The HOME OF KODAK

ENTRANCE TO KODAK PARK

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THE HOME OF *KODAK*

Chronological Record of Growth

GEORGE EASTMAN

SEPTEMBER, 1880

THE EASTMAN DRY PLATE CO.

STRONG & EASTMAN, *Proprietors*

JUNE 1, 1881

THE EASTMAN DRY PLATE AND FILM CO.

OCTOBER 1, 1884

THE EASTMAN COMPANY

DECEMBER 24, 1889

EASTMAN KODAK COMPANY

MAY 23, 1892

EASTMAN KODAK COMPANY OF N. J., INC.

OCTOBER 24, 1901

THE HOME OF KODAK

Facts about
the world's largest photographic
organization

Published by the
EASTMAN KODAK COMPANY
ROCHESTER, N. Y.

Aerial view of Camera Works and Main Office buildings

An Industry From An Idea

IT IS only a little less than fifty years ago that amateur photography was not the universal and simple pastime it is today. In fact there were no amateur photographers at all except for a few devotees whose enthusiasm outweighed the difficulties involved in the then crude art. One of these was George Eastman, a young bank clerk in Rochester, who in 1878 became interested in photography as an amateur.

"WET" PLATES

Those were the days of the collodion or "wet plate" process, when the outdoor equipment consisted of a mule pack of paraphernalia, including a bulky view camera, heavy tripod, glass plates, dark tent, nitrate bath and water carrier.

Having selected a view and set up the camera, the early amateur had to crawl under his dark tent to sensitize and load his plates, thrust them dripping into the camera, make his exposures and then creep back again to unload and develop them.

This was the pastime of photography as Mr. Eastman knew it when he began to experiment with photographic processes that were destined later to revolutionize its practice.

Before the Kodak and film photography were born. Equipment necessary for the amateur during the "wet plate" days

"DRY" PLATES

Mr. Eastman first became interested in "dry" plates which had recently been introduced. Under the firm name of George Eastman he succeeded in 1880 in making these of high quality which sold readily. They were coated with an emulsion of bromide of silver and gelatin.

This was the first step in the program of simplification which he had in mind. It also marks the beginning of what has since developed into the great Kodak industry. The first factory was a small room over a downtown store, and to provide additional capital the late Henry A. Strong was brought in as a partner in January, 1881, at which time the entire upper floor of another building was secured and fitted up as a factory. There, under the name of The Eastman Dry Plate Company (Strong and Eastman, Props.), the business launched forth. Prospects soon warranted increased manufacturing facilities, and in 1882 a factory was built on the site of the present sixteen story office building on State Street.

Dry plates scrapped the dark tent, nitrate bath and the other burdens of the traveling outfit. But plates, whether wet or dry, were heavy and breakable and it was the professional who consumed the bulk of the output.

The young inventor realized that the amateur needed something to hold the photographic emulsion which was light, flexible, unbreakable and convenient. Just what form such a base would ultimately take he did not know in the early 80's.

ROLL FILM HOLDER

His first attempt along this line was a roll film of coated paper to which the sensitized emulsion was applied. A device called a roll holder developed by himself and his associate, the late William H. Walker, adapted this roll film idea to the ordinary view cameras then in use.

A Kodak snapshot of the Eastman Dry Plate and Film Company's plant in 1889

This solved the mechanical end of the problem, but a paper film naturally had its drawbacks. In a search for a more satisfactory base, the Eastman "stripping" film was devised. This was so made that the negative could be "stripped" from its paper backing and transferred to a transparent support. A perfectly transparent negative was realized in this way, but the process was too difficult to commend it to amateurs.

All these experiments did nothing but confirm the need of some sort of transparent flexible film base to which the image

could remain affixed before developing, and through which prints could properly be made.

The company had in the meanwhile been reorganized as The Eastman Dry Plate and Film Company (1884-1889).

THE FIRST KODAK

It was in 1888 that George Eastman evolved his great invention, the Kodak. The name was also coined by him as a trade mark, which is now recognized throughout the civilized world. This first Kodak was a simple box camera combining the roll film idea and plate camera in a new, compact, simple, portable and easily manipulated form. It included an instantaneous shutter which could be wound up for a number of exposures by simply pulling a string. The roller mechanism comprised exposure indicating, film perforating and film tensioning devices, and was carried in a readily removable part of the case for convenience in loading and unloading. It took round pictures 2½" in diameter, and was loaded for 100 exposures. When the roll was exposed, the Kodak and roll holder were returned to the factory for unloading, reloading and developing.

The first Kodak and roll holder—1888

The way the first Kodaks were advertised in 1890

Another snapshot taken with one of the first Kodaks

This first Kodak was not the handy pocket folding edition of today, but compared to the burden of equipment which previously confronted the amateur, it was a miracle of achievement. Picture taking had been reduced to the simplicity of the well-known advertising slogan, "You press the button, we do the rest."

The "rest" was still too considerable to Mr. Eastman's mind to declare the emancipation of amateur photography as complete. The crux of the remaining problem as already noted was the film.

DISCOVERY OF FILM

The discovery of the nitro-cellulose film base came about entirely by accident. After the invention of the "stripping" film, Mr. Eastman continued his experiments trying to find a proper film support. Using soluble cotton dissolved in grain alcohol and ether, he produced collodion, but even with several coatings of this a thick enough film support was not forthcoming.

Next he tried replacing the sheet of gelatin used for backing the "stripping" film with a varnish to overcome the objection of slow drying.

One day wood alcohol and soluble cotton were tried as a varnish. This was very thick, like strained honey, and Mr. Eastman knew at once that the long awaited base had at last been found. Thus, the present nitro-cellulose film base came into being in August, 1889, and amateur photography as we all know it today was born, and incidentally motion pictures were made possible. In that same year The Eastman Company succeeded The Eastman Dry Plate and Film Company.

From then on, through successive and logical steps of

The Eastman Company's factory in 1891

The first factory buildings at Kodak Park in 1890

simplifying photography, the amateur has come into his own. The Kodak which was invented the year before was quickly adapted to the new roll film.

SUBSEQUENT IMPROVEMENTS

Daylight loading was patented in 1891 and put on the market the following spring. The name of the company was changed to Eastman Kodak Company

The Kodak Main Office Building in 1910

The first folding Kodak—1890

shortly afterwards. Daylight developing, introduced in 1902, completed the present Kodak system of photography. By also coating the non-emulsion side with gelatin the film in 1903 was made easier to handle because of its non-curling properties. The Autographic feature, added in 1914, provided a convenient method of titling, dating or affixing on any negative at the time of exposure such information as may be desired. In 1923 the first amateur motion picture camera, the Ciné-Kodak, was put on the market, and it is daily winning new adherents to enthusiasm for home movies.

KODACOLOR AND OTHER NEW DEVELOPMENTS

Mr. Eastman had foreseen the market his roll film would create, but never dreamed of the demand for film which would be born out of Edison's invention of the moving picture. This great discovery made pygmies of the most pretentious plans. To keep pace with this prodigious and then unknown demand was a huge problem. A glance at the Rochester industry will show how accurately the measure of these manufacturing necessities was undertaken and how one of the most complete and efficient factory organizations in the world has been built up.

Early Kodak with first daylight loading attachment—1891

Thus the stage was set for the greatest photographic invention since Edison, using Eastman's film, invented motion pictures. In July, 1928, a distinguished company of scientific and public men assembled in George Eastman's home in Rochester to see the first public demonstration of Kodacolor—amateur motion pictures in full natural colors. With this invention any photographer can slip a "color filter" into his Ciné-Kodak, thread it with a special film, and obtain color movies with no more difficulty than he takes ordinary Ciné-Kodak motion pictures or Kodak pictures.

Within the year 1928, already a significant period by virtue of the perfection of Kodacolor, several other notable photographic developments attracted attention to the Eastman Kodak Company. One was the establishment of Eastman Teaching Films, Incorporated, to produce an extensive program of classroom motion pictures in fields of education ranging from primary schools through technical and medical schools. Another was the introduction of the Recordak, a machine which photographs on narrow-width film the checks passing through a bank, thus providing a record which banks have heretofore not easily been able to keep. Another was the introduction of Kodaks and other cameras finished in color, consonant with the modern style trend.

