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ON

Colour Photography.

CONTENTS.

IMPORTANCE OF COLOUR PHOTOGRAPHY FOR SCHOOLS AND THE COMMUNITY IN GENERAL.

Few of the arts were accompanied in their evolution with such success as photography and its applications. Circumstances were so favourable that the development of photography was not retarded, but was, on the contrary, continuously accelerated. From the time of the discovery of photography and onwards the best scientific forces have applied their talents to develop this remarkable art.

Side by side with photography, rapid progress was made in optics, and especially in photographic optics.

The period of the wet-collodion process, besides developing photography, also raised it from the artistic point of view. At that time photography was in the hands of men specially gifted and possessing very extensive knowledge. After the discovery of the dry process, photography became the property of the "man in the street." From the artistic point of view photography began to lose, but gained considerably in another —maybe more valuable—respect, namely, that of being spread among the masses.

The discovery of Poitevin placed photography on a very high level in the domain of printing. This application of photography left the dry process far behind, and, as we see now, gives very good results in printing. Needless to say, photogravure, collotype, and half-tone reached a high degree of perfection. The discoveries made by several scientists in sensitising sensitive layers to coloured rays enabled photo-technicians to apply these discoveries to the reproduction of coloured objects, and we see that the results obtained in the art of colour printing are excellent. Everyone who looks at a well-executed coloured reproduction wishes to get the same results by means of pure photography.

At the present time monochromatic photography also has attained great success in every respect, and certainly in some works it has approached the domain of a pure art; but if we can say of printing that it has reached its culminating point, we hardly say the same about photography.

Photographic reproduction of coloured objects and of nature has only just recently emerged from its infancy. Certainly the problem itself is very difficult, and even for such results as are now obtained long preparatory work of many scientific forces was necessary. It is difficult to say whether the time of direct photographic reproduction of coloured objects will come, following the discovery of hitherto unknown chemical properties of silver or any other elements. The only case where direct reproduction has been carried out—the work of Professor Lippmann—is not the true solution, because it is based on the principles of pure physics. All other attempts at coloured reproduction up to the present time have not resulted in direct reproduction, although they attained good, and in some cases excellent, results. None of the methods based on dividing the spectrum into three coloured regions gave good results, and all who tried to get such results failed, and certainly always will fail.

A brilliant solution of the problem was made by the brothers Lumière. Their results, though insignificant at the beginning owing to many purely technical difficulties, have now reached a high degree of perfection, but all the same I cannot say the method itself is perfect, because there is one great and unavoidable defect. This defect is inherent in all methods in which the time of exposure for all three regions of spectrum is fixed beforehand, notwithstanding the different quality and intensity of light during the taking of the photograph. This defect is partly corrected by means of a supplementary screen, but only partly so, and therefore the really good and correct reproduction of the colours of objects by this method is possible only during a limited space of time during the day. In certain circumstances the lighting or angle of light makes it necessary to alter the ratio of time of exposure for three regions of the spectrum, and this applies particularly to most views from nature. Neither the method of MM. Lumière nor any similar method can accomplish this, and so the result is but unsatisfactory. In such cases none of the supplementary screens can help, as is clear to anyone. I have seen many thousands of colour positives of MM. Lumière, and they confirmed what is stated above in regard to the attempts made to reproduce the above-mentioned objects. This also applies to views with strong contrasts and with coloured objects in deep shadows.

Certainly every method existing at present has its faults, and therefore what is said above is not in detraction of the merits of Autochromes, but rather as a regret that this defect is unavoidable in that really excellent method.

I doubt whether Autochrome will really be taken up by the masses, as there are many obstacles in the way, such as the high cost and slight permeability for weak sources of light. In any case, however, Autochrome is the first big step in colour photography, and we must acknowledge its great merit in that it has provoked interest in this art and has provided an incentive to work in this branch of photography. Probably the knowledge accumulated on the subject of colour photography will enable fresh steps to be taken in the near future towards leaving behind all existing methods, just as Autochrome left behind the method of superposing three layers, which was described at the time by MM. Lumière.

