52573

The Scientific Shop

ALBERT B. PORTER

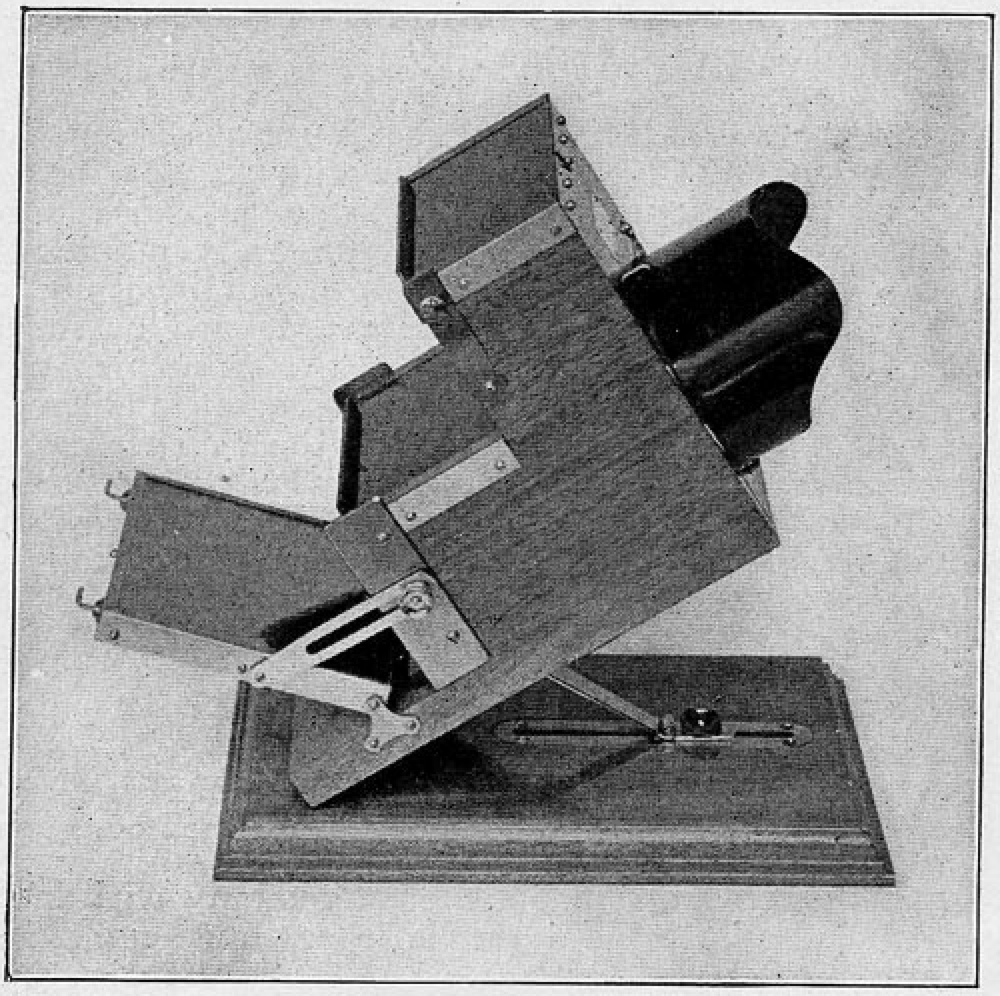
Scientific Instruments 324 Dearborn St., CHICAGO

CIRCULAR 348
Second Edition

MAY 1907

Kromskop Color-Photography

F. E. Ives Patents



C 1067

No other system of color photography has as yet produced results equal to those obtained by aid of Mr. Ives' "Kromskop"* process, nor does any other system give so direct and striking a proof of the essential accuracy of the Young-Helmholtz-Maxwell theory of color sensation. Mr. Ives' process consists in taking three (or, for stereoscopic effect, six) negatives of the same view through three plain color-screens having respectively the primary colors, red, green and blue. Positive transparencies are printed from these negatives. These transparencies are placed in a viewing machine, or "Kromskop," where they are seen through color-screens similar to those used in making the original negatives, and the several images are fused into one by means of a system of reflectors. The resultant image is so true to nature in every quality of color, texture, sheen, translucency, atmosphere, and solidity, that it is hard at first to believe that one is not looking directly at the scene itself. The brilliant hues of sunset clouds, the soft coloring of old tapestries, the delicate iridescence of Tiffany glass, the cool greens and hazy distances of landscapes, the warm colors of hothouse flowers, and even the rainbow tints in the Niagara mist, are all reproduced in a manner so perfect as to be beyond the conception of one who has not seen the pictures themselves.

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*Pronounced "Chrome-scope."

The Kromskop consists of a mahogany box fitted with stereoscopic lenses and having colored glasses on the outside and transparent reflectors inside which are so arranged as to blend into one the three stereoscopic transparencies which constitute the Kromogram in such a manner as to reconstruct the scene before the eyes. The Kromograms themselves, though devoid of color, are permanent color records, and can be made with the Kromskop cameras by anyone having a moderate amount of photographic skill.

The Junior Kromskop is a monocular instrument which reproduces colors as perfectly as the larger instrument, but which does not show pictures in stereoscopic relief. It is sometimes preferred by artists, who are accustomed to mentally viewing things as pictures instead of in three dimensions, by amateurs unaccustomed to handling stereoscopic cameras and yet desiring to make color records, and by those to whom the question of first cost is of importance.

Kromograms can be projected on the lantern screen by means of the Lantern Kromskop used in conjunction with any ordinary lime light or electric lantern. The pictures are the same as those used with the Stereoscopic and Junior Kromskops, but are specially mounted in wooden frames. With the lime light good results are obtained up to four feet square, and with the arc light up to six feet square or more. The attachment is admirable for demonstration of the principles of color photography, and for exhibition of color pictures to small audiences.

A special form of this instrument, called the Science Lantern Kromskop, shows a circular disc, the elements of which may be separated on the screen to show the analysis of color and the process and effect of superposing three images. The Science Lantern Kromskop is especially recommended for school and college demonstrations.

