

**ABSTRACTS OF PAPERS FOR THE HOLLYWOOD CONVENTION**  
**MAY 24-28, 1937**

*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.*

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

Further renovation of obsolete sound and picture equipment and continued expansion of studio floor space and facilities were noted during the past year. Another stimulant to the aroused interest in color processes was given by the announcement of a new three-color subtractive process. A multi-layer emulsion contains components in the three separate layers which react with the developing solution to produce dye images *in situ* in the layers. The completely unblimped camera has still to be adapted for modern sound pictures but a number of refinements were introduced in mechanisms and lenses. A growing tendency to use less general illumination and more effect lighting was noted.

Push-pull recording announced a year ago has made rapid inroads against previously employed systems. One type of light-valve uses four ribbons for recording all push-pull tracks. Following the lead of the Fletcher two-way horn development, systems incorporating the fundamental principles of this reproducer came into widespread use. Commercial equipment for push-pull recording with ultraviolet radiation was installed in several production centers here and abroad. The use of non-slip printers was extended considerably as a further laboratory refinement.

In the 16-mm. field, new emulsions were made available for ordinary and color photography, and several new cameras and projectors were announced. A gradual but definite invasion of the 35-mm. field was noted as equipment for use in small auditoriums was being adopted. Such installations would probably not compete directly with 35-mm. equipment but would augment such equipment.

Summaries of the motion picture progress in Great Britain, Germany, and Austria are appended to the report.

**"Soft X-ray Motion Pictures of Small Biological Specimens;"** H. F. Sherwood, *Eastman Kodak Co.*, Rochester, N. Y.

Soft x-rays have been used in radiographing leather, textiles, paper, biological specimens, *etc.* The most recent application is in recording soft x-ray motion pictures directly on the film, using a special emulsion having a high sensitivity to soft x-rays. Radiographs were made at a speed of 16 frames per second.

The camera used was a universal model C, with the lens removed and a piece of infrared gelatin filter (Wratten No. 87) covering the gate to protect the film from light, and at the same time, to furnish a support for the subject. The camera shutter absorbs the soft x-rays from the tube during the short exposures between frames, thus allowing continuous operation of the tube.

A special form of x-ray tube fitted with an extremely thin window is required for the production of radiation suitable for radiographing thin subjects.

Soft x-ray motion pictures of the yellow meal worm show peristaltic waves, gas bells leaving the stomach through the mouth, and the effects of various anesthetic vapors upon the internal movements.

**"Educational Film Progress and Problems;"** S. K. Wolf, *Erpi Picture Consultants, Inc.*, New York, N. Y.

During the past year the educational sound-film has shown greater progress than in any previous year since its inception. In September, 1936, it overcame a possible crisis when a 16-mm. standard was adopted and ratified at Budapest by the International Standards Association. The increase in production of films and sale of projection apparatus and films has more than doubled any previous year's activities in Europe and in this country. Abroad the 16-mm. educational film has been subsidized and assisted in a number of ways. In Hungary, Germany, and other countries, school children are taxed to support the production of educational sound-films. In some countries educational sound-films are being exhibited on entertainment programs. Objective experiments have been continued with new productions, adding to the already overwhelming evidence of the fact that the film-taught student acquires and retains more than the student instructed without films. Production technic, particularly in the field of technical animation, has shown remarkable improvement.

Producers in coöperation with school authorities have developed a utilization program properly integrating the films into the curricula, training the teachers, and organizing a complete audio-visual program as contrasted to the former less organized use of films.

While there has been continued improvement in the engineering development of the educational film medium, there remain many unfinished problems that must be solved before the educational film can realize its full pedagogical and commercial potentialities. The quality requirements of the teaching film are substantially the same as those of the entertainment film. The mechanical and optical requirements are more severe. The educational film already feels the need for a color process, which thus far is not available. Different negative and print materials will probably be necessary for educational pictures. Better light-sources for the 16-mm. projection will be required. The operation of the projection equipment must be simplified if it is to be used as a universal classroom teach-

ing tool. The noise created by the operation of present projectors is distracting, and must be reduced to a level not in excess of 40 decibels. This presents a real acoustical engineering problem. The responsibility for the solution of these problems lies with the motion picture engineers, and offers a real challenge to the profession as well as a great opportunity.

The educational film needs the whole-hearted support of the entire motion picture industry, and, in particular, that of the major producers, whose wealth of educational material will give a great impetus to educational films. Perhaps the greater immediate need of the educational film is more adequate distribution.

**"Denham Studios of London Film Productions, Ltd.;"** L. C. Fermaud and J. Okey, *London Film Productions, Ltd.*, Denham, Middlesex, England.

The studios occupy 28 acres of a 165-acre estate in Buckinghamshire, about 17 miles from the center of London. Fine gardens stretching to the edge of dense woodland provide a natural setting that can be adapted easily for exterior photography. There are seven stages, totalling 120,000 square-feet of floor area. Two stages are 250 by 120 by 45 feet (high); two are 125 by 120 by 45; and three are 120 by 80 by 35. Details of the foundation and wall construction are given. The main reviewing theater is designed for reviews and for scoring; for the latter the reverberation period can be adjusted to 0.8 second and for the former, 1.5 seconds.

A description is included of the various shops that service the studios, not only for set construction but also for equipment. The Metal Shop, for example, has turned out over 700 lamps for set lighting, two optical printers, a projection printer, a stop-motion machine, and a rear projector.

In the sound stages, only the dubbing channel is of the permanent type. A brief description is given of the portable sound channels, the camera department, and the processing laboratories. Two automatic developing machines, capable of developing 480 and 1000 feet per hour, are available for film processing. Automatic mixing equipment is used for preparation of solutions.

The electrical power plant is described and details are included on fire protection, water supply, and sewage disposal.

**"The Evolution of Special-Effects Photography from an Engineering Viewpoint;"** F. W. Jackman, *A.S.C.*, Hollywood, Calif.

The development, and particularly the present status, of special-effects photography is discussed. In the early days, special-effects photography, or "trick camerawork," as it was called then, was not only mechanically crude, but was treated virtually as a matter of "black magic." The desired effects, although achieved more frequently by luck than by skilled intent, were almost invariably held as the closest of trade secrets—or more correctly, as personal secrets of the cameraman.

With the general advancement of the business and of the individuals therein, this condition has vanished to a large extent. Today there are definite, well-established classifications of this type of photography, governed by laws as positive as those covering any other branch of engineering. In building a bridge, for instance, the structural engineer knows that if a given load is to be carried, the supporting members must be of certain specifications. In the same way, the special-effects photographic engineer knows that if a certain effect is to be had, the components of his shot must be properly coördinated. In a miniature, a

known scale in the model, combined with equally known factors of lens, camera, speed, *etc.*, will combine to produce a natural effect, while any deviation from any of these will appear artificial. The same holds true of the back-ground projection composite process, optical printing, and the like. In a word, the modern special-effects cinematographer who succeeds is the one who tackles his problems from an engineering, rather than a wonder-working point of view.

**"Special Engineering Problems in a Motion Picture Studio;"** W. Strohm, *Twentieth Century-Fox Film Corporation*, Beverly Hills, Calif.

The Engineering Department at the Twentieth Century-Fox Film Corporation Studios is responsible for the various technical operations of the studio, which can be classified under the headings of Air-Conditioning, Plumbing, Foundry Mechanical, or Electrical activities.

