ABSTRACTS OF PAPERS FOR THE CHICAGO CONVENTION
APRIL 27–30, 1936

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.

G. E. MATTHEWS, *Chairman*

C. N. BATSEL	M. E. GILLETTE	H. B. SANTEE
L. N. BUSCH	R. F. MITCHELL	T. E. SHEA
A. A. COOK	W. A. MUELLER	P. R. VON SCHROTT
L. J. DIDIEE		I. D. WRATTEN

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

The Progress Report for 1935 shows decided advances in both professional and amateur cinematography, in sound recording technic and equipment, as well as in sound reproducing systems, for general theatrical usage.

Outstanding in the field of cinematography, although restricted at present to the amateur field, is the new Kodachrome color-film. The year 1935 was also noteable for the extension of the three-color Technicolor system to feature production.

Several advances are reported in new silent cameras for professional work. A very interesting development has been the polarizing filter introduced by the Eastman Kodak Company, which should prove to be a great aid both in profes sional and amateur cinematography.

In the field of lighting, interesting developments are reported in connection with the new gaseous conductors, which threaten to revolutionize the field of lighting as well as to provide new light-sources for projection. New lens spots utilizing the Fresnel type of lens were introduced successfully in studio work this year.

Development of the push-pull method of recording received impetus following the demonstrations at the S.M.P.E. Convention at Hollywood. Considerable interest has been aroused by the announcement of RCA of the use of ultraviolet light in recording. New theater systems involving new methods of pulling film, as well as a new type of multi-cellular horn, commonly known as the Fletcher horn, have been offered to the public during the past year.

"The Museum of Modern Art Film Library;" John E. Abbott, *Director, The Museum of Modern Art Film Library,* New York, N. Y.

Until last year, no organization existed for preserving films of outstanding merit or for arranging for distribution and study by those interested in film as a living art and in its history and development. A grant from the Rockefeller Foundation, and private gifts, permitted The Museum of Modern Art to establish such a Film Library under the Presidency of John Hay Whitney, with Will H. Hays, Chairman of the Advisory Committee.

The functions of the Film Library are to trace, obtain, and preserve important films, American and foreign; to edit and assemble such films into programs for educational and non-commercial exhibition; to arrange notes and critical appraisals of such films; to assemble a library of books and data on the films; and,

otherwise, to make available information concerning the artistic, dramatic, and technical phases to all who may be interested. The series for 1936 consists of (*1*) the development of narrative (1894–1911); (*2*) the rise of the American film (1912–15); (*3*) D. W. Griffith (Intolerance); (*4*) the German influence; (*5*) the talkies.

"The Application of Sound Motion Pictures to the Identification of Criminals;" Col. H. N. Schwarzkopf, *Superintendent, New Jersey State Police*, Trenton, N. J.

In June, 1934, in developing the principle of extending the applications of science to the solution of crime, the idea was conceived of reproducing the police "line-up" in sound motion pictures. Such a process would make a permanent record of what now is a passing incident; which record would be available not only to police departments but also for display to the public when necessity demands. After a period of research and study, experimentation with 16-mm. commercial sound motion picture apparatus was begun, with sufficiently satisfactory results to justify continuation and expansion.

In October, 1935, the entire matter was laid before engineers and technicians, with special recommendations for the development of 16-mm. and 35-mm. apparatus. As a result of this conference complete sets of equipment for 35-mm. and 16-mm. recording have been developed to the point that policemen, unskilled in recording technic, can accomplish uniform results satisfactory for criminal identification purposes.

This is a triumph for both the motion picture industry and the organized police; and as its use is extended it will result not only in speedier apprehension of habitual criminals, but will, likewise, unquestionably exercise a far-reaching preventive effect.

Report of the Sound Committee; P. H. Evans, *Chairman*.

Progress being made on the projects assigned to the Committee is discussed. These include the study of frequency response characteristics of release prints made by the use of the Sound Committee's frequency reference standard. The report will not include any conclusions or data relative to these projects.

"Photoelectric Cells and Their Method of Operation;" M. F. Jameson and T. E. Shea, *Bell Telephone Laboratories*, New York, N. Y.