Kromskop Price List

The prices given below are not subject to discount. No charge is made for boxing on orders of ten dollars or more

C 1067 **Stereoscopic Kromskop,** in polished mahogany with lacquered brass fittings, adjustable light diffuser, and eight selected kromograms **$50.00**

C 1068 **Stereoscopic Kromograms,** each **1.00**

C 1069 **Junior Kromskop,** monocular (non-stereoscopic), in polished mahogany, with adjustable light diffuser, and six selected kromograms **25.00**

C 1070 **Junior Kromograms,** each .... **.75**

C 1071 **Stereo. Kromskop Night Illuminator,** in polished mahogany, with two incandescent gas burners, reflector, and two mantles **12.00**

C 1072 **Junior Kromskop Night Illuminator,** polished mahogany, with one incandescent gas burner, mantle, and reflector **10.00**

C 1073 **Lantern Kromskop,** with six selected slides **65.00**

C 1074 **Science Lantern Kromskop,** permitting the separation of the three colored images on the screen and illustrating the physiological analysis of color, with six selected slides **80.00**

C 1075 **Special Stand,** hood and hand feed arc lamp or lime light jet, to make the Lantern Kromskop complete in itself and independent of ordinary lantern **20.00**

C 1076 **Extra Slides** for the Lantern Kromskop, each **1.00**

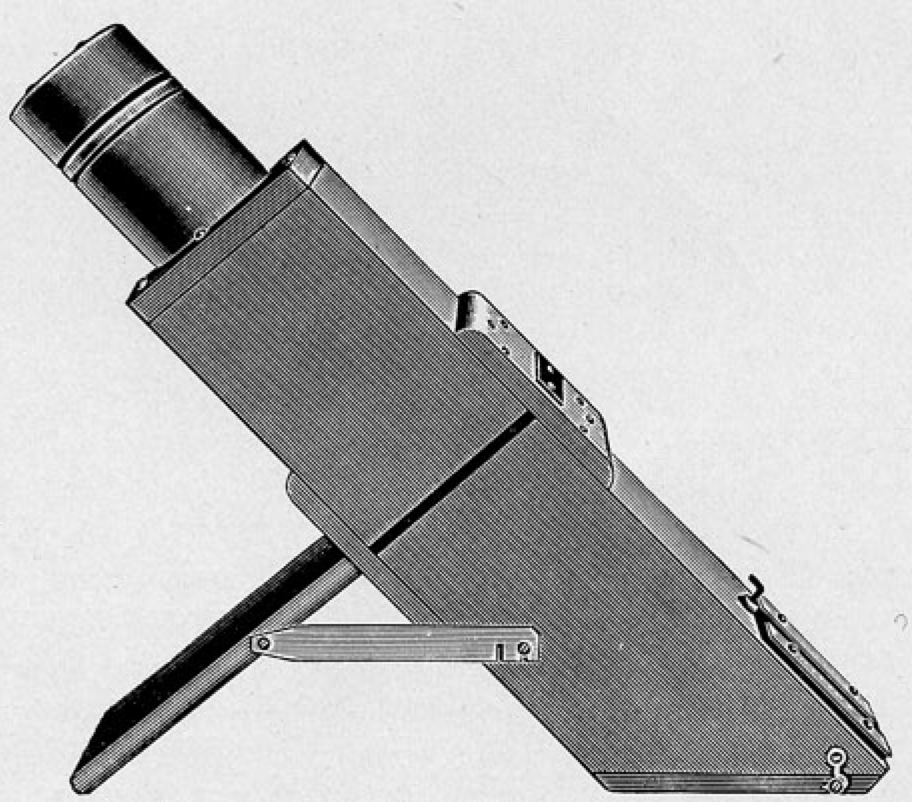
C 1077 **Same,** brass bound, each **1.50**

C 1078	**Kromskop Multiple Back,** to attach to ordinary camera, for Kromskop color photography, with one 2½x8 in. double plate holder	25.00
C 1079	**Extra 2½x8 Double Plate Holders,** each	1.50
C 1080	**Stereoscopic Multiple Back Camera,** complete, with inverting prisms, and one double plate holder	65.00
C 1081	**Extra 5x8 Double Plate Holders,** each	1.50
C 1082	**Kromskop View Camera,** one plate, one exposure	75.00
C 1083	**Reversing Mirror**	2.50
C 1084	**Double Plate Holders,** each	1.50
C 1085	**Printing Frames,** 2½x8, each	.80
C 1086	**Deep Hard Rubber Developing Trays** for 2½x8 plates, each	.75
C 1087	**Dark Room Safe Light,** 6½x8½	2.00
C 1088	**Same,** 8x10	2.50

Wood's Diffraction Color-Photographs

Patented 1904 and 1906. Other patents pending

Scientifically the most interesting, and artistically the most beautiful invention of the new century.