Aerial view of a portion of Kodak Park

Kodak Park

KODAK PARK, the largest of the plants of the Eastman Kodak Company, has grown from its meager tract of sixteen acres of farm land in 1890 to a plant occupying more than four hundred acres. With its paved streets and lawns, sewers, water system, railroad tracks, power plants and fire department, it is a community unto itself devoted to the manufacture of photographic film (motion picture, Ciné-Kodak, Kodak, x-ray and portrait), photographic papers (upward of one hundred and fifty grades and varieties), photographic dry plates, photographic chemicals, Kodalak (a pyroxylin lacquer) and Kodaloid, a transparent nitrocellulose sheeting.

Within Kodak Park, factories are also maintained for the manufacture of raw paper, boxes, film cartons and labels, shipping tins for motion picture film, artificial leather, gelatin and acids (nitric and sulphuric) and for the manufacture of many minor items.

More than one hundred and twenty buildings of steel, concrete and other construction, with a floor space of more than eighty-eight acres, have already been erected. Buildings under construction will add several more acres of floor space.

Wide, well trimmed lawns and ivy covered buildings surround the main entrance, giving a feeling of repose in marked contrast to the activities within the plant itself.

Sixty or more freight cars can be accommodated in the company's own private switch yard, and seven and one-quarter miles of track winds its way through the park connecting the main buildings.

Between six and seven thousand persons are employed at Kodak Park. Because of the great diversity of the products manufactured, more than 60 per cent of the gainful occupations listed by the United States Census Bureau are represented, besides many other lines of work peculiar to the industry.

Huge presses stamp out the tin containers for motion picture film

One of the main photographic products manufactured at Kodak Park is motion picture film. An idea of the output may be gathered from the fact that more than 85,000,000 feet are being made each month, or roughly 200,000 miles a year. More than 5,000,000 pounds of cotton are consumed annually in the manufacture of this and other films. Next to the government mints, this company is the country's largest consumer of pure silver bullion, using annually the equivalent of one-tenth of the silver mined in the United States for sensitizing Eastman photographic products.

Every one of the factory buildings at Kodak Park has been planned with an eye to the safety of the worker and his health. No overhead shafting with its ever whirling pulleys and slipping, creaking belts is seen in any of the plants. Instead each machine is run by an individual electric motor of which there are about 4,200. The total capacity of the power plant for these motors and 42,000 lights in the various buildings exceeds 13,500 horsepower. Another 5,500 horsepower is furnished by the local power company.

Steam for generating electricity and refrigeration and for heat is supplied by two power houses, developing a total of 17,000 horsepower. The boilers in these power houses consume about 500 tons of coal a day, but the back-breaking job of firing such mammoth grates is done by mechanical stokers. The most impressive thing connected with the power houses is the height of

CARTON MAKING

*Printing—Die Cutting—*Oval, *Trimming the Cut—Gluing and Folding—the Finished Film Container*

Interior of one of the power houses

the three great chimneys which carry far from the confines of the park any offending fumes or flying particles of ashes which might in any way affect the quality of the products manufactured. These towering stacks, visible for many miles, quickly enable visitors to locate the plant's site. Two of them are three hundred and sixty-six feet high, and the third is three hundred and fifty feet high and has a diameter of thirty-two feet at the base and twenty feet at the top.

Almost all industries are brought to a common basis by the fact that they cannot carry on without water. To produce its products the Eastman Kodak Company consumes tons and tons of hundreds of different materials from lumber and nails to the most precious metals, but water, a primary element of nature, is as essential to the maintenance of the industry as is bar silver. Without it in unlimited quantity and in unceasing supply, Kodak Park's buildings and marvelous equipment would be just so much concrete, steel and lumber.

Thirty-six years ago, when the first building at Kodak Park was constructed, a six-inch well was sufficient to fulfill the new plant's demand for water. Today the manufacturing needs require an individual water system. A modern filtration and pumping station on the shore of Lake Ontario, four miles away, with an intake far out from shore, is capable of furnishing 16,000,000 gallons of water a day through a 24-inch main to a five million gallon reservoir located under one of the buildings in Kodak Park. There is another pumping station with a capacity of 15,000,000 gallons a day which maintains a pressure of one hundred pounds in the several miles of mains and at 115 hydrants throughout the plant. The total capacity of this individual

system is sufficient to supply a community of more than 200,000 population.

All buildings are protected by overhead sprinklers, but as an additional safeguard against fire damage, a regular department is maintained, consisting of one hundred and fifty trained men, under the direction of a chief and two deputy chiefs. Part of this force is available at all hours. Besides the regular fire fighting equipment, similar to that connected with any up-to-date municipal department, pulmotors, smoke helmets and diving suits, are available for use in emergencies. A total of nearly 3 miles of extra fire hose is placed over hydrants outside various buildings. Additional precautionary measures, to protect Kodak Park at all times against a possible fire menace, include a steel tank with a capacity of 150,000 gallons, built 150 feet above the reservoir, and two auxiliary fire pumps, each with a capacity of 1,000 gallons per minute.

Every room in which film is sensitized and handled must be kept at uniform temperature and humidity the year round to insure uniform quality. To provide a constant supply of conditioned air, two refrigeration plants are maintained. They have a total capacity equal to the melting of approximately 6,000 tons of ice every 24 hours.

The nature of the sensitized products manufactured at Kodak Park, their extreme sensitiveness to impurities, dust, dirt and even atmospheric changes, require that they shall be manufactured and handled under exacting conditions imposed on few other products. The tiniest particle of dust on the film, for example, may, under the magnification of the projecting lens, become, on the face of the heroine, freckles as large as one's hand. Fortunes may have been spent in the production, and half the globe traversed in pursuit of the picture before the fatal blemish is discovered. Equally fatal, though perhaps not so costly, may be the dust destroying particles on the amateur's film. A Kodak is the recorder of the moment and some moments never come again.

Kodak Park's twin chimneys stretch 366 feet into the sky

An adequate water supply and trained firemen provide protection against any possible fire menace

From rag pulp

—to finished paper

In serious realms of photography as, for instance, the medical and scientific branches, where the diagnosis, the structure of the supporting steel column, or even the theory of the universe may depend on the telltale plate or film, the presence of the tiny intruder may be fraught with costly consequences.

Stern laws of necessity consequently conspire with Eastman philosophy for the comfort and physical well being of the worker. Surroundings that are free from dust and dirt are essential. Kodak Park's site provides the maximum of safety from these. Its green acres are an effective barrier—a broad no-man's land against the enemy of dust along the highways. Its own paved streets—five miles of them—are not merely sprinkled but flushed at high pressure many times a day.

Many freight cars move daily through the Park, but their hauling is done by steam locomotives that are fireless and therefore emit neither smoke nor soot.

Scrupulous care in the collection of refuse, and a modern incinerator plant for its disposal, keep the Park precincts pure and undefiled.

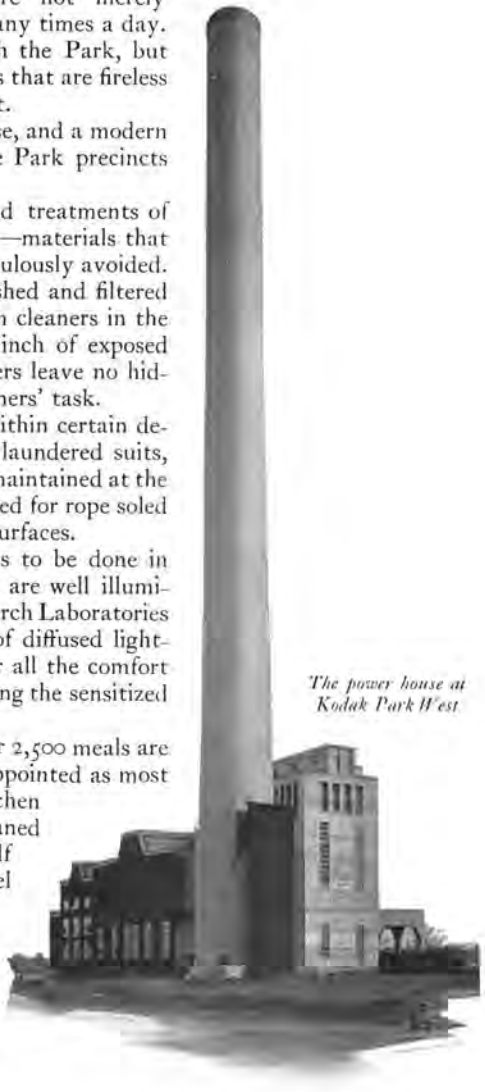
In the construction of all buildings and treatments of interior surfaces—wall, ceilings and floors—materials that will disintegrate and cause dust are scrupulously avoided. The air fed to various departments is washed and filtered to trap the elusive dust particles. Vacuum cleaners in the hands of cleaning squads go over every inch of exposed surface many times daily. "Round" corners leave no hiding place for dirt and make easy the cleaners' task.

