available band, and of developing and utilizing methods of transmission that would make most complete use of the frequency band available. For convenience in the experimental work, the signals were generated from motion picture film. The film was scanned mechanically by means of a lens disk containing 240 lenses. The film was moved continuously at 24 frames per second, and its motion, together with the motion of the lenses in the disk, swept each frame of the film in 240 juxtaposed lines. Light passing through the film was received on a photosensitive surface; the resulting photoelectric current was amplified and by means of modulating and demodulating apparatus transmitted as a single sideband lying between approximately 150 and 950 kc. At the receiving end the single sideband signal was restored as a signal from zero to 800 kc.

For reception, special cathode-ray tubes were used in which particular attention was paid to the definition of the spot and the linearity of response. Synchronism between the two ends was obtained by sending a single frequency over a separate channel and using it to operate sweep circuits at the receiving end. The use of mechanical scanning and the high-definition receiving tubes resulted in pictures of very satisfactory quality within the limitations set by the frequency band. (Illustrated with slides and motion pictures.)

**"The Inter-Relationship of the Various Aspects of Color";** L. A. Jones, *Kodak Research Laboratories*, Rochester, N. Y.

An understanding of the subject of color and color measurement involves a knowledge of many and diverse phenomena. Pursuit of this knowledge leads into many fields of physical or objective science, such as physics, physiology, biology, chemistry, etc., as well as into the domain of a subjective science, psychology.

While it may not be possible or even desirable to attempt to draw sharp lines of demarcation between all the various aspects of the problem, it does seem desirable, for the sake of orderliness and clear thinking, to suggest a certain division of the subject into a few definite categories and to attempt to define the relations that exist between the various aspects of the problem as a whole.

The present treatment of the subject is designed largely as a means of establishing orientations in the general field. An attempt is made to develop a logical and unambiguous nomenclature that will enable us to discuss various aspects of the subject without the confusion that exists so generally at the present time when individuals of diverse trainings and viewpoints attempt to discuss the subject of color. The subject-matter divides itself rather logically into three clear-cut categories, which may be referred to as the physical, psychophysical, and psychological. Attention is drawn to the relation existing between the correlated aspects in each of these three categories. An attempt is made to clarify the purely physical factors involved and to discuss certain sensory and perceptual aspects of color and the relations existing between them and their physical and psychophysical correlates.

**"The Theory of Color Reproduction";** A. C. Hardy, *Massachusetts Institute of Technology*, Cambridge, Mass.

All methods of three-color photography are the outgrowth of a suggestion made in 1855 by Clerk Maxwell, the illustrious British physicist. The method that he suggested would now be classed as an additive process, since the final reproduction was effected by projecting three lantern-slides in register on the same screen; one lantern being supplied with a red filter, one with a green filter, and one with a blue filter. Maxwell suggested further that these lantern-slides be prepared from three negatives, each negative being exposed through the same filter that was to be used in projecting the corresponding lantern-slide. An extension of Maxwell's reasoning to subtractive processes leads to the conclusion that the dyes used in the production of the positive images should each be complementary in color to the corresponding taking filter.

Despite Maxwell's intimation that his process was theoretically incapable of perfect reproduction, the basic features of Maxwell's reasoning have been incorporated into the commonly accepted theory of color reproduction. The recent progress in the science of colorimetry has made it possible to investigate the relation that should obtain between the characteristics of the taking filters and the colors of the reproduction primaries. Such an investigation shows that the taking filters required for perfect reproduction have characteristics that are very different from those in common use.

The paper is concerned with the establishment of the conditions that lead to faithful reproduction by any three-color process. Examples of the application of these fundamental conditions are given for both additive and subtractive processes.

**"Screen-Film Negative-Positive Process";** T. T. Baker, *Dufaycolor, Inc.*, New York, N. Y.

Progress in two directions has greatly simplified the making of prints from screen-film negatives. The study of emulsion characteristics and of the mechanics of development with silver bromide solvents has led to the avoidance of color di-

lution in copying one screen material from another. Sodium thiosulfate in a metal developer has been shown to localize development in the lower strata of the film, so that the silver image is formed in close contact with the reseau, largely eliminating scatter at the boundaries of differently colored units; the crystalline structure of the silver salts and grain-size frequency also assists in preventing scatter. Residual color dilution as the result of the 45-degree oriented reseaux is explained, and the way in which this has been counteracted by suitable choice of gammas in the negative and positive material. The production of a vapor-lamp emitting the line spectra of mercury and cadmium without appreciable spectral background, combined with a liquid didymium chloride filter has provided a triple monochromatic light-source, the spectral lines of which coincide with the peaks of the reseau transmissions, thereby eliminating dilution of color due to overlap, such as has always previously been present with color filters of the narrow-cut type. The Dufaycolor contact printing machine with automatic control of both hue and printing light is described. The technics of printing, and development with standard equipment, are described with lantern-slides and projections of recent 35-mm. cine prints (which are at present circulating in English theaters).

**"Problems Involved in Full-Color Reproduction of Growing Chick Embryo";** E. S. Phillips, *New York State College of Agriculture, Cornell University, Ithaca, N. Y.*

Attempts to record on 16-mm. color film the physiological changes that take place during the 21-day incubation period of the hen's egg presents problems varying with each day's growth. Because the author was working with living subjects that required strict adherence to narrow tolerances in order to maintain normal embryological development and even life itself, it was necessary to adapt photography to the problem.

Development of the embryo is shown in three different ways, *i. e.*, (1) transmitted light, with shell entire; (2) removal of part of the shell, and subsequent photography by reflected light; and (3) removal of the entire shell, and placing the embryo in a watch crystal, thus showing all parts in their relative sizes.

In all three methods, temperature, humidity, and light control constitute the major problems.