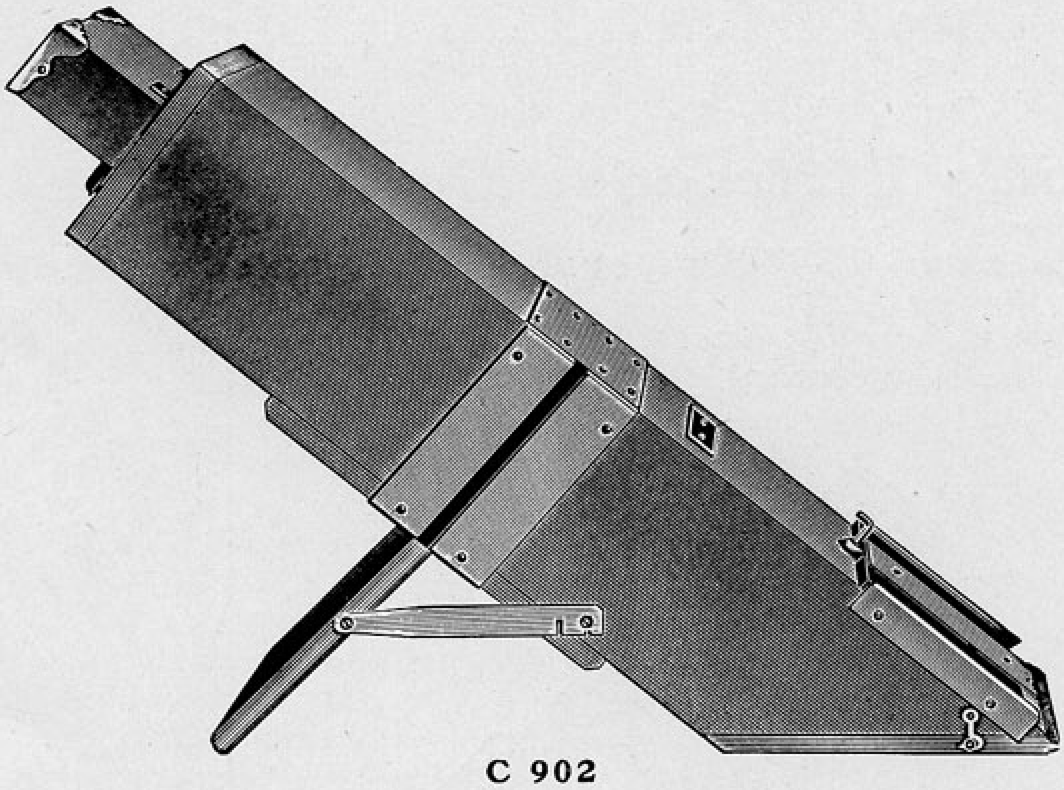


C 901

Prof. R. W. Wood's interesting and beautiful process of making photographs showing objects in their natural colors has recently been revised and perfected by Mr. Herbert E. Ives, while Mr. F. E. Ives has designed an improved viewing machine for examining the photographs. It will be remembered that Professor Wood's process utilizes diffraction gratings for the reproduction of color, the photograph consisting of three superposed gratings, one for each of the primary colors. The photographic transparency is colorless and the image is almost invisible until the transparency is placed in the viewing machine, when the image springs into view in the natural colors of the object in a manner little short of magical.

The recent improvements in apparatus and methods, which are described in Mr. Ives' paper reprinted below, have conquered all the earlier difficulties and have led to the production of color photographs which are more perfect than any which have ever been made by any process utilizing but a single plate, and even rivalling the effects given by Mr. F. E. Ives' Kromskop. The new photographs are very brilliant and faithfully reproduce the most delicate shades and color-tones, while they are entirely free from streaks and spots.

The new viewing machine, which is called the "Diffraction Chromoscope," is a great improvement on the device originally used, for all troublesome adjustments of instrument and light have been eliminated. The diffraction Chromoscope needs merely to be placed before a window or artificial light to be ready for use, and the photographic transparencies need merely to be slipped into the chromoscope to show in natural colors. The chromoscope is not liable to disarrangement and the photographic transparencies are perfectly permanent and can be shown anywhere and at any time.



C 902

The Diffraction Chromoscope is now made in three patterns which are sold at the net prices given below.

Net Price List

C 901 **Diffraction Chromoscope, School Model**, small size, monocular, in varnished cherry, showing 2⅜ inch circular pictures, with grooved slide box and six slides $12.50

C 902 **Diffraction Chromoscope, College Model**, binocular, in cherry, with special satin finish, showing 2¾ inch circular pictures, with grooved slide box and six slides 25.00

C 903 **Diffraction Chromoscope, Parlor Model**, binocular, in polished mahogany, showing 2¾ inch circular pictures, with polished slide box and six slides 35.00

C 904 **Extra Slides**, 2⅜ inch size, each .... .50

C 905 **Extra Slides**, 2¾ inch size, each 1.00

C 906 **Night Illuminator**, consisting of Welsbach gas lamp with mantle and shade, flexible tubing, and conical reflector 3.50

We have a few viewing machines of the original pattern (C 907) which are offered at $5.00 each to those who may be interested in the historical development of diffraction color-photography or who may wish to use the machines for purposes of demonstration.

Improvements in the Diffraction Process of Color Photography

BY HERBERT E. IVES

(*Reprinted from the Journal of the Franklin Institute, June, 1906.*)

The diffraction process of color photography, invented by Prof. R. W. Wood, of Johns Hopkins University, in 1899, is an applicaton of the well-known three-color method of reproducing colors by photography. This method depends primarily upon the observations of Young, Helmholtz and Clerk Maxwell, that all the colors of the solar spectrum may be counterfeited to the eye by mixtures of three narrow bands of color from the spectrum. These colors are **red,** near the Fraunhofer line C; **green,** near E, and **blue,** near F. For instance, red and green mix to give the eye a sensation of yellow indistinguishable from the true yellow of the spectrum; red and blue mix to give purple; and the three colors acting together produce a white whose difference from ordinary white light can be detected only by analysis with a spectroscope. What applies to spectrum colors applies equally well to the varied hues of nature. The coloring of such an object as a basket of fruit can also be duplicated to the eye by mixtures of the three primary colors. The tint of an apple, by a large proportion of red, less of green and blue; of a lemon, by nearly equal parts of red and green; of grapes, by a large proportion of blue.

The three-color process can be reduced to two problems; first, the production of three photographic negatives, each of which shall be an exact record of the amount of one of the primary colors requisite to mix with the others and counterfeit to the eye the color of the object photographed; second, some means of furnishing each record with its appropriate color and combining it with the others.

The solution of the first problem has been arrived at from experimental quantitative determinations of the mixing proportions of the primaries to produce the other colors. From these determinations three color screens can be prepared, which, when used with suitable photographic plates, will yield three (black and white) negatives, each having the desired distribution of light and shade to form a record of one primary color. The negatives thus obtained are the basis of all three-color reproduction methods.