This is an explanatory paper covering in a simple manner the laws governing the release of electrons from photoelectric surfaces, their collection at anodes, and the creation of ions in photoelectric cell gases by the "ionization" process. The paper deals with the spectral selectivity of various photoelectric surfaces, the influence of spectral characteristics of illumination, and the dynamic characteristics of vacuum and gas-filled cells. The paper will be accompanied by a demonstration of the various operating features of photoelectric cells.

"Harmonic Distortion in Variable-Density Records;" B. F. Miller, *Warner Bros. First National Studio*, Burbank, Calif.

This paper consists of two portions, the first being concerned with a derivation of the equations expressing the exposure wave-form on variable-density records obtained by means of the light-valve under conditions of sinusoidal ribbon modulation and known over-all photographic sound-track gamma. Curves indicating the theoretical percentage of second and third harmonic print distortion are plotted against frequency, several values of over-all gamma being assumed. It is shown that the distortion at low frequencies is almost exclusively due to

departures of the over-all gamma from unity, while the distortions at high frequencies are mainly dependent upon the velocity of the light-valve ribbons.

The second portion of the paper is devoted to the presentation of experimental distortion data obtained from variable-density frequency data obtained from variable-density frequency films, and the comparison of these data against those obtained from theoretical analysis.

"Improved Resolution in Sound Recording and Printing by the Use of Ultraviolet Light;" G. L. Dimmick, *RCA Manufacturing Co., Inc.*, Camden, N. J.

The resolution of sound-film records has been increased by the use of ultraviolet light in recording and printing. Because of the absorption characteristics of the emulsion, exposures made by ultraviolet light are restricted to the surface. This reduces the spreading of the image. The fogging of the track that usually results from halation and reflection from objects in the path of the light is almost entirely eliminated. Since the light energy is restricted by means of a filter to a very narrow band, the chromatic aberration of the lenses is reduced.

The definition of the very fine recording light-beam is limited by diffraction. This limitation is materially decreased as a result of the decrease in wavelength of the radiant energy.

"The Acoustic Design of Music-Scoring Stages;" C. M. Mugler, *Acoustical Engineering Co.*, Los Angeles, Calif.

The design of the scoring stage built at Columbia Pictures Studio, at Hollywood, are described and discussed. The stage embodies an innovation in architectural and acoustic design based upon the "controlled reflections and diffusions of sound waves," discarding the "live and dead end" theory of acoustic design which has been greatly followed in the past.

"A High-Quality Reproducing System for Small Theaters;" H. Pfannenstiehl, E. O. Scriven, and J. F. D. Hoge, *Bell Telephone Laboratories*, New York, N. Y.

This sound reproducing system is intended particularly for use in small-sized theaters having seating capacities up to 600 persons. The sound pick-up part of the system consists of a sound head attachable to the various models of Simplex projectors. The film, after leaving the intermittent mechanism in the projector, passes through a chute in the sound head; then over a flywheel-controlled smooth roller, where the sound-track is scanned by an optical system; back to the hold-back sprocket in the projector, and thence to the take-up magazine. The sound-head contains no drive-sprocket mechanism.

The arrangement permits a very simple and easily operated film-drive control. A motor, belt-connected to the projector drive-gear and mounted upon a bracket that maintains the belt tension constant, drives the projector. The photoelectric cell in the sound head is transformer-coupled to an amplifier arranged for wall mounting. This amplifier is contained in a cabinet that includes also a rectifier for supplying current to the exciter lamp, to the exciting coils of the stage speakers, and to a monitoring loud speaker. A control cabinet arranged to be mounted upon the wall in front of the projector contains a gain control and apparatus for switching from one machine to the other. The control cabinet is operable from either projector position.

"The RCA Recording System;" B. Kreuzer, *RCA Manufacturing Co., Inc.*, Camden, N. J.

This paper deals with the newly designed RCA recording system. Photo-

graphs are included showing the constituent parts and complete assemblies, together with diagrams of the various types of installations. The performance of the equipment is discussed and a typical re-recording layout is shown. Design improvements resulting in higher quality and greater ease of operation are explained.

Report of the Projection Screen Brightness Committee; C. Tuttle, *Chairman.*

This report of the Committee will discuss the data that have been gathered concerning screen brightness, and which will be presented in a symposium to be published in the May issue of the JOURNAL. Points to be covered are the following: (*1*) What should be the brightness level? (*2*) What brightness can be achieved? and (*3*) Is standardization at this time desirable?

