

The Development of Scientific Investigations in the Leningrad Ciné-Engineers Institute

By V. S. MANKOVSKIĬ and S. M. PROVORNOV

Translated by GEORGE FULFORD

SOVIET scientists are faced with the important problem of accelerating the rate of technical progress in the national economy. The creation of more progressive technical means is of the very greatest importance in cinematography, which has a very important place in the Communist Party Program as a powerful tool for ideological work.

The Leningrad Ciné-Engineers' In-

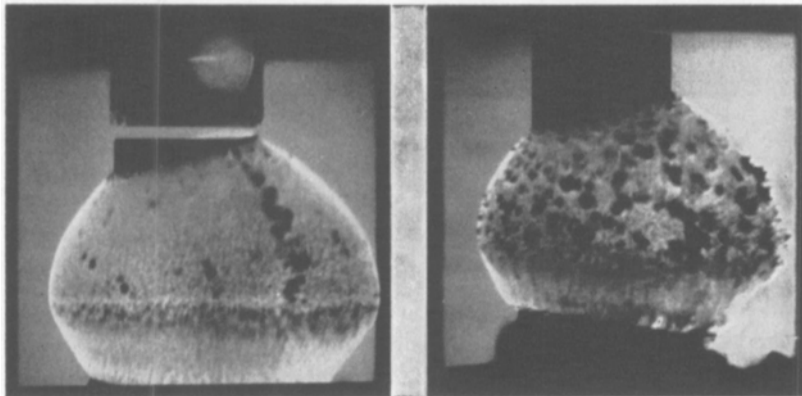
Translated from *Tekhnika Kino i Televideniya* of November 1964, pp. 1-5, by George Fulford, Photo Products Dept., E. I. du Pont de Nemours & Co., Parlin, N. J. 08859.

stitute is one of the oldest centers in the Soviet Union for training engineering and technical manpower and carrying out scientific investigations in the fields of photography and cinematography. Its objectives were formulated as early as September 1918, in a decree of the Soviet of the Peoples' Commissars of the R.S.F.S.R.,* when there was founded "the Higher Scientific State Establishment known as the Higher Institute of Photography and Phototechnology, for

* R.S.F.S.R. = Russian Soviet Federation of Socialist Republics.

the most rapid possible improvement of the levels of professional development in all fields of optical, photographic, and phototechnical printing matters, and equally for special scientific research."

From its inception, the Institute, which deals with the whole range of the natural sciences, electronics, equipment construction and chemistry, has carried out investigations in the fields of ciné equipment construction, ciné sound techniques, and technology for producing and processing cine photo materials. Today the Institute represents a ciné techni-



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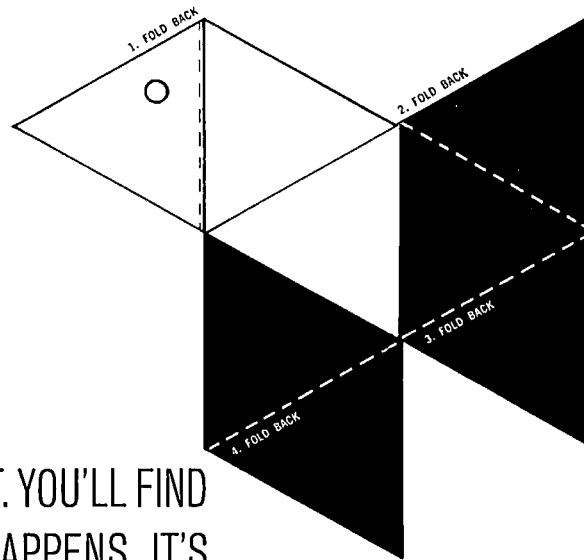
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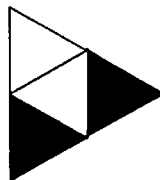
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Magnetic heads and complete systems using these have been developed and put into production; these ensure high density signal recording over a wide frequency range. Supports for thermoplastic and photoplastic signal recording have been developed and investigated.

