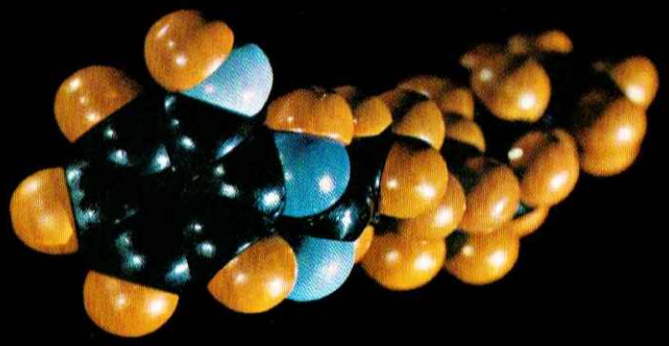

RESEARCH
LABORATORIES

RESEARCH AT KODAK



"Modern industrial research is concerned primarily with the evolution of new processes and new products. It is essentially a group activity in which the combined efforts of many people produce advances which can change the lives of all of us. As knowledge grows, it becomes ever more important that new-found facts be interchanged among research workers by adequate systems of communication. Thus with coordination of effort and exchange of ideas, industrial research helps to meet the needs of a rapidly changing world."

Dr. Cyril J. Staud,
Vice-President in Charge of Research,
Eastman Kodak Company.

RESEARCH ORGANIZATION

Dr. Cyril J. Staud (left) Vice-President in Charge of Research, Eastman Kodak Company, and Director of the Research Laboratories, Rochester, N. Y. Dr. John A. Leermakers, Associate Director of the Research Laboratories.

A STRONG RESEARCH and development program has been a tradition with the Eastman Kodak Company since its very early years. The research program was formally established with the founding of the Research Laboratories in Rochester, New York, in 1912. It has continually expanded as the Company has grown and diversified under the stimulation of research.

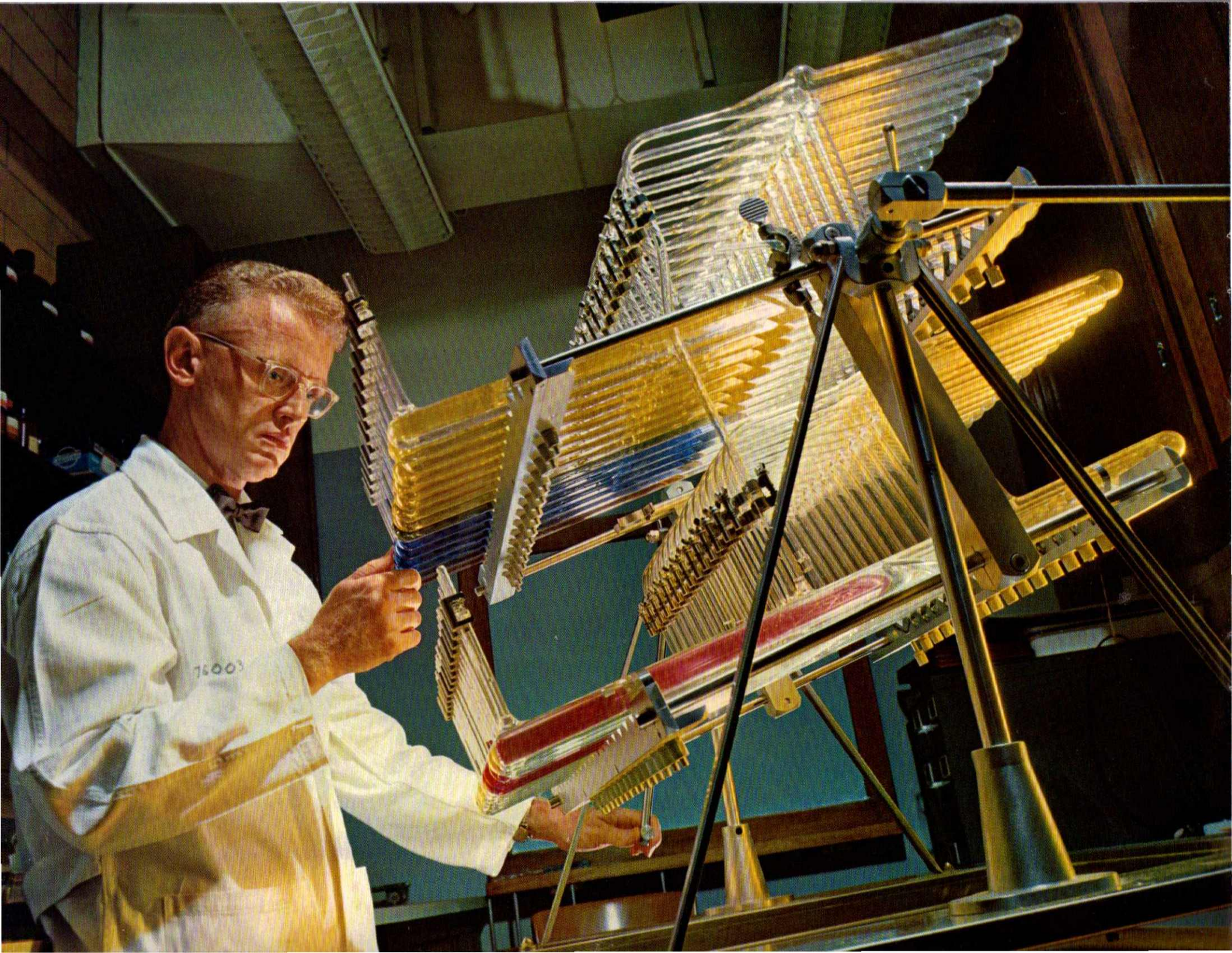
Associated with the major manufacturing units of the Kodak international organization, there are now research laboratories which conduct their own programs of fundamental and exploratory research, and of development of new and improved products. These groups are located in Rochester, New York; Kingsport, Tennessee; Longview, Texas; Panama City, Republic of Panama; Harrow, England; Vincennes, France; and Abbotsford, Australia. In addition, the production divisions of each of the associated companies also maintain technical staffs for late-stage product development, and control of products and processes.

The Research Laboratories in Rochester, the major center of research for the Company and the subject of this brochure, were established by Dr. C. E. Kenneth Mees. Dr. Cyril J. Staud succeeded Dr. Mees as Director of the Laboratories in 1947 and also as Vice President in Charge of Research for the Company in 1955. Since their founding, the Research Laboratories have grown from a staff of 20 to a staff of more than 1,000 persons. The original organization reflected an interest in three general areas of investigation: chemistry, physics, and photographic science and technology. Today, the Research Laboratories consist of six technical divisions: Chemistry, Physics, Synthetic Chemicals, Emulsion Research, Color Photography, and Applied Photography; and a department of Photographic Theory. The Photographic Services Department, the Patent Department, the Information Services Department, and the Administration Division provide the supporting services required by the technical staff.

The Kodak research program has three important features: (1) fundamental research, in which the objective is new knowledge; (2) exploratory research, in which basic information is utilized in the search for new materials, processes and techniques; and (3) early-stage development, in which work is directed towards new materials and processes for general sale and for scientific and military applications. Major contributions to chemistry, physics, and the science of photography have come from fundamental studies in the Research Laboratories. The exploratory work has led to the evolution of completely new materials and new systems of photography. Amateur motion pictures and color photography are notable examples. The staff of the Research Laboratories, in addition to conducting its own extensive scientific and technical programs, works with the production divisions on problems related to new products and processes.

Members of the research staff are encouraged to present papers at scientific meetings and to publish their work in scientific journals. Since the Laboratories were established, more than 2,300 scientific papers, designated "Communications from the Research Laboratories," have been published. These papers are shortened and issued annually as *Abridged Scientific Publications.* Numerous books have been written by the staff on the science and technology of photography and on various specialized branches of physics and chemistry. One, *The Theory of the Photographic Process,* is the most authoritative book on the science of photography.

The wide range of research activities provides a stimulating atmosphere and many opportunities for scientific careers. A chemist or physicist may advance in whatever direction his interests develop – in science, in research administration, or into the manufacturing, sales or business operations. The extensive research programs guarantee diversification and growth of the Company and numerous opportunities for the future.



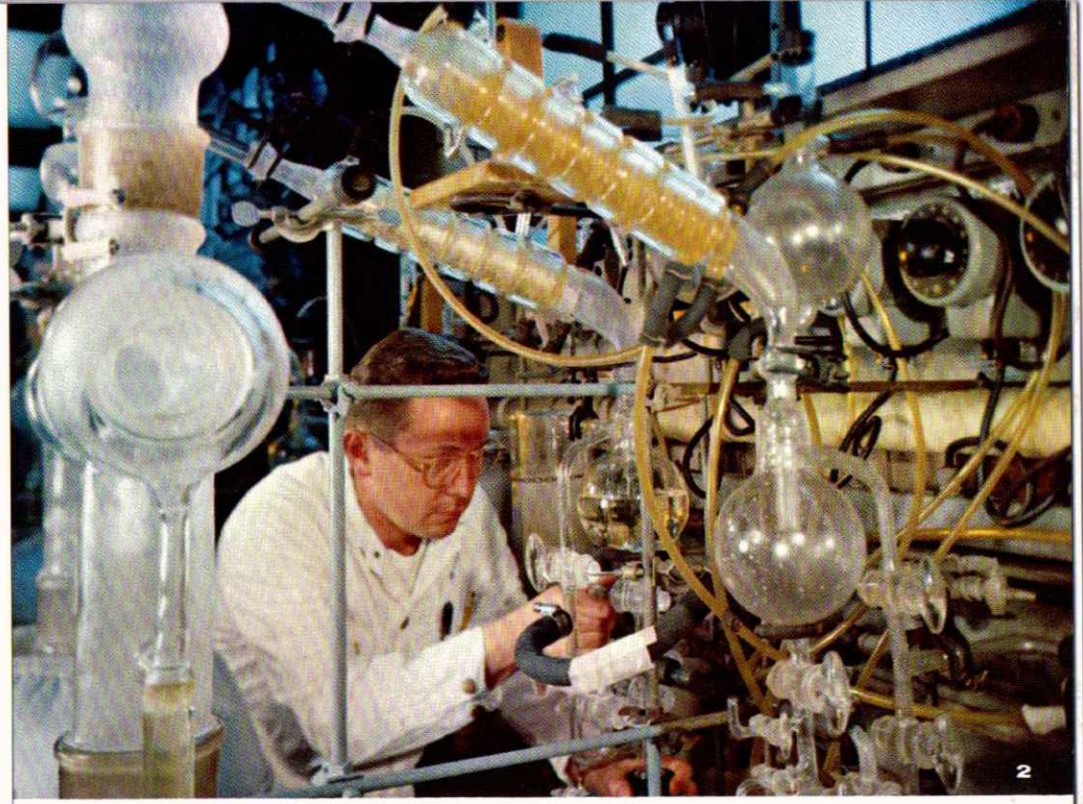
CHEMISTRY

The improvement of existing products, and the development of new products and of new areas of commercial interest depend on an advance in understanding of the nature of materials and systems, on the application of existing knowledge, and on the discovery of new materials and processes. Since Kodak is primarily a chemical manufacturing company, it conducts extensive programs of fundamental and exploratory research in chemistry which have continually increased the utility, quality, and diversity of Company products.