Even street clothes may not be worn within certain departments, but are changed outside for laundered suits, which go at least weekly into the laundry maintained at the plant for the purpose. Boots are exchanged for rope soled shoes that will not grind dust from floor surfaces.

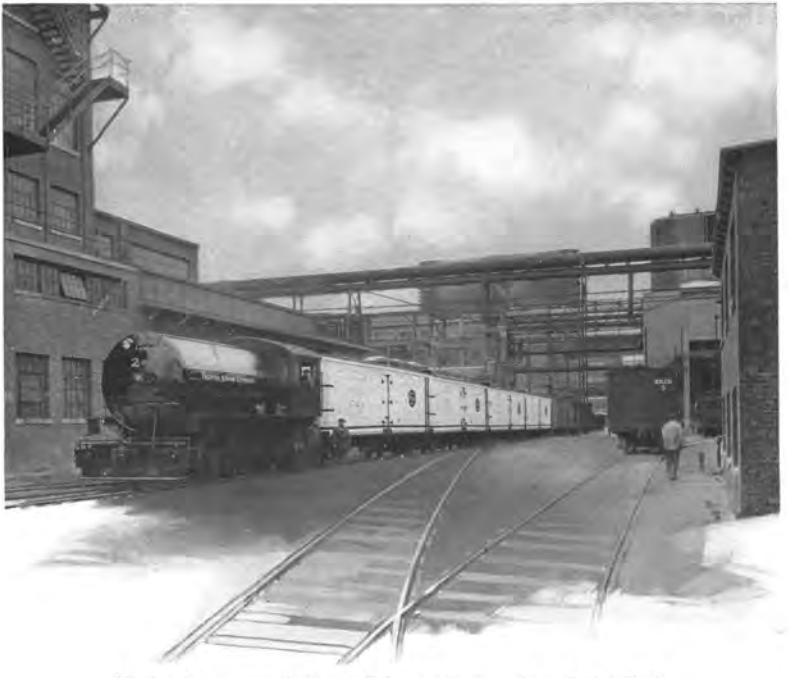
Much of the work at Kodak Park has to be done in so-called "dark" rooms, but even these are well illuminated. Experts at the Kodak Park Research Laboratories have successfully worked out a system of diffused lighting, in safe colors, which gives the worker all the comfort of a soft overhead light without endangering the sensitized products being handled.

The immaculate dining halls, where over 2,500 meals are served daily, are as attractive and well appointed as most city restaurants. The kitchen and kitchen utensils, wherein the food is cooked, are cleaned to laboratory standards, and the food itself is as good and well served as any hotel chef can show.

In connection with these dining halls there are reading and rest rooms where the noon hour may be pleasantly spent. The men's reading room is furnished with magazines and suitable fiction,



The power house at Kodak Park West



Fireless locomotives eliminate all damage from smoke at Kodak Park

and carries the privilege of smoking. On the top floor above the dining halls is a huge assembly hall the full size of the building. It is used for basketball, indoor baseball and dancing and here also employees hold their regular social gatherings.

Paper is stored in a uniform temperature

An athletic field provides tennis courts, baseball diamond, football grounds and a cinder track. These activities are under the direction of the Kodak Park Athletic Association, the strongest and most active athletic organization in the city.

Every precaution is taken by the Medical Department to safeguard the health and supervise the working conditions of Kodak Park employees. Fully equipped hospital facilities are available with three physicians

Spacious lawns surrounding Kodak Park

and a number of trained nurses in charge. A corps of "first aid" volunteers is also chosen from the employees, who are trained in all first aid work.

Kodak Park is thus an application of the broad lines of the new economy; that a whole man is more efficient than a part; that health, happiness and comfort are as indispensable to the worker as tools; that without his personal interest and loyalty, only the husk of service is rendered.

Great quantities of pure silver bullion are consumed annually to sensitize Eastman photographic products, and part of the building above is devoted to this purpose. Total consumption of silver bullion is only exceeded by the government mints

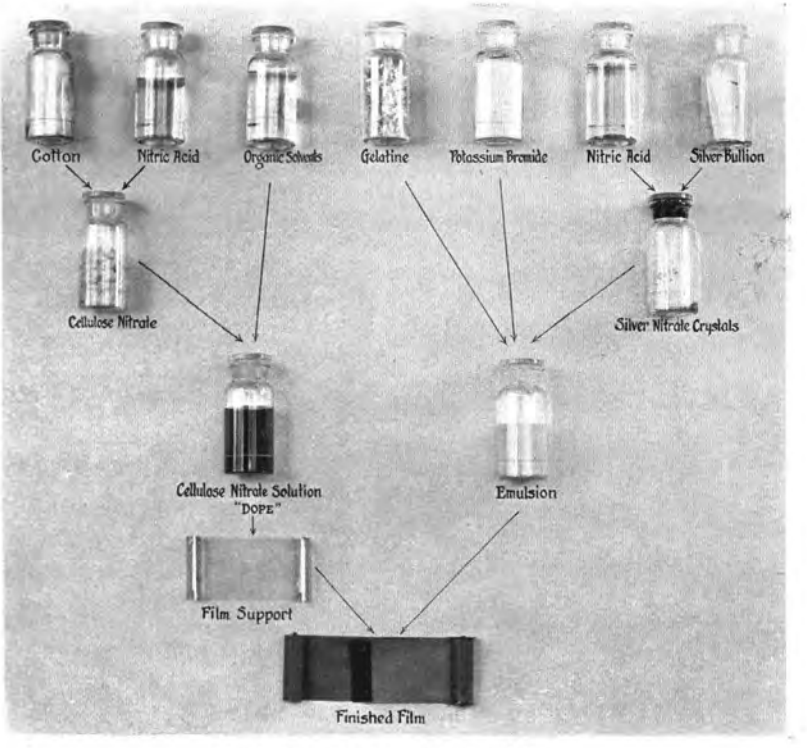
Film-Making

FILM-MAKING is the chief activity at Kodak Park—film to record the thrilling episodes of the screen classics or film for your Brownie, Kodak or Ciné-Kodak. Kodak roll film is universally known, but motion picture film is something which the average person never sees at all, although millions daily see the wonders that it works.

Motion-picture film consists of a thin transparent ribbon upon one surface of which a photographic emulsion has been spread. The usual width is $1\frac{3}{8}''$, of which $\frac{3}{16}''$ is left on each side for a margin. The actual photographic exposure in the camera is recorded on the film $1''$ wide and $\frac{3}{4}''$ high. Film usually comes in rolls of approximately 1,000 feet, and it is in rolls of this size, technically called "reels," that the product is supplied to users. On the margin, perforations enable the film to be fed through the camera and the theater projector at the proper rate of speed, and in the latter instance also to keep the picture steady on the screen.

Mr. Eastman's experiment with cellulose nitrate as a film base succeeded just at the time Thomas A. Edison was in the midst of his motion-picture experiments. Only one thing stood in the way of the latter's success. This, the coincidence of the Eastman discovery solved. The film base was the "missing link" for which Mr. Edison had been looking, and which made

Washing and drying cotton preparatory to nitrating



Chemical stages in the manufacture of film

Where the film "dope" is stored before it is sent to the coating machines

Battery of coating machines which spread the film "dope" on the rims of huge polished wheels to form the transparent film base

motion pictures possible. While the Eastman discovery assured the success of motion pictures, movies in turn opened up at once a new and rapidly growing field for film.