Whilst colour photography was advancing by slow steps, the cinematograph literally "rushed" on the world's stage, having passed its laboratory period very rapidly. Everything was at the service of this favourite—great interest and plenty of money. The work of men of pure science was not required for the cinema, all having been done beforehand. The only merit of the cinema, namely, its capacity of reproducing life actions, covered at the very beginning its big defects, in the removal of which many people interested themselves. Even now there are many such defects, but no attention is paid to them; everyone tries in some way or other to justify them as one justifies defects in their beloved, sometimes even turning them into merit.

Being in all respects very accessible, the cinematograph fell into hands into which such a powerful instrument should never have fallen. Up till now the cinema is used chiefly as a means of recreation, and in most cases it cannot be said to be a useful recreation. Comparatively low admission charges and an abundance of picture-houses made the cinematograph accessible to all, and old and young alike thronged to this kind of entertainment. It is very deplorable that such a powerful weapon for the attraction of attention as cinematography takes almost without exception no part in either school education or in the education of the masses. Only quite recently someone began to pay attention to its educational side, and attempts, yet feeble and lacking sufficient organisation, are being made in this direction. I remember that a year before the war in Germany a society was formed to take up the pursuit of instructive and educational objects. This society had a very large programme, with solid scientific forces behind it. I am not aware what happened to it, and I am equally ignorant as to whether any similar attempts were made in other countries, but it seems to me that it is necessary to give more attention to this subject. No one will deny that memory, aided visually by an interesting exhibited subject, will leave our ordinary methods of memorising far behind, and with a rightly and fully planned cinematographic, scientifico-educational programme, courses in many sciences can be considerably facilitated and accelerated.

At the present time, when every child visits the cinema, all interest in ordinary monochrome pictures disappears, and even if the latter could be made attractive to a certain degree it aids memory very little. The argument that application of the cinematograph to education is dangerous is true to a certain extent, but with correct organisation this argument cannot be regarded as a serious obstacle, especially at the present time when the technique of this art is very well developed. In any case, I do not see any danger to the multitude which would surpass the danger of shows in any ordinary picture-house. Certainly, for a small school the cinematograph in its present technical state is not accessible. The necessity of powerful sources of light is in itself the great obstacle, yet I understand such attempts have been made in France.

It seems to me that at the present time there is outside of the cinematograph a powerful means to attract the attention of children and adults as well and by means of a visual memory to fix in their minds everything shown. This can be brought about, I think, by the development of colour photography, which is beyond the competition even of such a powerful adversary as the usual film of a picture-house. Having shown in Russia for over ten years pictures from Nature and life by means of optical colour projection in schools, and to a public of every description, I had sufficient opportunity to be convinced that with suitable explanation everything shown is assimilated with remarkable rapidity and ease and remains in the memory, if not for ever, at least for a very considerable time. Having made myself several thousand colour photographs of Russian scenes for my projections, I was much preoccupied with the problem of ascertaining the method which could be employed for the preparation of colour diapositives from monochromatic negatives for propagation in schools, because although I could show my projections, the optical appliances were expensive and complicated, and therefore quite out of reach of the schools. I regarded such a problem as quite insoluble even by means already existing, because if elementary schools are to use would-be colour pictures it is necessary to count upon conditions which will be admissible to such schools in all respects.

I must add that I had in view not exclusively Russian schools, but elementary schools in general, because if this problem is solved, then all others are solved.

After thorough consideration, I came to the conclusion that to be successful, the following conditions are necessary:—

1. Complete transparency of a picture.
2. Small cost.
3. Possibility of mass production.
4. Durability of coloured ingredients composing the picture.