**"The Multiplane Camera";** W. E. Garity, *Walt Disney Productions, Ltd., Hollywood, Calif.*

In line with the policy of continued improvement in cartoon technic, it was recognized that several developments could be undertaken which if successfully adapted, would add much to the power and charm of animated motion pictures. By confining cartoon photography to a single plane in front of the camera, the expense and difficulty of creating a convincing illusion of depth and a real-life appearance of camera movement made the consideration of a several-plane technic imperative. The out-of-focus diffusion and the differential movement of foreground and background elements of scenes can be attained most easily by separating those elements on different planes in front of the camera. The problem resolved itself into the adaptation of glass-shot technic to cartoon production. In separating the scene elements into several planes, many other advantages were gained, such as the lighting control of single-scene elements, the ease of using spe-

cial-effects equipment, and the possibility of using backlight and process backgrounds.

The answer to the problem was a permanent machine, the multiplane camera, which was built to use the standard cartoon technic of animated characters in connection with several plane backgrounds. The machine was built with the view of accuracy of control, complete flexibility of scene set-up, and efficiency of operation. This required plane elements that could be quickly and accurately assembled, an accurate indication system, and an interlocked system of control.

Because the light level on each plane is an important part of every set-up, a sensitive quick-reading light-measuring system had to be devised. The number of machine adjustments involved was so large that a master control sheet was laid out, giving complete operation information for each frame of film. As a final check before exposure, a periscope type of finder was devised so that the chief operator could give the set-up a visual check before each exposure. To write out the master control sheets it was necessary to develop a scene-planning group of artists and technicians to control and plan the use of the machine in creating the desired illusions.

The results in giving increased power to animated motion pictures have been very satisfactory, as can be best illustrated by viewing the screen results. The adaptability of the multiplane technic to animation photography has proved to be so flexible that its complete possibilities will come only with experience.

**"A Method for Determining the Scanning Loss in Sound Optical Systems;"**  
E. D. Cook, *General Electric Co.*, Schenectady, N. Y., and V. C. Hall, *Eastman Kodak Co.*, Rochester, N. Y.

The usual methods of evaluating the frequency characteristic of sound records have been satisfactory for the determination of the required correction for overall losses. However, the losses due to aperture and optical effects are not known with sufficient precision to permit an inferior limit to be assigned to film loss only.

The method described was chosen in connection with a high-fidelity development, and consists in comparing direct measurements made on images formed by contact printing of a geometrically shaped test-object on the film with measurements of frequency records made using the recorder optical system. While the results obtained can not be applied generally, the method is capable of segregating film loss from other losses for the specific conditions under which the test is conducted.

**"An Optical System for the Reproduction of Sound from 35-Mm. Film;"** J. H. McLeod, *Kodak Research Laboratories*, Rochester, N. Y., and F. E. Altman, *Hawk-Eye Works*, *Eastman Kodak Co.*, Rochester, N. Y.

An optical system has been designed and tested for use in 35-mm. sound reproducers. It is the slitless type of optic, and gives a scanning image that is 0.001 inch wide when used with an exciter lamp having a coil diameter of 0.055 inch. A toric lens is used to form a curved-line image of the filament of the lamp. This curved image is then re-imaged by a highly corrected objective lens of numerical aperture 0.28. The objective lens has inherent curvature of field, but this curvature is compensated for by the curvature of the line-image formed by the toric lens so that the final image is flat. The toric lens also acts as a condenser lens to throw

an image of the filament into the objective lens. Careful tests of samples show that the final image is flat, straight, and of uniform width and intensity.

**"Sound Recording by Color Modulation (Van Leer System)";** A. L. W. Williams, *Brush Development Co.*, Cleveland, Ohio.

A method of recording sound is described in which advantage is taken of the variation in sensitivity of photographic film to light of different wavelengths. On standard film there is a portion of the sensitivity-wavelength curve in which the sensitivity changes linearly over a wide range with a small change in wavelength or color. An optical system and apparatus are described, designed to vary the color of the recording light over this narrow band and capable of wide-range recording. By this system very small deflection of the recording galvanometer is required, enabling a simple crystal oscilloscope to be used for the purpose. Chromatic aberration is almost eliminated. Large errors in exposure or development may easily be corrected so that minimum distortion occurs.

**Report of the Standards Committee;** E. K. Carver, *Chairman*.

The tentative drawings that have received initial and final approval by the Standards Committee have been published in the March issue of the JOURNAL of the Society. The uncompleted items at present under consideration are:

- (1) Drawings for standard cores for cine film.
- (2) Further consideration of the proper separation distance between the two halves of the push-pull sound-track.
- (3) Drawings of sprockets for 16-mm. sound-film.
- (4) Revision of the standard release print to correspond with the revisions made by the Academy.
- (5) Review and possible revision of the glossary of technical terms.
- (6) Carrying out actual tests on the new sprocket perforation for 35-mm. film, which, it is hoped, will displace the old Bell & Howell perforation.

**"An Ultraviolet Push-Pull Recording Optical System for Newsreel Cameras";** G. L. Dimmick and L. T. Sachtleben, *RCA Manufacturing Co., Inc.*, Camden, N. J.

Recent advances in sound recording technic, notably exposure with ultraviolet and the class B push-pull track form, are incorporated in a variable-width recording optical system of extraordinary compactness, for newsreel work. The overall dimensions are approximately 6 inches long by 4 inches wide by  $3\frac{7}{8}$  high, and the weight complete is about  $3\frac{1}{4}$  pounds. This compact form is made possible by the development of a new galvanometer window lens of very special form, and of an objective lens of 7.6 mm. E.F. and  $f/2$  speed which will cover the sound-track width satisfactorily. The power drain of the exposure lamp is 21 watts at 4.9 volts, and the galvanometer input at full modulation is about 30 milliwatts.

The class B push-pull track inherently provides ground-noise reduction without the use of special equipment. Response of the print at 6000 cps. is 3 db. below that at 1000 cps. with ultraviolet light, and 6 db. below it with white light. The turn of a lever and the reduction of the lamp current to 3 amperes prepare the system for white-light recording when battery power must be conserved and quality is less important.