The responsibilities enumerated above cover a considerable portion of the technical activities of a studio, and a great deal of effort is required to take care of the routine matters that arise each day. However, the interesting work of this department lies in the special engineering problems that arise in the production of motion pictures. A solution of these problems is made much more difficult because they must always be solved satisfactorily in a very short space of time. Also, due to the motion picture requirements, commercial equipment is usually not satisfactory, and suitable equipment must be designed and built in the studio.

This paper describes some of the various engineering problems that have been encountered in the production of motion pictures at this studio.

**"A New Viewpoint on the Lighting of Motion Pictures;"** G. Gaudio, *A.S.C.*, Hollywood, Calif.

The lighting of motion pictures is discussed, with relation to a new technic developed by the author and employed in several recent productions, notably *Anthony Adverse* and *The Life of Emile Zola*.

The use of artificial lighting for motion picture scenes originated with attempts to imitate the flat overall illumination produced by daylight on the early "daylight stages." When the concepts of modelling and effect lighting were introduced, they were regarded merely as adjuncts to an overall flat general lighting. They have, in the main, so continued until today, despite the great advances made in optics and sensitive materials.

The author holds that under modern conditions, this technic is faulty. He has therefore dispensed with the so-called "general lighting," and has for some time done all his lighting with various types of spotlighting units. This enables him to light more precisely; to accommodate his effects and his equipment to the physical requirements of modern production technic; and to achieve more natural effects upon the screen.

The paper will be illustrated by motion pictures showing scenes discussed in the paper, from recent productions and possibly from some earlier productions.

**"Recent Developments in Motion Picture Set Lighting;"** E. C. Richardson, *Mole-Richardson, Inc.*, Hollywood, Calif.

The basic principles of motion picture set lighting are outlined and the technic of "key" lighting, employed by most cinematographers, is discussed.

Several new types of lamps that have found extensive use are described in detail. Technical data regarding them are presented along with information regarding their application in cinematography.

**"Light-Weight Stage Pick-Up Equipment;"** L. D. Grignon, *Paramount Productions, Inc.*, Hollywood, Calif.

In the past year and a half light-weight microphones and new pick-up equipment have been made available. This paper describes certain apparatus designed and built to take full advantage of the newly acquired features. The apparatus described in the paper consists of a fish-pole type of microphone boom with accessories and a complete stage pick-up unit.

The microphone boom is readily adaptable to a number of pick-up conditions where light weight, small size, and ease of handling are necessary.

The stage pick-up unit is readily portable and of relatively small weight and size. It includes the pick-up amplifier, booster amplifier, and power supply, with a small amount of storage space. It completely replaces the large type of monitoring booth previously employed. The weight of the unit being about 300 pounds, a great saving in operating costs is effected and greater simplicity of operation achieved.

**"Color Print Processes;"** O. O. Ceccarini, *Metro-Goldwyn-Mayer Studios*, Culver City, Calif.

Color photography applied to publicity stills represents a very valuable asset for the motion picture industry. The demand for high-quality results and speed places color stills in a special class of their own, and therefore the discussion of the various methods for obtaining color-separation negatives is carried out essentially upon the basis of these requirements. For the production of sample prints on paper, many of the available methods are discussed, such as carbon, carbro, dye transfer, chemical toning, *etc.*, emphasis being placed upon the methods that are capable of giving results most suitable to the needs of motion picture industry. The general discussion and the extensive bibliography should be found valuable by those who wish to study the subject of color photography in greater detail.

**"The New Agfacolor Process;"** *Agfa Ansco Corp.*, Binghamton, N. Y.

A survey of the history of monopack or multilayer photographic color processes is given, including the coloring methods of greatest importance at the present time. These are: (a) silver dye-bleaching methods and (b) silver dye-coupling methods. Silver dye-coupling methods appear to be most promising, and have been successfully applied to monopack films according to two distinct principles.

In one method, color-forming compounds are added to the developing solutions. Color separation in this method depends upon control of the speed at which bleaching solutions penetrate superposed emulsion layers.

In the second method, employed in the new Agfacolor process, the different color-forming substances, instead of being added to the developing solution, are incorporated in emulsions that are coated in superposition so that three differently colored images are simultaneously formed in a single development. The metallic silver is subsequently removed by solvents leaving only pure dye images.

This new process is based upon the pioneer work on color-forming methods of R. Fischer who, before the World War, developed the process substantially as it is now being used. The contributions made by Agfa in improving this process are the perfection of dyestuff coupling components better than those available to Fischer, improved methods of preventing diffusion of the color-forming compounds, and methods of precisely controlling the manufacture of multilayer film

upon a large scale, so that the present film is the practical expression in commercial form of Fischer's process.

**Report of the Color Committee; J. A. Ball, *Chairman*.**

The Eastman perforation, although adopted by the Society as a standard for positive and negative film, has certain disadvantages for use in connection with color processes and for background projection. The reasons for these limitations are analyzed, and a proposal is made that the important advantages of the Eastman filleted rectangular shape be retained in a perforation, the dimensions of which are the same as those of the Bell & Howell perforation. Such a perforation would fit existing Bell & Howell registering pins.

The use of a photocell having most of its sensitivity outside the visible spectral region imposes an added burden to those working upon color sound processes. Search is urged for a cell that would have all the advantages of existing caesium cells but with its chief sensitive response in the visible range.

The term "Direct Color Developer Process" is recommended for a color process wherein non-diffusing color-formers in the emulsion (multiple-layer) combine with the oxidation products of the developer to form insoluble dyes. A process of this type was introduced recently by Agfa.

**"Advanced Technic of Technicolor Lighting;"** C. W. Handley, *National Carbon Co.*, Cleveland, Ohio.

Within the past several months the technic of lighting Technicolor motion pictures has changed from more or less flat, evenly illuminated sets of high light level to a method whereby the cinematographer now uses a much lower level of general illumination and has greater freedom with the use of "modelling" lamps.

Recent developments in arc lamps for use in Technicolor lighting are discussed. The changed technic of lighting, made possible by the new equipment and the laboratory advancements, is briefly explained. The uses of each type of illuminant, diffusion screens, black screens, and other lighting-control devices are described. An explanation is given of the part taken by the chief set electrician, or "gaffer," in lighting motion picture sets.

**"Some Lighting Problems in Color Cinematography;"** T. T. Baker, *Dufaycolor, Inc.*, New York, N. Y.

In an additive process of color photography it is generally conceded that the primaries used are blue-violet, green, and orange bands of the spectrum, which overlap to some extent in the transmissions, and are not narrow and sharply divided. It is also well known that the latitude in exposure of a color-screen process is smaller as compared to that of black-and-white negative stock. Underexposures will frequently tend to excessive blue, and overexposures to some other predominant color, these effects being in some measure due to differences in the shapes of the foot and shoulder of the characteristic curves of an emulsion when exposed to light of the three spectral areas used. But overexposure will always result in a dilution of the colors. This is due to the invasion of each primary into its neighbor's territory. There is thus a color saturation latitude in the screen or matrix, as distinct from a true emulsion latitude. The object of this paper is to discuss a method of calculating the approximate range of light-intensities that can be used in studio lighting while maintaining the most correct color balance of which any particular additive color process may be capable.