"The Motion-Picture Screen as a Lighting Problem;" M. Luckiesh and F. K. Moss, *Lighting Research Laboratory, General Electric Co.*, Cleveland, Ohio.

The motion picture on the screen is discussed as a visual task, and its lighting and that of its environs is approached in the manner recommended by the authors for all lighting problems. After choosing the proper quality of light, and after making the screen brightness as great as is practicable, the problem becomes chiefly one of quality of lighting or distribution of brightness in the visual fields. Various aspects of visibility and psychophysiological effects of seeing are discussed. The problem is divided into two parts: (*1*) The attainment of maximal visibility within the central field (the motion picture on the screen) without regard to the surroundings; and (*2*) the illumination of the surroundings in such a manner as to produce maximal comfort and minimal loss of visibility. The problem is unraveled from the usual entanglement of physiological optics, much of which is largely of academic interest rather than of practical importance. It is shown to be a problem of lighting, to be guided by the same concepts, principles, and knowledge embodied in the science of seeing as are other lighting problems. Suggestions are made for practical studies of the possibilities of evolving the lighting of the motion picture screen and its environs from its present primitive stage of purely localized lighting which is generally undesirable.

"Source Construction and Color of Light of Some Incandescent Lamps;" R. E. Farnham and R. E. Worstell, *General Electric Co.*, Cleveland, Ohio.

This paper discusses first the advantages of concentrating the source of gas-filled incandescent lamps. The various forms available and their application to optical systems and reflectors are shown.

Data regarding the temperature (color and maximum) of the various types of lamps are presented, and the similarity of the radiation of incandescent lamps to that of a Planckian radiator of suitable temperature is indicated. Curves showing the amount of light emitted at various wavelengths or colors for all lamps of interest to the motion picture industry are presented, in terms of both equal visual output and equal wattage.

A discussion of the energy in the ultraviolet region and the effect of glass bulbs and lenses concludes the paper.

"Present Trends in the Application of the Carbon Arc to the Motion Picture Industry;" W. C. Kalb, *National Carbon Co.*, Cleveland, Ohio.

The present trend in the application of the carbon arc to the needs of the motion picture industry is toward more extensive use of the high-intensity arc. This is true both in the theater and in the field of motion picture production.

The limitations of the low-intensity arc, both as to brilliancy and quality of light, are discussed and compared with like properties of the high-intensity arc. The needs of the small theaters for increased volume and improved quality of projection light having been met by the development of the a-c. high-intensity and Suprex arcs, the demands of the largest theaters for still more light for projection are now met by the new super-high-intensity arc.

The trends of projection lamp design as related to light upon the screen are briefly discussed. The paper covers also the new white-flame carbon arc for broadside illumination, the new Sun arcs and rotary spots designed to prevent interference with sound productions, and the application of the new super-high-intensity arc to background projection.

"Theory and Use of Photoelectric Exposure Meters;" A. T. Williams, *Weston Electrical Instrument Corp.*, Newark, N. J.

The theory of photoelectric exposure meters and its application toward determining correct exposure are discussed. In addition to the elementary theory of exposure and exposure meters, calibration data are presented in sufficient detail to enable the photographer or cinematographer to use the meter as a photographic tool with originality, avoiding the necessity of following stereotyped instructions or of considerable experimentation. Applications of the meter for black-and-white as well as for color photography are discussed.

"A 13.6-Mm. Super-High-Intensity Carbon for Projection;" D. B. Joy, *National Carbon Co.*, Fostoria, Ohio.

A new 13.6-mm. super-high-intensity carbon is described which will burn at currents as high as 190 amperes and which has a higher intrinsic brilliancy and a more uniform distribution of light across the crater face than the regular 13.6-mm. carbon rated at 120 to 130 amperes.

Tests comparing the light upon a projection screen from this new carbon and from the regular carbon show conclusively that the available light upon the screen has been increased by at least 30 per cent. The arc lamp used with these carbons must be properly designed to take care of the increased current and carbon consumption.

"A Film Emulsion for Making Direct Duplicates in a Single Step;" W. Barth and F. Schoeck, *Agfa Ansco Corp.*, Binghamton, N. Y.