**"Processing Ultraviolet Recording on Panchromatic Films";** J. O. Baker, *RCA Manufacturing Co., Inc.*, Camden, N. J.

The necessity in newsreel work of making the original sound recording on panchromatic film has always meant a serious sacrifice in quality and ground-noise ratio, as compared with the results that can be attained when sound is recorded on a separate film. While ultraviolet recording materially increases the fidelity of response, with panchromatic as well as with standard sound negative film, the low contrast and inherently high base fog of panchromatic film when processed for negative picture development produce noise and considerable reduction in volume range.

The track density on the panchromatic film is rather low, of the order of 1.0 to 1.2, when recorded with a practical optical system for a single-film system. When this track is printed upon commercial release print stock the dense portion of the negative track will print through, producing a fog density in the clear portion of the printed track. This fog in the clear portion tends to produce noise and reduces the volume range. When the panchromatic negative and print are processed in accordance with commercial practice, the reduction in volume range is of the order of 6 decibels.

Printing the panchromatic negative upon a high-contrast emulsion improves both the noise and volume range. Since the release prints must be on standard picture positive stock and not on high-contrast film, it is here proposed to make a master positive on high-contrast emulsion and to re-record from this to a standard sound negative, which would be used in the ordinary way to make the release prints. An improvement in release print ground-noise of 8 to 12 decibels is obtained by this method, and the volume range is increased by 6 decibels. Briefly, the proposed method is a means for increasing the density contrast of the final release print track when the original is recorded on panchromatic film.

**"Design and Operation of Theater Loud Speaker Systems";** J. F. Blackburn, *Lansing Manufacturing Co.*, Los Angeles, Calif.

Although really satisfactory loud speakers have been commercially available for only a comparatively short time, all the essential elements of a good loud speaker have been at hand for many years, so that the reasons for the late appearance of suitable units must be sought in the economic rather than the technical field.

The loud speaker with its horn and other adjuncts is considered analogous to the antenna and plate circuits of a radio transmitter. It is pointed out that probably only in acoustics and in radio transmission do we have to be so wavelength-conscious, since only in these cases do the wavelengths of interest range from very small to very large, compared with apparatus dimensions. This wide range at once denies the use of the types of simplifying assumptions that are so convenient in other fields, and introduces several sets of mutually contradictory requirements for the apparatus. To date, apparently no one has succeeded in fulfilling all these requirements in a single piece of apparatus, so that it becomes necessary to use multi-channel systems with appropriate frequency-dividing networks.

One solution to the requirements just outlined is discussed in detail from the engineering point of view. The comparatively meager published design data are

reviewed and commented upon in the light of the author's experience with the units described. Some information is given regarding possible modifications of performance by minor changes in the units. Experiences in the application of these units in the field are discussed and suggestions are given to users.

**"Push-Pull Recording with the Light-Valve";** J. G. Frayne and H. C. Silent, *Electrical Research Products, Inc.*, Hollywood, Calif.

Push-pull recording on film is accomplished by means of a double light-valve having four ribbons. Distortions introduced by the recording medium which are represented by second-order harmonics balance out in reproducing, as do also the frequencies introduced by the action of the noise-reduction system. As a result, push-pull recording not only eliminates certain defects of conventional recording, but permits the application of new technics that allow further extension of the volume range and improvement in the naturalness in the final product.

**"The Educational Value and Preparation of U. S. Army Training Films";** R. T. Schlosberg, *Capt., U. S. Army Signal Corps*, Washington, D. C.

Problems encountered, considered incident to the preparation of army training films, and teaching principles and their application to instruction through the medium of sound-films are discussed. The method employed and the criteria for the selection of subjects are outlined, as also the general method by which such film subjects are produced.

**"New Uses for Instructive Motion Pictures";** H. Roger, *Rolab Photo-Science Laboratories*, Sandy Hook, Conn.

Problems are described that were encountered during the production of several motion pictures with sound for the New York State Department of Health. These films represent a type that has found new uses in instructing physicians and nurses, as well as the general public, in the treatment of pneumonia patients. They represent a part of a nation-wide campaign program against the spread of pneumonia. One or two films will be demonstrated.

**"Making an Industrial Film";** J. A. Norling, *Loucks & Norling Studios*, New York, N. Y.

Industrial films can be classified as sales films, which are made for the purpose of putting a sales message across to the prospective consumer; sales-training films, which are devised to train salesmen and are not planned for public use; educational films, which may contain some sales-promotional material; advertising films, which are usually very short bits released in theaters. Of the many industrial pictures made in the last few years, by far the most important are those classified as sales, sales promotional and sales-training.

Problems that arise in the production of these films are discussed. The increasing demand for color has set up many new problems for the producer of industrial motion pictures and slide-films. Growing appreciation of high production quality among industrial clients has also increased the difficulties and expense of the producer. These matters are touched upon but the main portion of the paper is devoted to one typical film—a detailed case history of its making, from the original scenario to the ultimate use of the film in reaching the market. (The presentation will close with a demonstration reel.)

**"An Industrial Visual Instruction Laboratory";** J. G. T. Gilmour, *General Electric Co.*, Schenectady, N. Y.

The history, methods of operation, equipment, and types of work are described of the section of the General Electric Co. that prepares, produces, and distributes the pictures used by the Apparatus and Supply Division of the Company.

**"A Higher-Efficiency Condensing System for Motion Picture Projectors";** F. E. Carlson, *General Electric Co.*, Cleveland, Ohio.

In motion picture projection optical systems for tungsten-filament sources, the condenser design is such that the source is imaged well ahead of the picture aperture. This position is dictated by considerations of uniformity of screen brightness. It is not the optimal position from the standpoint of utilization of light, for it entails losses at the aperture. At the best position for efficiency, the degree of brightness uniformity is unacceptable because of the non-uniform brightness of the source. The paper describes a method for reducing such losses without sacrificing picture quality.