Investigations in the field of technical electronics have been connected with the development of electric supply systems, stabilizers and amplifying equipment. In particular, in recent years the Institute has developed the electric supply systems and terminal amplifiers used in the equipment for the Kremlin Meeting Hall, a system for the control and regulation of film printing processes, high-quality sound equipment for small ciné theaters, precision voltage stabilizers for photometric light sources, as well as a number of other devices. Work has been

† VUZ = institute of higher learning ≅ "college."

carried out in cooperation with the Lenkinap plant and the Ts.K.B.‡ of the State Committee on Cinematography of the Soviet of Ministers of the USSR.

Various stereophonic systems have been studied, as well as methods for measuring nonlinear distortions and disturbances of steady-state conditions in the operation of electroacoustical equipment.

The electrovacuum laboratory of the Institute has been carrying out interesting work such as developing and producing single-cascade photoelectric amplifiers. Techniques for producing selenium photo elements have been developed and applied to their production in the KEMZ plant. In connection with the need for significant reduction in the heating of ciné frames by the powerful light sources in modern projection equipment, the laboratory has carried out an investigation of interference filters and reflectors. This work has been completed successfully, and cold light reflectors were first used in the equipment for the Kremlin Meeting Hall, while the technology for their production has been extended to the plant scale.

The Institute has carried out work to

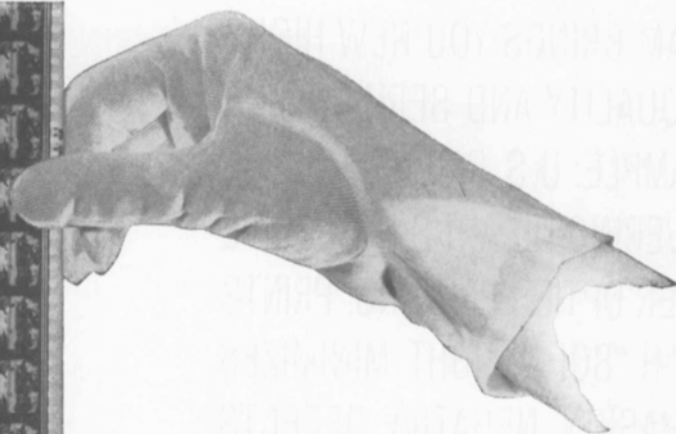
‡ Ts.K.B. = Central Construction Bureau.

improve ciné projectors and develop ciné equipment. A theory has been developed for radial lenticular rasters as well as methods for their use; the factors affecting the separation of images in stereo pairs have been determined. Super-high-speed ciné cameras have been developed using fine-structure optical rasters. These developments have made it possible to create the RKS-1 camera for filming at 100 million frames/sec and the RKS-2 image-dissection camera which permits filming at frame frequencies of 10 to 500 million/sec. New speed stabilizers were developed for sound tapes as well as new sound units and cameras of the KTS-1 television-camera type.

In addition, the Institute has continued work on an investigation for designing and producing optical systems for ordinary, wide-screen and wide-format cinematography; this is being carried out in cooperation with the Ts.K.B. of the State Committee on Cinematography. New wide-angle lenses LIKAR-1 and LIKAR-2 with focal lengths of 16mm and 12mm, respectively, have been designed for 35mm photography; also recently designed were anamorphous Bufokator systems (7, 8 and 9) with viewing angles of 77 to 92°; and ciné camera lenses with $F = 28, 40$