In the case of Dufaycolor film, a wedge spectrogram representing average ex-

posure is taken, the steepness of the wedge being of a suitable range, such as from a density of 0 to 2.5. This spectrogram, on development and reversal, shows the peaks throughout the wedge spectrum as completely saturated, (*i. e.*, 100 per cent of the reseau or matrix saturation). But as any particular spectral zone is followed from the peak downward, toward the base-line, it is seen that as the image approaches the base-line, and therefore approaches maximum exposure, the color becomes diluted and may even turn to white.

This is caused by the fact that, upon overexposure, a scatter effect carries the light effect behind (say) a green element into the region of neighboring blue and red elements, so that the resultant color is reseau-green plus *some* blue and red, totalling reseau-green plus white. This effect is found to be accentuated in reseau composed of less saturated color elements.

By measuring from the peak to the position in any ordinate in the spectrogram where distinct dilution of the color becomes apparent, the permissible range of light intensities on the set can be computed from the difference in log opacity of the two points on the ordinate.

Diagrams of the apparatus used and samples of the spectrograms are included in the paper, and practical examples of still and motion picture films will be shown as demonstrating the advantage of keeping the light-intensity range of the subjects photographed within that indicated by the spectrograms.

**"Twenty Years of Development in High-Frequency Cameras;"** H. Joachim, *Zeiss-Ikon Aktiengesellschaft*, Dresden, Germany.

The construction of the high-frequency camera of the Zeiss-Ikon Company has behind it twenty years of development. The original model was designed by H. Lehmann and appeared upon the German market in 1917 as the Ernemann high-frequency camera. The principle of this apparatus is based upon optical compensation, to which end a reflecting drum with exterior mirrors was employed as compensating element. Films exposed with these machines exhibited a frequency up to 500 pictures per second.

The new model, which first appeared upon the market in 1930, is likewise constructed upon the principle of mirror compensation, with the difference that instead of the exterior mirrors a reflector drum is supplied with mirrors on the inside according to the patents of Professor Thorner.

In this way an extraordinarily simple driving mechanism has been obtained, as well as a specially compact form; so that with a holding capacity of approximately 60 meters of standard 35-mm. film, the size of the camera does not exceed the dimensions of a normal cine camera. The latest model permits an exposure frequency of about 1500 pictures per second.

The camera is therefore suited for practical use in technical photography of all kinds. It can be equipped with certain intermediate lenses for close-ups or with a supplementary distance tube for distance exposures. For photographing micro high-frequency films a particular apparatus has been developed.

In order to evaluate the exposures, a time-marking device is made use of, in which a glow-lamp, controlled by an electric tuning-fork, produces the time records on the film at periods of  $\frac{1}{1000}$  sec.

The method of operating the camera, and several new and older films produced with the high-frequency filmer, will be demonstrated.

**"A High-Precision Sound-Film Recording Machine;"** H. Pfannenstiehl, *Bell Telephone Laboratories, Inc.*, New York, N. Y.

In this recording machine an improved type of sprocket drive mechanism is employed to propel the film at a constant velocity at the recording light-beam. In addition to the film drive and control mechanisms, the recorder is provided with several accessory devices to facilitate operation and thereby reduce the cost of sound-film production.

These accessory devices consist of a slater, which photographically records the "take" number of the record in the sound-track area; an electromagnetically operated punch mechanism, which punches an identifying notch or hole in the film; an electromagnetically operated shutter arranged to cut off the recording light-beam at an extremely high speed so that a definite and sharp cut-off point is produced on the sound-track that may be used for synchronizing purposes; and a switch mechanism to control automatically various operations of the machine in their proper sequence.

The recorder may be equipped with any of the optical systems required for recording sound on single, double, or other types of sound-track. Associated with the optical system is a photoelectric cell and amplifier unit by means of which direct monitoring of the sound being recorded may be done.

All mechanisms and devices are enclosed within the housing of the recorder and are accessible for operation. All manual controls are located upon a panel convenient to the operator on the front of the base of the recorder. Provision is made also for remote control of such devices as the slater, punch, shutter, *etc.*, as well as the starting and stopping of the machine.

This recorder may be used with either the Bell & Howell or Mitchel film magazines. The machine was developed by the Bell Telephone Laboratories in co-operation with Electrical Research Products, Inc., to meet current studio requirements.

**"A New Dynamic Light-Valve;"** E. Gerlach and H. Lichte, *Klangfilm G.m.b.H.*, Berlin, Germany.

A description of a new type of dynamic light-valve with oil-camped mirror used in the *Eurocord* recording equipment. Damping by oil, though influenced by temperature, is compensated automatically.

**"A Dubbing Rehearsal Channel;"** H. G. Tasker, *Universal Pictures Corp.*, Universal City, Calif.

Preparation of sound effects, music and, dialog tracks for the dubbing process requires accurate synchronism of each sound with the corresponding action. This is ordinarily accomplished by a preliminary step in which the synchronism of one sound-track at a time is checked against the action in a moviola, in which the picture is seen through a small viewing lens.

The image being small, the accuracy with which synchronism may be checked is not good. Hence this is followed by a final step, in which the synchronism of all tracks is checked during rehearsals in the dubbing room proper. Owing to the ponderous character of the dubbing machinery the latter process is quite slow and laborious.

This paper describes the form and use of a machine that permits accurate synchronism of the various sound-tracks with the corresponding action, but with all the mechanical freedom of the usual moviola.

The machine will accommodate six sound-tracks, with provision for controlling the output level from each, and may be instantly started, stopped, or reversed. The mechanical design facilitates threading and easy displacement of any sound-track by a known amount to bring it into synchronism. The action is projected upon a screen  $4\frac{1}{2} \times 4$  feet in size, which enables accurate observation of the degree of synchronism attained.

**"A Transmission-Measuring System Utilizing a Graphic Recording Meter;"**  
W. W. Lindsay, Jr., *General Service Studios, Inc.*, Hollywood, Calif.

The need for a graphic record of transmission measurements has been recognized for many years.

The requirements that this system attempts to fulfill are as follows:

(1) The equipment must be stable, rugged, and simple to operate, and the recording portion of it must be portable and operated by alternating current.

(2) The response must be independent of frequency from 35 to 10,000 cps.,  $\pm 0.2$  db., and the effects of line voltage changes must also remain within these limits.

(3) Effects of turn-over and wave-form errors, together with interference from stray magnetic fields at power supply frequencies, must be reduced to a minimum.

(4) A linear decibel scale, and a logarithmic frequency change of oscillator output with respect to time, are desirable.

(5) There should be accurate marking of the completed record in terms of the oscillator frequency dial calibration.

The first three requirements have been satisfactorily met, the fourth not at all, and the fifth partially so.

Experimentation with most of the generally known circuits, as well as several of our own, led us to believe it difficult to obtain a strictly linear decibel scale and at the same time provide the required degree of stability, simplicity of operation, freedom from line-voltage changes, or tube replacements. Space limitations and lack of a suitable commercially available condenser prevented adopting a logarithmic frequency change with respect to time. A cam arrangement is the most simple solution of this problem.

It has been found that the simple method of engaging the oscillator dial driving pinion at the beginning of the record has been entirely satisfactory for use as a frequency fiducial for the application of the transparent chart (which is marked in decibels and in frequencies corresponding to the oscillator dial calibration) to the graphic record.