The base of all film, whether used for still or motion pictures, is a cellulose product. Cotton supplies this necessary ingredient. As cleanliness and purity are of prime importance in all film-making, weeks are first spent in washing and drying the cotton which goes into the making of the transparent base. All vegetable gum and other impurities are removed with caustic soda in large rotary vats. For eliminating the moisture the cleansed cotton is then passed through huge dryers.

The next step in film-making is a treatment with a mixture of nitric and sulphuric acids to render the cotton soluble later in alcohol. This reduces it to what is technically known as "cellulose-nitrate." This process, while

A fortune in silver. Many tons are used annually for sensitizing Eastman products. Each bar weighs about 42 pounds

not altering the physical appearance of the original cotton, does, however, change it chemically so that it will be soluble in the various mixtures which would have no effect upon the unnitrated product.

Mechanical dippers are used to nitrate the cotton, after which the acid and cotton are sent through a chute to a centrifugal, which, when rotated at high speed, separates the excess acid from the cotton. Next the nitrated cotton is immersed in large tanks of water and drained and rinsed over a period of weeks. Centrifugal wringers spun at high speed remove all the moisture before the cotton is ready for the solvents.

Huge drums or barrels, having a capacity of 4,000 pounds each, are used to bring about a thorough mixing of the cotton and the wood alcohol, which is the chief solvent. The drums are sealed and revolved for a period of several days, and the solution which results has the consistency of syrup or extracted honey. This is then pumped through mechanical filter-presses to render it absolutely free from dirt, dust or foreign particles.

This "dope," as it is called at Kodak Park, is next piped to air-tight tanks and held ready to be converted into sheets. The solution, now glass-clear, is poured on the surface of great polished wheels which run continuously night and day. One of these wheels, of which there are upwards of 50 at Kodak Park, now produces twenty-five times as much film base as the whole of the first Eastman factory.

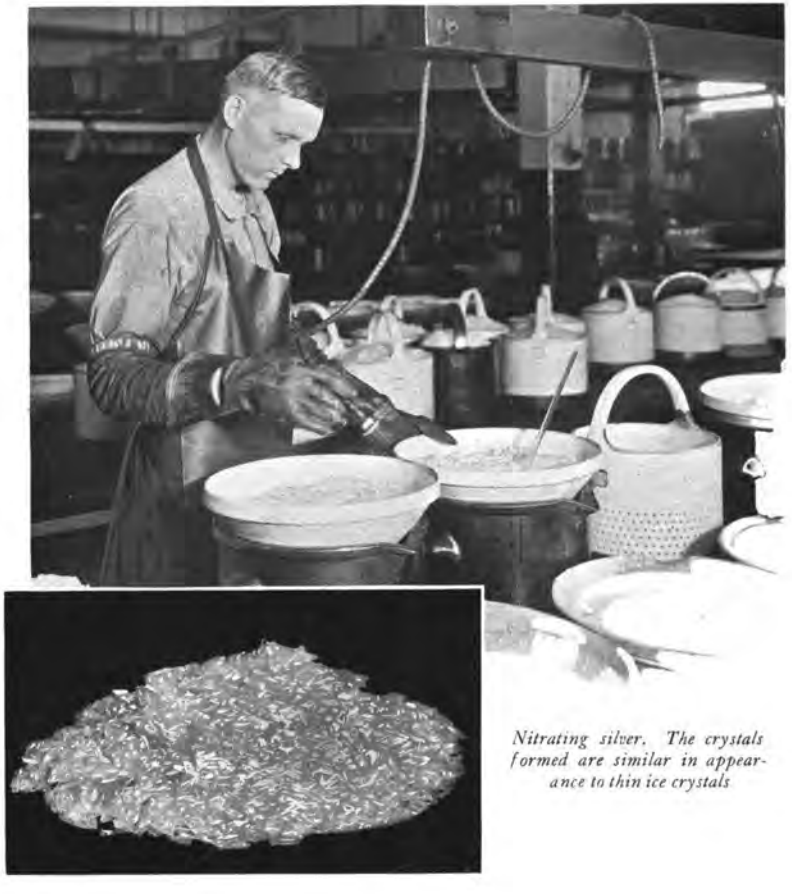
As the film must be uniform in thickness, this operation calls for extreme care in handling. The standard thickness of film base is from .005 to .00525 of an inch, and the degree of accuracy obtained at Kodak Park is such that

the variation does not exceed .00025 of an inch in sheets 2,000 feet long and 3½ feet wide.

For easy handling the base is rolled on a core in large rolls similar to printing paper rolls, and in this form, after a period of aging, is sent to the sensitizing rooms.

Silver is the active element in the sensitizing material called the "emulsion" with which the film is coated. The pure silver bullion comes in bars, each weighing about 42 pounds. The bars are dissolved in nitric acid in porcelain dishes, and after crystallization, pure crystals of silver nitrate are obtained. Other ingredients of the emulsion are potassium iodide, potassium bromide and gelatin. If these bromide and iodide salts are dissolved in water, and to the solution thus prepared silver nitrate solution is added, an insoluble yellow salt is precipitated which is very sensitive to light, turning black after a few minutes exposure.

If this solution is coated on the base, the film would have very little



Nitrating silver. The crystals formed are similar in appearance to thin ice crystals

sensitiveness, and for all practical purposes it would be worthless. For this and other reasons, the precipitation must be conducted in some material that will avoid these difficulties.

The material commonly employed is gelatin, a substance analogous to glue in composition, and like glue in that it is extracted from the bones and hides of cattle. Photographic gelatin is usually prepared from calf skin by soaking the skins in lime water and subsequently extracting with hot water. The gelatin is dissolved in water and the bromide and iodide solutions carefully mixed with it. To this mixture, heated to the correct temperature, is added silver nitrate solution. The precipitate of the sensitive silver salt is held in suspension by the gelatin, and because of this it receives the term "emulsion."

Motion picture film is usually coated with either one of two grades of emulsions. Negative emulsion is very sensitive to light, and is used in the camera, while positive emulsion, which is much less light sensitive, is used for printing the pictures afterwards viewed on the screen. About ten times as much film is coated with the positive emulsion as with the negative. All emulsion

Coating the light sensitive emulsion on the film base. Insert shows the shredded emulsion before it is melted for the coating machines

Cutting motion picture film to its proper width of 35 millimeters. Insert shows a finished 250-foot roll of standard film and a 100-foot roll of Ciné-Kodak Safety Film; 4000 pictures are possible on each length

making is conducted in rooms lighted with safelights which have been specially manufactured for this purpose.

The actual operations of making the emulsion are conducted in silver-lined steam-jacketed vessels provided with suitable agitators. Soluble salts formed during the reaction must be washed out of the emulsion. This is accomplished by chilling it to a jelly, then shredding it by pressing the mass through a chamber with a perforated bottom and sides, and washing the spaghetti-like strands many times with cold water. The shredded emulsion is then melted and coated on the film base.

For this operation special delicate machinery is necessary in order to control carefully the thickness. The film base is handled in such a way that only one side comes in contact with the heated emulsion. After the film is coated it is carried in large loops through the chilling rooms to set and harden or become "conditioned." When thoroughly dried, motion picture film is

automatically cut into strips 1⅜ inches wide, and wound in rolls varying from 100 to 1,000 feet in length.

The final operation is perforating, where the greatest care is taken to have the work done accurately so that the film will run smoothly in the cameras, printers or projectors, thereby keeping the pictures steady on the screen. The reels of perforated film are then taken to the packing rooms to be wrapped in selected pure black paper and packed in tin cans which are sealed to keep the contents air and light tight. The cans are stamped with the emulsion number and footage, and are then placed in strawboard containers ready for shipment to the motion picture studios of the world.