**"A Water-Cooled Quartz Mercury Qamp";** E. B. Noel and R. E. Farnham, *General Electric Co.*, Cleveland, Ohio.

The structure of the water-cooled quartz mercury lamp, its operation, quality of radiation, brightness, and source size limitations are first described, followed by a discussion of the power-supply equipment, both a-c. and d-c. Applications of the lamp are as follows:

(1) Motion picture projection, both with single lamps and with several sources.

(2) Motion picture photography, both black-and-white and color. This part of the paper tells also of an application to very high-speed motion picture photography. For black-and-white photography the lamp is quite satisfactory. For color work the relatively limited red radiation may call for external methods, either in the use of fluorescent reflectors or a highly red-sensitive emulsion, to make up for this deficiency.

(3) Film printing. Because of the relatively high output in the blue-violet and ultraviolet regions this lamp may prove a very satisfactory source, especially where advantage is taken of the ultraviolet radiation.

The following additional applications, of secondary interest to the motion picture industry, are also discussed: photo-enlarging, photoengraving, and search-lights.

**"Theory vs. Practice";** F. H. Richardson, *Quigley Publishing Co.*, New York, N. Y.

Attention is directed to the discredit heaped upon the splendid work accomplished by scientific men in designing apparatus employed in projection, and upon the praiseworthy accomplishment of construction engineers in carrying those designs forward into completed equipments. Apparatus can not be made to function efficiently in theaters while men are in charge who lack practical and theoretical knowledge. The public, for the most part, is unable to form intelligent opinion as to where the fault for poor functioning lies, and almost invariably will credit it to imperfect equipment. Suggestions are offered looking toward placing thea-

ter projection equipment in the hands of thoroughly capable men, to the end that the equipment may be made to produce results of which it is capable and to last a maximum length of time in service without excessively high operating expense.

**"Good Tools Pay for Themselves";** J. R. Prater, *Congress Theater*, Pabouse, Washington.

The average projectionist does not equip himself with an ample supply of good tools, and the average theater management refuses to stock the projection room with anything more than a scant supply of tools of poor quality. After listing the tools that are known to be useful in the projection room the paper points out that were such tools available to the projectionist they would return their original cost in a relatively short space of time by enabling proper testing and alignment of equipment in addition to facilitating minor repairs of the equipment.

**"A Technic for Testing Photographic Lenses";** W. C. Miller, *Paramount Productions, Inc.*, Hollywood, Calif.

Different makes of lenses have different properties and characteristics which may render a lens ideal for one purpose and totally undesirable for another. Lenses of a given make and series often vary in quality among themselves. To obtain the best type of lens for a specific purpose it is necessary to subject the various makes obtainable to tests that will reveal the characteristics in such a way that they can be reduced to numerical quantities for comparison. Once the type of lens for a specific purpose has been chosen, it is of great importance to be able to select the best of that type from a group submitted by the manufacturer.

Equipment and technic used in tests that make such discrimination possible are described. A few general hints and precautions are given that will aid in determining the characteristics most desirable for various purposes. Special emphasis is placed upon the tests for lenses intended for use with standard 35-mm. equipment. It is a simple matter to apply the methods and principles to other classes of lenses.

**"Some Unusual Adaptations of 16-Mm. Equipment for Special Purposes";** J. L. Boon, *Development Department, Eastman Kodak Company*, Rochester, N. Y.

A casual observer, looking over the existing standard amateur photographic equipment, would probably be of the opinion that there is little need of altering a camera to do a special job. However, closer observation of the various problems that photography serves reveals that the standards of practice have been chosen merely to suit the needs of a common majority of users, and the minority are almost forgotten. Further observations show that an alteration to a standard camera to make it fit a specific purpose usually precludes its usefulness for many of the purposes for which it was originally designed, and also its utility for other special purposes.

An attempt has been made in this paper to make known some of the unusual adaptations of 16-mm. motion picture equipment, each to fulfill a definite purpose, and to show that industry is becoming more conscious of the utility of such photographic equipment as a tool in solving some of its problems.

**"A New 16-Mm. Projector";** H. C. Wellman, *Camera Works, Eastman Kodak Company*, Rochester, N. Y.

The new projector is housed completely in aluminum die-castings, and to provide quietness of operation, the pull-down gears are individually adjusted in assembly by means of an eccentric sleeve. To facilitate threading, the location of the pull-down claw is designated by the threading knob, the position of which can be detected by touch as well as by sight. Throwing a single lever engages the rewind mechanism and at the same time releases the lower reel.

A threadlight is built into the projector, so positioned as to be most effective for threading the gate and the sprockets. The single control switch, a new and unique feature, has four positions: the first is the *off* position; the second turns on the threadlight so that the machine may be easily threaded in a darkened room; the third turns on the motor (the threadlight remains on so that the operator can momentarily see that the loops are properly formed and that the projector is functioning properly); and the fourth turns on the projection lamp and turns off the threadlight.

**"The Shrinkage of Acetate-Base Motion Picture Films";** J. A. Maurer and W. Bach, *The Berndt-Maurer Corp.*, New York, N. Y.

A simple direct-reading film-shrinkage gauge has been constructed with which shrinkage readings may be made in a few seconds. The accuracy of the instrument is such that the maximum variation in a series of readings made upon a particular film will not be more than 0.02 per cent of the predetermined length measured. Readings have been taken systematically with this instrument over a period of five months to determine the shrinkage behavior of acetate-base films under various conditions of storage and use.

The results indicate that the safety-film base made by each of the three American manufacturers has a characteristic value of shrinkage that is ordinarily reached within a few days after processing. Subsequent shrinkage is slow but continuous over a long period of time. The ultimate value of shrinkage is of the order of 1.25 per cent except in the case of films that have been projected many times on projectors using high-wattage lamps. The bearing of this shrinkage information upon equipment design is discussed briefly.

**"A Criticism of the Proposed Standard or 16-Mm. Sound-Film";** J. A. Maurer and W. H. Offenhauser, Jr., *The Berndt-Maurer Corp.*, New York, N. Y.