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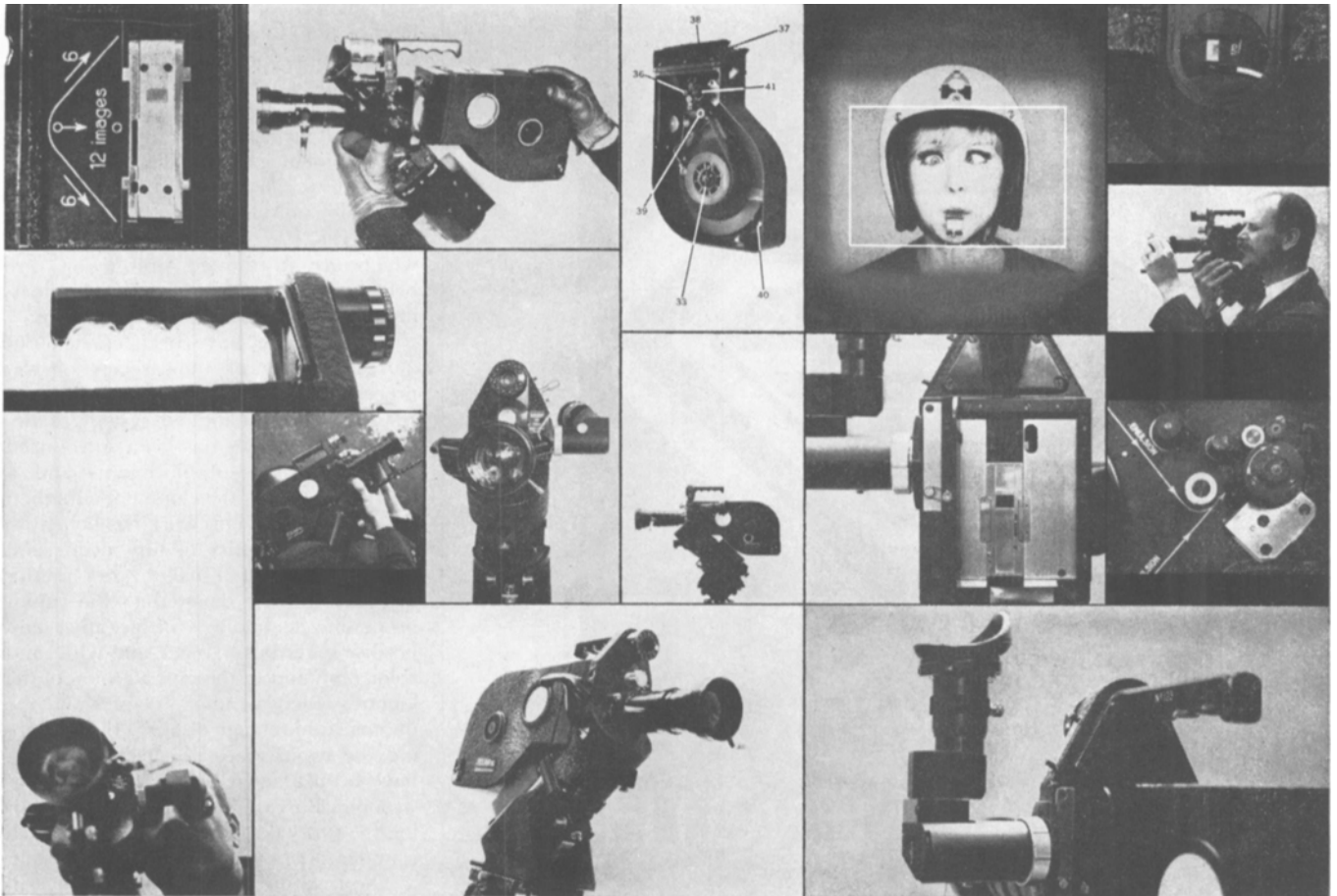


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and 56mm and with variable focal lengths for taking wide-format 70mm films. Systems have been developed with various focal lengths for projecting wide-screen films, as well as a series of fast lenses for projecting 70mm films.

Equipment has been developed in the Institute for measuring the geometric dimensions of ciné films. Devices of the types P.K.P.-2A, P.K.P.-3A, P.K.Sh., which are in limited production, are being used in ciné-film and film-duplicating establishments, and in cine studios.

Investigations have been carried out on the theory of the process of wet processing of ciné film materials, as a result of which a unified system of developing machines has been introduced in the printing establishments and a continuous-flow development method has been set up. This work has helped to improve the quality of film prints and reduce their cost. Further work in this direction will be devoted to the rapid-processing technology of negative and positive materials on black-and-white and color film, and to the investigation of the kinetics of extra-rapid processes and the photographic image quality. In developing the rapid-processing technology we have been assisted by the Central Construction Bureau in designing and building the spray developing machine, which is undergoing production tests at present.