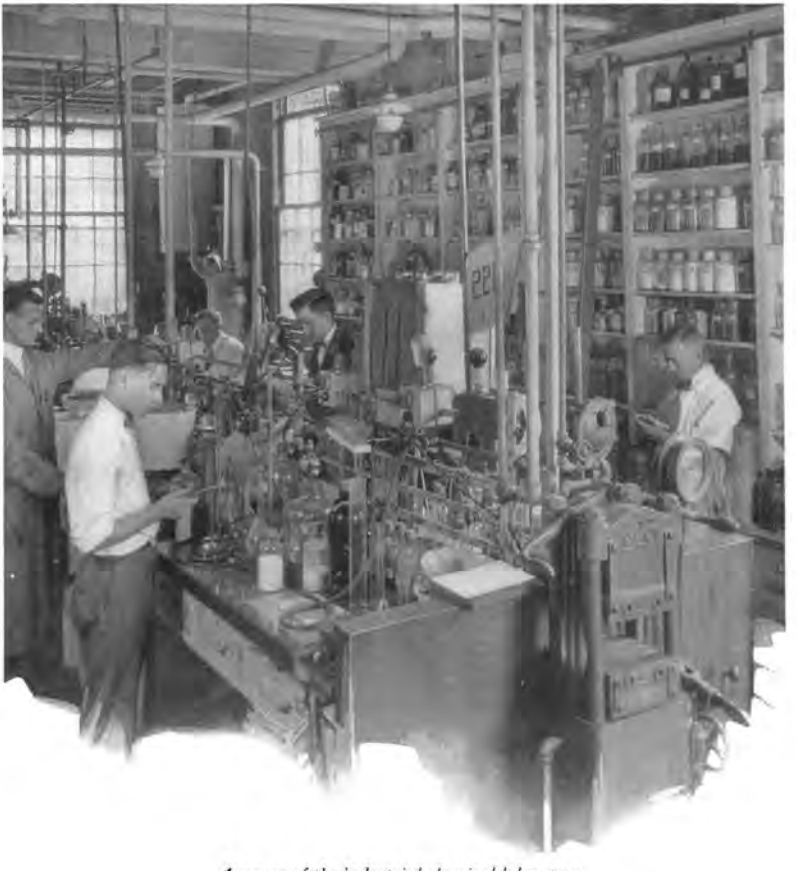
Ciné-Kodak Safety Film, which is made with the slow-burning cellulose acetate base, rendering it safe for projection in the home, is cut in 50- and 100-foot lengths, ⅝ of an inch wide. Paper leaders, enabling the film to be threaded in the Ciné-Kodak, and likewise taken out of the camera, in daylight, are then attached to both ends of each roll, and the whole is wound on a rigid metal reel. Each reel is then placed in a light-proof metal septum and packed in a square yellow carton which can be used for mailing the reel, after exposure, to the nearest Eastman finishing station.

Film for the Kodaks and Brownies is cut in the necessary widths for these types of cameras, covered with a duplex paper, and then spooled. The roll is wrapped with tin foil before it is finally placed in the familiar yellow package obtainable in every land.

Packing motion picture film

FROM AN AERIAL PHOTOGRAPH TAKEN BY DR. S. M. BURKA OF THE U. S. ARMY AIR SERVICE

Aerial view showing the vast extent of Kodak Park. The main entrance can be seen in the left foreground. The long building on the right, near the running track and baseball diamond, is the paper mill. It alone contains nine acres of floor space. Kodak Park West is seen in the background. More than a mile separates the huge chimney in the distance and the twin stacks of Kodak Park East



A corner of the industrial chemical laboratory

Kodak Research Laboratories

THE photographic industry is not wholly an amusement industry. It has also contributed greatly to the achievements of science—it has provided tools for the metallurgist, instruments for the doctor of medicine, and facilities for the astronomer.

It is an industry based on science, and thus all of its processes must be under the direct counsel of scientists. To keep the photographic art in all its phases in a continuous stage of advancement and improvement, the Eastman Kodak Research Laboratories were established at Kodak Park in 1912.

The work of the laboratories deals not only with the theory of photography, but with many points of practical importance, both in the manufacture of photographic materials and their use.

While these modern facilities are in sharp contrast to "The little room over a shop," where in 1878 Mr. Eastman began his experiments in photographic processes, the difference, after all, is only another measure of the progress photography itself has made in that time. Without such careful scientific investigation the art cannot hope to progress.

In their work, the laboratories are able to go further than the investigation of the behavior of finished products, as a plant is available for the manufacture of photographic materials on such a scale that results can be practically applied to the regular manufacturing departments. The actual organization of the laboratory covers practically the whole field of chemistry and physics, as applied to photography, and has in addition a special department devoted to photography itself. The following incomplete list of the subjects of study will give some idea of the ramifications of the work: Sensitometry, illumination, reflection and absorption, colorimetry, spectroscopy and geometrical optics, inorganic, organic, colloid and physical chemistry, astronomical and spectroscopic photography, photographic chemistry, portraiture, color photography, photo engraving, motion pictures and x-ray work.

There are one hundred and fifty persons on the staff of the laboratories, many of whom are chemists, physicists and photographic experts of the highest training; and several enjoy world-wide reputations.

An interesting sidelight of the laboratory activities is furnished by the synthetic organic chemical department, which was started because of the dearth of fine organic chemicals in the United States during the world war. If these chemicals had not been supplied, research along scientific, industrial

A section of the physical chemical laboratory

Another view of the physical chemical laboratory

and medical lines would have been paralyzed. This department patriotically stepped into the breach and today has available for shipment from stock more than 2,200 different organic chemicals of specified purity.

Another perhaps more popular achievement, which is credited to the laboratory's research endeavors, is the invention of the 16 mm. Ciné-Kodak Safety Film and the reversal process, which have enabled the amateur to make motion pictures as easily as he takes snapshots. By means of this reversal process, the same film which is exposed in the camera is used for projecting the finished picture. The resultant saving to the amateur cinematographer is obvious.

Often the work leads to the production of interesting by-products. An example of this line of endeavor is the discovery that rubber could be deposited from a liquid suspension by an electric current, and a process of electroplating rubber solutions thus has been developed and patented, which will doubtless be of great value in connection with the rubber industry.

While the primary object of the laboratories is obviously the improvement and development of the Eastman photographic products, their purpose is not strictly to limit laboratory investigation along purely commercial lines. Research results are almost always published in the leading scientific journals of the day. Since 1913, nearly 300 such communications, dealing chiefly with the theory of photography and allied subjects, have appeared.

A library containing the most complete collection of photographic literature in the world is maintained by the laboratories with a trained librarian in charge. Among its 10,000 odd volumes are also works on physics and chemistry, and a wide range of special topics pertaining to photographic research and manufacturing problems. Subscriptions are maintained for about 200

Physics laboratory, where the sensitivity of photographic materials to light invisible to the human eye is determined

American and foreign periodicals, and articles therein are briefly abstracted, classified and collected in a Monthly Abstract Bulletin. Translations are made from foreign literature on request, and the facilities of this library are extended to other libraries, institutions and investigators.

Thus the Eastman Research Laboratories have become the great clearing house for the adjustment of all scientific problems connected with all the phases of the photographic industry.

Where Brownies, Kodaks and Ciné-Kodaks are made—The Camera Works

Camera Works

THE Camera Works is devoted to the making of Kodak, Brownie and Hawk-Eye cameras, including the Ciné-Kodaks and Kodascopes. The second largest Eastman plant, it occupies about an entire city block, in the business section of Rochester. Occupying a floor area of more than eight acres, the men and women employed here, for the most part all skilled workers, number about 3,000. There is a total of 40 departments, each specializing in producing certain units. All units, when assembled, undergo a thorough examination and testing in the inspection department against all possible defects.

Eastman workmanship is no better demonstrated than in the performance of the products of the Camera Works which are in use throughout the world.

More than forty distinct camera models, several of which are equipped with three or four grades of lenses, are manufactured in the Camera Works. In addition to these, various accessories, such as tripods, self timers, shutter cables, Kodascope screens, auto focus enlargers, amateur printers, etc., are also produced in this great factory. The volume of work, the thousands of different operations, the millions of parts used in their assembling, and the hundreds of thousands of pounds of steel, brass, aluminum and leather consumed annually are all evidence of the world-wide demand for and the popularity of Brownies, Kodaks, Ciné-Kodaks, and Kodascopes.