Numerous means have been suggested and tried for combining the three color records with their corresponding colors. They may be placed in a triple lantern, each illuminated with its proper colored light and projected, superposed, upon a screen. The superposition may be effected by a system of mirrors, as in the Kromskop; by the use of three thin transparent films properly colored; by triple printing on paper, after the manner of much of the present-day magazine illustration.

A process which must be noted somewhat in detail because of its direct bearing on the recent development in diffraction color photography is the so-called Joly process.* Combination of the colors is effected in this by breaking up the three color records into narrow lines, arranged in succession, a line of the red record, a line of the green, a line of the blue, and so on, repeating across the picture. This triple record, whose lines should be close enough together to be indistinguishable by the eye, is mounted over a triple ruled color-screen,—a line of red pigment, a line of green, a line of blue, similarly spaced to the lines of the picture. The result, if the lines are fine enough—a condition never yet attained in the actual working of the process—is that the eye blends the lines to form a structureless color picture in the form of a transparency.

The diffraction process, which is the subject of this paper, departs widely from the other methods. Its distinguishing feature is that for the

*First published, as a matter of fact, by Louis Ducos du Hauron in 1869.

production of the primary colors to view the records use is made of the diffraction grating, that is, of a transparent polished surface, usually of glass, ruled with fine parallel straight lines, several thousand to the inch. It is the property of a diffraction grating that if a bright line or point of light is viewed through it, not only will the light source be seen, but spread out to either side will be a series of spectra, those nearest the source being called spectra of the first order, the next, of the second order, etc. If the number of lines to the inch on the grating be increased the spectra are thrown farther from the central image, and vice versa.

The power of a grating to produce color is taken advantage of in the following way: Suppose we have a convex lens forming an image on a screen of a bright source of light, such as a gas flame. If the eye is placed where the image is formed the lens is seen uniformly and brilliantly illuminated. Suppose now a diffraction grating is placed over the lens. In addition to the image formed as before there will be produced a series of spectra. If the eye is placed in one of these the lens will, as before, appear illuminated, not, however, by light of the color of the source, but by the color of light striking the eye.

If now we can make one of our color records in the form of a diffraction grating of varying strength to correspond to the desired differences in the amount of the primary color, and place it over a lens, points

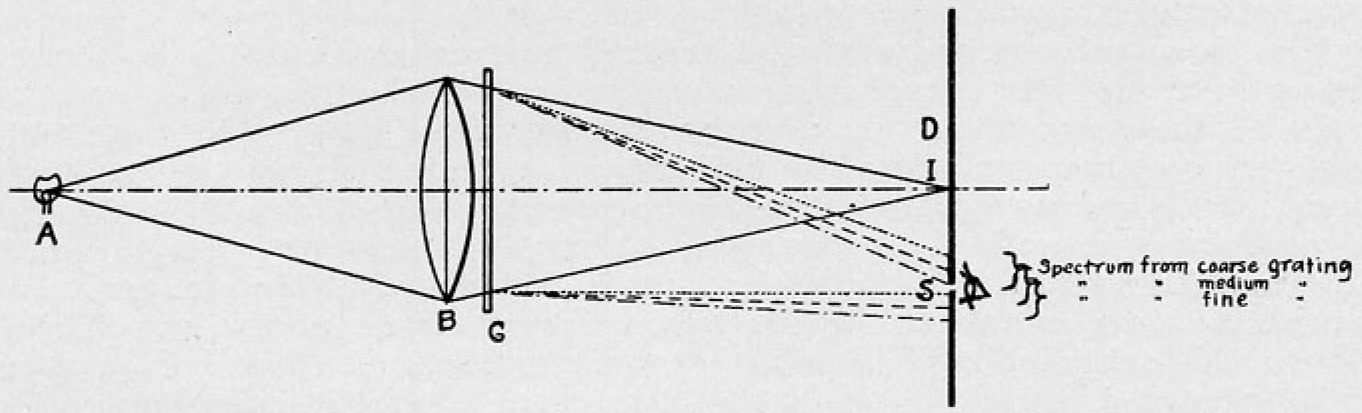


Fig. 1

can be found in the lateral spectra in which the lens (and the grating in coincidence with it) will appear as a colored picture. Further, since, as we have seen above, the distance of the spectra from the central image depends upon the fineness of the grating spacing, it is a simple matter to choose three gratings, one of which will send red to a chosen point, the second green, the third blue. Hence if we can make the three primary color records in the form of three diffraction gratings of three properly chosen spacings, each may be seen in its proper color by placing the eye in one of the diffraction spectra formed as above described.

In Fig. 1 we have represented the conditions for viewing diffraction color pictures. A is a source of light, B a convex lens, in front of which are three gratings G. On the screen D fall the central image I, and three spectra (only the first order spectra on one side are represented) so placed that the red of one, the blue of another, and the green of the third are superposed on the slit S, at which the eye is placed.

In Fig. 2 we have represented diagrammatically a diffraction color picture of a red flower with green leaves on a blue ground. The coarse spacing of the lines in the flower represents a grating to send red light to the eye, say 2,400 lines to the inch, the medium spacing of the leaf one to send green to the eye, say 3,000 lines to the inch, the fine spacing of the background one to send blue, say 3,600 lines to the inch. Mixed colors would be given by two or three gratings acting together.

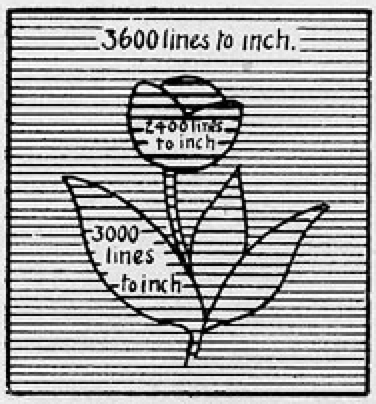


Fig. 2

To produce such gratings by photographic means the bichromated gelatine process, which lends itself well to the copying of minute structures, was used. In contact with a surface sensitized in this way was placed a glass grating; the image of the corresponding color record was then projected upon the surface for a sufficient time to give a full exposure. The grating was removed, another substituted and exposed under its corresponding color record, and so with the third. In this way all three grating pictures were printed, one on top of another,* forming a picture which by diffused light was transparent and quite invisible, showing its color only when viewed with the proper combination of lens and bright source of light. From the pictures made in this way copies could be made by simple contact printing on bichromated gelatine. Since a direct copy of a grating is still a grating, i. e., a series of lines, the process is a positive one and copies are not reversed in light and shade as in making copies of ordinary photographs.