Duplicates of positives or negatives can be made by the familiar process of exposure, standard development, and fixation of a single film without requiring second exposure and development, as in the case of amateur motion picture reversible film, or resort to the duplicate negative process. Contact printing is required with exposures about equal to those used in printing chloride photographic paper emulsions. The emulsion, although of silver bromide composition, is of an entirely different type from all other photographic emulsions, making use of the solarization effect for the first time in practical photography. Some commercial possibilities of the new type of emulsion are seen in the duplication of *x*-ray and other valuable transparency originals, aerial mapping, motion picture still picture printing, photo reproduction practice, and general commercial photography.

"Projection and Projectors;" A. J. Holman, East Orange, N. J.

Theaters should provide every facility for pleasing the patrons, who are the support not only of the theater but of the entire motion picture industry. Noth-

ing is more important to the industry than projection; yet producers, directors, and exhibitors show little interest in new projectors.

Lantern-slide technic is described, and its relation to motion pictures pointed out. Questions are raised as to how the motion picture has improved in the last twenty-five years, and why; what further improvement can be hoped for; and why intermittent illumination should be eliminated. Comparison is made between intermittent and continuous screen illumination, both with black-and-white and with Technicolor pictures, discussing the subject of eye-strain, persistence of vision, and various advantages of the continuous screen image.

The single lens-wheel theater projector is described in detail. The objective comprises one fixed component and one lens-wheel, the latter being the only moving optical part of the projector. A sphero-cylindrical condenser system is used, and a simplified film-feeding mechanism with sound pick-up is located directly above the picture aperture. Improved fire-shutter control and film-movement stabilizer, an accurate gear-train reduced to four gears, and a new quick-action take-up are some of the features of the new projector. The optical system is designed for additive three-color projection, with optical economizer.

"Action Is Needed;" F. H. Richardson, *Motion Picture Herald*, New York, N. Y.

A recently published editorial by a well known writer in the industry is quoted, in which the importance of excellence in projection is stressed. The possibility is discussed of realizing beneficial results through the coöperation of the Society of Motion Picture Engineers; and the opportunity for educational work with the organization representing the projectionists is pointed out. The manner in which such educational work might be financed and carried on effectively is discussed.

"The Development of Slide-Film Stereopticons;" Miss Marie Witham, *Society for Visual Education, Inc.*, Chicago, Ill.

A description is given of the improvements made during the past ten years in single-frame Picturol equipment, and the development of the new SVE double-frame Picturol projectors is described for the first time.

"The Department of Agriculture's Experience in the Preparation and Use of Slide-Films;" C. H. Hanson, *Extension Service, U. S. Department of Agriculture*, Washington, D. C.

Because of the rapidly increasing popularity of slide-films and the small demand for glass lantern slides, the Extension Service of the U. S. Department of Agriculture is now preparing all its new illustrated lectures in slide-film form only.

In order that slide-films may serve their purpose most effectively, they must give a faithful reproduction of fine detail in full-tone photographs, and in the same film give a readily legible image of line-drawings, charts, or reading matter. The technical difficulties involved in making originals, negatives, and positives are numerous, and the full development of the art of making educational slide-films of the highest quality will not come until considerable research and educational work has been done.

The opinion is expressed that of the many problems awaiting solution, perhaps none is more important than that of evolving and establishing standards for the guidance of those engaged in planning and making original copies. Second, there is an urgent need for definite information as to the best materials and technic to

use in making the negative and the positive. After ten years of experience in the production of slide-films, it is maintained, present equipment is ill suited to its purpose. Reasons are given, and a plea is made for the adoption of a larger aperture as standard and the design and manufacture of production and projection equipment of greater precision and adaptability.

"Visual Education and Film Slides;" J. B. MacHarg, *Lawrence College*, Appleton, Wis.

The value of pictorial helps in education was emphasized in the Middle Ages. The invention of lenses was soon followed by the stereopticon, but its usefulness was negligible until the introduction of photographic plates and powerful illuminants in the nineteenth century.

The invention of flexible film and Mazda light made possible film-strip slides having great advantages of convenience and cost. The necessity of a fixed series of slides introduces problems that have not been recognized in the production of much of the film-strip material now available. Definite principles should govern the production of film-strip sequences.

The many advantages of film-slides are as yet little known. Their convenience and negligible cost make their wider use desirable. At least three machines, adapted for this kind of slide, will soon be available.

Most film stereopticon positives now used in educational work are single-frame. The double-frame positive has some elements of superiority, and there is a great advantage in that equipment is available for its production by any advanced amateur.