KODAK MAKING

There are many steps in the making of a Kodak. From the raw materials stock room to the final inspection department each operator must know exactly his or her particular task. To facilitate handling, metals are received in sheets and cut in convenient sizes for stamping. There are about 240 power presses needed to stamp out the various metallic parts of the finished products. These presses not only stamp or punch out the many camera parts and frames, but also the parts that go into the several types of shutters.

More than two hundred automatic screw machines, almost human in their operation, make by the million the most delicate and minute parts of the Kodaks, such as screws, rivets, spindles and bushings. These machines are intricate lathes, equipped with special attachments for automatically threading and accurately turning these parts. The raw stock for these machines is in the form of rods which are fed through long pipes. The normal weekly output of these complicated machines is 2,500,000 parts. There are

Batteries of automatic screw machines which turn out millions of infinitesimal parts for Brownies, Kodaks, Ciné-Kodaks and Kodascopes. Worker is shown using micrometer gauge to check size of part

Assembling Kodaks. The final operation is adjusting the focusing scale with the lens

also hundreds of hand screw machines, lathes, milling, drilling and perforating machines, which are used in the various departments for special purposes.

All the exposed metal parts of Kodaks are first treated in the metal finishing department, where they are not only rendered rust-proof, but made to shine with the brilliancy of gold and silver.

BELLOWS MAKING

One of the most interesting processes in the making of a Kodak is the bellows making. The lining of the bellows, which is a rubber coated cloth, is placed on a special form and attached to an aluminum frame, front and back, to brace it. Paper stays or strips are then automatically glued on by a special staying machine. The stays are for stiffening the bellows and locating the necessary folds. The form is next passed on to another operator who glues on the outside leather covering. The form is then placed in a hand press until the glue is set and the bellows are removed from the form and passed on where the folds are put in by hand and pressed in hand pressing machines.

A corner of the shutter assembling room.— Upper insert shows a Kodamatic shutter, lower, a close up of a shutter assembler

SUB-ASSEMBLING

In what may be called sub-assembling rooms, the aluminum and steel frames and other parts of the cameras are fastened together. These are then sent to the lacquering room where various liquid finishes are applied, after which they are dried in automatic electric baking ovens. The outside leather covering is then glued on, the raw edges being burned with hot irons to harden them and prevent fraying. The frames are next placed in power presses to imprint decorative creases on the leather.

SHUTTER MAKING

One of the most intricate operations in all Kodak making is the assembling of the shutter. Infinite care and precision are required, and the operators must have skillful fingers with a well-developed sense of touch. In some shutters more than 100 different infinitesimal parts are used. The flat parts are stamped out by the punch presses, and the round parts by the special screw machines.

In this department the famous Kodamatic shutter is assembled with its

Ciné-Kodak assembling room. Insert shows worker checking timing of camera. —The completed amateur motion picture camera

range of seven corrected speeds and its automatic exposure scale controlled by the diaphragm. This aristocrat of shutters adorns the "Special" Kodaks.

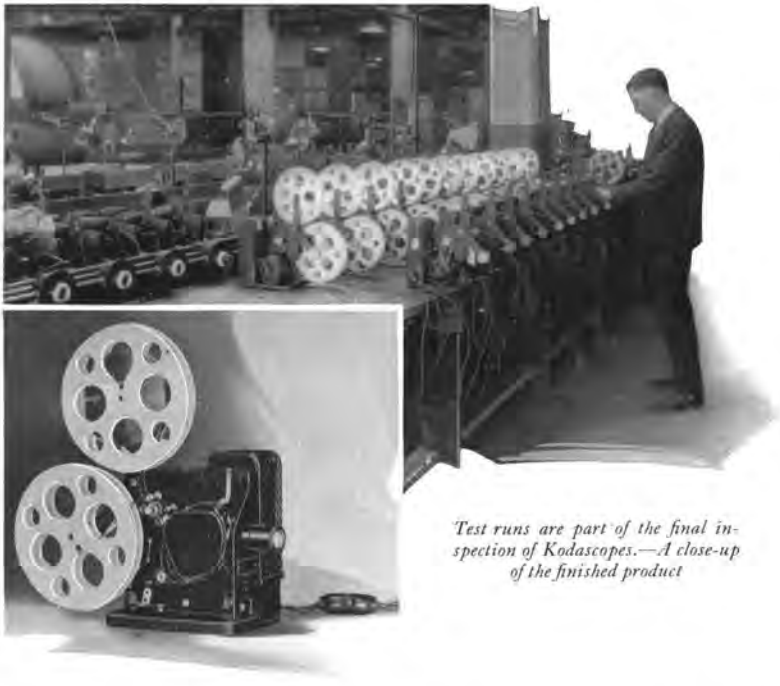
Here also the Diomatic shutter, which is really the younger brother of the Kodamatic, is made with its watch-like precision and effective timing.

ASSEMBLING

When all the parts of the Kodak are completed, they are sent to the assembling room. Here the frames and parts go from bench to bench until the assembled Kodaks finally reach the focusing department, where the focusing scales are attached to the beds of the cameras. They are then ready for inspection and must pass the critical eyes of this department before they are permitted to be shipped to dealers all over the world.

CINÉ-KODAK AND KODASCOPE

The newest product of the Eastman Kodak Company, the Ciné-Kodak, a motion picture camera for the amateur, deserves special mention. More than 400 workers devote their entire time to making Ciné-Kodaks and Kodascopes, the latter being the machine which projects the finished picture in the home.



Test runs are part of the final inspection of Kodascopes.—A close-up of the finished product

The smooth-working mechanism which is built into these outfits calls for great precision and exact workmanship. Critical adjustment of the spring motors and the many gears in the Ciné-Kodaks is necessary for these cameras to function properly. Every Ciné-Kodak must operate at a certain speed before it leaves the factory. This calls for a special "breaking in" test of the mechanism so that the amateur cinematographer will be assured of securing exact reproductions of normal action on his screen at home. No slight variance from the standard exposure of 16 pictures or frames a second is allowed, and this functioning of the parts is checked and rechecked until this rate of operation has been assured.

The focusing test is most exacting. Exposures of various figures and numbers on illuminated charts are made on the regular Ciné-Kodak Film so that a complete record of the performance of each camera is secured before it leaves the factory.

The Kodascope, motor driven and wired for ordinary house voltage, also undergoes a rigid inspection for timing, illumination, focusing and general operation. Projection of special test films in darkened tunnels provides another accurate check on each machine.

The Hawk-Eye Works, where all the Kodak Anastigmat lenses are ground

Hawk-Eye Works

THE Hawk-Eye Works of the Eastman Kodak Company, occupying another desirable city site, is devoted primarily to the manufacture of lenses. Even at a casual glance visitors can appreciate how exacting and painstaking is the process of manufacturing this highly technical and important adjunct to the camera.

Here also, in these scientifically equipped modern buildings of brick and concrete, are made optical instruments of high precision including colorimeters, sensitometers and similar laboratory apparatus.

The Wratten Light Filters required in all color reproduction work are also manufactured in this plant. They are made from specially tested optical glass and gelatin which is coated and tested in the Research Laboratories.

Every type of lens is fashioned at the Hawk-Eye Works which goes into Eastman equipment, be it the simple single lens for the Brownies or the huge 36″ *f*.5 lens used by the U. S. Army Air Service in photographing the ground from an altitude of three to five miles. It is the home of the Kodak Anastigmat, with its speeds of *f*.7.7, *f*.6.3, *f*.5.6 and *f*.4.5, and the Ciné-Kodak Anastigmat, with speeds varying from *f*.6.5 to *f*.1.9, the latter lens being so fast that its penetrating eye permits interior movies with ordinary daylight.