It is obvious that quite apart from its scientific interest the diffraction process promises very real advantages. For instance, the colors used are beyond question pure spectrum colors, and so there is no need to depend on dyes or colored glasses; also the ease and cheapness with which copies can be made places it in a class by itself among three-color processes. So perfect indeed did the process seem theoretically when first published that there was every reason to expect results fully comparable with the best of other methods.

This early promise was not fulfilled. A few pictures were obtained, interesting as scientific curiosities only. No dependence could be placed in the results; some colors reproduced well, others did not; occasionally a good picture would be made, but the same procedure applied to another subject brought no success. Six years after its publication the process had made no progress and seemed fated to rank as a failure.

Last summer, through the courtesy of Prof. Wood, the writer was loaned a number of diffraction gratings, ruled on the Rowland dividing engines at Johns Hopkins University. Experiments with these revealed a fundamental defect in the above-described mode of making diffraction pictures. By finding means to overcome this defect results have been obtained of a remarkable degree of perfection.

The defect referred to is that the three gratings, in order to get their joint effect, were **superposed,** being, as we have seen, printed one on the other. In so doing the assumption was made that the effect of superposing gratings was to add their separate effects. As a matter of fact, additional disturbing effects are introduced, partly due to the inability of the gelatine surface to take several grating impressions without mutual blotting out, and partly—chiefly, in fact—to the formation of a new compound grating. That is, if two gratings of different spacings are superposed, the two spacings periodically get in and out of step with each other, and this new periodic structure forms a diffraction grating. The new grating then forms its own series of spectra, which subtract light from the original ones. Therefore

*In practice it was found impossible to get three impressions on one gelatine surface and so two were made on one surface and the third on another, the two surfaces being afterwards placed in contact.

when the two gratings are superposed, the eye, instead of receiving a double quantity of light receives much less than the double quantity. Even more serious than this loss of light is the fact that the new spectra due to the two gratings together frequently fall in such a position as to introduce **false colors.** This is well illustrated by taking two gratings of different spacing and placing them on one another at right angles. Two sets of spectra will be formed, one by each grating, and parallel to it, and, in addition, a number of diagonally disposed spectra. As the gratings are turned into the same straight line all the spectra turn, and the additional diagonally-placed spectra take up positions between the spectra formed by the original gratings. Consequently, while the eye may receive red from one grating and blue from another, one of the spectra due to the two together may send some other color, such as green. This case actually occurred frequently, a pink rose reproducing as green, and red and blue color discs superposing to give green instead of purple.

These observations made clear the necessity for some method of obtaining the effects of the three gratings other than by superposition. It was at once seen that this could be accomplished by a procedure similar to the Joly process, namely, by having the grating elements in narrow juxtaposed strips. Some experiments had already been made by Prof. Wood with Joly pictures, not, however, with the specific purpose above mentioned, but rather to illustrate the possibility of making such pictures with very much finer color lines than it is possible to do by ruling alternating colored pigment lines for the observing screen. The mode of procedure involved laboriously ruling a special grating consisting of several lines of one spacing, followed by several of another, and then several of the third, repeating all the way across the plate. The width of each strip of lines was made to correspond to the width of an element of the Joly picture. From this grating a print was made on the special line picture, which had been previously flowed with gelatine. This in turn was used to print gelatine copies.

A practical disadvantage of this plan, aside from the use of the special grating, is that one is restricted to the use of original Joly pictures of a certain definite spacing of line, determined by the limitations of the process employed in their production. A much more serious defect arises, however, in this way: The "Joly lines" if made, as they should be, several hundred to the inch, themselves form a diffraction grating, which, as it is parallel to the three principal gratings, forms spectra superposed on those depended on to reproduce the colors of the object. This is quite as serious a defect as that arising from superposed gratings, and is sufficient to condemn the procedure.

From a consideration of these various difficulties it followed that some means of breaking the picture up into lines was imperative, and that that means should not involve the use of a special grating, nor of special Joly original pictures, difficult to obtain, and, most important of all, the narrow color strips or Joly lines must be arranged in some way so as not to give disturbing grating effects.