Organic Chemistry The variety and nature of Kodak products require the application of an unusually broad range of chemistry in the search for new chemical reactions to create compounds with specific characteristics to meet changing needs. The skills of the organic chemist, the most advanced instrumentation, and a large stock of organic intermediates are applied to such varied areas of investigation as: the effects of radiation on organic compounds; sensitizers and antifoggants for controlling the characteristics of photographic emulsions; polymeric latices for coatings; mordants for various dye systems; photo resists for the electronics industry; surfactants for coating operations; polymers for use as supports and as vehicles in which other materials are suspended; substances for antistatic coatings; developing agents and dyes, including unusual dyes such as Povan for the treatment of pinworm disease and Cardio-green for tracing the circulation of the blood. The synthesis of new compounds with unique properties through systematic molecular architecture has led to many important technological advances. The synthesis of couplers, the dye-forming constituents of color films, represents a major triumph in the application of organic chemistry to the evolution of color photography. Outstanding contributions are being made in the field of photosensitive polymers. Such techniques as nuclear magnetic resonance, electron-spin spectroscopy, ultraviolet and infrared spectroscopy, and gas chromatography are employed by the organic chemists of the Research Laboratories to follow chemical changes and to correlate molecular structure with physical properties.

Physical Chemistry Much of the work in physical chemistry is undertaken to provide a basic understanding of the behavior of materials and

(Left) **Countercurrent Distribution Apparatus Used in Dye Studies.** This type of apparatus has proven very useful in the isolation and separation of dyes formed in color films and for other analytical problems.



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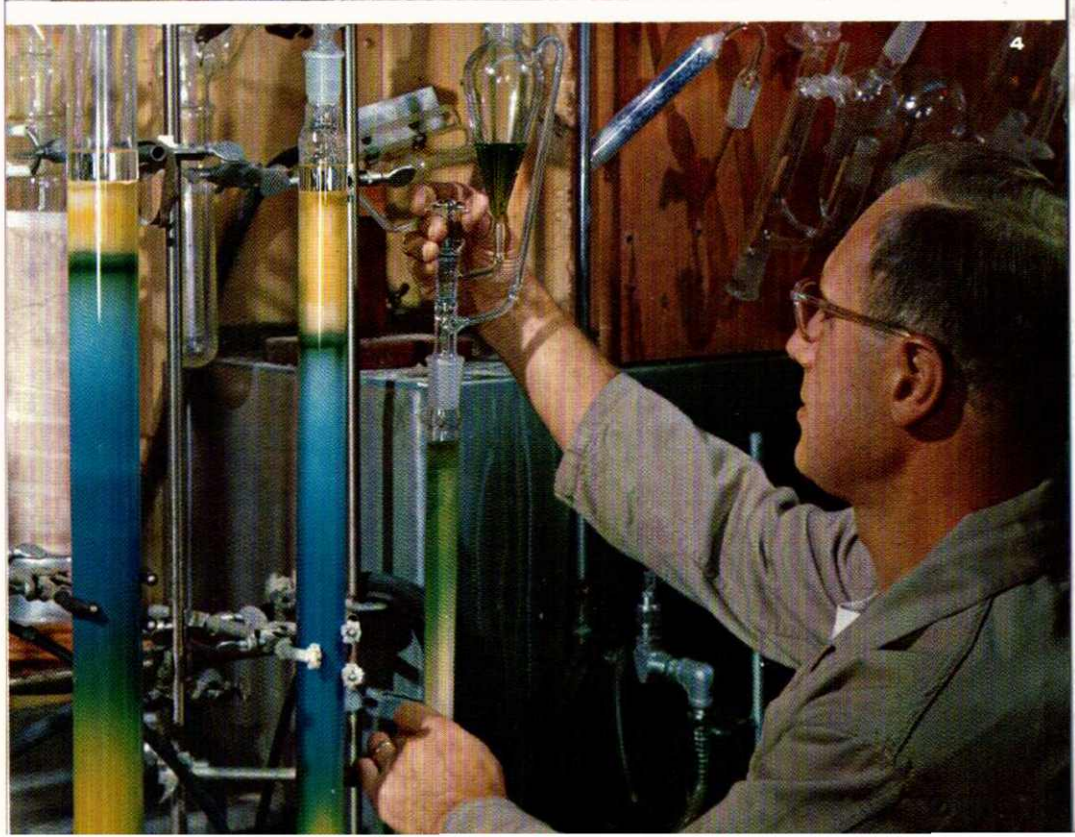

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of reaction mechanisms. The diffusivity of reactants through various materials, the reactivity of molecules in solution or of oriented molecules in the adsorbed state, phenomena involving monomolecular and thin films, catalysis, free-radical mechanisms, and the factors influencing the quantum efficiency of photolytic reactions are typical of the problems under investigation by physical chemists at the Kodak Research Laboratories. Areas of extensive study are the behavior of surfactants as coating aids or dispersing agents and the determination of the structure and properties of macromolecular materials. A particularly important investigation is the work on clarification of the mechanism by which certain photosensitive polymers are insolubilized when exposed to light. The physical chemistry of the solid state is also receiving emphasis.

Analytical Chemistry Because of the diversity of scientific and technical activities in the Laboratories, the resources and staff in the field of analytical chemistry have been developed to cover a broad range of subjects. The analytical chemist is primarily concerned with the development of new techniques and procedures, since all routine analyses are performed by technicians. Close working relationships are maintained with other scientists in such fields as solid-state physics, organic chemistry, physical chemistry, and photographic theory. Techniques have been devised for determining parts per billion of elements and microtechniques developed in the Laboratories have been adopted by analytical chemists throughout the world.

Chemical Technology Facilities are provided in the Research Laboratories to study the effects of enlarging bench-top processes to the full production scale. Many of the details in connection with production procedures are worked out before turning a new process over to the production departments. Examples of work in chemical technology include: fabrication and production studies of new film-forming polymers for use as film supports; design of special apparatus for separating complex chemical mixtures; and the development of new coating formulations for the production of magnetic recording tape and nonsilver photographic materials. A special facility is also operated for the study of reactions and catalysts at high pressures.

Synthetic Chemicals Since it was founded in 1918, more than 9,000 compounds have been synthesized, purified from available compounds, or isolated from natural products by the Synthetic Chemicals Division. Although many of these compounds are produced to satisfy the demands of scientists in the Research Laboratories and of Kodak manufacturing plants throughout the world, they are also made commercially available, through Distillation Products Industries, to scientists in industrial and university laboratories. Quantities produced vary from a few grams to several hundred kilograms and the variety is illustrated by the more than 4,000 compounds listed in the Eastman Organic Chemicals Catalog.

1

Measurement of the Tensile Properties of a Polymeric Film. Evaluation of the physical properties of macromolecular materials is an important phase in the development of new polymer compositions.

2

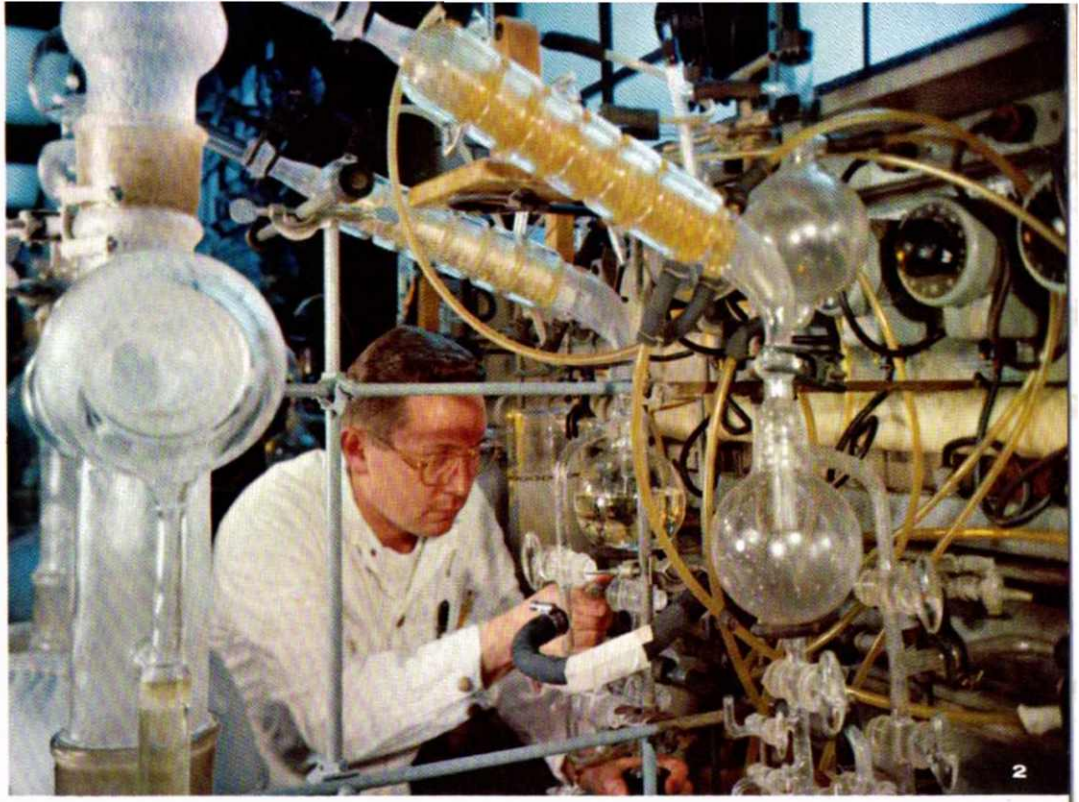
Purification of Ethyl Iodophenylundecanoate (Pantopaque). This radiopaque material is used in the making of x-ray photographs of the spinal column.

3

Analytical Procedure Involving the Use of a Radioisotope. Radiotracer techniques are used in fundamental studies as well as practical analytical problems.

4

Chromatographic Purification of an Organic Compound. This technique is used to separate the components of a reaction mixture.