A commercial audio oscillator and booster amplifier have been modified to provide uniform output, the frequency control being driven by means of a synchronous motor and gear train.

A high-impedance input, Class A, push-pull amplifier system is connected to a full-wave, approximately square-law tube rectifier, the d-c. output of which is connected to the recording meter. Tube heaters are in series across the 110-volt line, and the line voltage supply is obtained by a voltage-doubling circuit without power transformer or filter chokes. By simple means, this amplifier system has been made independent of frequency over the range of 35 to 12,000 cps.

The applications to which the equipment have been put are as follows:

(1) Gain runs of all kinds, including amplifiers, microphones, loud speakers, light-valves, frequency films, *etc.*

(2) A recording microdensitometer has been achieved by using a modulated light-source, moving the sound-track past a scanning aperture, and recording the amplified variations due to the density changes.

(3) As a recording volume indicator the instrument has been useful in studying recording and re-recording signal amplitudes.

(4) The recording meter alone has been used for making direct current or voltage records of various transient phenomena.

**"A New Instrument for Obtaining Automatically a Graphic Record of Audio-Frequency Characteristics;"** A. D. MacLeod, *Tobe Deutschmann Corp.*, Canton, Mass.

The requirements of the acoustical engineering profession for a practical tool to be employed in analysis of audio-frequency characteristics of such electro-acoustic devices as microphones, audio transformers, loud speakers, and amplifiers, and in the determination of sound pressure *vs.* frequency as affected by baffle and cabinet design, are met by the newly developed Tobe Audi-O-Graph. This instrument incorporates the following features, which have been found essential for a usable tool: (1) It is entirely self-contained; (2) is reasonably portable; (3) covers an adequate frequency range; (4) produces a permanent record; (5) is fully automatic; (6) is provided with a means for rapidly checking the whole or any portion of the record; (7) its recording characteristics are essentially the same as those that have been adopted as standard for acoustical measurement.

The construction, operating principle, and practical application of the instrument are discussed in detail.

**"A Continuous Level Recorder for Routine Studio and Theater Measurements;"** G. M. Sprague and J. K. Hilliard, *Metro-Goldwyn-Mayer Studios*, Culver City, Calif.

The use of the continuous level recorder as used in a recording plant to check its daily operation is described.

The recording equipment consists essentially of the commercial Esterline-Angus, 5-milliamperè recorder driven by a synchronous clock motor which has a large number of rates of paper speed. The motor is operated from a linear rectifier which, in turn, may be operated either directly from the equipment to be measured or from a logarithmic amplifier. The recorder is used to calibrate microphones, loud speakers, review room characteristics, networks, and general transmission characteristics.

**"Curve-Plotting Transmission Meter;"** L. A. Aicholtz, *Universal Pictures Corp.*, Universal City, Calif.

An automatic curve-drawing transmission-measuring equipment is described, similar to those developed by Metro-Goldwyn-Mayer, General Service Studios, and Paramount, which form the subjects of separate papers.

An interesting feature of the device is the use of a vacuum tube "compressor" circuit to obtain a volume scale that is approximately linear in decibels over a range of 30 or more. Since this "compressor" circuit is of the peak voltmeter type, it is arranged in push-pull to eliminate wave-form discrepancies that might otherwise arise due to mis-poling the circuits under test.

Another feature of interest is the provision of an 80-db. sending gain control in steps of 10 decibels, which greatly facilitates the use of the equipment in straight-away transmission tests.

Circuit diagrams, photographs, and transmission characteristics of the equipment are given, together with sample curves made with the apparatus.

**"Recent Progress in Acoustics;"** V. O. Knudsen, *Professor of Physics and Dean of the Graduate School, University of California, Los Angeles, Calif.*

Some recent developments in acoustics, especially in Germany, Russia, and in the author's laboratory, are reviewed.

Experiments by E. Meyer, of Berlin, help to clarify the differences between geometrical and diffuse reflections of sound in rooms, and reveal the nature of some of the errors inherent in reverberation measurements. Meyer also describes special absorbent materials, as thin wood panelling or stretched oilcloth, which are selectively absorbent for low frequencies.

S. Rschevkin, of Moscow, describes a method for prolonging, diminishing, or otherwise modifying the reverberation in a room by means of Helmholtz resonators.

A new electroacoustical device for the artificial production of vowels, by K. W. Wagner, of Berlin, is capable of generating typical German vowels that can not be distinguished from the originals. The oscillogram and sound spectrum of the artificial vowel resemble more closely the oscillogram and sound spectrum of the original vowel than do two sets of oscillograms and sound spectra of the same vowel "picked up" at two different microphone positions in the same room. The experiments reveal the nature of sound distortion caused by reflections from the boundaries of a room; they also show that the ear tolerates considerable distortion.

The paper concludes with a review of some recent work undertaken by the writer, including resonance in rooms, the acoustical design of broadcasting studios, and vistas in musical acoustics.

**"Sound Pick-Up Methods for Motion Pictures;"** J. P. Maxfield and A. W. Colledge, *Electrical Research Products, Inc., New York, N. Y.*

The proper recording of sound requires not only the requisite pick-up technic but suitable acoustic surroundings to enable its most flexible use.

The paper, therefore, discusses first the acoustic requirements of sound picture stages, sets, etc., with special reference to scoring, whether before or after taking the picture.

With this background, various methods that have been developed for obtaining and controlling the desired amount of acoustic perspective are treated. In particular, consideration is directed to the factors for which quantitative values have been determined. A discussion of the practical means for using these quantitative factors is given.

Preliminary information on the application of these technics to stereophonic recording and reproduction is discussed.

**"Mathematical Relations between Grain, Background Noise, and Characteristic Curve of Sound-Film Emulsions;"** W. J. Albersheim, *Electrical Research Products, Inc., New York, N. Y.*

Computations and measurements show that the background noise of film can be interpreted as the superposition of two types of noise: first, surface noise, and second, grain noise. The surface noise power decreases with the square of specular transmission; the grain noise power reaches a maximum at 50 per cent transmission. Accordingly, it is found that under the conditions of variable-width re-

ording the surface noise is predominant; for variable-density recording, the grain noise is the main factor. The average area of the grains or grain clusters can be calculated from the signal-to-noise ratio; their average volume from the total weight of silver per square centimeter at a given density. For equal grain sizes, surface exposure such as obtained by ultraviolet illumination is definitely noisier than penetrating exposure.

Upon the basis of random three-dimensional distribution of sensitized grains and of the quantum theoretical findings of previous investigators, the shapes of H&D curves were calculated. The assumption that a halide grain is sensitized by a single photon leads to a toe shape that is more rounded than those found in practice. The actual shape of the characteristic from toe to shoulder is accounted for by the assumption that it takes two photons to sensitize a silver halide grain. It is expressed by the equation:

$$D = \frac{D_{\infty}}{\ln \tau} \left[ \epsilon^{-e\tau} - \epsilon^{-e} + \int_{\tau}^1 \epsilon^{-x} \frac{dx}{x} \right]$$

in which  $\tau$  represents the translucence of the unexposed emulsion to the actinic light.

The experimental fact that the straight portions of H&D curves obtained from the same emulsion at various gammas originate from a single point which is depressed by bromide content is explainable by taking into account the fact that the emulsion contains silver halide grains of more than one size and speed.