The Institute is extending the investigation of the imbibition process for producing color images as well as the investigation of the macrograininess of imbibition matrices.

The use of polymers in cinematography is one of the new directions of the Institute's scientific work. Over a number of years the possibility of replacing gelatin in cine film emulsions by synthetic polymers has been under study. Many polymers have been synthesized and tested. In addition, new lightsensitive polymers have been synthesized and studied for the production of miniature semiconductor devices.

Other scientific developments in the Institute have been the investigation of the photo processing of unsupported layers, the investigation of the properties of emulsion stabilizers, improving the properties of cellulose acetate films, etc.

However, we must note that work carried out in the Institute is not always concluded successfully and on schedule. Sometimes the construction of equipment models is delayed, and developments are commercialized slowly. This is explained by the weakness in the manufacturing facilities of the Institute, and by insufficient interplay between some groups of scientific workers and the industrial facilities.

New Possibilities

So far the Institute has not built up a complex of scientific work for guiding the work of the younger scientists. Com-

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paratively little attention has yet been paid to automation and mechanization of the processes for producing and showing cine films.

Important new possibilities for scientific work in the Institute arise in connection with the Resolution of the Central Committee of the Communist Party of the Soviet Union and of the Soviet of Ministers of the USSR: "The further development of scientific research work in the higher schools" passed in February 1964.

In its session, the State Committee on Cinematography of the Soviet of Ministers of the USSR considered a report by the Institute on the present state and future of the development of scientific investigations and made a decision to expand scientific investigations in the field of ciné technology, to develop its material basis further and, in particular, to create professional scientific research laboratories in the Institute for cine optics, the use of polymers in producing cine photo ma-

terials, and studying the processing technology of ciné photo materials.

On the basis of this decision, the scientific community at the LIKI[§] has developed a program of investigations to be carried out in the coming years, the main features of which are mentioned briefly below.

One of the most important problems of the Soviet ciné industry in the coming years is to improve the quality of cinematographic images and their sound accompaniment. The solution of this problem will be the subject of scientific studies in the fields of optics, photography, acoustic techniques, ciné equipment and technical electronics.

Based on the methods developed earlier in the Institute for designing optical systems with aspherical surfaces, we plan to carry out a study of a new optical arrangement for fast wide-angle aspherical lenses with fields of view of 100 to 110° to ensure increased contrast and illumination uniformity over the whole picture, as well as to explore theoretically the possibility of creating fast anastigmats for taking and printing 70mm ciné films.

A great deal of attention will be paid to the problems of selecting rationally the characteristics of ciné-filming and ciné-projection systems, of creating methods for objective quality tests of the optical images formed by ciné projection lenses, of investigating the perception of perspective and geometric distortions in ciné images and the establishment of permissible limits for these, and of determining useful spectral coating characteristics for optical ciné systems.

Together with these investigations on ciné optics, we plan to develop wide-angle, small-sized lenses with variable focal lengths for taking 35mm and 70mm films, to create wide-angle and fast anamorphic ciné filming systems with fields of view of about 100°, wide-angle anamorphic systems with variable focal lengths and to improve the quality of optical images with smaller-sized anastigmats for the projection of 70mm films.

The cold light reflectors developed in the USSR are in no way inferior to the best foreign products but they still do not have sufficient moisture stability and hardness of the coating. At present, we are carrying out a continuing program of work on improving the quality of the mirror coatings (increasing the heat stability, mechanical hardness, and moisture stability), and on developing more efficient techniques for applying interference layers.

In continuing earlier work, we plan to investigate the process of blackening and the reasons for the appearance of photographic fog by a statistical study of the structural dispersity of the metallic silver, and also to improve the methods and develop equipment for the visual and photoelectric determination of the granu-

[§] LIKI = Leningrad Cine-Engineers Institute.