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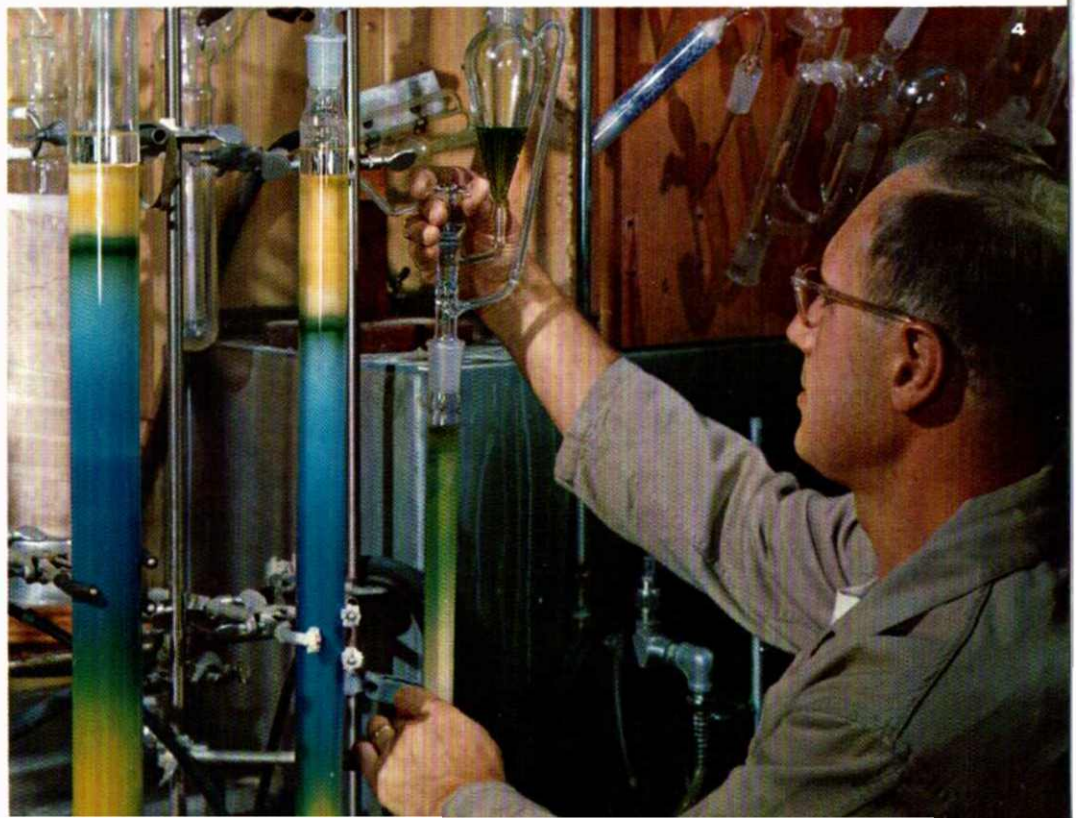

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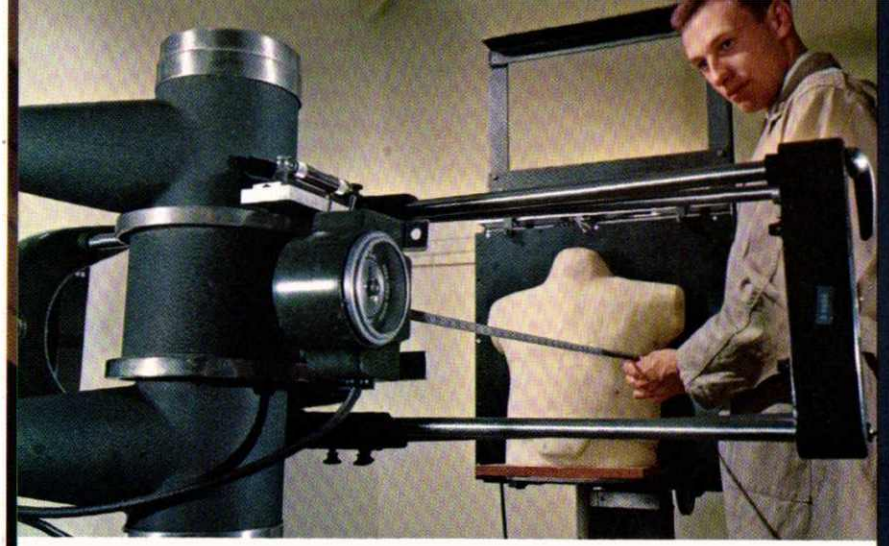
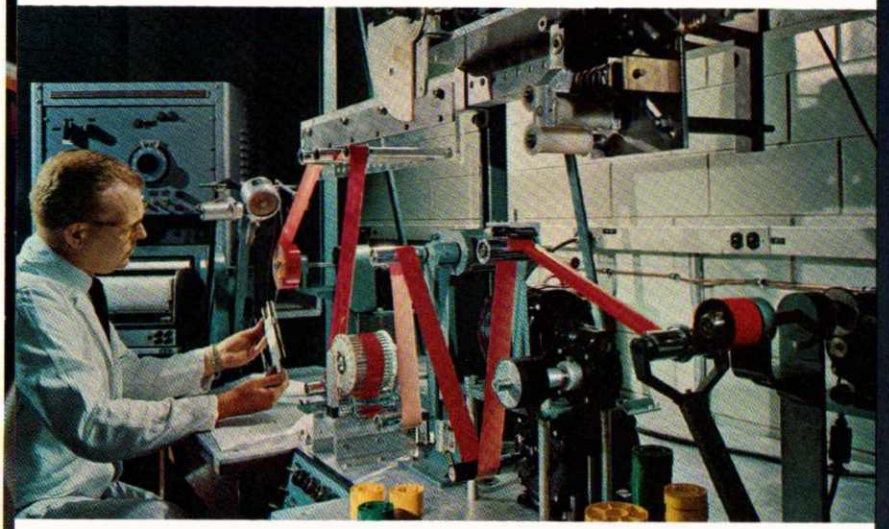
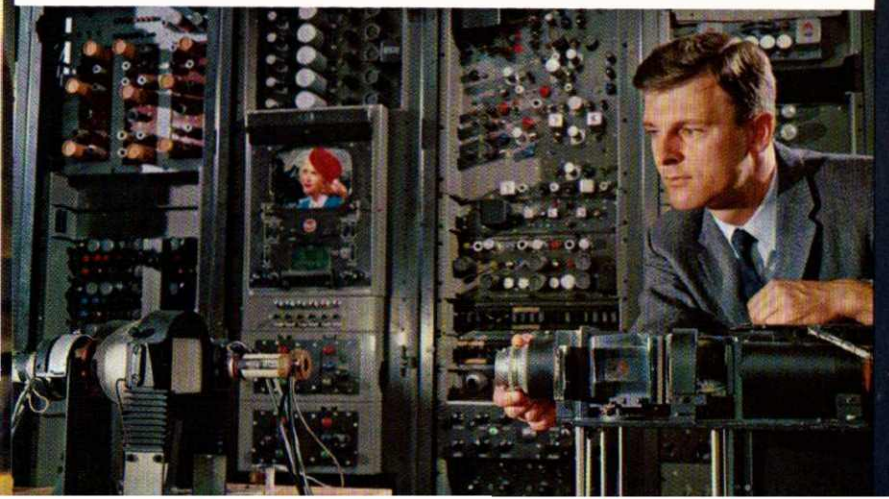


Radiography of a Plastic Chest Phantom. Sensitometric studies of experimental x-ray films are supplemented by evaluation of radiographs of the phantom (a plastic-encased chest skeleton containing artificial organs).



Evaluating Electrostatic Properties of Motion-Picture Film. Film is unwound from a stock roll and passed over several types of rollers to test its electrification properties. Conducting agents and antistatic coatings are evaluated in the search for low charge-generating films.



Television Scanner for Color Films. A color film is being televised using a flying-spot scanner and the image quality produced by the film-television chain evaluated.

PHYSICS

The Research Laboratories were established to apply science to photography and to advance the technology of the Company. At their founding, it was recognized that physicists would play an important role in the study and elucidation of photographic phenomena. Originally, the physicists were concerned primarily with the sensitivity of photographic plates and the eye, as well as with optical and instrumentation problems. As the scope of photography and the activities of the Research Laboratories have expanded, so have the interests and contributions of physicists in the Laboratories. To meet the needs of today, many branches of physics and the related fields of psychophysics and mathematics are utilized.

Sensitometry Photographic sensitometry is the measurement of the quantitative relation of the exposure and development of a photographic material to the image density produced, and of the fidelity with which the brightness scale of the original subject is reproduced by the photographic process. Many of the basic concepts in sensitometry have originated in the Research Laboratories and the methods of psychophysics have been successfully applied to this field. By making use of the tools of photometry, spectrophotometry, radiometry, colorimetry, and mathematical analysis, physicists at the Research Laboratories develop techniques for controlling the manufacture of photographic goods and provide data by which the performance of photographic systems can be analyzed. Fundamental work is also done in geometrical and physical optics and on the effects of turbid media and atmospheric conditions on the attenuation and scattering of light.

Image Structure Important attributes of a photographic image are the sharpness and clarity of its edges and fine detail. In the physical evaluation of these characteristics, techniques have been developed for measuring images at the microscopic level. Mathematical methods have been devised to describe the effects of lenses and emulsions on the distribution of light and density in the image, as well as to describe the influence of the structure of the developed image on the fidelity of tone reproduction, graininess, and the information capacity of photographic systems.

(Right) **Camera for Making Sinusoidal Exposures on Film.** The test pattern seen in the background is imaged on the film as a sinusoidal modulation of light intensity. Using this technique, data are obtained on the image-forming capabilities of a complete photographic system or a single element.

Solid State The silver halide crystal, which is the basic element of conventional photography, is the solid-state device of primary importance to Kodak. The interests of physicists in the Research Laboratories, however, include all photosensitive systems and research programs in solid-state physics involve extensive studies of many compounds – both organic and inorganic. Much attention is focused on the electronic properties of ideal crystals, as well as on the photoelectric and photochemical behavior caused by impurities and crystal imperfections. The effects of sensitizers and doping elements on the photoelectric properties of crystals are being studied in great detail. Important contributions are being made in the clarification of the electronic and ionic processes in silver halide crystals and of the trapping mechanism involved in latent-image formation.

Radiography To improve x-ray films for medical, dental, and industrial radiography and to create entirely new films to meet the demands of new applications, physicists conduct extensive programs. Specific projects include: the development of special techniques to determine the sensitivity, image sharpness, and granularity of experimental x-ray emulsions; the study of the properties of phosphor intensifying screens; the investigation of methods for reducing scattered radiation; the exploration of new radiographic techniques; and the search for better methods of photographically monitoring radiation.

Television and Sound Recording The widespread use of photographic materials in commercial television systems has created the need for research in this field. Modern equipment for monochrome and color television is maintained to evaluate motion-picture films and television apparatus. Materials, processes, and techniques for producing optical and magnetic sound records are also investigated.

Electrostatics Because photographic paper base and polymeric supports for film manufacture are good dielectrics, the generation of static electricity can become a serious problem in handling these materials. The objective of fundamental research on the nature of the electrification process, therefore, is to find means of correcting the conditions which favor the formation of electrostatic discharge.

Instrumentation For many of the fields of advanced research there is no adequate instrumentation. Hence, physicists in the Research Laboratories design precision instruments containing electronic, optical, and mechanical elements. Specialized versions of microdensitometers, granularity analyzers, resolving-power test equipment, cameras for sinusoidal exposures, image-transfer scanners, electronic and film-handling equipment for television chains, equipment for measuring electrostatic charges, and high-speed film-perforating equipment, accurate to a few ten-thousandths of an inch, all represent major contributions to the solution of research and production problems just as they represent major advances in instrument design.