If we examine these conditions we shall see their indispensability from the following considerations:—

1. The first condition is indispensable, because in the majority of cases primary schools have no powerful source of light, and with weak sources all the now existing methods will produce very weak pictures, thus losing all effect, or probably the picture would not appear at all.

2. The second condition—*i.e.*, cheapness—follows as a matter of course, and no explanation is needed.

3. Third condition—possibility of mass production, is certainly indispensable, since to satisfy the needs of the schools it is necessary to produce simultaneously and in large quantities. Not one of the methods existing at present, including colouring of the monochromatic diapositives, offers a solution. Besides, it is desirable that the schools should have permanent collections of pictures of their own, and not get them at various intervals "by chance," as it has been, and is, practised in certain places.

4. Fourth condition.—Durability is very important, because schools, even with adequate means, will not be able to change pictures which lose colour very quickly.

The methods for the producing of colour diapositives for the projection lantern existing at present can be divided into three groups:—

1. Autochrome and other similar methods—all of which do not answer the four conditions mentioned above.

2. Different methods of gluing together films to films or to a glass; these methods do not either answer the above conditions, and have besides the additional defect of ungluing on account of the heat of the lantern.

3. Colouring of the diapositives, even if made sometimes with very transparent colours, does not answer the principal conditions.

Having been occupied with this difficult problem for the last eight years, I have come to the conclusion that the principle of three separate regions of the spectrum—*i.e.*, the principle of the three separate negatives is the most advantageous one, because it allows a large amplitude in the ratio of exposures, and these negatives can be utilised for another very useful purpose—*i.e.*, for optical colour projection and for producing colour prints typographically.

Thus negatives can be utilised completely, while the preparation of divided negatives during the execution of certain systematic tasks will represent the largest expenditure.

Having accepted as a basic this principle of *three separate regions of the spectrum and three separate negatives*, we at once meet with very serious difficulty, namely, the impossibility of fixing animated objects. S. DE PROCOUDINE GORSKY.

(*To be continued.*)

BLUENESS OF WATER EFFECTS IN THE PAGET PROCESS.

At the meeting of the Royal Photographic Society on February 3 last Mr. Geoffrey E. Whitfield, of the Paget Prize Plate Company, read a communication entitled "Surface Reflection Effects," in which he dealt with the cause of the exaggerated blueness of water as rendered in the Paget colour process. His paper evoked a good deal of discussion, the report of which, in the R.P.S. Journal for March, we therefore append to the text of the communication.

He said that it had frequently been found when photographing by the Paget colour process that there was a pronounced blue colour in the reflection from wet surfaces, such as sheets of water or streets after a shower of rain. He showed a few lantern views taken on Paget colour plates to illustrate this condition. The blueness of a pond was remarkable, far more so than the sky, and he did not think that, except for the water,, the blue in the picture as a whole was too pronounced.

This excessive blue could be got rid of by putting in a filter which would absorb ultra-violet, this filter being used in addition to the ordinary filter. It might be assumed, therefore, that this extra blue was due to ultra-violet, more especially as it was only on the plate, not in the visual impression, that the blue was so evident. If this was the case, the question arose as to where the ultra-violet came from. It was well known that light reflected from water was polarised to a certain extent, and that the extent of the polarisation depended on the angular reflections. This could be demonstrated by looking at water through the Nicol prism. Polarisation meant that the light was split up into two beams. One was totally reflected from the surface and the other was absorbed. He thought it possible that the explanation of the ultra-violet appearing in this case might be that the absorbed beam—*i.e.*, the beam that went into the water—was specially selected according to the wave-lengths of the constituents, and very short ultra-violet waves might be reflected out of the water again, while the remainder were absorbed. If this was the case there would be reflected from the water surface, not only the ordinary reflected beam, but the ultra-violet of the otherwise absorbed beam, which would, of course, produce this extra amount of blue. This was purely a theory, and he hoped afterwards there would be some discussion upon it.