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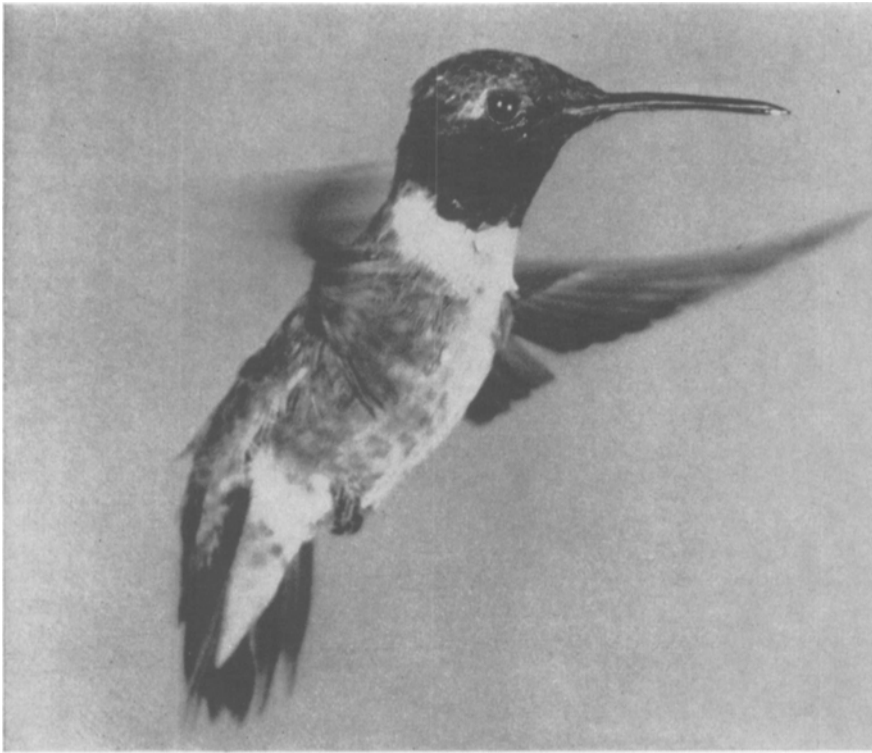
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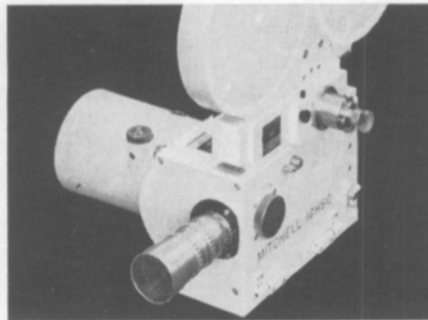
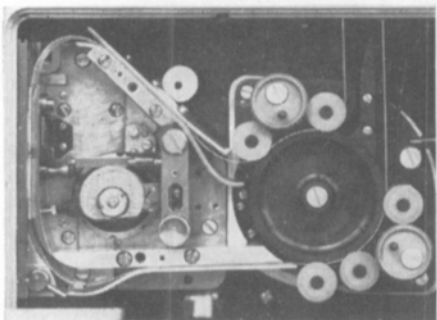
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lar structure and sharpness of color and black-and-white photographic images.

Our Institute, in cooperation with the NIKFI,[#] plans to carry out a broad investigation of the factors affecting quality in sound recording, to develop objective methods of controlling the quality of photographic sound tracks in the mass production of color and black-and-white prints, and to carry out work for improving the quality of stereophonic sound reproduction. Simultaneously, work will be carried out on improving the quality of magnetic heads, and particularly, on studying their wear resistance.