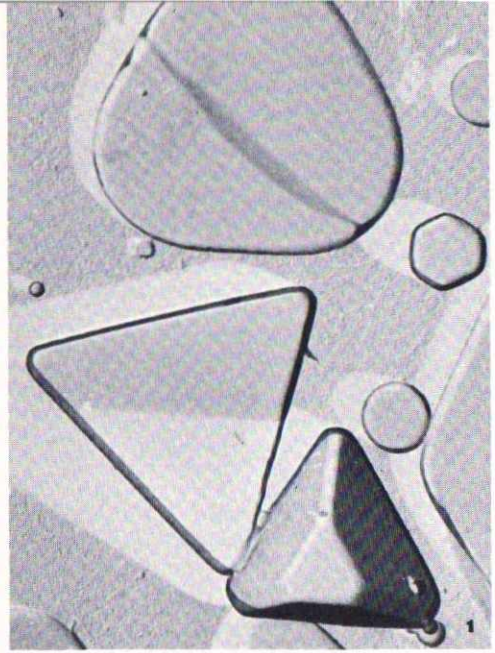
1 **Electron Micrograph of a Preshadowed Carbon Replica of Silver Bromide Crystals.** (20,000×—shadowed with Pt-Pd at 18°)

2 **Apparatus for Simulating Grain Patterns.** Spatially random spots of light of uniform size and precisely known number and distribution are generated in this apparatus. Photographs of these spots are used in information-theory studies.

3 **Magnetic Tape Evaluation.** Many kinds of measurements are required to evaluate the performance of magnetic tape. Measurements are made with electronic apparatus which is designed and built in the Research Laboratories.

4 **Sinusoidal Test Patterns.**

5 **Flash Photolysis of Large Silver Chloride Crystals.** Light flashes of one-microsecond duration produce a coloration in the crystals. The time-dependence of this process is being measured at the temperature of liquid nitrogen.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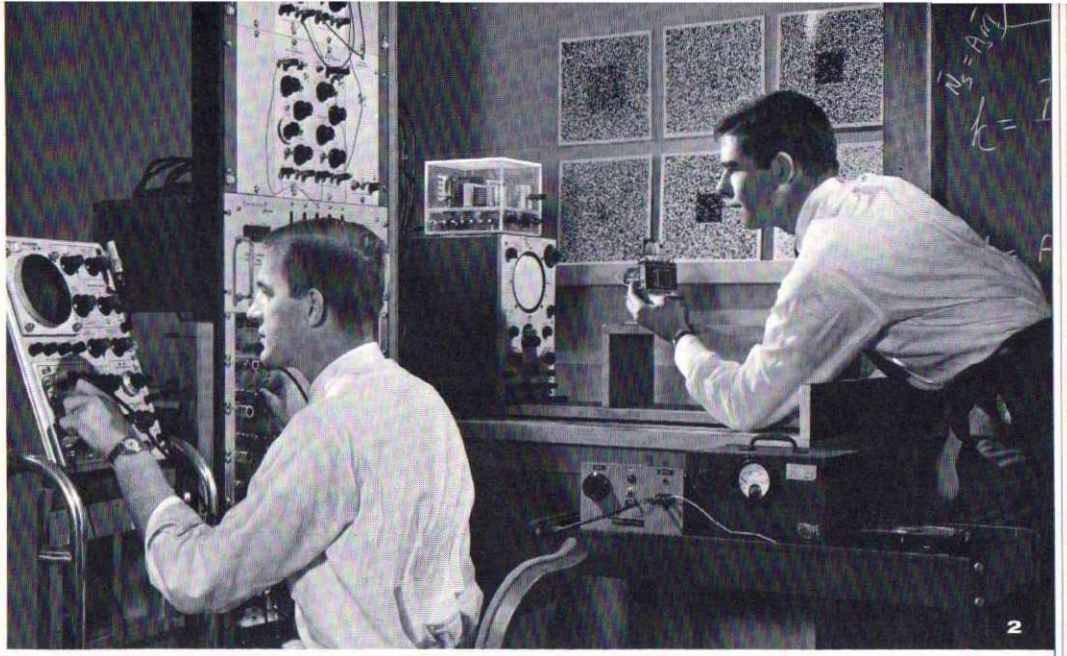
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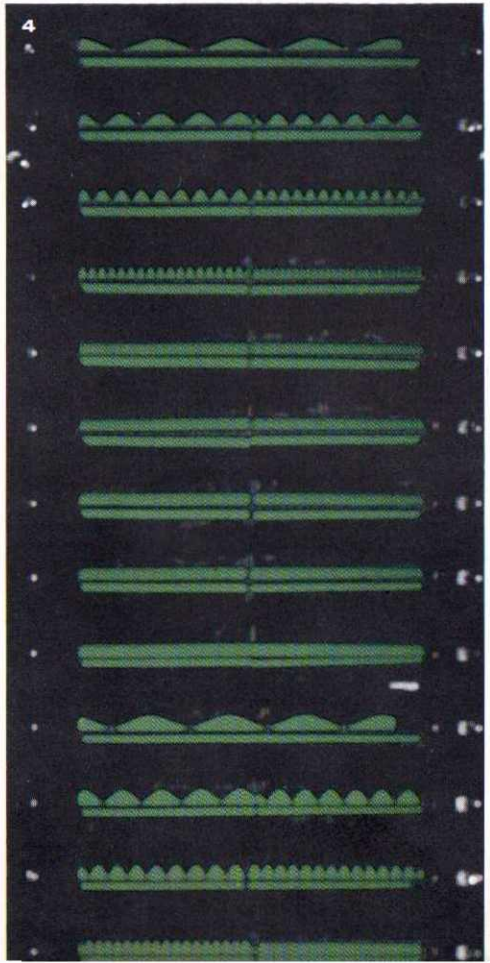
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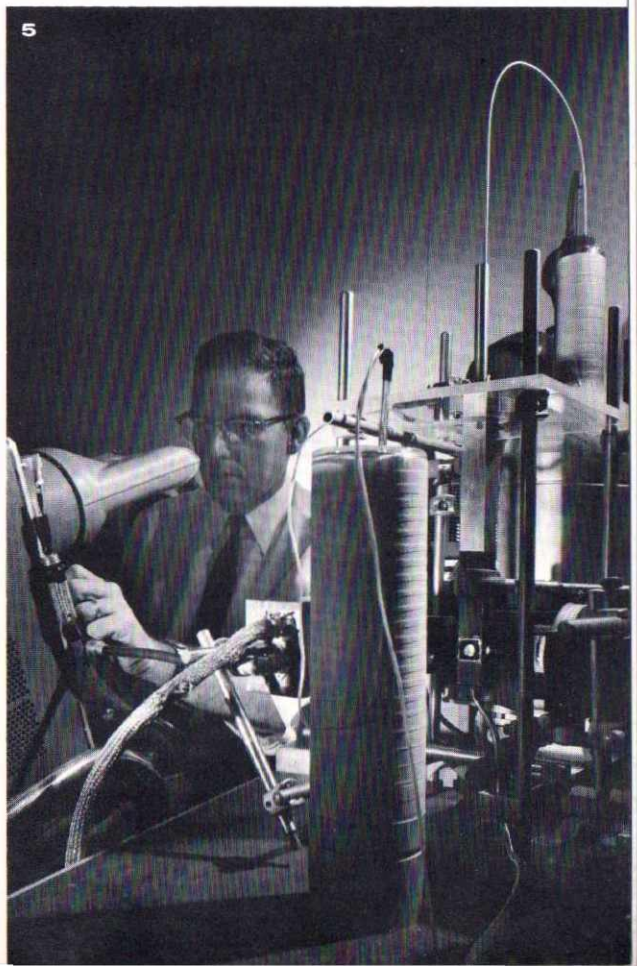
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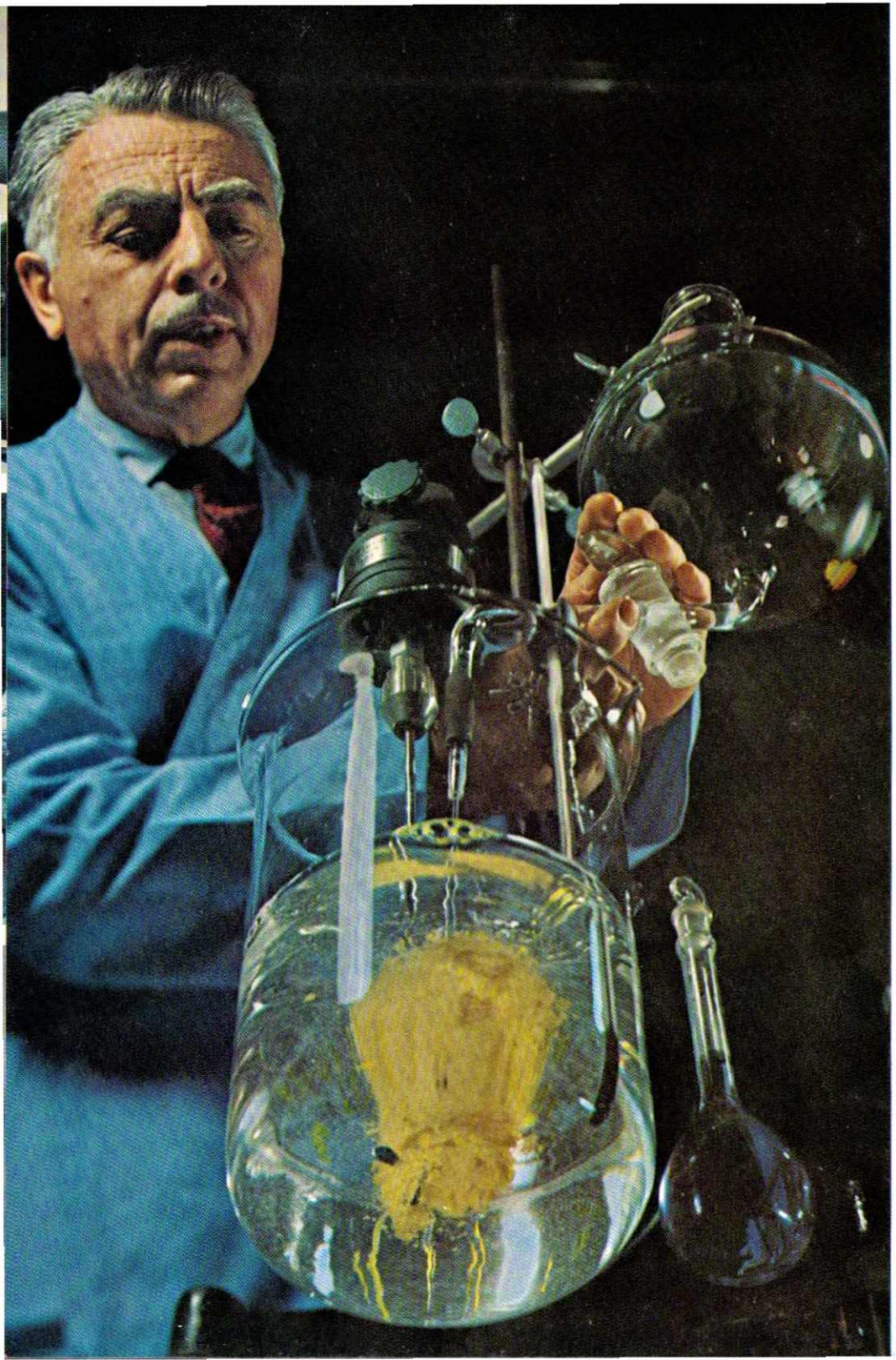


PHOTOGRAPHIC SCIENCE AND TECHNOLOGY

The high level of technical competence of the research, engineering, and manufacturing staffs in the Eastman Kodak Company is reflected in the reputation for quality and reliability of Kodak products. The programs in photographic science and technology in the Research Laboratories contribute to this reputation in many ways.