**"An Improved Noise-Reduction System for High-Fidelity Film Recording;"**  
J. O. Baker, C. N. Batsel, and H. J. Hasbrouck, *RCA Manufacturing Co., Inc.*,  
Camden, N. J., and Hollywood, Calif.

This recently developed method for making noiseless film records uses a twin mask shutter and replaces the familiar biased galvanometer and displaced zero line. The new noise-reduction arrangement was developed for either standard RCA symmetrical sound-track or class *A* push-pull, which is rapidly gaining favor because of its numerous advantages. These include cancellation of "zero shift" or distortion of the sibilants, and the elimination also by cancellation of any sounds caused by action of the ground-noise system such as shutter "thumping." The ground-noise timing can be successfully speeded up.

When combined with ultraviolet light the new optical system and noise-reduction method are capable of producing records of extreme quietness and great brilliance, free from sibilant distortion and other extraneous noise. More consistently good recording is possible because maintenance of the equipment is made easier and more accurate by means of precision adjustments.

As compared with previously used shutter systems, an appreciable decrease in ground-noise is now achieved by extremely sharp focusing of both shutter masks and the recording aperture, which are all in effectively the same plane, avoiding the "soft" focus image experienced when a shutter is positioned as close as possible but not sufficiently close to the mechanical slit. Placed where it is, the new shutter also greatly reduces the amount of light falling upon the galvanometer at low modulation levels so that less stray light enters the slit and there is a minimum chance of fogging in the clear unmodulated portions of the sound negative.

Since the shutter edge images are perpendicular to the mechanical slit, the

photographic sharpness is greater than could be realized were the edges at a more acute angle to the slit, as would be the case with a single mask of triangular shape.

A new optical monitoring system is introduced providing easy and accurate observation of both the speech modulation and ground-noise reduction action at the same time. The light-spot is larger and can be focused sharply upon the card. More light is provided, making visible instantaneous amplitudes not regularly repeated and of high frequency, known as "fringe." These high-frequency peaks, although very dim, are frequently observed, extending well beyond the body of the modulation.

**"A Device for Direct Reproduction from Variable-Density Sound Negatives;"** W. J. Albersheim, *Electrical Research Products, Inc.*, New York, N. Y.

Variable-density negatives exposed on the toe of the H&D curve have been known to be superior in brilliance and high-frequency response to the average sound-print, although they show some harmonic distortion. Variable-density negatives recorded on the straight-line portion of the characteristic are highly distorted, but show a remarkably low background noise level.

In order to eliminate the negative distortion, the playback apparatus should produce the same type of compensating distortion that occurs in a straight-line print; that is, the output should be a negative power function of the input. The exponent, called apparatus gamma, should be variable, to fit the variations in negative gamma. Preferably, the apparatus should be capable of reproducing prints as well as negatives. These purposes are achieved in the negative playback unit, *RA-222*, by four distinct steps:

- (1) An essentially linear input stage usable for reproduction of prints.
- (2) An exponential feedback stage which converts the output of the first stage into a logarithmic form.
- (3) A linear, variable-gain stage which reverses the polarity and provides gamma control.
- (4) An exponential output stage which converts the logarithmic response into the desired power function.

The possibility of reproducing straight-line variable-density negatives opens up the following fields of use:

The quality of newsreels and other rush shows can be judged before printing.

The correct gamma of newsreel negatives can be estimated from the best setting of the reproducer gamma control.

Release negatives can be obtained by re-recording directly from the original negatives, with a saving of time, printing expense, and with improved sound quality.

To obtain highest quality of reproduction for special first-run showings, the sound-track may be a negative directly re-recorded from the original without intervening printing process.

All these uses have been successfully made of the negative playback unit. It is a self-contained, a-c. operated apparatus, which can be adapted to the existing types of film reproducers. By a single switching operation it can be set for the reproduction of positive prints or of negatives. A calibrated control makes it adjustable to the reproduction of variable-density negatives of a wide range of gamma. In addition, gain control and adjustable low-frequency equalization have been provided.

The results are being demonstrated by reproduction from typical variable-density noise-reduction negatives to show the increased clarity, volume range, and freedom from noise-reduction "hush-hush."

**"Changing Aspects of the Film Storage Problem;"** J. G. Bradley, *Division of Motion Pictures and Sound Recordings*, The National Archives, Washington, D. C.

Photographic film records are taking on new values. Business concerns, libraries, government agencies, and private collectors are beginning to realize the future value of photographic records. The hope that such records may be preserved over a long period of time has given impetus to storage plans, both in terms of chemical preservation and fire prevention. Volume to be stored is increasing rapidly. Federal Government's interest in aerial photography has resulted in an undreamed of volume of aerial film maps and additional government agencies making use of motion pictures. The volume in government circles alone will shortly exceed one hundred tons. The principle of unit isolation and unit application of cooling agent seems most logical in the prevention of film fires.

**Report of the Projection Practice Committee;** H. Rubin, *Chairman*.

Among the projects under consideration by the Committee during the past six months are those of screen brightness; its desirable values and methods of measuring it; the question of using a visual test-pattern for checking screen illumination; revisions of the projection room plans; questions of projector motors and take-ups, and difficulties incident to the starting of projector motors; requirements of sound screens; and a recently initiated survey of theaters throughout the United States to determine not only existing conditions of projection, but also for the purpose of establishing a set of recommendations regarding theater structures.

**"A Wide-Range, Linear-Scale, Photoelectric Cell Densitometer;"** W. W. Lindsay, Jr., *General Service Studios, Inc.*, Hollywood Calif.; and W. V. Wolfe, *RCA Manufacturing Co., Inc.*, Hollywood, Calif.

The need for an instrument having a wide range of density and linearity of scale calibration has been recognized for some time. The more general types of instrument involve the balance of two illuminated spheres by visual observation, and are therefore to a large extent dependent upon the skill and fatigue of the observer.

Various forms of photocell densitometers have been built and are in general use in most studios. The majority of these instruments utilize a meter with a scale calibrated in density or per cent transmission. Physical factors impose a scale calibration that becomes rapidly congested as the higher density end is approached.

The writers undertook the construction of a densitometer along different lines, involving the use of a modulated light-source, a stable high-vacuum photocell, and an amplifier having essentially constant gain, in conjunction with a precision attenuator containing a linear decibel scale, and a multiplier. The amplifier has band-pass characteristics, to eliminate harmonics and power supply frequencies. An indicating meter of rugged construction is used.

The instrument operates as follows: The photocell is placed in the operating position; the gain of the amplifier is adjusted so that the zero density point on the attenuator scale reads reference meter deflection; then the unknown density is inserted, and the amplifier gain readjusted to read the reference meter deflection

again. By suitable calibration, the gain of the amplifier may be interpreted in terms of density.

The apparatus has been in use, giving satisfactory performance, for a period of two years. During the past year, the addition of a Raytheon voltage regulator has reduced line voltage fluctuations to a minimum.

A historical résumé, the discussion of theoretical factors, density standards, and limitations of the instrument, together with details of the various mechanical and electrical features that were used to improve its performance, conclude the paper.

**"Standardization of Photographic Densitometry;"** C. M. Tuttle and A. M. Koerner, *Kodak Research Laboratories, Rochester, N. Y.*

It is desirable that all laboratories dealing with photographic problems shall be in agreement upon the significance of the term "density," and that the means for numerical determination of this value shall be specifiable.