After showing by an example that the same effect was obtained in the case of street surfaces after rain, he said that with a Paget colour plate on a dull winter day it was very difficult to get a satisfactory picture out of doors; the pictures always came blue, and the worse the day the bluer the result, and if it were raining the blue was still more pronounced, but there was possibly another cause for this. The atmosphere was largely made up of particles of moisture and dust. Taking a bottle of water to which was added a little silver nitrate, he photographed it before a window. Part of the bottle was photographed by transmitted light and gave a dull representation of the scene outside, while the edges of the bottle were photographed by reflected light—by the light of the room—and were a pronounced blue. The transmitted light met the minute particles of suspended matter, and the very small wave-lengths of blue and violet and ultra-violet did not get through. They were not able to get round the particles and were thus not recorded on the plate. In the case of the reflected light the opposite thing happened. The longer wave-lengths went into the bottle, and the shorter wave-lengths were reflected back on to the plate, producing a blue colour. The portion of the subject which was taken by transmitted light had no blue, but a decidedly orange tint. This was very likely the cause of the atmosphere always appearing rather blue to the eye. The blue rays were reflected from the atmospheric particles entirely while the other rays were partly absorbed, with the result that a slightly blue light was reflected to the eye. When using a camera, ultra-violet would be reflected along with the blue, and, in the absence of an ultra-violet absorbing filter, would produce too blue a result. Possibly there might also be some polarisation taking place as well from the moisture particles. When the sun was setting we got the same result as by transmitted light through the bottle—that is a minus blue result—the blue waves being unable to penetrate the atmosphere and the rest of the rays coming through to the camera. This would account for the orange colour of the sun and light in general when the sun was very low, especially in winter, when the atmosphere was thick, and also for the somewhat blue colour of the atmosphere when the sun was higher.

The way to stop the blue effect was to add a filter capable of absorbing the ultra-violet. Of the two filters commonly used for this purpose, one was aesculine and the other Filter Yellow K. The first was colourless, but kept very badly. The other was yellow, and in addition to absorbing ultra-violet absorbed blue, which threw out the whole colour balance. Possibly aesculine could be put on the taking screen instead of on the filter, the taking screens not being usually subjected to the light so much as the filter.

In conclusion, he showed a colour picture in which a girl's face was represented unduly red in consequence of a red reflector in the vicinity. It showed the great influence that surrounding coloured objects have on the colour of the subject. When working monochrome one had always got to look out for reflections, but in colour photography it was not only a case of reflection, but of colour reflection in addition. It was necessary to be careful of the colour of the surrounding objects. It would sometimes happen that a result appeared to be quite untrue to the subject, and yet further investigation would show that at the time the photograph was taken the conditions were such as made it a perfectly accurate representation.

MR. W. B. FERGUSON said that he noticed that in Mr. Whitfield's pictures of water, though the lakes and rivers were much bluer than the sky, they were also very much darker. When any object, on being exposed in white light, showed colour, it was generally admitted that, some of the light being absorbed and some not, the colour one saw was due to the light which was not absorbed. If whitish light from the sky fell on water, part was absorbed and part reflected. There was something in pure water—the purest water in nature was that of the Lake of Geneva, which was intensely blue—which absorbed yellow and orange rays. It seemed to him that with the light (approximately white light) from the sky falling upon any water, a certain amount of yellow light would be absorbed in that water, and therefore the light not absorbed must be white light minus yellow, and accordingly bluer than it would otherwise be. This might furnish an explanation of why the reflected image of the water was bluer and much darker than the sky. Against this view, of course, was the statement of the lecturer that a screen the gelatine, but tannic acid is found best. Thus the gelatine of the green coloured picture areas is rendered hard, and will not absorb the next following red dye solution if immersed for a brief time. This obviates the necessity of applying the waterproof resist a second time, thus reducing the time, labour and cost considerably.