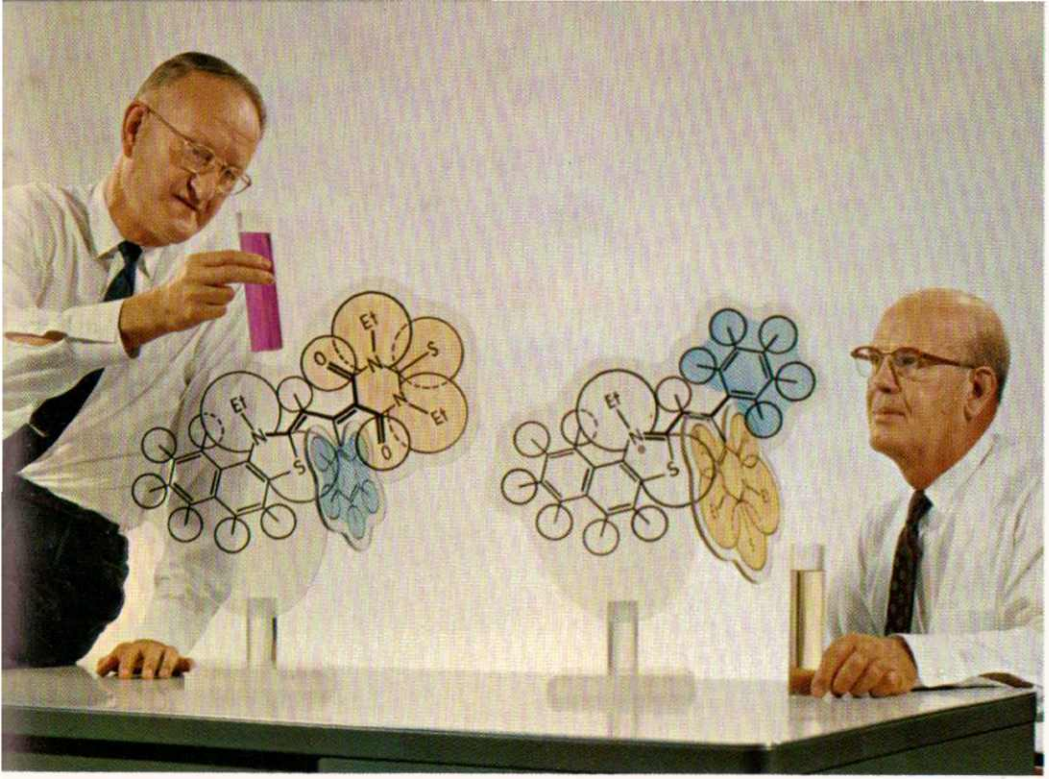
To the chemists and physicists associated with this work, several critical responsibilities have been assigned. One responsibility is to increase the fundamental knowledge of the science of photography. A second responsibility is to apply this knowledge and the knowledge from other scientific fields to the exploration for new products, new techniques, and new applications of photography. A third responsibility is to cooperate with the production divisions in putting the results of research to work and to assist these divisions in solving their technical problems.

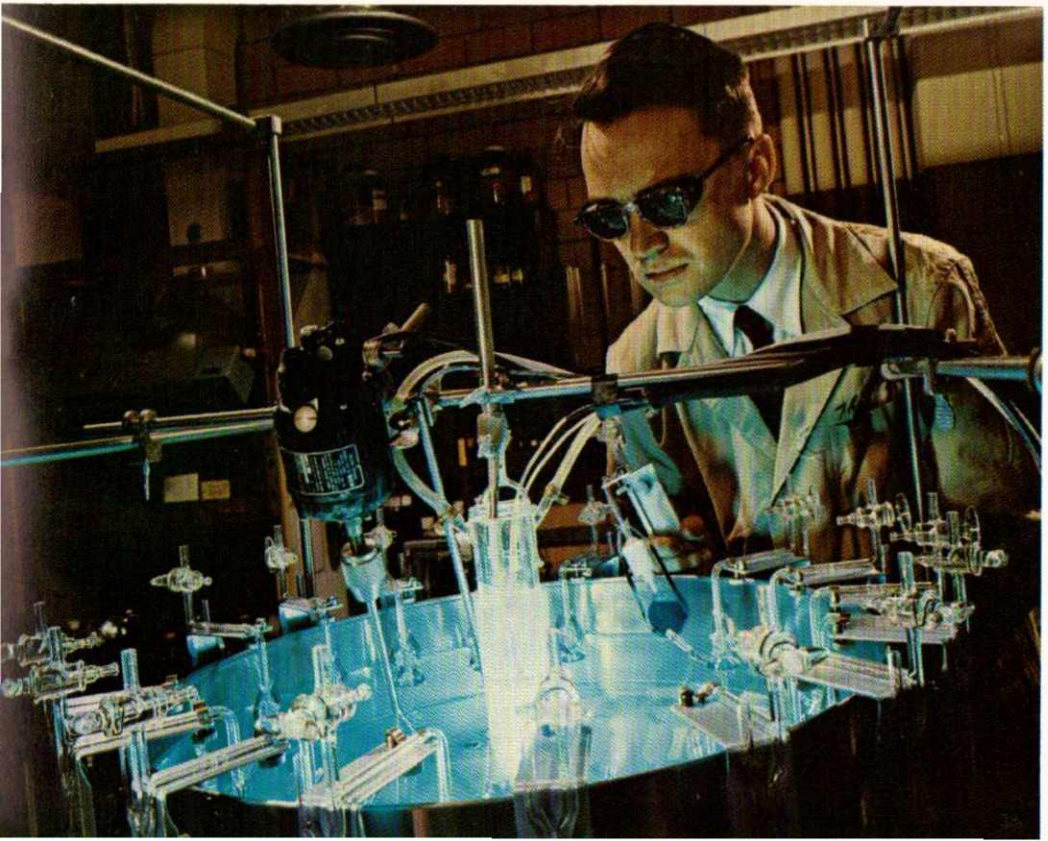
Photographic Theory The study of the theory of photographic processes involves investigation of the nature of light-sensitive materials of all types, the factors that control their sensitivity to light, the changes induced in them by the action of light, and the mechanism of the formation and development of the latent image.

Because of the importance of silver halides in photography, the action of light on silver halide crystals is studied in great detail, both with simplified model systems and with simple photographic emulsions. One model consists of large crystals grown from melts of silver halide salts which are either highly purified or have known amounts of impurities. Techniques have been worked out for measuring the distribution of printout silver and of latent-image centers in exposed crystals. The structure of silver halide crystals is investigated by x-ray diffraction and information is acquired on the imperfections that occur in silver halide crystals. Highly specialized techniques for applying microsecond pulses of light and electrical force to crystals have been developed to study the motion and trapping of electronic charge carriers and the motion and concentration of ionic defects. This work has led to further understanding of the process of latent-image formation.

Extensive studies have been made on the mechanism of development of the exposed crystals, on the effects of various developers on the

(Left) **An Experiment on One of the Factors Influencing the Precipitation of Silver Halide Crystals.**





microscopic structure of the silver image, and on the reactions involved in the formation of image dye when oxidized developer reacts with coupling compounds. Scientists in the Research Laboratories have contributed significantly to the elucidation of the mechanism by which certain dyes alter the sensitivity of silver halide crystals. Theories have been advanced which correlate dye structure with function.

Emulsion Technology The preparation of the light-sensitive layers, known technically as emulsion layers, is a highly complicated operation. A large number of chemists are assigned to the study of the emulsion-making techniques and to the development of new silver halide emulsions for a wide range of applications. These investigations have such objectives as increasing the absolute sensitivity of emulsions to light, improving the keeping properties of these emulsions, decreasing the graininess, and reducing the tendency to fog, i.e., the tendency to produce density in unexposed areas. Extending and carefully controlling the spectral sensitivity of emulsions are equally important.

Effects of sensitizing dyes, dye-forming couplers, and many other types of compounds prepared by the organic chemists are determined by incorporating them into emulsions and measuring the photographic result. The influence of the methods used to prepare silver halide crystals on their sensitivity, grain size, and general photographic properties are also important. Modified natural and synthesized polymers are evaluated as peptizers and as vehicles for the silver halide grains. Both physical properties of polymers and their compatibility with photographic systems are investigated.

The general technology of coating photosensitive layers, subbing layers for adhesion control, antistatic and antihalation layers is intensively studied. In the case of the preparation of multilayer color materials, very precise coating techniques have been developed. Surfactants are screened as aids in the preparation of extremely uniform and extremely thin emulsion layers.

Processing Research Research on the processing of exposed photographic emulsions is closely related to emulsion technology. The chemical components for developing, stabilizing, bleach baths, etc., are worked out in conjunction with the design of new emulsions. The large number of emulsion and processing variables must be manipulated

(Upper) **Dye Models Showing Allopolar Isomerism.** In the investigation of color sensitizers for photographic emulsions, more than ten thousand dyes have been synthesized and new phenomena, such as allopolar isomerism, have been discovered. In solution, the trinuclear dye shown assumes one or other of two configurations, one deeply colored and the other almost colorless, depending on the polarity of the solvent.

(Lower) **A Study of Dye-Fading Reactions.** This modified Warburg apparatus is used for the study of the photo-oxidation of dyes.

with great skill. Many compounds are screened for their potential usefulness as developing agents, fixing agents, etc., for monochrome and for color materials.

In the course of processing research, processing systems are formulated for special applications; new emulsion–developer combinations are evolved; and simplified and convenient rapid developing systems are designed. Methods of supplying processing materials in the most convenient form are also worked out.

The design of processing equipment for laboratory, military, and commercial applications is another important aspect of this work. Prototype equipment is constructed and emulsion-processing chemistry is adjusted to the system requirements. An example is the X-Omat Processor which reduced processing times for x-ray film to approximately one-tenth that previously required.

Color Since the introduction of Kodachrome films in 1935, more than 60 new color products having their origin in the Research Laboratories have been marketed by the Eastman Kodak Company. The research programs that have made possible this progress represent a broad spectrum of the scientific and technical work of the Research Laboratories. The constant improvement in quality of Kodak color products has been fostered to a significant extent by theoretical studies.