It has been proposed that the standard dimensions of 16-mm. sound prints be changed, principally by widening the sound record and scanned areas. The question is reviewed from the standpoint of the cumulative effects of film shrinkages and mechanical inaccuracies in the steps leading to the final sound print and in the projection of that print, following the method described by R. P. May in the April, 1932, *JOURNAL*.

A film having sound records of various widths will be demonstrated to support the contention that increased width of sound-track is not needed, and that if any change from the present standard is to be made, it should be in the direction of a narrower track to provide a wider margin outside the sound-track and a wider safety area between the sound-track and the picture.

**"A Continuous Optical-Reduction Sound-Printer";** M. G. Townsley, *Bell & Howell Co.*, Chicago, Ill.

Optical-reduction printing from 35-mm. negative to 16-mm. positive has come into wide use. A new printer has been developed for making optical-reduction prints. The printer departs from conventional design in that the film rolls are horizontal, making possible oil-damped filters and flood lubrication without friction-producing oil-seals. The printer operates in either direction and stops automatically at the end of the negative. A three-phase, 220-volt synchronous motor drives the main worm shaft from which all the working parts are driven at a printing speed of 60 feet of 35-mm. film per minute. Uniform film motion is achieved by a heavy flywheel and independently filtered drive to each film drum.

The self-contained optical unit produces on the 16-mm. film an image of the 35-mm. track moving in synchronism with the 16-mm. film, with longitudinal and transverse magnifications of 0.40 and 0.84, respectively. Provision is made for printing masking lines at the edge of the track. A 10-volt 7 $\frac{1}{2}$ -ampere d-c. lamp is operated from a pair of 6-volt storage-batteries and a full-wave charger. Lamp current is controlled by a rheostat and ammeter.

**"An Automatic Camera Timer for Time-Lapse Cinematography";** H. Roger, *Rolab Photo-Science Laboratories*, Sandy Hook, Conn.

Ever since the invention of motion picture, time-lapse cinematography has been used extensively to speed up slow actions. More or less complicated devices have been constructed, mostly by the cameraman himself, to take single exposures at various time intervals. In modern cinematography, especially in the industrial and scientific field, time-lapse photography has found a great many new uses in recording slow processes. The camera timer described in this paper operates not only the camera but also the light, in synchronism with the camera shutter. The timer is the result of more than twenty years of practical experience in this field.

**"A New Framing Device for 35-Mm. Projectors";** H. A. DeVry, *Herman A. DeVry, Inc.*, Chicago, Ill.

This device embodies a unique application of the silent chain drive to the motion picture mechanism, in such a way that the up or down movement of the film effected by the framer is accomplished without disturbing the synchronism between the shutter and the intermittent. Also, since the framing is done by an overhanging arm built directly onto the intermittent, the intermittent moves only rotationally, and remains always so close to the aperture that there is no room for buckling of the film. In fact, it is impossible for any buckling to occur due to framing.

**"A Film Cement Pen";** R. J. Fisher, Rochester, N. Y.

The purpose of this device is to make the application of film cement in splicing film easier and neater, and allow no waste of cement by spilling or evaporation. It replaces the bottle, brushes, medicine droppers, *etc.*, and is a time-saving element where it is necessary to make many splices, as in film exchanges, studios, and laboratories.

**“New Piezoelectric Devices of Interest to the Motion Picture Industry”;** A. L. Williams, *The Brush Development Co.*, Cleveland, Ohio.

Devices discussed are: (a) phonograph pick-up with uniform response (without further compensation) 30 to over 10,000 cps. with forces so low that it will reproduce this range from soft direct recordings with negligible wear; (b) record cutter which, used in conjunction with the pick-up, will record over same range; (c) high-fidelity headphones reproducing to over 10,000 cps. with high sensitivity and high impedance (over 7500 ohms per pair); (d) unidirectional microphone (changeable at will to bidirectional or non-directional) using ribbon pressure gradient unit and sound cell pressure unit.

**“Characteristics of Supreme Panchromatic Negative”;** A. W. Cook, *Agfa Ansco Corporation*, Binghamton, N. Y.

The new panchromatic negative film is compared with earlier types of super-sensitive material. It has a light-sensitivity twice as great as that of Superpan. This permits a 50-per cent reduction in set lighting, or the use of a smaller lens aperture for gaining greater depth of field with undiminished illumination. Relative color-sensitivity is substantially unaltered. The film is doubly coated, with two emulsion layers superposed upon a gray antihalation layer between the emulsion and the support. Despite increased sensitivity, Supreme negative has equally good keeping qualities, finer grain, and lower developing fog than Superpan. Development characteristics are similar and no alteration of laboratory procedure normally employed for typical supersensitive materials is suggested, although the long scale of the film allows great latitude in development. Extremes of light and shade beyond limits imposed by earlier supersensitive materials can be recorded faithfully, as indicated by the long straight-line portion of the characteristic curve, a very short toe, and a shoulder falling in the region of densities far beyond those encountered in practice. These advantages are reflected in the quality of negatives taken under adverse lighting conditions.

**“A New Indicator for Sound-Level Measurements”;** S. K. Wolf and S. J. Begun, *Acoustic Consultants, Inc.*, New York, N. Y.

This device consists of a long glass tube approximately 18 inches long and one inch in diameter. In the tube are three electrodes, one of which extends the entire length of the tube, and a mixture of inert gases at a very low pressure. The inside of the glass is coated with a material that fluoresces under the ultraviolet and positive ion bombardment, due to a constant voltage applied to the electrodes of the tube. The coating is of three different types, each of which will fluoresce a different color—green, blue, and red. The “blue” extends for seven inches at the lower end of the tube, next the “green” for four inches, and finally the “red” for the upper remaining seven inches.