By the improved method the means for water-proofing the film for selective colouring of the picture image areas not only has the advantage of manufacturing a positive film which can be distributed and used in the regular standard projector in all moving picture theatres, but also lends itself to the production of more natural shades of colours of the varied subjects, by it being practicable to vary the tints and densities of the green and red coloured picture areas governing it, as the particular colours of the various subjects or scenes would require. This cannot be commercially and satisfactorily accomplished with the methods employing recurring projecting colour filters. It is found in practice that a set of colour projecting filters is not always entirely satisfactory for showing colours from films of various scenes; of course, the colour filters could be changed, but it is not feasible nor practicable to leave it to the operator of the picture theatre to change or adjust the colour filters, as by the method here described the finished tinted film ready for the market will have tints of the required density to produce satisfactory results in colours for each subject or scene.

In the drawings A designates a positive moving-picture film printed from a negative made by the aid of a colour screen having primary colour filter sections through which colour-separated picture sections are taken. In tinting the film A a waterproof resist, cover or blanket B is employed. This comprises a strip of cloth which has spaced openings b equal in size to a picture section, and in a case where it is desired to tint alternate sections a, a^1 of the film A, green and red respectively, the openings b are separated by a blank area b^1, also equal in size to a picture image section of the film A. The under-surface of the element B is covered with a solution of rubber, so that the element B can be caused to adhere to the film. The film and waterproof cover are so applied that the openings b will register with one set or group of picture images and the blank portion b^1 will register with the other set or group of image sections. The waterproof cover B can be of the same width as the film, as shown in fig. 1, and be devoid of perforations for the gear wheels, or it may be provided with perforations b^2 along its edges to register with the perforations of the film, as shown in fig. 4. The method of utilising the waterproof resist or cover B has been fully explained, and by its use the positive film will have alternate sections tinted red and green, as shown by the differently shaded picture sections in fig. 3, these sections being designated red and green respectively by the reference characters R and G. It will be understood, however, that more than two colours may be employed, and in this case the waterproof resist will have the openings further apart so that more than one set of picture image sections will be blanketed at a time and protected from the effect of the tinting dye utilised for tinting the uncovered or exposed picture sections.

IMPORTANCE OF COLOUR PHOTOGRAPHY FOR SCHOOLS AND THE COMMUNITY IN GENERAL.

(*Continued from page* 15.)

As we know very well there is no camera existing which could get three pictures through three regions of the spectrum simultaneously and with the necessary speed. It is true attempts have been made to produce something like it, but they still remain attempts, and patents lodged on this subject have no sign of realisation. Moreover, if we give up the idea of reproducing not only animated objects, but also unanimated objects, which may move for certain reasons, then we must give up the idea of supplying schools with any kind of systematic material. Therefore, pictures scrapped from "dead nature" only remain, and all work is futile.

Readers must not imagine that I have not tried to procure such a camera; all leading firms have had my requirements made known to them, but the result was in the negative, and I had almost given up all hope, when I determined to construct such a camera myself.

My whole process—now completed—took a great deal of time and work. It was necessary to invent and construct many very complicated appliances to attain the final end. *I am far from saying that the problem of colour photography has been finally solved by my own work, my task was to propagate colour photography amongst large numbers of people, even though only in the form of a good substitute for a reality.* The near future, however, will show how far I have succeeded in attaining this object, but as for myself I am quite confident, as many thousands of colour diapositives have been made by this process and had a great success in schools. As the production of three pictures from one and the same object was possible only by means of prisms or mirrors, and in any case with considerable loss of light, and consequently with the impossibility of taking a photograph rapidly, I selected the principle of the motion of the film in the cinematographic camera. I have chosen the same breadth—9 cm., with the only difference that the film has no perforations and moves every time only for three pictures through corresponding screens. The designing of such a camera took a very long time, and I had considerable difficulties, especially as the film was so broad.

At present this problem is solved, and the construction of the camera is being carried out in England.

The work with such a camera will be quite easy, which is very important, as will be seen later on. The control of the ratio between exposures for separate regions of the spectrum at different intensities of light is accomplished with ease and rapidity, and this is most important with such a method.