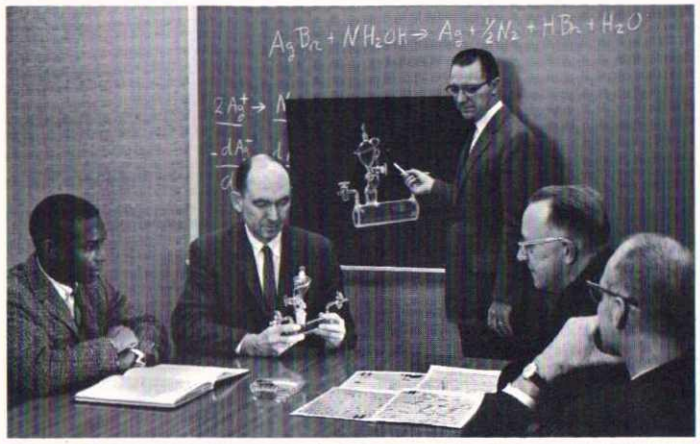
The results of much of the fundamental work in the Research Laboratories are brought together during the development of new color materials and processing solutions. For example, the examination of the color-reproduction characteristics of a new film utilizes such fundamental concepts as the interrelations of the spectral sensitivity of the receptors in the film and the absorption characteristics of the image dyes, and the influence of color temperature and brightness of the viewing illumination on the appearance of image dyes. These and other factors lead to very complex relationships which require the development of computer programs for their analysis. At present, a mathematical model is being developed which will predict the effect that a change in any constituent in the system will have on the color-reproduction characteristics of a film. As a result of this activity, important innovations have been made in methods of building color-

(Upper) **Quality Evaluation of Color Prints.** The appraisal of color photographs is the final step in evaluating the emulsion and processing technology involved in the development of a new color process.

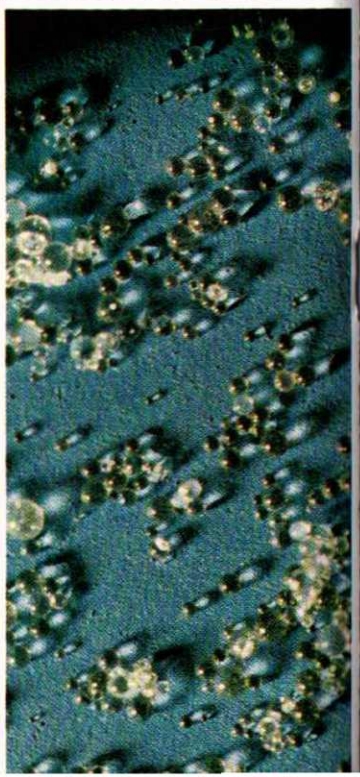
(Center) **A Conference on Equipment Design.** The mechanisms of the reaction of developing agents with silver halides and reactions involving the evolution and absorption of gases are studied in this unusual reaction vessel.

(Lower) **Additive Color Studies with Interference Filters.** Exploratory research is conducted on many phases of color science.

(Right) **Processing of Sensitometric Strips for the Evaluation of Color Films.**



(Below) **Photomacrograph of Poly (Methyl Methacrylate) Beads** (10×).



improve many aspects of printing. The investigation of color fidelity in halftone reproduction has lead to new techniques for color correction and new materials which are expanding the use of color in printing.

Photosensitive resins developed in the Research Laboratories have been applied to such fields as microminiaturization of electronic circuits, production of transistors, and chemical milling of intricate parts. The evaluation of new photosensitive polymers and the development of techniques for their commercial exploitation are important programs.

The use of photography in document reproduction necessitates research on the image-forming characteristics of lenses and emulsions, the development of special photosensitive materials, and the development of electronic, optical, and processing equipment. In the field of microreproduction, the information-handling capacity of imaging systems and of film and paper emulsions is a subject of great interest.

Studies are made to improve the technology of photomicrography and to explore special problems related to phase-contrast microscopy, dark-field illumination, metallography, ultraviolet and infrared photomicrography, and color cine photomicrography.

Special problems related to military photography are investigated, including high-resolution aerial photography, methods of missile-tracking, simplified processing systems for airborne and ground use, aerial color photography, and cathode-ray-tube photography.

A tropical research laboratory at Panama City, R. P., maintained by the Research Laboratories, is concerned with the special environmental problems of heat, humidity, and fungus attack as they relate to photographic materials and equipment.

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In addition to these rather well-defined areas of photographic research, scientists are given freedom to conduct far-ranging exploratory research for new methods of obtaining monochrome or color images and for new applications of photography. This type of research has produced such products as simplified photomechanical printing plates, a colloidal transfer system for copying printed matter, an emulsion-coated elastic base for use in the detection of stomach, breast, and intestinal cancer, and a unique photographic paper which can be processed in less than one second.

In the vigorous conduct of the programs listed, the Research Laboratories generate much new knowledge and technology which are immediately made available to the manufacturing organizations. The technical staffs of Kodak Park Works and the Apparatus and Optical Division in Rochester consult with the Research Laboratories' staff on many problems and thus assure that new knowledge, new ideas, and design and engineering data resulting from work in the Laboratories are quickly reflected in the Company products.

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Color Since the introduction of Kodachrome films in 1935, more than 60 new color products having their origin in the Research Laboratories have been marketed by the Eastman Kodak Company. The research programs that have made possible this progress represent a broad spectrum of the scientific and technical work of the Research Laboratories. The constant improvement in quality of Kodak color products has been fostered to a significant extent by theoretical studies.

The results of much of the fundamental work in the Research Laboratories are brought together during the development of new color materials and processing solutions. For example, the examination of the color-reproduction characteristics of a new film utilizes such fundamental concepts as the interrelations of the spectral sensitivity of the receptors in the film and the absorption characteristics of the image dyes, and the influence of color temperature and brightness of the viewing illumination on the appearance of image dyes. These and other factors lead to very complex relationships which require the development of computer programs for their analysis. At present, a mathematical model is being developed which will predict the effect that a change in any constituent in the system will have on the color-reproduction characteristics of a film. As a result of this activity, important innovations have been made in methods of building color-correcting mechanisms into films.

(Upper) **Quality Evaluation of Color Prints.** The appraisal of color photographs is the final step in evaluating the emulsion and processing technology involved in the development of a new color process.

(Center) **A Conference on Equipment Design.** The mechanisms of the reaction of developing agents with silver halides and reactions involving the evolution and absorption of gases are studied in this unusual reaction vessel.

(Lower) **Additive Color Studies with Interference Filters.** Exploratory research is conducted on many phases of color science.

Studies of the mechanisms of color development and dye coupling reveal a situation which involves several competing reactions. The sensitometric evaluation of experimental emulsions leads color specialists to a consideration of the stoichiometry and the rates of reactions involved in dye formation. Experimental results are also related to the structural features of sensitizers, couplers, solvents, etc., which are used in the emulsion layers to confer desired properties. The color and emulsion specialists work closely with synthetic chemists so that the synthetic work is directed along the most fruitful paths. A large store of knowledge correlating molecular structure with photographic activity and physical properties has been built up which is used to select chemicals for specific purposes and to guide future research.

Applications of Photography Photography has played an important part in the scientific and technical progress of this century and has done much to improve the efficiency of business and industry. The scientific staff of the Eastman Kodak Company has contributed in many ways: by developing new products and equipment for specific scientific and industrial purposes; by giving technical assistance to astronomers, engineers, printers, physicists, and research workers in general; by the invention of new image-forming systems; and by discovery and development of photographic methods for studying and improving industrial operations.

Scientists in the Research Laboratories have made many contributions in the application of photography to the graphic arts. Films and processes have been created that are in use in gravure, lithographic and letterpress printing. New techniques and films are being studied to

1

An Experimental 35mm Film Processor. Chemists, engineers, and technologists combine their knowledge of emulsions, processing chemistry, and machine design to provide basic chemical data and experimental equipment for production engineering.

2

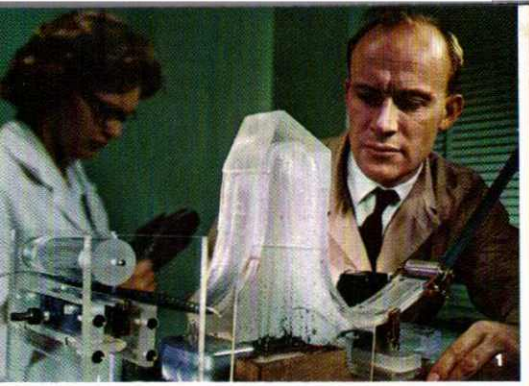
Studio for the Practical Evaluation of Films. Research and development of new photographic materials involve extensive testing in a well-equipped studio under controlled conditions which duplicate those existing in the trade.

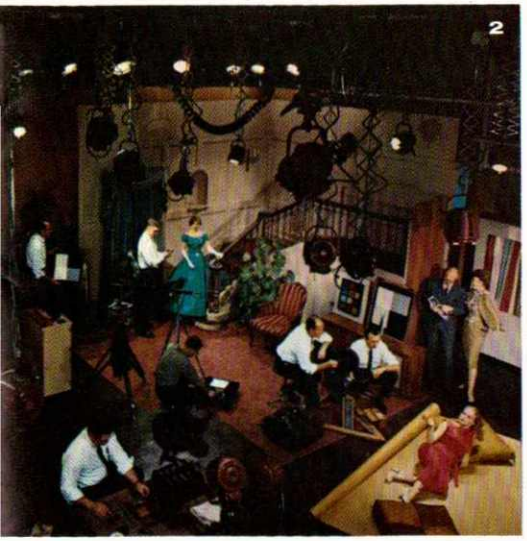
3

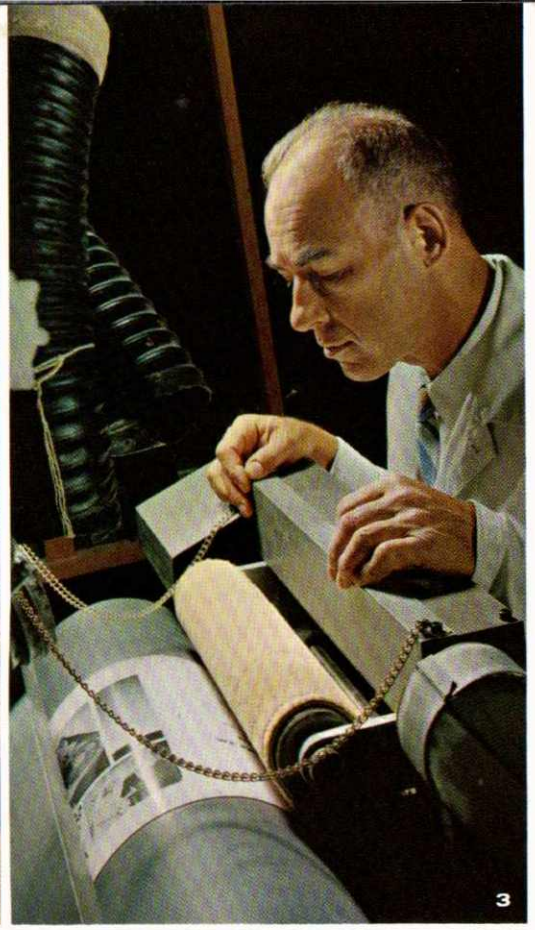
Experimental Machine for Etching Printing Plates. Basic knowledge of photographic emulsions, plastics, and solvents; and highly specialized technology are combined in the development of new graphic arts processes.