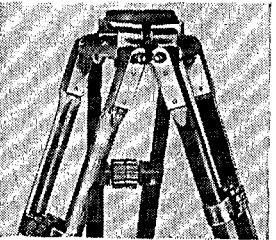
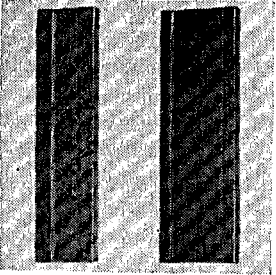
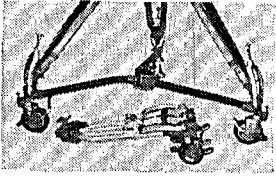
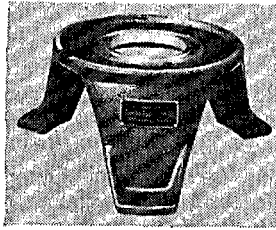
For improving the quality of sound reproduction, it is important to carry out studies for stabilizing the velocity of the sound records. On the basis of methods developed earlier for designing these speed stabilizers, we propose to develop modifications of the stabilizers and new speed stabilizer units, particularly for small tape speeds in magnetic recording.

In connection with the recent paper by V. G. Komar and V. G. Chernov ("Future Direction of Research and Development of Cinematography in the USSR," *Jour. SMPTE*, pp. 254-256, March 1965), we would like to emphasize how necessary it is for the scientific and production organizations to carry out a great complex of work in the present five-year period and to further the technical quality of ciné films. Mention must be made of the review of existing standards and limits and the development of new ones for all ciné photo materials, apparatus and industrial processes for producing ciné film. Apart from this, we must develop a new and more up-to-date combined method for measuring the various parameters defining the main quality characteristics of the equipment complexes and technological processes. Finally, in addition to firmly establishing the standards, we must develop and produce standard equipment for carrying out the necessary measurements.

We think that in the coming years it will be necessary to include in the plan, work related to the adaptability of mass produced ciné projection equipment to various sizes of ciné theaters with a maximum interchangeability of such parts as roller mechanisms, velocity stabilizers for the sound tapes, sound units, etc. Apart from its purely economic advantages, such work makes it possible to improve the quality of ciné film exposition and greatly simplifies spare-part and ciné equipment repair problems.

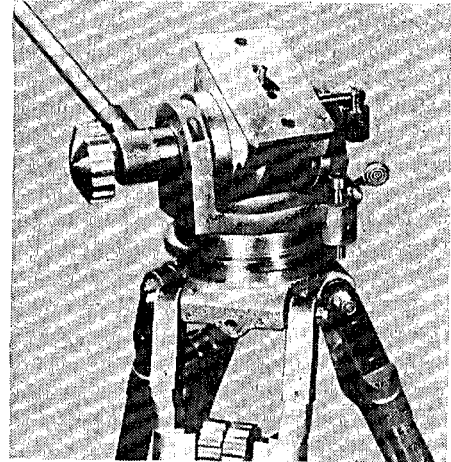
The technological improvement of the basic cinematographic processes and the search for new methods of carrying them out are extremely important for the progress of ciné technology. Pertinent investigations are carried out in ciné photo material technology, photography, technology of ciné photo equipment con-

[#] NIKFI = Scientific Institute for Cinematography.



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struction, processes, equipment, and general chemical technology.

The Institute's work on the synthesis and study of high molecular synthetic materials has shown that the introduction of polymers can lead to great changes in the technology of film production. We therefore plan to synthesize a series of new polymers which can be combined with cellulose and which will ensure better physico-mechanical film-base properties. Work will also be carried out in connection with the partial replacement of emulsion gelatin by polymers having greater heat stability and mechanical strength, as well as lower cost. The synthesis and study of light-sensitive,

photoconducting, and thermoplastic polymers occupy an important place in the plans of the Institute.

Improvement in ciné-film manufacture is closely related to improved machines and equipment for ensuring high accuracy in the film geometric parameters. To this end, we plan to develop new devices for controlling the dimensions of individual 16mm and 70mm films, and also for controlling the dimensions of the items of ciné equipment which are used in film production, cinematography and projection.