A voltage of 250 volts is placed across the two small electrodes to produce a striking voltage and establish a zero point on the tube. Then the alternating voltage is applied to the long electrode from the output of a voltage amplifier to which a microphone is attached to pick up the sound under observation. The range of the tube is approximately 70 db. When the signal is too weak, the “blue” portion of the tube lights up; if the signal is brought up to a higher level the “green” portion lights up, representing the 3-db. change required to modulate

a broadcast station from 65 to 85 per cent. If the signal is still stronger the "red" portion of the tube lights. Approximately 250 volts a-c. are required to operate the tube over its full range. The tube can be calibrated to read directly on a decibel scale, and by using a special type of logarithmic amplifier, the scale is linear. The great advantage of the tube is that the entire audio intensity range is on one scale and no switching scales need be done in operating this instrument.

As a practical example of the use of the tube, the blue region may indicate that a speaker's voice is too low, the green that it is satisfactorily strong, the red that the voice is too strong.

**"The Resonoscope";** S. K. Wolf and L. B. Holmes, *Acoustic Consultants, Inc.*, New York, N. Y.

The "resonoscope" employs a special cathode-ray oscillograph in conjunction with a standard set of musical frequencies—the twelve notes of the chromatic musical scale, produced by twelve electrically driven tuning forks, which synchronize an oscillator in step with them. This oscillator provides a *horizontal* sweep circuit for the cathode-ray tube. A voltage amplifier picks up music or any single musical tone, through a crystal microphone, and energizes the *vertical* plates of the cathode-ray tube. This gives a visual picture of the wave-form of the musical note under observation. If the note is of the same pitch (or frequency) as the standard, or any harmonic of it, the wave-form will appear stationary on the screen of the cathode-ray tube. If the note is flat, or lower in pitch, than the horizontal sweep standard, the wave-form will appear to be moving to the left; if higher in pitch than the standard, or sharp, the wave-form will move toward the right. The movement indicates to the musician whether he is playing in tune or is sharp or flat. The speed with which the wave-form moves across the screen is an indication of the extent to which the instrument is out of tune.

Any of the twelve standard frequencies in the instrument may be selected by turning a control on the panel of the instrument, and each setting of the control accommodates all octaves of the particular note. One of the special features of the circuit is that the horizontal sweep circuit is automatically changed in frequency to compensate for the change in frequency in going from one note to another. This allows the sweep circuit to be synchronized at all times by the standard frequency of the tuning forks and assures the observer that the number of wave-forms on the screen of the cathode-ray tube is a direct indication of the octave he is playing or tuning. The frequencies of the standard chromatic scale are calculated for a true tempered scale, which has the most practical use for all types of tuning. The pitch of the scale is 440 cycles per second for *A* above middle *C*, this being the international pitch for tuning. This pitch is the one being used in the present models but any pitch can be had by substituting a new set of standards.

**"A Roller Developing Rack with Stationary Drive";** C. E. Ives, *Kodak Research Laboratories*, Rochester, N. Y.

In a previous paper a rack was described that provided for continuous motion of a 200-ft. length of motion picture film during processing but could be used with the rack-and-tank equipment. The purpose of this roller rack was to give a type of treatment in processing essentially similar to that given by a continuous ma-

chine while retaining the features of batch equipment that are helpful in experimental processing.

The rack previously described included a built-in driving motor and reduction gear, an arrangement that was most feasible for a single unit. With more extensive use it became desirable to have multiple units operated from stationary drives at the tanks and at the loading and unloading stations.

A new design has been worked out in which the weight of the rack was reduced greatly by the use of stationary drives. Further reduction in weight was attained by the substitution of tensioning springs for the weighted supporting beam associated with the movable lower shaft in the earlier model. This shaft was mounted upon the frame by lever arms in such a way as to use the torsional rigidity of the shaft itself to maintain it parallel to the upper shaft while allowing it the necessary vertical movement.

**"A New Projector Mechanism";** H. Griffin, *International Projector Corp.*, New York, N. Y.

This new projector is provided with synchronized front and rear shutters operating in the same direction and providing considerably greater screen illumination; an automatic fire-shutter safety trip for fire prevention; a Bijur one-shot oiling system to provide positive lubrication under pressure, together with ball bearings having sealed lubrication for extremely long service; heavier film-gate construction, the entire unit being readily removable for cleaning and having adjustable tension devices and locking positively both in the open and closed position; readily removable film-trap having edge-guiding means and provision for easily cleaning and replacing worn film runners; a new ring-type fire-shutter governor; easier threading facilities; new automatically positioned threading lamp; illuminated pearl gray enameled interior; and other distinctive improvements.

**"New Safety Switch for Motion Picture Projection Rooms";** E. R. Morin, *Department of State Police*, Hartford, Conn.

An emergency switch has been designed for projection rooms, which in the event of a fire simultaneously starts or speeds up the ventilating fans, and turns on the auditorium lights. Details are given of the safety requirements for the construction of theater projection rooms in the State of Connecticut.

**"A Solution of the Galvanometer Window Lens Problem in Recording Optical System Design";** G. L. Dimmick and L. T. Sachtleben, *RCA Manufacturing Co., Inc.*, Camden, N. J.

In the design of the variable-width recording optical system, the lens that images the aperture upon the slit should, ideally, be located at the galvanometer mirror. Early systems employing a vertical cutting edge permitted, with fair success, the use of a simple lens close to the mirror, but the stigmatic image thus obtained ruled the method out when oblique cutting edges were adopted. Resort was then made to a simple achromatic lens located axially between the aperture and galvanometer mirror.

The design of a very compact system for newsreel work has required that the lens be again located at the galvanometer mirror. This makes it necessary for the light to pass obliquely through the lens both before and after reflection from the

mirror. Both a simple lens and a corrected lens have been designed to meet this requirement, and it is found that definite advantages in the way of image quality inhere in such a lens when the design is properly executed.

**"A Study of Processing Conditions for the High-Resolution Sound Recording Emulsions";** J. O. Baker, *RCA Manufacturing Co., Inc.*, Camden, N. J.

The high-resolution recording emulsion described in the January, 1938, issue of the JOURNAL has been found satisfactory for recording as a negative provided that a sufficiently high density is obtained. With ultraviolet recording on the standard emulsions, the best value of print density is of the order of 1.4 for a negative density of 1.9.