The great problem of visual teaching is to supply apparatus and materials so efficient and so easy to use that they *will* be used. Film-strip and film-slides are the least expensive and most convenient of all devices for visual teaching by light projection. They open a broad field for important development.

"The Business Screen—Some Demands Made by and upon It;" W. F. Kruse, *Bell & Howell Co.*, Chicago, Ill.

The use of motion pictures for advertising has been with us for a number of years, but it has been only in the past few years that the use of the business film has reached such outstanding proportions. A major portion of such films is now shown on 16-mm. sound equipment. Some idea of the extent of growth of the business may perhaps be appreciated by considering that the Chrysler Corporation has allotted a major portion of its advertising allowance for the past two or three years to motion pictures. This is typical of many other organizations.

Some of the applications that have been made, and the various groupings into which the several types of advertising pictures fall, are described. A brief historical explanation is given as to why the various types of such films have come into use and the reasons why these applications are likely to be extended.

Specifications for the ideal sound projector as outlined by advertisers are briefly given, together with a brief comparison of what is available and how close it is to the ideal.

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

Recent progress and development in the various fields employing non-theatrical motion pictures and equipment are outlined. These fields comprise principally industry and education. Great advances in the use of 16-mm. sound prints are

reported, and the possibilities of this medium are shown to be achieving wide recognition.

The necessity for an S. M. P. E. 16-mm. sound test-reel is stressed, and some recommendations for preferred practice are made for the consideration of the Standards Committee.

"Photographic Race-Timing Equipment;" F. Tuttle and C. H. Green, *Eastman Kodak Co.*, Rochester, N. Y.

As a result of the need of greater accuracy in rendering decisions of racing events without appreciable delay, equipment was developed to permit viewing, within three minutes, paper enlargements made from 16-mm. motion picture negatives of the finishes. The general requirements for the early rapid processing machine and the machine itself are described, with sketches, and the early cameras and their requirements are also mentioned.

As a result of experience gained in the field with this equipment certain changes were found desirable. The design of the new camera is considered in detail, and illustrations of the camera and a finish of a race are shown. The new processing machine and its enlarging head are described, with illustrations of the assembled equipment.

"Use of Motion Pictures in an Accurate System for Timing and Judging Horse-Races;" E. M. Honan, *Electrical Research Products, Inc.*, Hollywood, Calif.

The installation and operation of an accurate system for timing and judging horse races at Santa Anita Park, Calif., are discussed. The equipment consists of photoelectric cells and associated exciter lamps placed around the rack at proper positions; a visual electric timing board placed in the infield; two electrically driven cameras associated with electrically driven clocks mounted in a booth above the grandstand exactly at the finish line; and connected to the cameras in a darkroom immediately behind them is a rapid film processing and printing equipment.

When the horses at the starting position interrupt the light-beam focused upon the photoelectric cell, an electrical impulse is transmitted to a central control cabinet mounted in the camera booth, and thence to the electric clocks associated with the cameras and to the rotary selector switches operating the electric timer in the infield. The time of each quarter-mile interval of the race is recorded visually on the electric timer.

Two special Eastman 16-mm. cameras are mounted exactly at the finish line. These cameras are equipped with a double-lens train: one to photograph the horses as they cross the finish line, and the other to photograph upon the same frame the reading of the electrically driven clock upon which the camera is mounted. The cameras are driven directly by synchronous motors, and may be operated at speeds ranging from 62 to 101 double frames per second. The electric clocks associated with the cameras are driven by crystal-controlled 200-cycle current. The clocks are started by the impulse from the first photoelectric cell in the race, and are stopped manually after the cameras are stopped. The cameras are operated manually to photograph the order and the time of the finish.

"Analysis of Sound Waves;" H. H. Hall, *Cruft Laboratory, Harvard University*, Cambridge, Mass.

Most sounds consist of a spectrum of frequencies of various intensities. The

distribution of the frequencies and intensities determines the quality of the sound. The spectrum may remain fairly constant in time, or it may go through rapid changes. Sound analysis is the process by which the various components of the spectrum are detected and measured. A complete analysis should furnish the frequency and amplitude of each component as well as its phase relatively to the other components, at a given instant of time. If the spectrum changes in time, a complete analysis should be made at intervals throughout the duration of the sound, the lengths of the intervals being determined by the rate at which the spectrum is changing.