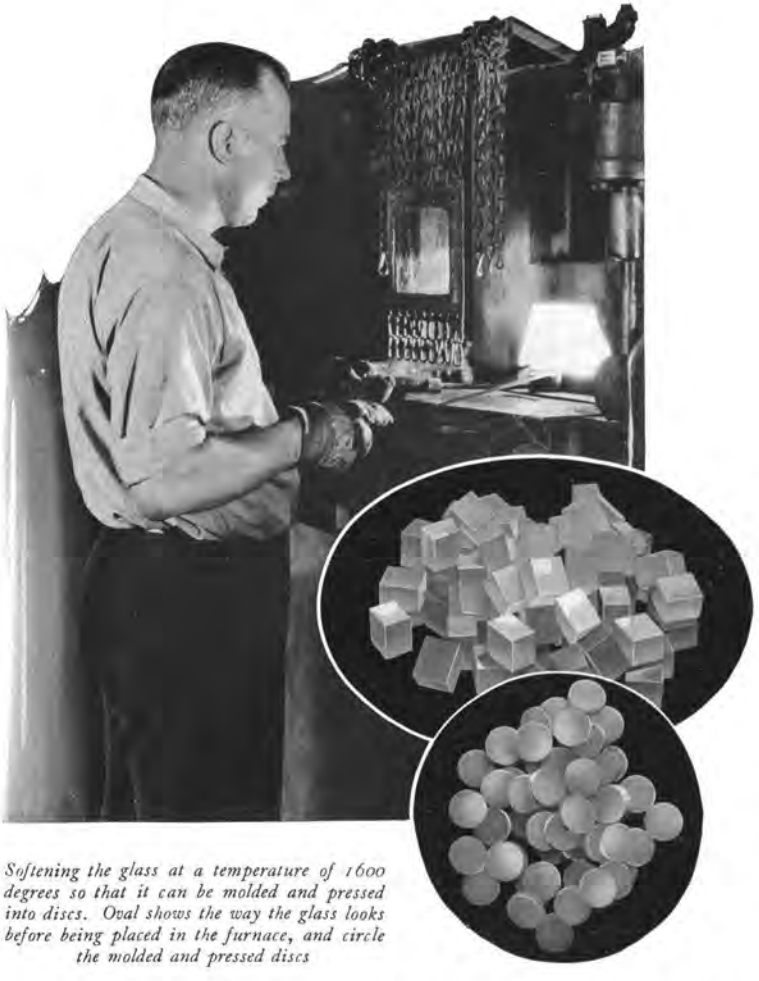
Exacting requirements have to be met in the process of manufacturing from the moment the raw optical glass enters the factory until the final

inspection. Each Kodak Anastigmat lens must emerge successfully through ten rigid tests, performed in ten different departments. In two final tests, which are identical, the judgment of one set of inspectors is pitted against that of another.

Optical glass comes from the manufacturer in slabs, and all defects, such as folds, stones or fire cracks, are marked on this raw stock and later ground out on a small carborundum wheel. The slabs are then ground on all sides. This removes all the surface glass which is usually filled with bits of clay as the result of molding. The slabs, which are now free from all apparent defects, are cut into strips on milling machines equipped with gauges of diamond impregnated saw discs. All strips of uniform size are sent through the machine again, and emerge as squares or cubes, each containing the required amount of glass for the lens disc into which it is to be pressed.

The cubes are then placed in a gas furnace where they are heated to a temperature of 1600 degrees, which softens the glass enough to be molded. They are then removed from the furnace and dropped into a die where a plunger, working under pneumatic pressure, presses the softened glass into a round disc. The discs are then placed in an electric annealing oven whose temperature, regulated by an automatic heat control, may be set to rise to a predetermined height which is usually around 1,000 degrees. At this heat whatever strain may be present in the discs will be gradually relaxed. Then from about 96 to 120 hours the same automatic control slowly cools the oven

Where scientific precision instruments are manufactured for use in the factories and research laboratories of the company



Softening the glass at a temperature of 1600 degrees so that it can be molded and pressed into discs. Oval shows the way the glass looks before being placed in the furnace, and circle the molded and pressed discs

to prevent introduction of new strains in the discs. If these strains or tensions were allowed to remain in the discs the lenses when finished would not refract the light uniformly, and they would be liable to fly to pieces during the grinding operation. After the discs are removed from the annealing oven, they are examined for strains in an instrument called a polariscope. If no strain is present, the lenses are next examined for pressing defects. In this inspection the discs are placed in a glass dish containing a liquid whose refractive index approximates that of the discs.

In order to give the discs the desired photographic surface it is necessary to grind them against a flat grinding shell in the case of a plane surface, or against a spherical shell in the case of a spherical surface. To grind a disc of glass it is necessary to employ some material harder than glass in a powder

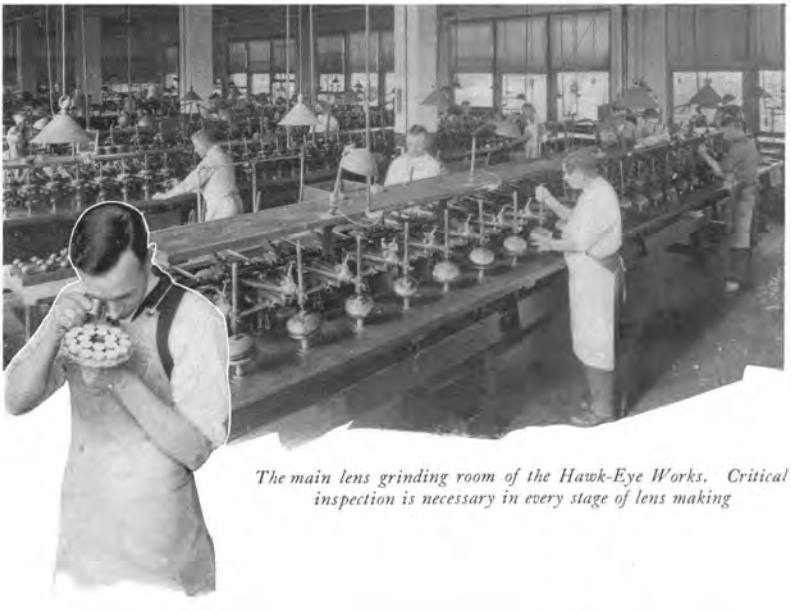
Placing the pressed lens discs in the automatic electric annealing oven to remove all strains

form, such as diamond dust or emery. The glass disc is rubbed against a grinding shell of the desired shape with the emery or other abrasive material between the surfaces. In this way the glass is gradually made to assume the shape of the shell.

Lens grinding shells are cup shaped (concave), or ball shaped (convex). If the lenses are large in diameter or the curves very steep the lenses are ground singly. When the lenses are small or the curve very flat, as is many times the case in Kodak lenses, a number of the discs are worked together affixed to a metal blocking tool with melted pitch.

The process of grinding consists of gradually shaping the glass to the exact contour of the grinding shell. Coarse emery is first used until the approximate curve is obtained. Then finer grades of emery with more accurate tools until the surface is smooth and a more exact fit of the curve to the tool is obtained. Although machines perform this grinding operation very satisfactorily, the finest surfaces can be obtained only by hand work. This hand work is too expensive and not necessary for the cheaper grades of lenses, but in high grade anastigmat lenses a great deal of the finer work is done in this way. When the surface has been rendered so smooth that it is semi-transparent, the lens is ready for polishing.

The process of polishing is similar to that of grinding except that rouge is used instead of emery and the polishing shell is covered with a layer of felt



The main lens grinding room of the Hawk-Eye Works. Critical inspection is necessary in every stage of lens making

The discs are held on their grinding shells with melted pitch

Lens discs in their shells ready for grinding

The centering room of the Hawk-Eye Works where the edges of lenses are ground and beveled

or wax. In anastigmat lenses greater care as to thickness must be exercised, and each lens is roughed on both sides and smoothed to a definite thickness before the operation of fine grinding and polishing is begun. The polishing of all anastigmat lenses is done on wax lined polishing shells which produce a more perfect polish than is possible with a felt-lined shell. This process is very delicate. Considerable experience is required in the adjustment of the machine to give to the polished surface the curvature that the lens should have. Comparison is made in this case by fitting the polished lens to a test glass having the correct curvature, really a lens having an equal, but opposite curvature. If the two curves differ by even 1/30,000 of an inch there will be circles of color or rings showing that the curves are not the same.