The inherently low image-spread of the high-resolution emulsion requires a higher negative density for the same print density of 1.4. The negative density is of the order of 2.2 to 2.5. The noise is thereby reduced for two reasons: first, the inherent noise of the high-resolution emulsion is lower than that of the standard emulsions; and second, the higher negative densities give less trouble from the so-called "pin-hole" effect.

General practice at the present time is to make a master sound positive of the selected takes from which a re-recorded negative is made for use in the production of release prints. The paper discusses the processing conditions for the high-resolution emulsion when used as (a) an original negative, (b) as a master positive, and (c) as a re-recorded negative for final printing onto the standard release print positive.

**"A New Sound System";** G. Friedl, Jr., *International Projector Corp.*, New York, N. Y.

A brief review is given of the advanced features of the new Simplex sound system, and the considerations involved in developing a high-quality system for small as well as for large theaters are outlined. The engineering requirements of high-quality reproduction are set forth, and the methods employed for meeting these requirements even in the smallest system are explained.

The development is outstanding because of its very low noise level, which insures an effectively wide volume range. The advantages of wide frequency range are preserved by the special care given to the reduction of flutter. The power of even the smallest system is sufficient to reproduce faithfully the latest improved types of recordings, such as the "Hi-Range" prints. The system employs a refined type of rotary stabilizer mechanism, with provision for dual track reproduction, such as from push-pull or stereophonic recordings. Special facilities are provided for mounting and adjusting the projector mechanism. Change-over controls are of the electronic type employing grid-biasing circuits so as to eliminate switch contacts and mechanically interlocked controls. Standardized power amplifiers of 15-watt capacity with extremely low limits of harmonic distortion are used singly or in parallel for various system combinations. Two-way loud speaker systems are employed, with special switching facilities that simplify checking loud speaker units as well as amplifier characteristics.

**"The Properties and Applications of Ozaphane";** J. Holloway, *The Holloway Co.*, New York, N. Y.

Chemical and mechanical differences between Ozaphane and gelatin emulsion

films are discussed. A report is made of accelerated life tests conducted by the New York Testing Laboratories and the U. S. Bureau of Standards. The duplicating properties of Ozaphane are discussed, and reference is made to the following applications: sound-track, home phonographs, radio broadcast, organ recordings, *etc.*; microphotography trends, resolution of Ozaphane; color transparencies; toy film, in black-and-white and in color.

The diazo dye process is treated as applied to bases other than cellophane; surface and complete sensitization. A spectrographic analysis is given of diazo dye-stuffs and it is shown how projection and sound-track utilizations are affected. (Samples of film will be projected and a demonstration will be made of a home phonograph using Ozaphane film.)

**"Tracing-Distortion in Sound Reproduction from Phonograph Records";** J. A. Pierce and F. V. Hunt, *Cruft Laboratory, Harvard University, Cambridge, Mass.*

When the spherical tip of an ideal reproducer stylus slides over a warped groove surface having a sinusoidal profile, the traced curve is not exactly sinusoidal. An analysis of the harmonic content of the traced curve, similar to that given by Di Toro (*J. Soc. Mot. Pict. Eng.*, Nov., 1937) but avoiding his approximations, is directly applicable to reproduction from vertical-cut records. These results may be applied to reproduction from lateral-cut records by taking the original groove surface as inclined approximately 45 degrees from the horizontal, projecting the traced curve upon the horizontal and vertical planes, and adding in proper phase the guidance of the stylus tip by *both* sidewalls. It is shown that there is a residual vertical component of stylus motion ("pinch" effect) and complete cancellation of all even harmonics in the tracing distortion. Computation of the remaining odd harmonics indicates that, when the ideal lateral-cut reproducer characteristics include ideal "following" for vertical motion at signal frequency, a lateral-cut record may be reproduced with one-fourth to one-tenth the rms. distortion of a similarly recorded vertical-cut record. These results are displayed for convenient reference by contours of constant distortion upon a universal chart, the dimensionless coördinates of which characterize any recording condition and allow immediate specification of the maximum permissible recorded amplitude, maximum predistortion of the frequency characteristic, and the required clearance angle of the recording stylus.

**"Multiple-Channel Recording";** H. G. Tasker, *Universal Pictures Co., Inc., University City, Calif.*

Multiple-channel recording is a device for achieving needed flexibility at the time of dubbing or re-recording orchestral music presented as such in the picture. If producers, directors, and film editors could predict for the music and sound departments which portions of the orchestra would be seen from which angles in the finally edited picture, or if the editing could be completed before the music was recorded, there would be less merit in multiple-channel recording.

The reverse is true: The music is recorded first, the musicians photographed later, synchronizing their movements to a play-back of the record. Meanwhile, the pictorial treatment has taken partial shape in the minds of producer and director. Still later it takes final shape in the hands of the film editor. Sound and action are then placed in the hands of the sound department for dubbing, but

it is then far too late to do more than an ineffectual raising and lowering of volume. The violins or the woodwinds can not be lifted above the surrounding sections to match a close-up of the picture.

Multiple recording, meaning the provision of a separate recording channel, complete with microphone, amplifier, recording machine, *etc.*, for each important section of the orchestra (usually six) and all propelled in synchronism, provides an excellent solution of the problem. The resulting multiplicity of sound-tracks (recorded, of course, in advance of the photography) will afterward provide the dubbing mixer with the means of easily blending a final sound-track that will be wholly in keeping with the final edition of the picture. The application of this method to the recent production *100 Men and a Girl* is described. The use of "close-mix" tracks, separate vocal tracks, *etc.*, in conjunction with multiple recording is also described.

**"Application of Non-Linear Volume Characteristics to Sound Recording";** J. O. Aalberg and V. G. Stewart, *RKO Radio Studios, Inc.*, Los Angeles, Calif.