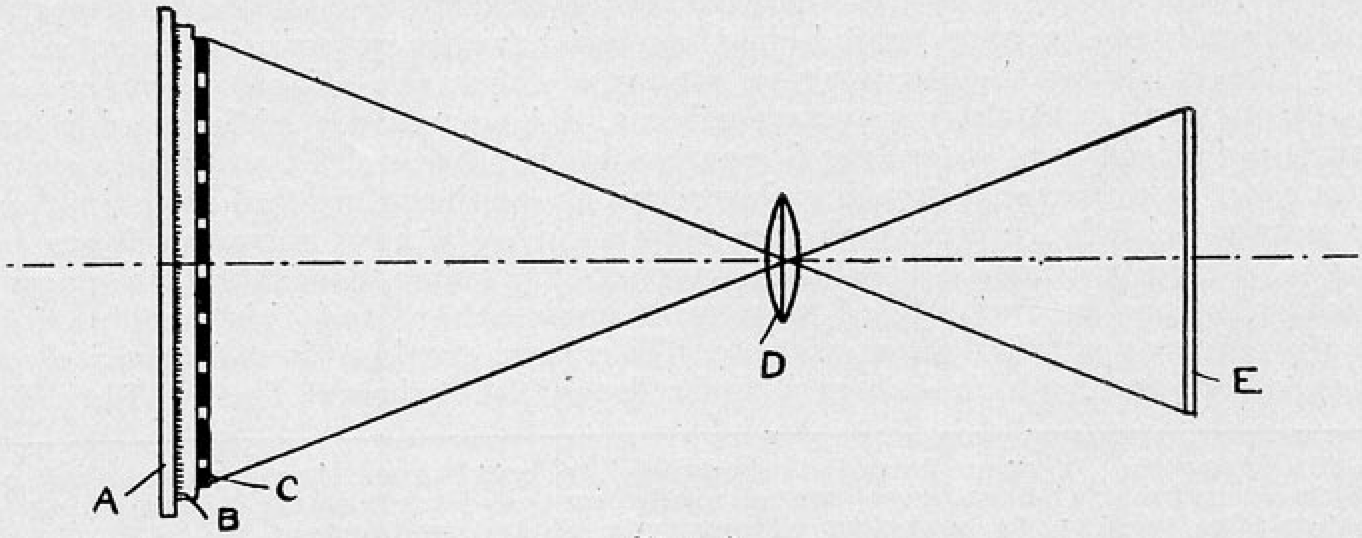


Fig. 3

All of these ends were achieved by the following procedure:

In Fig. 3, which represents the method of making the improved diffraction pictures, A is the bichromated gelatine plate, rigidly fixed in position; B is a glass diffraction grating; C is a line screen, ruled with at least two hundred lines to the inch, with the opaque lines twice the width of the transparent;* D a lens, and E a positive color-record to be copied. The latter is an ordinary three-color positive containing no lines or structure,† and the grating is an ordinary continuously-ruled one. With say the red record at E and the corresponding grating at B, an exposure is made, resulting in a series of narrow strips. A second positive is then placed at E, the corresponding grating at B, and the ruling C moved the width of a transparent portion. A second exposure is then made, the opaque lines shielding the previously exposed surface, and a similar treatment given to the third positive. There results finally a picture made up of alternating strips of three different gratings.

To eliminate the grating effects of the narrow strips of gratings considered as lines, the device is used of making the strips (Joly lines) run at right angles to the diffraction grating lines, so that the spectra produced by them are thrown off in another direction and do not enter the eye. Although the device is simple it is of extreme importance, and its adoption is rendered possible only by the plan described for making the pictures. The difficulties in the way of ruling a special grating with the three gratings disposed in a similar manner are practically insuperable. It is obvious that the strips of grating can be made as narrow as desired, easily narrow enough to be indistinguishable as such by the eye.

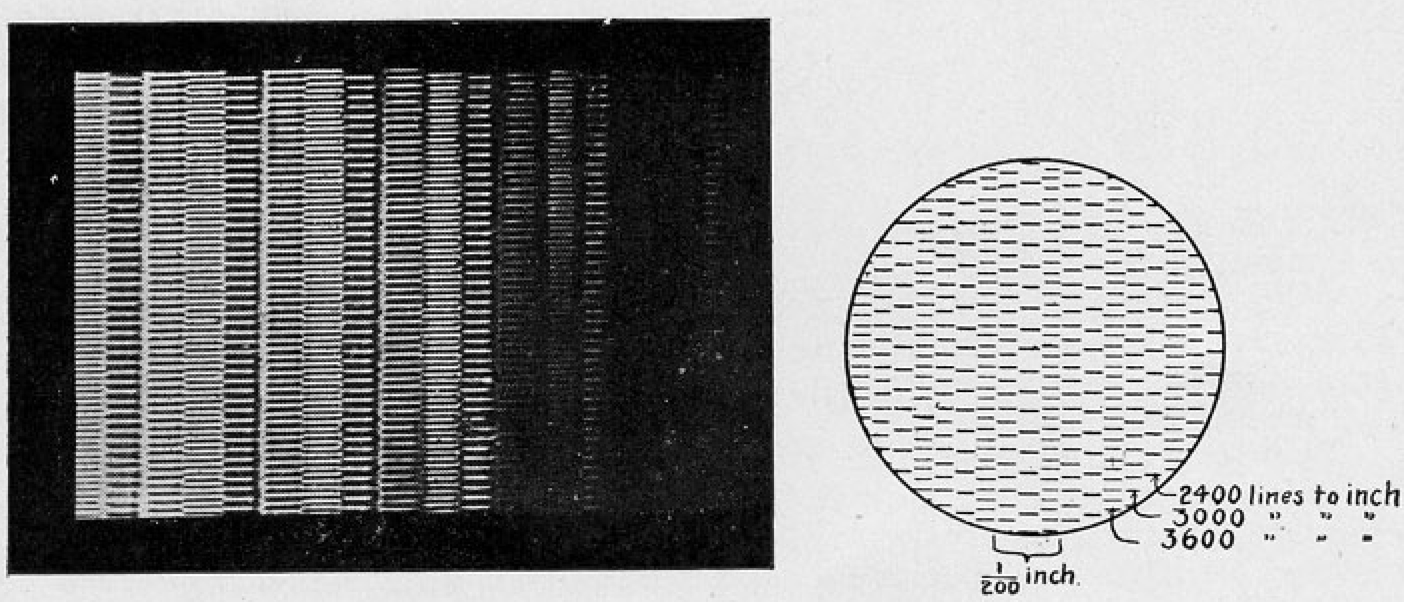


Fig. 4

Fig. 4 gives an idea of the appearance of the finished picture under the microscope. The short, fine lines are the diffraction grating lines furnishing the three primary colors; 2,400 to the inch for the red, 3,000 for the green, and 3,600 for the blue. The broad strips at right angles to the grating lines constitute the "Joly lines," of which there should be at least 200 groups of three to the inch.

When viewed with a lens and bright source of light the pictures made in this way are entirely free from the formerly-obtained defects. The colors are pure and brilliant, and, unlike ordinary Joly pictures, the color lines are too fine to be visible. The results indeed approach those obtained with the Kromskop.

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*The opaque line screens were ruled by Mr. Max Levy, to whom, for his interest and generous assistance, the writer is greatly indebted.