Future

The continuous increase in film con-

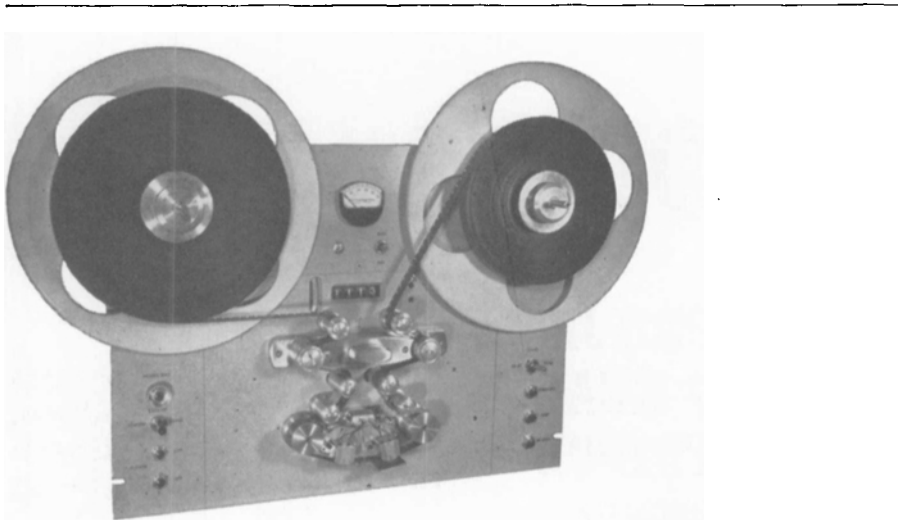
sumption for motion pictures and television, the high quality requirements for images and sound, the demands of the new types of cinematography, and the need to increase the distribution of motion-picture prints are all factors in the problem of improving the chemico-photographic processing of ciné films, and in the search for new technological processes. Experiments carried out by the Institute will extend the scientific investigations in these fields. We will study the kinetics of chemico-photographic processing of cine films and the qualities of the cinematographic images related to processing. It is planned to assess the possibility of using methods of photo-processing by pastes, jets and foams in cinematography, and of developing new, simple, and highly efficient methods of processing nuclear emulsions. Apart from investigating phenidone developers, we plan to study vanadium and several other new developers. In this connection, we must mention the work on investigating air parameters for the efficient drying of ciné films and the automatic control of developer temperatures.

The methods and equipment for kinescope recording developed in the Institute may lead to major changes in ciné-filming techniques. Models of the closed-circuit television system give good image quality, and the cameras have a very short pulldown. It is planned to build commercial models of this equipment and to study the possibilities of the new forms of image filming using kinescope recording.

The improvement and development of new technical processes for manufacturing ciné photo materials and ciné films must be pushed forward simultaneously with solving the problems of the economic efficiency of the processes. According to the program of scientific work on cinematography, it seems to us that the NIKFI, as the main Institute, should assume the main role in providing the specialists for the economic studies in the technological developments. This is important not only for solving questions as to the economic advisability of commercializing any new technology but also for forming a correct estimate of the validity of the initial data on which the proposed new technological process is based.

Exploring new perspectives in the development of ciné-techniques occupies an important place in the activities of the Institute scientists.

Based on our studies of the kinetics of the chemico-photographic ciné film processing and the development of methods for rapid processing, we will investigate and develop extra-rapid basic processes for producing fine-grained halftone images. We propose to extend the work on seeking more efficient methods of recording of electrical signals with the high densities necessary for recording



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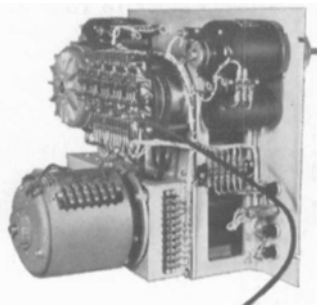
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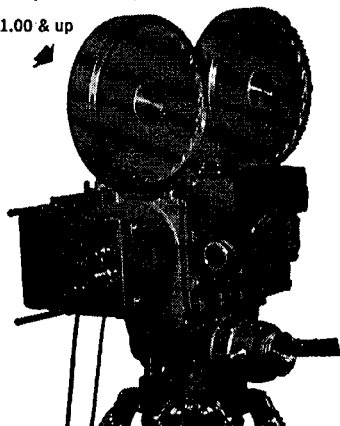
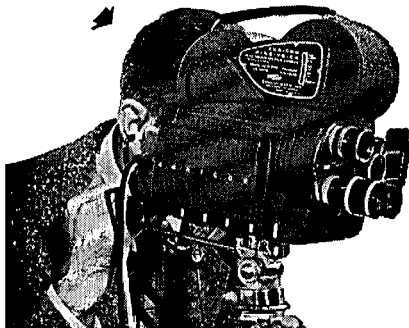