In different optical systems, the apparent "light stopping power" of a given photographic image specimen will vary because of the manner in which the sample reflects, scatters, and absorbs light. Since the numerical value obtained depends upon the characteristics of the optical system used in the densitometer, it becomes necessary to specify the optical system to be used as a reference standard. Because it may be definitely specified, the integrating sphere is suggested as the light collector for this standard optical system. Precautions that must be followed in the use of the sphere for this purpose are enumerated.

It is shown that once some standard optical system is adopted, several other types of optical systems may be employed in practical instruments if the calibration of these instruments is made under actual working conditions with photographic images previously measured in the system adopted as standard.

The paper concludes with a discussion of the interrelationships of  $\log_{10}$  apparent opacity as determined in several optical systems commonly used in densitometry.

**"The Objective Quantitative Determination of the Graininess of Photographic Emulsions;"** A. Goetz, *California Institute of Technology, Pasadena, Calif.*

A graininess meter as an instrument for the objective and quantitative determination of the density fluctuations of photographic emulsions is described. The instrument, specially designed for this purpose, produces a microphotometric record of a uniformly exposed area in terms of relative transparency fluctuations ( $T/T_m$ ;  $T_m$  = mean transparency). The resolving power of the optical system is larger than the individual grain size, so that granularity as well as graininess is recorded. Unlike the usual microphotometric records, the records are produced in such a way that they can directly undergo a process of partial integration in a photoelectric integrator designed for the purpose. Thus a record of the distribution of transparency fluctuations is directly obtained. In addition to this the sum total of fluctuations can also be obtained. The former, however, is chosen to determine a measure of the graininess in the form of a logarithmic average obtained by a simple graphical method which weighs the size of the fluctuation in approximation to the subjective impression. The average of the transparency fluctuations relative to the mean transparency of the specimen thus obtained is used as the expression for the graininess.

The graininess meter has been applied to the following problems: The graininess-density diagrams of various commercial negative and positive film materials; the effect upon the emulsion by the variation of the mode of development; the quantitative measurement of the increase of graininess in contact prints with respect to the graininess qualities of the negative materials from which the print is made; the effect of the optical nature of the printing light upon the graininess increase of the print.

**"Sound-Track Blooming;"** F. D. Williams Co., Los Angeles, Calif.

A demonstration of the various methods of blooming sound-track films, with special emphasis on the "flash" method. A series of drawings and film exhibits will be used to show a direct comparison of the methods and explain the value and qualities of each system of blooming.

**"Toning of Positive Film by Machine Method;"** J. M. Nickolaus, *Metro-Goldwyn-Mayer Corp.*, Culver City, Calif.

A description of the toning of the entire release of the Metro-Goldwyn-Mayer production *The Good Earth*, using a modified developing machine.

**"Fixing Baths and Their Properties;"** J. I. Crabtree, H. Parker, and H. D. Russell, *Kodak Research Laboratories*, Rochester, N. Y.

In addition to removing the unreduced silver halides from an exposed and developed emulsion, the fixing bath should (a) arrest development immediately, and (b) harden the gelatin film so as to prevent excessive swelling during washing and reduce mechanical injury during handling.

The fixing agent usually consists of sodium or ammonium thiosulfate, or a mixture of sodium thiosulfate with ammonium chloride. The bath also contains an acid (usually acetic acid) to arrest development, sodium sulfite which inhibits the precipitation of sulfur, and potassium or chrome alum which tans the gelatin.

The addition of developer carried into the fixing bath tends to cause the precipitation of aluminum sulfite, but this can be prevented by (a) revival of the bath with acid at intervals, or (b) the addition of boric acid which also extends the pH range over which effective hardening is obtained. The exhaustion point at which revival should occur may be determined with pH indicators.

Various fixing bath formulas are included and their properties discussed in terms of (a) developer capacity, (b) sludging and scumming propensity, and (c) hardening life.

**"The Super Simplex Pedestal;"** J. Frank, Jr., *International Projector Corporation*, New York, N. Y.

This new pedestal embodies a number of unique features, including spirit-level; lamp house table, with universal joints permitting accurate adjustment; sufficient mass to assure steadiness of the projected picture; support arms for various makes and types of sound-head attachments; spacers to permit the use of existing port holes; and a lateral adjustment device.

**"Cine Kodak Model E;"** L. R. Martin, *Eastman Kodak Co.*, Rochester, N. Y.

Simplicity of operation and control in this camera is obtained by using a single-plane film path, with the supply reel above and ahead of the take-up reel. The mechanism is built as a unit with all the controls mounted upon the frame. A single-claw pull-down is used, driven by an eccentric. The camera operates at three speeds: 16, 32, and 64 pictures per second. Standard equipment includes

an  $f/3.5$ , 20-mm. fixed-focus lens. A feature of the camera is the addition of a supplementary film-footage scale adjacent to the field of the finder.

**"A Film Mutilator Machine;"** O. F. Neu, *Neumade Products Corp.*, New York, N. Y.

To circumvent the film pirate who for years has been exhibiting film productions in various parts of the world without properly compensating the producers, a film mutilator has been developed.

The film mutilator housing is constructed of cast iron; steel rippers in an aluminum mutilating jaw perforate the film as it passes through brass film-guides and rollers. Each frame is perforated, completely destroying the pictures and sound-track, making it absolutely impossible to reprint, duplicate, or exhibit the film. There are two models having four types of perforations: single perforation in frame; double-staggered perforations in frame; double perforations, one in frame, the other in sound-track; triple perforation, double-staggered in frame, the other in sound-track. One model is hand driven, the other motor driven. The film is fed automatically into a slot in the left side of the housing, passes over the mutilator hub and perforators, and out through a slot on the other side.

**"Complete Cue-Mark Elimination Plus An Automatic Change-Over;"** S. A. McLeod, *Automatic Change-Over Co.*, Los Angeles, Calif.

The vexing problem of cue-marking, both by producers and projectionists, is well known to all. Defaced cue-marked films have not only been costly and troublesome to the producers and projectionists, but, most important of all, have resulted in poor picture presentation to the theater-going public.

Elimination of all cue-marks or any need of them, plus an automatic, electric transfer to the oncoming projector is now possible through the use of an automatic change-over mechanism which automatically performs the following operations: (1) gives a buzzer warning; (2) starts the oncoming motor; (3) changes over the dowsers; (4) changes over the sound.

Two trigger fingers or levers attached by means of a side plate to the reel, set by the projectionist between the film windings, predetermine the timing. The unwinding film, releasing each finger, causes an impulse to be carried mechanically by means of pawls to two half-round plunger shafts in the magazine's hollow axle or spindle shaft. This spindle supports at its outer end a switch housing, enclosing two mercury switches. The mechanical impulse by means of the plunger shafts is here converted into an electrical impulse.

These electrical impulses are then carried to a main control cabinet mounted upon the wall between the projectors, conveniently accessible to the projectionist, and embodying automatic electric interlocks, relays, solenoids, and features for controlling the operations. The regular controls remain unaltered, allowing a return to the old "manual or visual" controls if desired. The entire unit may be adapted to all present makes of standard projection equipment, and the film trigger plates may be quickly attached to standard reels.