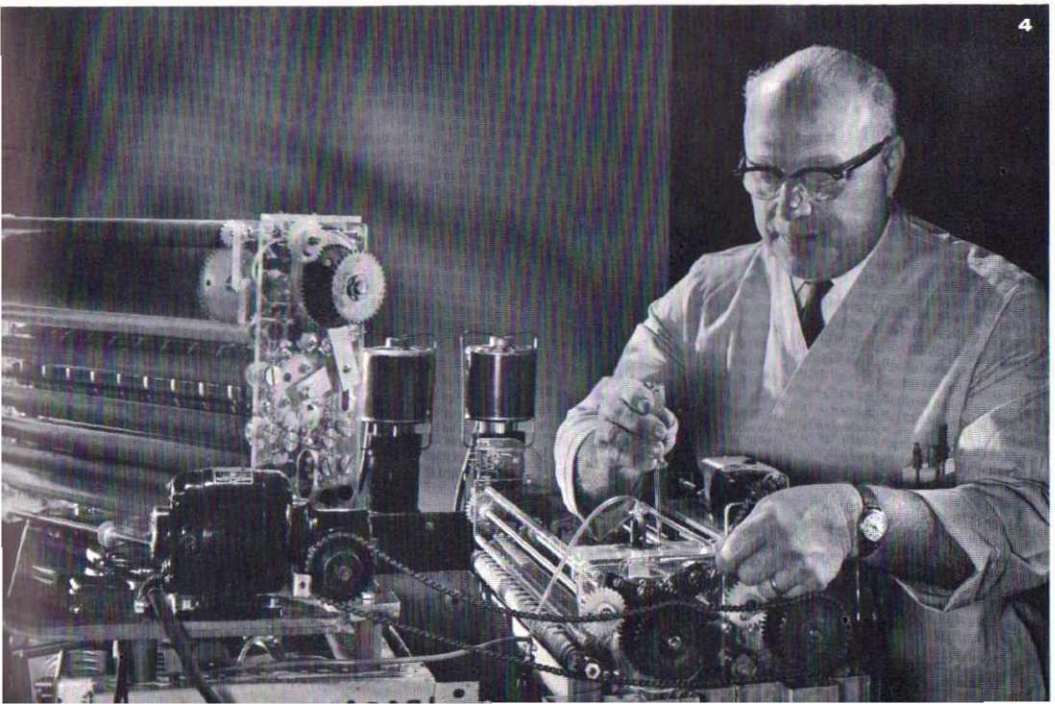
4

Prototype Roller-Transport Processor. Chemical and mechanical engineering skills are utilized in the design and early-stage development of equipment for processing photographic materials.









improve many aspects of printing. The investigation of color fidelity in halftone reproduction has lead to new techniques for color correction and new materials which are expanding the use of color in printing.

Photosensitive resins developed in the Research Laboratories have been applied to such fields as microminiaturization of electronic circuits, production of transistors, and chemical milling of intricate parts. The evaluation of new photosensitive polymers and the development of techniques for their commercial exploitation are important programs.

The use of photography in document reproduction necessitates research on the image-forming characteristics of lenses and emulsions, the development of special photosensitive materials, and the development of electronic, optical, and processing equipment. In the field of microreproduction, the information-handling capacity of imaging systems and of film and paper emulsions is a subject of great interest.

Studies are made to improve the technology of photomicrography and to explore special problems related to phase-contrast microscopy, dark-field illumination, metallography, ultraviolet and infrared photomicrography, and color cine photomicrography.

Special problems related to military photography are investigated, including high-resolution aerial photography, methods of missile-tracking, simplified processing systems for airborne and ground use, aerial color photography, and cathode-ray-tube photography.

A tropical research laboratory at Panama City, R. P., maintained by the Research Laboratories, is concerned with the special environmental problems of heat, humidity, and fungus attack as they relate to photographic materials and equipment.

• • • • •

In addition to these rather well-defined areas of photographic research, scientists are given freedom to conduct far-ranging exploratory research for new methods of obtaining monochrome or color images and for new applications of photography. This type of research has produced such products as simplified photomechanical printing plates, a colloidal transfer system for copying printed matter, an emulsion-coated elastic base for use in the detection of stomach, breast, and intestinal cancer, and a unique photographic paper which can be processed in less than one second.

In the vigorous conduct of the programs listed, the Research Laboratories generate much new knowledge and technology which are immediately made available to the manufacturing organizations. The technical staffs of Kodak Park Works and the Apparatus and Optical Division in Rochester consult with the Research Laboratories' staff on many problems and thus assure that new knowledge, new ideas, and design and engineering data resulting from work in the Laboratories are quickly reflected in the Company products.

SERVICES

To create an atmosphere which sustains productive research, and to aid the scientist in achieving the maximum effectiveness in his work, a number of essential services are provided in the Research Laboratories.

Information Services Two modern libraries provide convenient and prompt access to published information. Some 40,000 volumes provide extensive coverage of scientific literature from all parts of the world. As a result of the close cooperation between the libraries at the Research Laboratories and other libraries throughout the Company, including the libraries at Harrow, England, and Vincennes, France, material from these collections is readily available to scientists in Rochester. The book collection includes works on almost every branch of the physical sciences and technology, with great emphasis on chemistry, physics, and photographic science. An excellent collection of the standard reference works and indexes to these fields is maintained. Subscriptions to about 1,000 journals and periodicals are maintained to insure that information on the most recent work is available to the staff; many of these are bound for convenient reference. Many other materials are available on microfilm. Attractive areas are provided in the libraries for general reading and for more serious study. Easy to use reader-printers and copying facilities are on hand so that the scientist may quickly make copies of significant material.

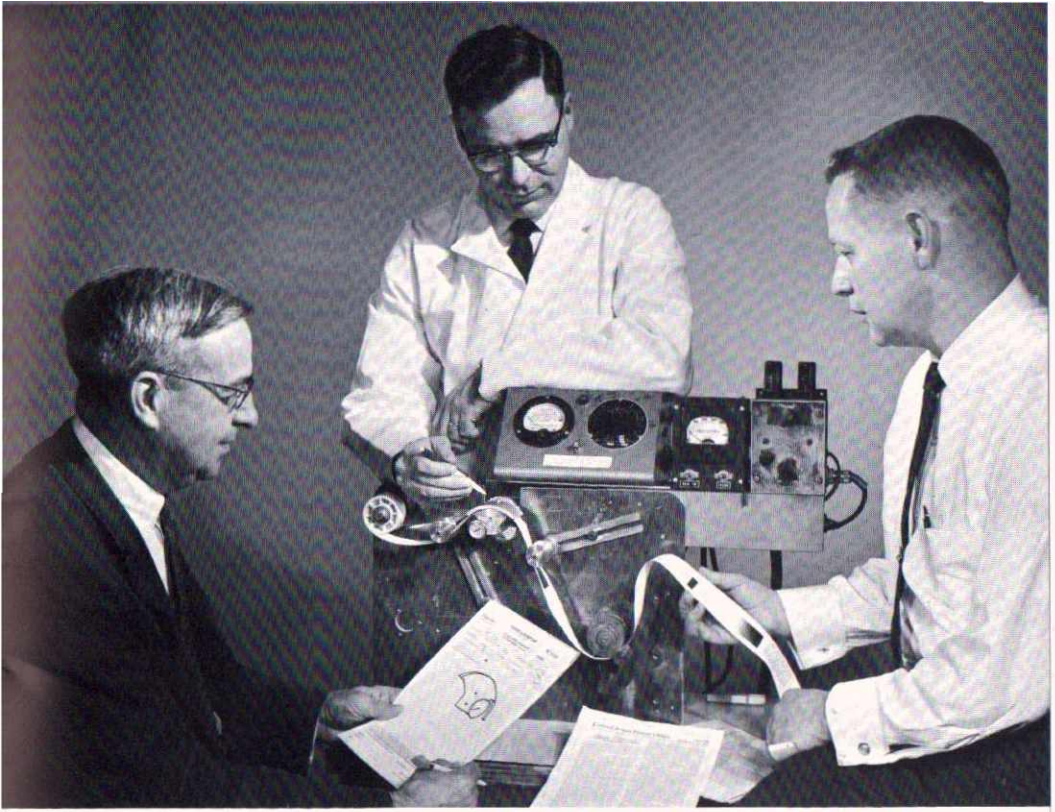
To keep Kodak scientists informed of recent acquisitions, a *Research Library Bulletin* is published every two weeks and sent to members of the staff. Literature specialists are available to aid research workers in all phases of literature searching, to compile bibliographies, and to provide translations of foreign articles. As another information service, the world's photographic literature and the scientific and technical literature related to the research programs are surveyed continually and

(Upper Left) **Reading Area in the Library of the Physics Laboratory.** The periodical collections of the research libraries include all important journals on chemistry, physics, and photography published throughout the world.

(Lower Left) **Reference and Study Area in the Library of the Research Laboratories.** Abstract journals and many standard scientific reference publications are arranged in the study area for convenient use by the staff.

(Upper Right) **A Patent Conference.** Inventions by staff members are written up and filed as Invention Reports. Counsel is provided for the scientist by a member of the Patent Services Department of the Research Laboratories and an attorney from the central Patent Department of the Company.

(Lower Right) **Machine Retrieval of Chemical Information.** In a central file, structural and physical data on organic chemical compounds are indexed on punched cards and magnetic tape. Company technical reports and published literature are abstracted and indexed.



action required, data needed, infringement problems, and the like.

Inventions believed to be patentable are described in formal Invention Reports drafted by the inventor. A detailed subject index of these reports is maintained for easy reference. To aid in keeping abreast of new developments outside the Company, new United States and foreign patents are scanned for items of interest to the Company.

Photographic Services Complete facilities are provided for general photographic services for all departments of the Research Laboratories. The services include the preparation of still photographs and motion pictures of new equipment, new products, and new processes and the preparation of illustrations for reports, lectures, and articles.

Whenever a scientist plans to make a technical presentation either within or outside the Company, audio-visual counseling service is provided and a competent staff of artists and technicians prepare illustrative material that will have maximum effectiveness. The staff is skilled in the preparation of animated cartoons, charts, color slides, black-and-white drawings, and line material. A supply of modern audio-visual equipment is maintained for use by staff members.

Other photographic services include: photomicrography; microfilming; photoduplication; and the printing of research reports, conference notes, bulletins, and literature-review abstracts.

Administration The Director of the Research Laboratories, his assistants, and the Division Heads deal primarily with policies and matters directly related to the scientific and technological work while the many necessary functions of non-scientific administration are delegated to a business manager and his staff.

The Administration Division assists the management of the Laboratories and the scientific and technical staff by providing: a budgeting and cost-accounting section; a wage and salary administration function; a personnel procurement office; a counseling service; a purchasing office; stockrooms for essential items such as chemicals, glassware, hardware, electronics, and office supplies.

Engineering Well-equipped shop facilities are provided in the Laboratories. Here design engineers, technicians, machinists, cabinetmakers, welders, sheetmetal workers, and electricians assist the research scientists with their projects. Shop supervisory personnel provide counsel on research projects requiring the design and building of experimental equipment. If the scientist wishes to build a model himself, there is a "do-it-yourself" area where he or his laboratory assistant can work. Machinists are on hand to advise or assist him. The staff of the electronics section assist the scientists in the design and construction of sophisticated equipment such as data-recording devices, and modify or adapt standard pieces of equipment to perform special functions. The engineering and shop services are designed to be able to furnish promptly the specialized equipment needed by the scientists and technicians for their research problems.

useful information is abstracted and published biweekly for wide distribution within the Company. An abstract bulletin of Company scientific reports is also published each month.