†Positives from negatives made for the Kromskop were used.

As a further modification of the original method the writer has found it possible to dispense with three gratings and obtain the colors with a single grating spacing properly used. To do this the source of light must be a rather long slit. Viewed through a grating the slit of course gives long spectra parallel to its length. If now the grating be rotated about the perpendicular dropped from it to the slit, the spectra move in toward the slit. [The accompanying shift parallel to the length of the slit is compensated for by the slit being long.] So, by suitable rotation any desired spectrum color may be obtained at a chosen point. Starting with a grating of 3,600 lines to the inch to give the blue when parallel to the slit, a rotation of about 21½ degrees will give the green, of 42 degrees the red. In the absence of suitable dividing engines to rule three properly-proportioned gratings this affords an exact and easy method of securing the three colors. It has the further advantage, that in printing copies such difficulties as securing perfect printing contact will affect all three colors alike, which is not the case with gratings of different degrees of fineness.

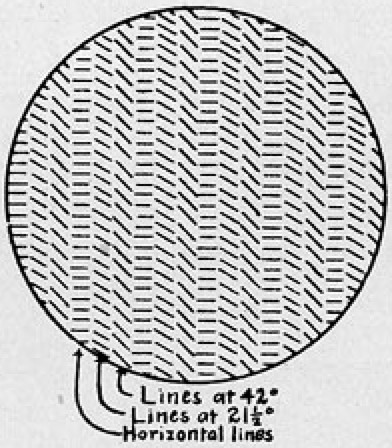


Fig. 5

Fig. 5 shows a portion of a picture made in this way with one grating spacing.*

With these improvements probably the last word has been said on the diffraction pictures themselves. A very important improvement in the means for observing them, due to the writer's father, Mr. Frederic E. Ives, must be described.

The lens and bright light used by Prof. Wood do not form at all a convenient arrangement, nor is it desirable to use artificial light. A convenient apparatus, easily set up, not liable to get out of order, and suitable for daylight use, became desirable as soon as the pictures were perfected. The instrument about to be described was devised a few hours after the first pictures were obtained, and admirably fulfills its purpose. The greatest difficulty attending the use of daylight is that of getting sufficient light,—the illumination of the sky, toward which an instrument would naturally be pointed, is far from intense enough. This will be appreciated when it is remembered that only a very small portion of the original light is diffracted, perhaps ten per cent at most. This difficulty has been overcome in a novel manner. Instead of depending on a single slit, as the narrow source of light, a series of slits is used, each furnishing one spectrum. In this way, with four slits, two first order and two second order spectra are utilized, yielding probably three times the light obtainable from a single slit.

*After working out this idea the writer learned that some years ago Mr. Thorp, of Manchester, suggested the use of a single grating spacing to secure all three colors. Mr. Thorp's plan, however, was to use three sources of light and merely rotate the gratings until they "found" the source and each cleared the source belonging to the other two. He found a rotation of ten degrees convenient. As far as the writer knows this is the first publication of a plan to secure any desired color by rotation through a definite angle to be calculated from the wave length.

Fig. 6 gives the instrument in section. A, B, C, D are the four slits; M a mirror; L_1 and L_2 lenses; P the diffraction picture; and S the slit through which the picture is observed. The lenses of course form an image of each slit at A′, B′, C′, D′; from each of these images, however, a certain amount of light is diffracted by the picture P; from B and C first order spectra fall on S, from A and D, second order. The use of second as well as first order spectra is a distinct advantage in that, as gratings never give a perfectly uniform distribution of light and color, certain desirable qualities of the picture are found in one order and not in the other, while if both orders are used the resultant evening up of qualities produces particularly satisfactory results.

By disposing the grating lines in a horizontal direction and using horizontal slits as sources the pictures may be viewed by both eyes, a desirable condition for convenience and comfort.