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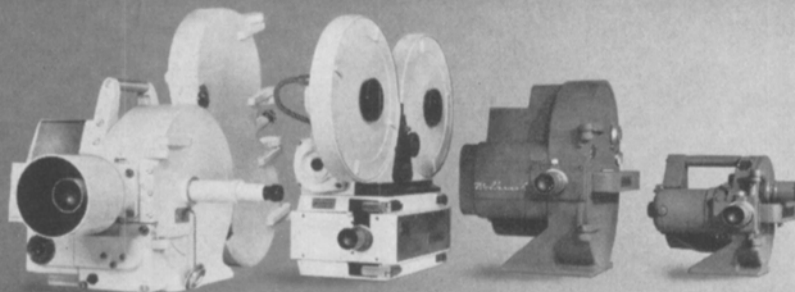
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television images and for a number of technical uses. In this direction, we will study systems for magnetic, thermoplastic and photoplastic signal recording.

Work will be carried out on the synthesis and study of photoresistors.

The creation of polymers with sufficient light sensitivity will make it possible to create small-sized electronic devices and also open the way for producing new light-sensitive materials.

In the future development of new cinematographic systems there remains the problem of creating a cinematographic system with variable dimensions (Variascopic) screen-image shapes. The Institute will therefore develop anamorphic systems with continuously variable anamorphicity, to be used in ciné filming and projection.

We propose to explore the possibilities of loudspeakers of various constructions and for various purposes.

Increase of the apparent brightness of images on ciné screens, kinescope recording and more efficient illumination for motion-picture sets are all possibilities opened up by the use of special film transports with small pulldown times. A group of scientific workers at the Institute is working to create more suitable film transport mechanisms.

In the proposed program of scientific work in the field of ciné technology, it would be wrong to forget the branches of science and technology which use photographic and cinematographic methods of investigation. It is necessary to use high-speed photography for investigating time-dependent processes of microsecond durations. The improvement of image-dissection cameras developed earlier in the Institute, the development of super-high-speed cameras, the improvement of synchronizing devices and methods for interpreting the recorded data are all problems which must find a place in the program of scientific work.

New Divisions

In order to promote investigations on important problems in ciné technology, three divisions in the scientific research laboratories of the Institute will be created in 1965. The divisions will consist of ciné optics; the use of polymers in the production of ciné films; and the techniques of processing ciné film material. The organization of these divisions of the laboratory will set up favorable conditions for the development of the respective investigations, and accelerate development and commercialization.

Strengthening the creative links between the scientists of the Institute, the scientific workers of the NIKFI and the workers of the ciné plants will ensure that the scientific investigations are carried out more successfully and accelerate their commercialization.

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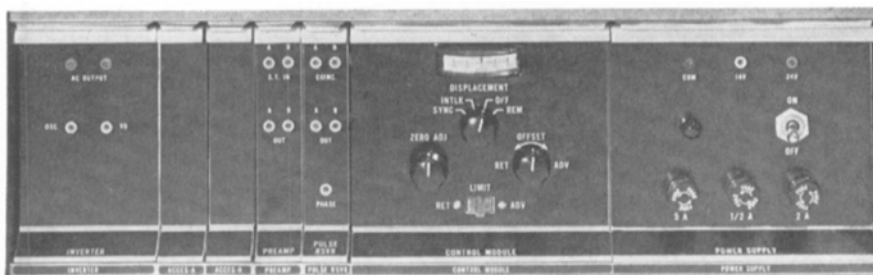
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