**"A Magnetic Recording-Reproducing Machine for Objective Speech Study;"** S. J. Begun, New York, N. Y.

A small sound recording machine that utilizes the magnetic method has been developed. This machine is especially adapted for students, speakers, singers, and others who wish to improve themselves along their particular line of endeavor.

The machine utilizes an endless steel tape as sound carrier. The recording time is approximately thirty seconds. The steel tape is moved over four rolls on the edges of a metal framework. The amplifier, loud speaker, and the mechanical parts for driving the steel tape are built inside the framework, and all are encased in a portable cabinet. Switches are provided upon a panel for operating the amplifier and the motor. A plug connects the microphone to the machine. Normally the machine is set for reproduction, but when the push-button is pressed for only an instant, it is possible to record for thirty seconds. After this interval has elapsed, the push-button falls back into its original position and the machine continues to reproduce until the push-button is again pressed and a new record made. An indicating system is used in conjunction with the push-button to mark off the recording time. As the method of magnetic recording is used, it will not be necessary to change the steel tape during the life of the machine. The circuit is so designed that making a new record automatically wipes out the previous one.

The machine has a frequency response of from 150 to 4000 cps. Ordinarily a carbon microphone is provided, but for obtaining quality of reproduction, a magnetic-coil microphone is recommended.

**"Infrared Negative as Applied to Special Effects Photography;"** W. Hough and W. Leahy, *Pacific Coast Technical Division, Agfa Ansco Corporation, Hollywood, Calif.*

A new type of 35-mm. infrared negative is discussed, with special reference to the practical application of this type of film to certain phases of motion picture production. Sensitometric and general data are given comparing this type with existing panchromatic and infrared-sensitive emulsions.

**"Two New Emulsions for Duplicating Work;"** *Eastman Kodak Co., Hollywood, Calif.*

Continued work on the process of making duplicate negatives has resulted in the production of two new emulsions by the use of which it is possible to make duplicates of excellent quality and graininess.

The duplicating positive material is a medium-contrast yellow-dyed emulsion of fine-grain characteristics, suitable for handling under positive printing room illumination. It requires more exposure than motion picture positive film but has sufficient speed for use under practical laboratory conditions. A developer of the *D-76* type is found best for obtaining fine grain, good emulsion speed, and quality control.

For the duplicate negative a special panchromatic duplicating emulsion on gray support is used. The extended sensitivity of this material permits printing from the master positive of proper density and contrast with the printing equipment regularly used for duplicate negative printing. Development of the duplicate negative is to a lower contrast, but it requires the same developer as the master positive and approximately the same time of treatment. Detailed information on the control of quality and on the processing conditions are given.

It is anticipated that duplicate negatives made by the use of these materials may be used instead of the original negative for release printing.

**"Laboratory Equipment for the Smaller Laboratory;"** A. Reeves, Hollywood, Calif.

Although the technical problems faced by motion picture processing plants located away from the great centers of production are the same as those encountered in Hollywood, they are of a different order of magnitude, due to the smaller volume of work to be handled. For the same reasons, economic considerations, such as avoiding duplication of machinery, *etc.*, are of unusual importance. Notwithstanding this, the quality of the equipment used and of the work put out should adhere to the same high standards demanded in the finest major studio laboratories of any production center.

This paper describes laboratory equipment built to meet these needs, including a developing machine, so designed that it may be used interchangeably for processing negative and positive film, alternating these two types of service without requiring re-threading.

A light-tester of unusual accuracy and simplicity is also described. This instrument is built so that no fluctuations of current supply or other external factors can disturb the accuracy of its results, and is so designed that it may easily be matched to the light-settings of any printer. This same machine, by simply pressing a button, may be converted into an accurate sensitometer, thereby enabling any laboratory, regardless of its location with respect to the servicing facilities of the major film manufacturers, to utilize the important safeguard of sensitometric measurements in routine production.

"Present Aspects of the Development of 16-Mm. Sound;" A. Shapiro, *The Ampro Corporation*, Chicago, Ill.

A review of recent developments in 16-mm. sound, including technical advancements and perfections contributing to raising the standards of illumination and quality, and a discussion of the extent to which limitations of picture size and audience have been raised for large-audience performances.

Adoption of the 16-mm. sound-film for educational purposes is discussed. Its function as a medium for auditorium instruction for general education of an extra-curricular nature and its use in the classroom as a corollary to textbook and oral instruction are treated. The use of sound-films for unusual or difficult experimentation is not practical in the ordinary school.

There has been an increasing use of 16-mm. sound for commercial and industrial purposes. An example is the extensive use made of such films by automobile manufacturers for sales exploitation. Picturizations of plant and manufacturing processes have been used as convincing evidence of quality and precision manufacture.

A gradual but slow increase of home users is noted. Rapid development of roadshows indicates a repetition of a cycle of the earlier history of the motion picture. Sources of entertainment film and features now available are outlined. Attitude of large producers toward supplying 16-mm. sound prints, and foreign sources of material are mentioned.

The relationship between 35-mm. and 16-mm. branches of the industry is discussed. Where is the legitimate domain of 16-mm.? Limitation of both types of film, the most effective fields for each, and the encroachment of 16-mm. in the entertainment field are brought out. The possible effect upon the general trend of type of entertainment pictures is indicated, and suggestions for the regulation of the 16-mm. industry are offered.

**Report of the Non-Theatrical Equipment Committee;** R. F. Mitchell, *Chairman*.

A summary is presented of correspondence conducted with the British Institute of Cinematography. The report of this organization is abstracted as follows: (1) A theoretical analysis of the light losses in a projector using direct illumination is made, showing that for every 100 lumens emitted by the lamp, only 2.43 lumens find their way through the projection lens; and (2) it is suggested that unit intensity be used as a method of comparison between one projector and another and that 1 foot-candle be regarded as an average value for home use and 4 foot-candle for small auditoriums.

Objection is taken by this Committee to the latter proposal, and the opinion is expressed that the suggested values are too low. A satisfactory intensity should cover projection of adequate quality.

Attention of the Society is directed to the matter of standardizing the procedure for the determination of total screen lumens.

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

Revised drawings for most of the standards, except those on sound sprockets, have been prepared and are to appear in a forthcoming issue of the JOURNAL.

There have been no fundamental changes except with regard to the sound-film. For 35-mm. film, the dimensions of the sound-track have been changed; and for 16-mm. sound-film, similar changes have been made and the distance between the picture and the corresponding sound has been changed to 26 frames.

**Report of Sub-Committee on Perforations;** J. A. Dubray, *Chairman*.

The Sub-Committee has investigated the possibility of adopting the SMPE standard perforation for negative film, and has come to the conclusion that various factors, especially the stock of background films, makes it impossible to use the SMPE standard perforation universally.

The Committee now proposes that the rectangular perforation proposed by Howell and Dubray in 1932 be adopted as the standard perforation for both negative and positive. This perforation would operate satisfactorily on all apparatus designed for the Bell & Howell perforation, and should give little or no trouble on apparatus designed for the SMPE standard perforation.

**"Depue Combination Picture and Ultraviolet Non-Slip Continuous Automatic Sound Printer;"** O. B. Depue, Chicago, Ill.

This printer has the following features: The picture-printing head gives a full-width picture, uses a standard aperture, and a sound aperture white light. The sound printing head is non-slip, uses ultraviolet light, has a rotary stabilizer, a generator supply for the light, and an automatic light-control board.