A machine-based report index and an index to all organic and polymeric compounds synthesized or used within the Kodak organization put the extensive fund of Company research and development experience at the immediate disposal of scientists in the Research Laboratories. Reports and information on chemical compounds are fed into this index from all parts of the Company and the index facilities are made available to all Company scientists and engineers. In conjunction with the chemical index, a list of new organic and polymeric compounds is distributed weekly. The information abstracted from the literature is also indexed.

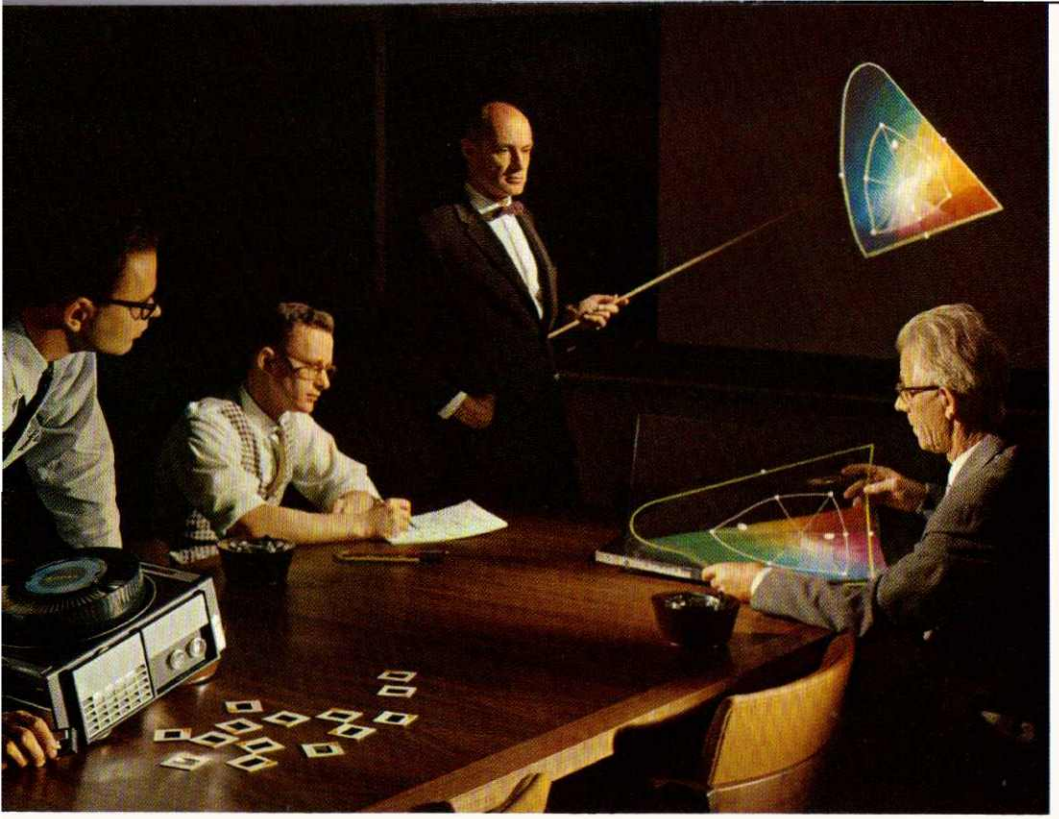
Editorial services include: assisting the scientific staff in the preparation of manuscripts for external publication and placing them in the appropriate journals; guiding the preparation of text and audio-visual aids for lectures; publishing special reports; and compiling, reviewing, and circulating technical data for approval which will eventually be used in data books, package inserts or other Kodak publications.

Patent Services All Kodak chemists, physicists, engineers and technicians have a responsibility to submit promptly information on worthwhile developments to the Kodak Patent Department for a determination of the action necessary to protect the Company's interests. In the Research Laboratories, a Patent Services Department provides liaison between the Laboratories' staff and the Company's Patent Department, to assure appropriate patent action and consideration of possible infringement on developments of commercial interest. In addition, certain summary sources of information such as conference minutes and Research Laboratories' Reports are examined to uncover material that might require patent action or that should be brought to the attention of the patent attorneys in connection with invention reports already on file.

While the invention report is being processed by the attorneys, it is reviewed several times in the Research Laboratories so that changes in its commercial significance, new data, and related work can be brought to the attorneys' attention promptly. In the subsequent prosecution of the application, it may also be necessary to arrange for further experimentation to support affidavits, or to help in marshalling arguments to reply to the objections raised by the Patent Examiner. Meetings are organized as needed between inventors from the Laboratories and the Kodak attorneys to discuss the details of new developments, the patent

(Upper Right) **Planning the Visual Aids for a Technical Presentation.** Editorial assistance and artwork are provided to insure effective presentation of scientific papers at conferences, seminars, and meetings of professional societies.

(Lower Right) **A Section of the Engineering Shops.** Shop supervisory personnel offer their counsel to staff members on equipment design for research projects.



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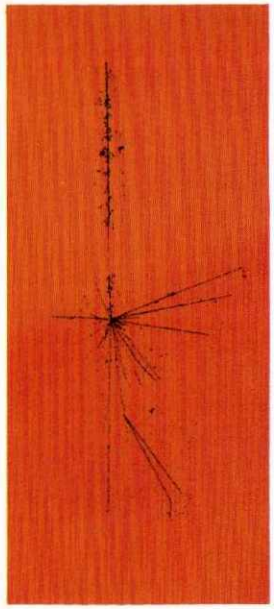
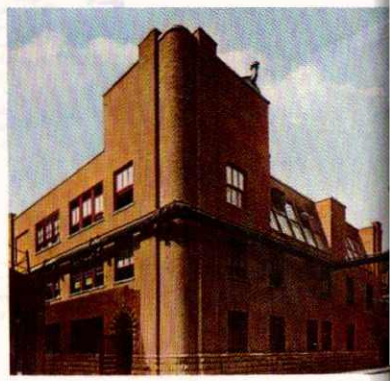


(Upper) The Orion Nebula, a huge cloud of glowing gases, photographed on Kodak High Speed Ektachrome Film. Official U. S. Navy Photograph.

(Lower) Photographic tracks (magnified about 150×) of a nuclear explosion initiated by a high-energy cosmic ray particle, recorded at 93,000 feet. Courtesy B. Peters and H. Bradt.

The services of photography to mankind range from studies of the infinite distances of space to investigations of the infinitesimal distances of atomic structure. The need for better scientific tools has been a stimulus to photographic research and to the development of high-performance materials for important scientific applications.

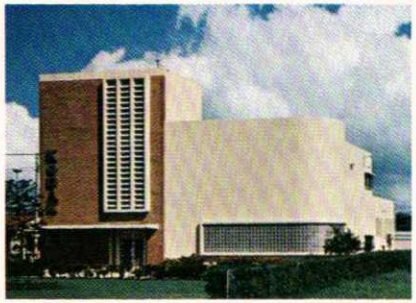


Original Research Laboratory — 1912, Rochester, N. Y.

KODAK RESEARCH AROUND THE WORLD

Distillation Products Industries Laboratory,
Rochester, N. Y.

Tropical Research Laboratory,
Panama, R. P.



Kodak Limited Laboratory,
Harrow, England

Physics Laboratory,
Kodak Research Laboratories,
Rochester, N. Y.

Kodak Research Laboratories,
Rochester, N. Y.

Kodak Pathé Laboratory,
Vincennes, France

Tennessee Eastman Laboratory,
Kingsport, Tenn.

Texas Eastman Laboratory,
Longview, Texas

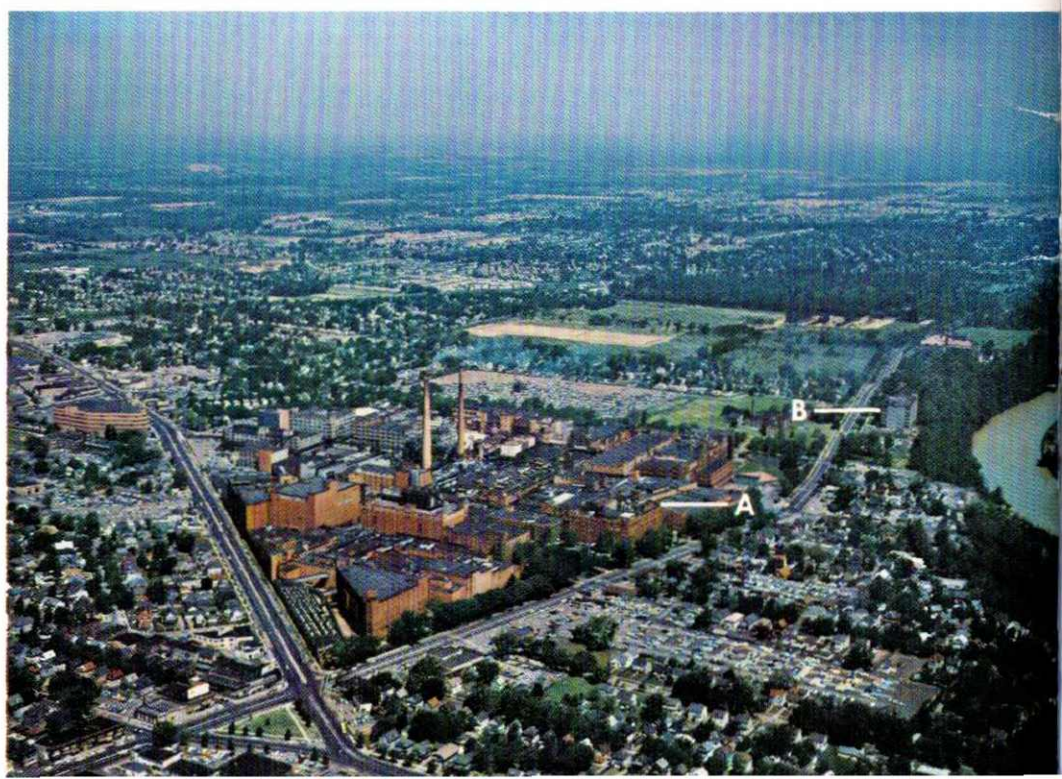
Kodak Australasia Laboratory,
Abbotsford, Australia

RESEARCH LABORATORIES

EASTMAN KODAK COMPANY

ROCHESTER 4, NEW YORK

(Upper) Aerial view of Rochester, N. Y. showing location of main plants of Eastman Kodak Company. A — Main Offices; B — Camera Works of the Apparatus and Optical Division; C — Hawk-Eye Works of the Apparatus and Optical Division; D — Kodak Park Plant.



(Lower) Aerial view of East Side of Kodak Park Plant, Eastman Kodak Company, Rochester, N.Y. A — Kodak Research Laboratories; B — Physics Laboratory.

"Scientific research is the yeast of business. It leavens the mass, transforming it into a system which results in the continuous production of new and valuable inventions. At the same time, like yeast, science grows as it is nourished by the industry which it is transforming. Thus the association of science and industry strengthens both, and this is reflected in material prosperity and intellectual progress."

Dr. C. E. Kenneth Mees,
Director of the Research Laboratories,1912-1947.