One of the most essential features of a photographic lens is that the center of all the curves of the component parts shall be situated exactly on a straight line, in other words that the lens should be centered.

Lens mounting completes the manufacturing process

The mounting is also very important, especially in anastigmat lenses, which consist of four lenses separated by air spaces. It is not sufficient to fit the components to a standard distance, as the least variation in thickness or in the nature of the glass calls for a special adjustment. All brass mounts must be turned with great precision, and must be true to the smallest fraction of an inch. If the mounting is imperfect, all the care and accuracy exercised in the preparation of the lens will have accomplished little, and the lens will not form a satisfactory image.

Thus it is seen that lens making involves mathematical computation of the first order and highly skilled workmanship throughout. Each step must be performed with the utmost care, as any mistakes in the early stages of manufacture—in the pressing and annealing and the early inspection of the glass in pressed discs—will result finally in the rejection of the lens after the more expensive operations of grinding and polishing have been performed.

The largest lens ever ground for a photographic purpose in this country. Made at the Hawk-Eye Works, for the U. S. Army Air Service, for long range aerial photography. Its great dimensions can be realized by a comparison with the Vest Pocket Kodak alongside

Buildings in the Main Office group

Kodak's Main Office

THE main executive offices of the Eastman Kodak Company are located in four buildings next to the Camera Works. Towering above the buildings in this group, and the skyline of the city, is the sixteen story office building built on the site of Mr. Eastman's first factory. Here more than 1,150 employees daily look after the business affairs of the company.

SPECIAL DEPARTMENTS

Besides the usual departments connected with the routine administration of the business, the main office building contains departments devoted to special research and development of new products, service to the amateur photographer, Kodak, Ciné-Kodak and Kodascope inspection and repair, and film developing, printing and enlarging. The total floor area in the main office covers more than 8½ acres.

KODAK POST OFFICE

Some extent of the great activity in which the company is engaged may be gathered from the fact that it is necessary to maintain a separate branch U. S. post office in the main office building. There are only a few of this particular type of post office in the country.

Five government mail clerks are regularly employed sorting the tons and tons of mail and parcel post matter that goes out to all parts of the world. The postal receipts from this office last year totaled nearly one quarter of a million dollars, a business equal to that of a good-sized city.

The daily incoming first-class mail averages around 3,700 letters and the outgoing is slightly less. The total number of pieces of parcel post matter last year was in the neighborhood of 465,000. Pieces of third class matter, which includes the many advertising publications of the company, swell the total to many millions.

PHOTOGRAPHIC MUSEUM

An interesting commercial museum, containing a sample of practically every photographic device the company has ever made, is maintained at the main office as an adjunct to the company's patent department. There are also many examples of photographic apparatus which antedate the company's activities.

INDUSTRIAL RELATIONS

In the main office, as in all the other plants, the welfare of the worker is of first consideration. These activities go back to the early days of the industry, when it pioneered such provisions for the well-being of employees as reading, rest and lunch rooms and medical service. These provisions have

A separate department repairs all types of Eastman cameras

Auditorium and recreation hall, Kodak Main Office

naturally broadened with the growth of the organization, and now include all that a modern progressive industry can suggest for the education, health, comfort and physical well-being of its workers.

The Industrial Relations Department, which concerns itself with the welfare of every Kodak employee, was established as early as 1919. While it is recognized that major and minor executives down to assistant foremen share in the responsibility for maintaining harmonious relations between management and men, yet it is seldom possible for executives to be occupied with their own special problems in their field and give more than casual attention to the intricate problems underlying human relations in industry. It was for the purpose of giving specific and intensive study to these problems and advising on them that the Industrial Relations Department was established and is maintained.

MEDICAL DEPARTMENT

Chief among the functions of the Industrial Relations Department is the work of the Medical Department, the staff of which consists of a director, five other physicians, two of whom are on full and the others on part time, and nine trained nurses. All prospective employees receive a rigid physical examination before beginning work and periodic re-examination of all employees has recently been instituted.

DENTAL WORK

Through special arrangement with the Rochester Dental Dispensary—one of Mr. Eastman's own city benefactions—dentists are also detailed to visit all the plants from time to time to clean, without cost, the teeth of employees who desire this service.

AUDITORIUM AND CAFETERIA

In 1925 a huge auditorium containing a well-equipped modern stage was opened for the use of the employees in the main office. Adjoining this is also a new cafeteria, seating 600, with a special service dining room for those who prefer to be waited on. Separate rest and reading rooms for men and women have also been provided. In the auditorium, dancing, movies, basketball or indoor baseball are enjoyed during the noon hour period. The hall is also available in the evening for any entertainment employees may care to give for their own amusement.

BUSINESS LIBRARY

A Business Library is maintained for the use of all employees of the company, containing trade and technical publications as well as books, periodicals and pamphlets on general business subjects. It is open for reference any time during office hours with trained librarians in charge.

SAFETY MEASURES

The fire and accident prevention of the entire company is in the general charge of one person, the General Safety Supervisor, who devotes his time exclusively to this work. A constant effort is made through the provision of adequate mechanical safeguards and through frequent inspection to prevent accidents occurring to employees.

EMPLOYEES' PUBLICATION

An employees' publication, the *Kodak Magazine*, is issued monthly and distributed to all employees without charge. Its contents include many personal items relating to workers in the various plants, hints on health, accident prevention and the need of thrift, and any other timely articles which would prove of interest connected with the management and progress of the company.

RETIREMENT FUND AND INSURANCE

With the beginning of 1929 a plan became operative whereby practically all of the 20,000 Kodak employees the world over are eligible to receive, upon retirement at the age sixty-five for men and sixty for women, substantial annuity payments. The retirement annuities are based on salary earned during active employment; and they are paid by a large insurance company with which the sum of $6,500,000 was deposited jointly by the Eastman Kodak Company and the Kodak Employees' Association. Life insurance and disability benefits are included in the plan.

HOMES FOR EMPLOYEES

Another welfare function of the Industrial Relations Department is the group construction of homes for employees, whereby five- and six-room dwellings may be purchased at a cost about 20 per cent less than similar houses built individually.

Types of employees' homes financed by the Eastman Savings and Loan Association and Kodak Employees' Association, Inc.

WAGE DIVIDEND

In 1912 the company adopted its wage dividend plan for employees which has been continued up to the present time without substantial modification.

The wage dividend is a recognition of the value to the company of trained steady workers, and a reward for continuous service. It is not regarded as a substitute for wages, nor is it ever considered in establishing the rate of pay of any employee. Since its inception more than $25,000,000 has been distributed.

EASTMAN SAVINGS AND LOAN ASSOCIATION

To encourage thrift among all the company employees, a savings and loan association, with a permanent staff, is operated under the jurisdiction of the New York State Banking Department. Practically all the funds of the association are loaned on first mortgages. The association attends to all transactions in connection with mortgages so that members are saved the trouble and expense a single investor might have in loaning his money. More than 6,900 employees of the company are members of the association, with an average subscription of twelve shares, and with a total matured value of nearly $9,000,000. The association has already financed more than 1,100 homes for employees. In addition to the help which the Savings and Loan Association affords in home building, the Kodak Employees' Association has funds available for second mortgages on employee homes.

World Wide Eastman Service

IN addition to the plants in Rochester, N. Y., there are also production units at Kingsport, Tennessee; Toronto, Canada; Harrow, England; Vacz, Hungary; Vincennes, France; Copenick, Germany; and Melbourne, Australia.

Branches, retail stores and finishing stations for Ciné-Kodak Film are operated by the company in important centers throughout the world. And on every continent Kodak dealers are equipped to render Eastman service to all types of photographers, whether amateur or professional.

Wood chemical plant of the Tennessee Eastman Corporation at Kingsport, Tennessee

Canadian Kodak Co., Limited, Toronto, Canada

New York, Chicago and San Francisco branches

Kodak Ltd., London, England

Kodak Société Anonyme Francaise, Paris, France

Kodak House, Cape Town, South Africa

Upper Left—Kodak Argentina, Ltd., Buenos Aires. Upper Right—Kodak Brasileira, Ltd., Rio de Janeiro. Lower—Kodak Mexicana, Ltd., Mexico City

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