Both picture and sound-head are driven by separate 3-phase motors to assure steady film motion. The motors are mechanically tied to assure synchronism in starting and stopping, and are equipped with a compensating device allowing the motor to slip instantly into phase with bucking.

**"Recent Advances in Recording Galvanometers;"** G. L. Dimmick, *RCA Manufacturing Co., Inc.*, Camden, N. J.

Since the incorporation of the magnetic type of recording galvanometer in the high-fidelity recording system, a number of improvements have been made. The distortion and magnetic hysteresis have been reduced, the frequency character-

istic has been improved, the effect of temperature upon the mirror has been eliminated, and the stability of the galvanometer has been increased.

The general theory of the galvanometer is discussed briefly. The method of damping is shown and described in detail, and a mathematical analysis of its operation is given.

The magnetic structure of the galvanometer now in use is made of silicon steel. A small amount of distortion results from the changing permeability with flux density. The use of nicaloi for both the pole-pieces and the armature has reduced this distortion to a negligible amount.

The complete characteristics of the present design and of the modified design are given. These include frequency, amplitude, and impedance characteristics. Curves showing the effect of direct current in the bias winding upon the wave-shape distortion are given.

In the modified design, certain mechanical improvements have been made. The difference in the coefficient of expansion of the duralumin mirror plate and the glass mirror has caused warping with changing temperature. A nickel-iron alloy, having nearly the same coefficient as glass, has been substituted for the duralumin. In the galvanometers now in service the mirror plate is fastened to the ribbon with cement. This was necessary because of the difficulty of soldering to duralumin. The nickel-iron alloy plate is now soldered to the phosphor-bronze ribbon, and this results in greater stability of the galvanometer in operation.

**"Linear Decibel Scale Volume Indicator;"** F. G. Albin, *United Artists Corporation*, Hollywood, Calif.

A volume indicator meter for use with recording systems is described, having the following salient features: (1) response proportional to the peak, amplitudes; (2) meter deflection proportional to level in decibels.

Both features are considered advantageous, first, because recording modulators are overloaded by peaks, for which reason the indicators should indicate peak levels. Second, the range of levels according to a decibel scale is considerably expanded over that with a linear amplitude scale. Furthermore, the ear recognizes sound level increments logarithmically, and therefore the response of the meter should also be logarithmic.

**"An Automatic Sound-Track Editing Machine;"** G. M. Best, *Warner Brothers Pictures, Inc.*, Burbank Calif.

The sound-track cutter requires a film reproducer in his daily routine work; a reproducer that can be threaded quickly and will not tear or damage the film, and will produce sound quality of sufficient excellence to judge splits or cut-outs in music recording.

Such a device has recently been developed, and its mechanical details and operation are described. By means of a geared motor drive and a series of friction rollers, the sound-track is fed past the light-beam of the reproducing system at standard speed, with a reversible feature that is automatic and instantaneous. No sprockets or clamp rollers are used, and the work of the cutter is speeded materially through its use.

**"The RCA Recording System and Its Adaptation to Various Types of Sound-Track with Demonstration of Recent Recordings of the Class A Push-Pull Type;"** G. L. Dimmick, *RCA Manufacturing Co., Inc.*, Camden, N. J.

The photographic recording of sound is accomplished by modulating a narrow

beam of light and projecting this light upon a strip of moving film. There are three ways in which the amount of exposing light may be varied. A light-beam of fixed dimensions may have its intensity varied; a beam of constant intensity and length may have its width varied; or a beam of constant intensity and width may have its length varied. The first two types of modulation produce variable-density sound-tracks, while the third type produces variable-width tracks.

The RCA recording optical system can be made to modulate either the intensity or the length of the light-beam. The unit consists essentially of an incandescent lamp to produce the light, a system of lenses to direct the light, an aperture and slit to limit the light, and a reflecting mirror galvanometer to modulate the light. A magnetic shutter for ground-noise reduction is also part of the standard variable-width recording unit. The lens system is designed to have high optical efficiency, low stray light, and good definition of the images. A system of mirrors and lenses intercepts a small portion of the recording light and projects it upon an external card. This system magnifies the deflection of the galvanometer and shutter to such extent that the degree of modulation and the zero settings can be observed easily by the unaided eye. Facilities are provided for adjusting the lamp, the galvanometer, and the focus and placement of the recording light-beam.

Many different types of sound-track can be made with the recording optical system without sacrificing any of its advantages as a light modulator. By the use of the appropriate condenser and aperture assembly, the system will record standard bilateral variable-width track, standard variable-density track, push-pull class *B* variable-width track, push-pull class *A* variable-width density track, and push-pull class *A* variable-width track. The manner in which each of these systems functions is shown and described in detail.

The recording galvanometer is very rugged in design and stable in operation. The relatively large mirror is vibrated at substantially constant amplitude from zero to ten thousand cycles. Being of the magnetic type, the galvanometer is self-protected, and is reasonably free from damage due to overload. Damping of the galvanometer is accomplished in a way that eliminates any effects of the damping material at low frequencies and minimizes the effect of temperature upon the frequency characteristics. The details of construction, method of damping, and operating characteristics are shown and described.

**"RCA Developments in Television;"** R. R. Beal, *Radio Corporation of America*, New York, N. Y.

A brief review is given of the studies made of the several characteristics of television images and other factors that have been effective in establishing standards, in determining satisfactory performance, and in guiding the step-by-step development of the RCA electronic system of high-definition television.

The system employs the "Iconoscope," a cathode-ray tube for translating the visual image into electrical impulses, and the "Kinescope" for transforming the electrical impulses back into the variations of light-intensity to reproduce the image. The sensitivity and characteristics of the "Iconoscope" as a pick-up device are discussed.

The fundamentals of the RCA high-definition television system now under experimental field test in the New York area and the standards presently employed are reviewed. Photographs of the studios and other parts of the field-test facili-

ties are included. A brief review is given to indicate the progress made and the results attained up to the present time in these field-tests.

The technic of formulating and presenting television programs is peculiar to the requirements of television. The development of the technic is presently related to programs employing artists in studios, outside pick-ups, and motion picture film. The requirements of program technic are discussed.

#### ERRATA

Kellogg, E. W. "The Quest for Constant speed," April, 1937, p. 337.

In my paper *The Quest for Constant Speed* the system for averaging imperfections in the driving gear for a wax recorder is attributed to Messrs. Elmer and Blattner. This system was described in an S. M. P. E. paper by Elmer and Blattner, but mention should have been made that the fundamental patent, No. 1,747,866, is due to L. A. Elmer.

The damping arrangement shown in Fig. 8, employing a pair of metal bellows, is credited to H. Pfannenstiehl. I have since learned that while the reproducing machine in which this device was used was due to Pfannenstiehl and the paper describing the complete machine was published by him, the damping arrangement shown in Fig. 8 was due to Elmer, and was first disclosed in U. S. Patent No. 1,922,699.

Since the purpose of the paper was in part to give credit for some of the contributions that had not been adequately covered in previous publications, I am anxious to correct any wrong impressions that may have been given.

E. W. KELLOGG

Rayton, W. B., and Cook, A. A.: "The Effect of Aberrations upon Image Quality," April, 1937, p. 377.

In line 15, on p. 384, the letter *B* should be read *D*.