For purposes of analysis, sounds may be grouped into three classes: (*1*) Sounds that may be maintained at constant frequency, constant intensity, and unvarying quality for a period long enough to carry out the analysis; (*2*) sounds that are essentially transient in nature; (*3*) sounds that may be maintained constant, on the average, but whose frequency, intensity, and quality vary periodically within this time. The first two groups of sounds require different methods of analysis. The third group in certain instances may be analyzed by the methods used for class (*1*), while in other instances the method used for class (*2*) may be necessary.

Sound analysis may be made to yield valuable information concerning the source of the sound and the possibility of good transmission and reproduction. It furnishes also a measure of the quality of the sound. Methods of analysis and some results obtained are given. The analyzer built at the Cruft Laboratory is described, and examples of analyses made with it are presented.

"Copper Oxide Rectifiers for Motion Picture Arc Supply;" I. R. Smith, *Westinghouse Electric & Manufacturing Co.*, Pittsburgh, Pa.

The copper oxide rectifier approaches in many ways the ideal rectifier, having a combination of characteristics found in no other rectifier. These include long life, no moving parts, silent operation, and rugged construction. Although first applied in radio, since 1927 many industrial applications have been made. These include use in telephony, fire-alarm systems, operation of time clocks, circuit breakers and all types of contactors, and many other applications.

The rectifier is a resistance device, having negative temperature coefficient of resistance and a ratio of back to forward resistance of several thousand. Rectifiers can be built for any voltage and current output desired by paralleling the disks or connecting them in series, as required.

Ratings depend upon heat-radiating ability. Heat is dissipated by convection cooling, with large radiating fins. Resistance characteristics undergo change with time, the extent depending upon temperature and duty-cycles. Standard ratings are based upon the aged characteristics, not the new. Nine-year old life tests indicate an indefinite life, if properly applied. Fan cooling affords better heat dissipation, lowering the temperature of the units, permitting safe operation at higher outputs, and reducing size of the units. Large outputs, such as for arcs, can then be obtained from small rectifiers. The copper oxide rectifier appears to be finding acceptance in the motion picture industry as in other industrial applications.

"A New Monitoring Telephone Receiver;" H. F. Olson, *RCA Manufacturing Co., Inc.*, Camden, N. J.

A high-fidelity telephone receiver has been developed having uniform response

over a wide frequency range. The new type of vibrating system compensates for the loss of low-frequency response due to the normal leak between the ear-cap and the ear. Uniform response is maintained at the high frequencies by employing a system having small effective mass reactance. Experimental data obtained on an artificial ear are presented, showing the effect of the acoustic leak upon the response of various types of telephone receivers. Subjective tests are also described and data given corrobrating the tests on the artificial ear.

"The Magazine Ciné-Kodak;" O. Wittel, *Eastman Kodak Co.*, Rochester, N. Y.

Unique points in the design of the magazine are the inclusion of a loop-maintaining sprocket, a protective metal shutter that automatically covers the film before the camera can be opened, and a film indicator that registers whether the machine is in or out of the Ciné-Kodak.

The camera itself, which is unusually compact, is operated by two spring motors that will drive the mechanism at 8, 16, or 64 frames per second. While the shutter is of the rotary type, it is conical in shape, to reduce camera thickness. The pull-down is of the ratchet type.

The one-inch $f/1.9$ lens is interchangeable with lenses of various focal lengths. A novel, practical finder system, which is combined with the carrying handle, provides correct fields for any of these lenses by sliding a negative element to various positions between the peepsight and the finder lenses.

"1000-Watt 16-Mm. Filmosound;" R. F. Mitchell and W. L. Herd, *Bell & Howell Co.*, Chicago, Ill.

A 16-mm. sound-film projector is described, incorporating many unusual features, such as stream-line base, 1000-watt lamp and *T-10* bulb, motor drive take-up and motor rewind, built-in film humidifier, and many other advanced ideas. A special amplifier and loud speaker have been developed for this equipment. The amplifier has an undistorted output of approximately 25 watts. Connections for two projectors enable a professional show to be put on.

The entire equipment, including cords, film, and accessories, is carried in two cases, the total weight being about 85 pounds. The equipment is used extensively for lecture work and for industrial presentations to audiences of a size ordinarily associated only with the smaller theaters. The paper concludes with some interesting acoustical data on the application of the equipment and the types of halls encountered in practice.