The advisability of using a non-linear volume characteristic in dialog recording is discussed. In this connection consideration is given to the following points: (a) the difference of level existing between the original and reproduced speech; (b) the advantages of a system in which manual monitoring can be confined to overall level correction rather than to momentary peaks; (c) the advantage of limiting the range of all except trained voices to assure the highest possible intelligibility. An analysis is then made of the various types of compression possible and a terminology is developed.

Consideration is given to the type of device most applicable to motion picture recording. The electrical circuits and operating characteristics of a compressor that has been in commercial service for 18 months are discussed. Practical results and advantages obtained by the use of the device during this period are analyzed and the possibility of additional applications is indicated.

**"The Philips-Miller Method of Sound Recording";** R. Vermeulen, *N. V. Philips Gloeilampenfabrieken*, Eindhoven, Holland.

The first attempt at mechanographic recording and reproducing was made as early as 1891 but no successful solution of the problem was applied until the invention of J. A. Miller in 1931. The principle of this invention is described as inertia-free magnification. After the introduction of the principle, the inventor coöperated with the research laboratories of the N. V. Philips Company, of Eindhoven, Holland, in order to solve the problems involved in bringing the system to commercial use.

The method of obtaining a mechanical amplification of forty times is described and illustrated. The mathematical and theoretical advantages of the system over photographic methods are discussed, as also the film or tape that has been specially prepared for this process of recording. Some of the difficulties or precautions that are peculiar to the system and are new to the art of recording, relating to the cutting instrument, cutting material, and the coating of the film, are described. One type of recording machine is described with drawings of the most interesting mechanical parts. A bibliography of articles on the subject is appended.

**"Electrical Networks for Sound Recording";** F. L. Hopper, *Electrical Research Products, Inc.*, Hollywood, Calif.

Electrical networks are employed in sound recording for modifying and limiting the frequency-response characteristic. The necessity for their use, application, and design are described. Particular emphasis is placed upon the constant-resistance type of structure.

**"The Application of Electrical Networks to Sound Recording and Reproducing";** H. R. Kimball, *Metro-Goldwyn-Mayer Studios*, Culver City, Calif.

The use of electrical networks with recording and reproducing systems to accomplish beneficial results has been steadily increasing. Two types of networks are in general use, namely, wave-filters and attenuation equalizers. This paper discusses in some detail the use of these networks with sound systems as reflected by present practices and later presents practical data for engineering the networks with a minimum of time and effort. The uses to which attenuation equalizers are put divide these networks into two general classes: first, fixed equalizers to provide fixed equalization for sound channels; and, second, variable equalizers to provide means for varying at will the relative amplitudes of the frequency components of sound signals. Although the means for engineering variable networks is far from being ideal, the review given in the paper of present practices should be valuable.

**"Silent Gasoline Engine Propelled Apparatus";** J. E. Robbins, *Paramount Pictures, Inc.*, Hollywood, Calif.

Problems are discussed connected with the design, construction, and operation of electrical generators and water pumps running under full load sufficiently silently to permit satisfactory sound recording. The units described were the result of demands for silent power equipment for making shots on boats, trains, bus interiors, inaccessible canyons, etc. As an example of what is sometimes required, one of the largest units was installed in the hold of a windjammer used throughout the Paramount Production, *Souls at Sea*, and although the microphone was at times directly above (approximately 30 feet) the spot occupied by the generator, no noises were picked up by the sound recording equipment.

Four units are described, namely, one 144-kw. Hispano Suiza, one 57-kw. Lincoln Zephyr, and one 41-kw. Ford V-8 generator, and one high-pressure Ford V-8 water pump. In each case the entire mechanical unit is rubber-mounted on a sub-frame within a semi-airtight compartment constructed of an outer shell of 22-gauge auto-body steel, four inches of sound-absorbing material with an inner lining of asbestos cloth. The entire exhaust system is water-cooled, employing special mufflers also housed within the case. One radiator, mounted outside, cools the water for the engine as well as the exhaust. All are practically automatic in operation, with electrical governors, temperature regulators, etc. The machines have been in operation approximately fifteen months and have required very little service other than normal maintenance.

**"Variable-Matte Control (Squeeze-Track) for Variable-Density Recording";** G. R. Crane, *Electrical Research Products, Inc.*, Hollywood, Calif.

A review of the relation between the width of variable-density sound-track and the signal-to-noise ratio indicates the advantages to be gained by applying a vari-

able matte to the sound-track. To provide this facility, a sound-track matting system has been developed for application to existing standard studio equipment. By means of selsyn-type motors, a foot-operated control unit drives an indicating meter, an attenuator, and a masking device on the recorder. A new condenser lens assembly is used on the recorder and the system may be used for either single or push-pull recording.

**“Permanent-Magnet Four-Ribbon Light-Valve for Portable Push-Pull Recording”**; E. C. Manderfeld, *Electrical Research Products, Inc.*, Hollywood, Calif.

The general adoption of the push-pull recording technic has necessitated providing adequate modulating equipment for portable recording channels. The four-ribbon permanent-magnet light-valve herein described is an important unit in this equipment. It has been designed to provide the smallest practicable mechanical structure without sacrificing the operating and maintenance advantages possessed by the larger type of valve used in fixed channels. The magnetic field of the valve is provided by permanent magnets. The individual ribbons are so mounted as to allow spacing and tension adjustments at any time.

**“Overload Limiters for the Protection of Modulating Devices”**; R. R. Scoville, *Electrical Research Products, Inc.*, Hollywood, Calif.

Two types of volume-limiting devices are discussed. The first type automatically limits the envelope of a signal to a predetermined maximum amplitude in such manner that harmonics are not generated. A time factor is incurred wherein the envelope amplitude is changed when the limiting value is approached. A second type of volume limiter acts instantaneously to prevent excessive signal amplitudes, and is used primarily for the protection of equipment against damaging signals and where such odd harmonics as are generated during the limiting period can be tolerated. Equipment of this type is described in detail and compared with limiters of the first type.