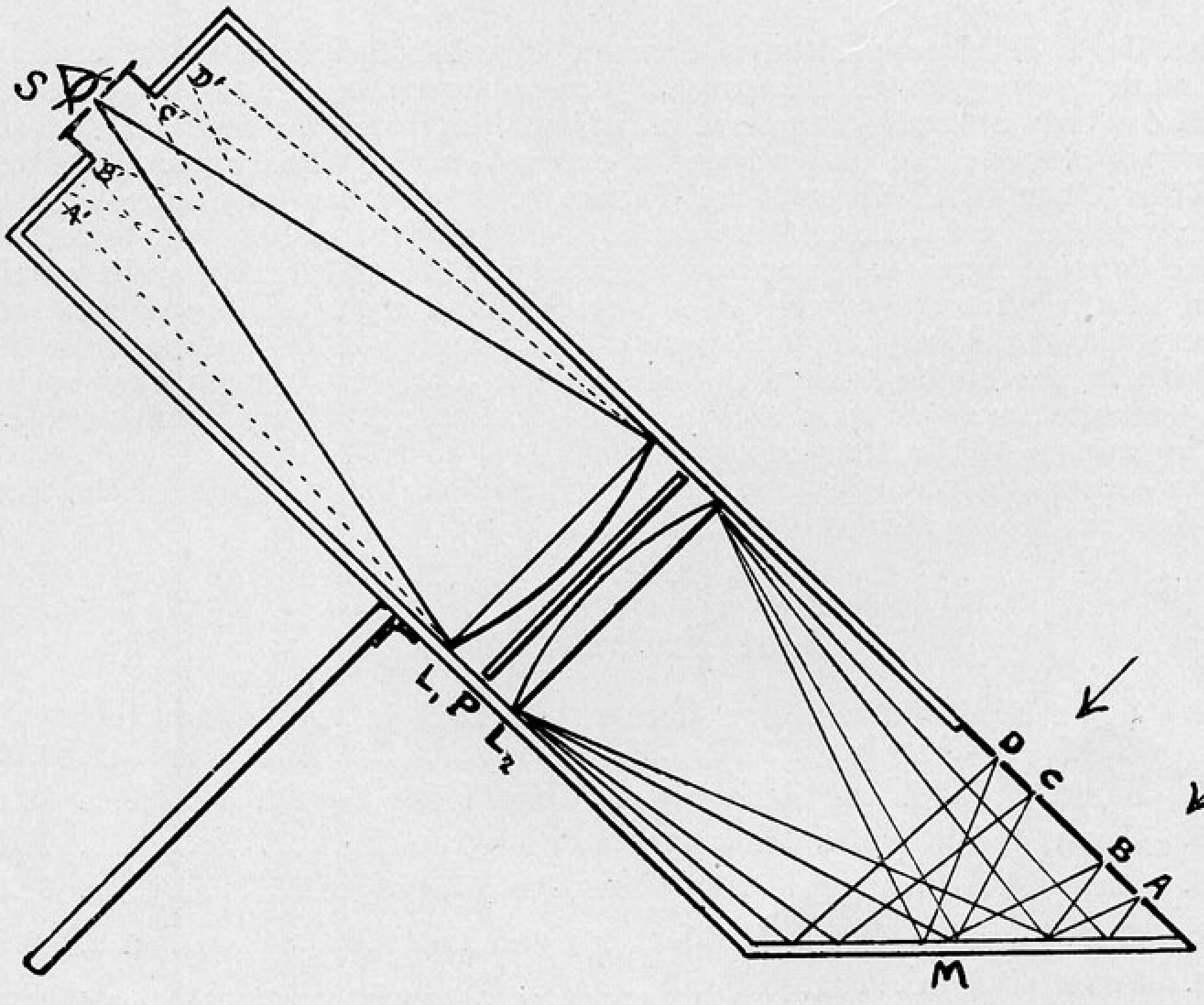
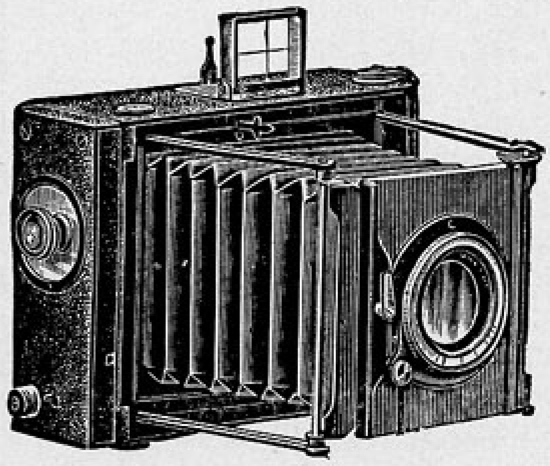


Fig. 6

As an instrument the "Diffraction Chromoscope" is simplicity itself. It is, in fact, used much as the old stereoscope. There are no adjustments; to use, it is merely placed before a window or Welsbach light and the pictures dropped to place. On looking into the eye slit before the introduction of the picture nothing it seen, the inside being perfectly black. The pictures themselves are transparent, colorless, and appear as plain pieces of glass under ordinary conditions of illumination. On placing them in the instrument the colors immediately flash out, a transformation which seems almost magical, affording a scientific demonstration of rare beauty.

Aside from the obvious use of the apparatus for scientific purposes it is expected that its simplicity and the perfection of the results will ultimately lead to many important uses. Now that the long standing obstacles in the way of success have been removed the process should develop rapidly. Such further steps as application to lantern projection and means for making the pictures directly in the camera are under consideration.

The Zeiss Minimum Palmos Camera



C 1246

The Zeiss Minimum Palmos Camera is a hand camera made of light metal, with folding front, focusing objective mount, and focal plane shutter. The width of the shutter slit is adjustable from the outside, and the existing adjustment can be read on an external scale. The camera is fitted with Zeiss Unar (f 4.7-5) or Zeiss Tessar (f 6.3) lenses, and may be used with dry plates, cut films, film packs, or daylight-loading roll-films.

The time of exposure is varied by altering the width of the slit or the tension of the shutter-spring. A slit width of 2 mm. combined with the highest spring tension gives an exposure of about 1-1000 second, while the full width of the slit (equal to the size of the plate) and the lowest spring tension results in an exposure of about 1-10 second. Time exposures are made by means of the lens cap.

The camera is exquisitely finished, and the workmanship is of the kind which has made the Zeiss Works famous.

Net Price List

C 1243.	**Zeiss Minimum Palmos Camera,** 3¼x4¼ in., and **Unar** lens 1:4.7, f = 5¾ in.	$87.00
C 1244.	**Same,** 3¼x4¼ in., with Tessar lens 1:6.3, f = 5¾ in.	79.00
C 1245.	**Same,** 4x5 in., with **Unar** lens 1:5, f = 6 in.	91.00
C 1246.	**Same,** 4x5 in., with **Tessar** lens 1:6.3, f = 6 in.	89.00
C 1247.	**Zeiss Double Plate Holder,** 3¼x4¼ in.	4.70
C 1248.	**Same,** 4x5 in.	5.00
C 1249.	**Zeiss Cut Film Sheath,** 3¼x4¼ in.	.35
C 1250.	**Same,** 4x5 in.	.40
C 1251.	**Zeiss Roll Holder,** 3¼x4¼ fitting Kodak film	13.50
C 1252.	**Same,** 4x5 in.	15.00
C 1253.	**Leather Carrying Case holding** 3¼x4¼ in. camera and 4 Plate Holders or 1 Roll Holder and 1 Plate Holder	4.30
C 1254.	**Same,** holding 3¼x4¼ camera and 6 Plate Holders or 3 Plate Holders and 1 Roll Holder	5.80
C 1255.	**Same,** holding 4x5 in. camera and 4 Plate Holders or 1 Plate Holder and 1 Roll Holder	5.00
C 1256.	**Same,** holding 4x5 in. camera and 6 Plate Holders or 3 Plate Holders and 1 Roll Holder	6.50

Note: The **Tessar** lens is recommended if the finest definition, rather than the highest attainable speed, is desired.