The fact that negatives are made on a film and not on a glass plate is important, because it is easy to transport such negatives, and there is no danger of breaking them. With this apparatus it is possible to take not only snapshots, but also negatives of long exposure.

The additional work is done as follows:—From one of the regions of the spectrum of this negative the positive is made on a plate covered with emulsion, which is able to receive further chemical treatment. The printing of the positive is made on a special machine which can easily make five hundred copies of one and the same subject in an hour. In one working day four thousand can be made, so the question of quantity depends on the number of machines employed. This machine can be controlled by one man.

After simultaneous development of the whole number of positives, the latter, also simultaneously, are treated chemically so that they get colour complementary to that of the region of the spectrum, from which they were printed. Afterwards the positives are put into an apparatus when the emulsion mentioned above is poured over them. After the emulsion is dry, the positives again enter the printing machine, which not only prints on this emulsion the second spectral region, but also simultaneously and exactly superposes the second picture on the first one. The image corresponding with this second spectral region undergoes conversion into the second complementary colour, and the same operations are repeated with the third.

All intermediate operations of chemical treatment are executed by machines as well, and thus many positives can be made in a very short time and with little labour.

While devising the printing machine I met one very important difficulty—to keep the time of the exposures absolutely exact, so that the whole number of diapositives of the same subject have the same quality.

There are several time switches and similar apparatus, but all of them are unsuitable, because they do not automatically give the exact time of exposure. Therefore I devised such an apparatus myself. This apparatus works independently of human control, and is connected with the printing machine. It can be fixed for an exposure time from one to more seconds.

All the above may appear very complicated and slow, but it must not be forgotten that machines are working, and that thousands of lantern slides can be executed simultaneously. Certainly, such work cannot be accomplished in an ordinary laboratory, but must be carried out in a factory specially provided for this purpose.

With the possession of such a camera schools can be supplied regularly and systematically, but it is necessary to have a proper organisation, as the process—no matter how thoroughly it is executed—alone is not enough.

From my point of view, this organisation must consist of the following :—

First of all there must be a staff to take photographs, *i.e.*, produce negatives. Such a task could be undertagen by the schoolmaster alone, or with the help of more or less grown-up people.

It is impossible, in reproducing pictures of any country, to have special operators in every part. Schools are spread everywhere, and school people know all the places of interest in their locality very well. Besides, children as well as adults take an interest in photography, and, knowing the importance of their task for all countries in the world, they will be exceptionally interested. It is even possible to fix a certain fee for every well-executed negative. This plan has two advantages—first, the work is in reliable hands; secondly, at a minimum of cost, which is not a minor consideration if one wants cheap diapositives.

The work with the camera is so simple that every schoolmaster can easily manage it. A far more serious problem is the personnel of the higher authorities of big centres. Their problem is to give instructions to makers of negatives of what must be taken in this or that place, and it is not sufficient to give only numeration of objects to be taken, but to explain how the photograph must be taken. For instance, in a certain locality with a wealth of ancient customs, it is necessary to point out that people dressed in national costumes must be taken from three points, namely, from the front, back and side view. The same also applies to geographical photographs; it is necessary to say from which point the photograph is to be taken. In course of time there will be very important material, and it will be a great honour to the country to offer this material for the purposes of education. Naturally, this work will take some time, but it is necessary to work out such a programme only once, and then complete it from time to time.

The negatives, when developed, must be sent to a special institution, where they will be sorted and sent to the factory for manufacture in the required quantities, and the larger the number the cheaper the coloured positive for schools.

In such a way all rarities worthy of attention in a museum can be reproduced, etc., but before that I think it is better to study one's own country first and then others. The results of such a study, through looking at colour reproductions, are very fruitful in many respects.

Photography penetrates into all domains of knowledge. To many sciences it is not only of assistance, but is the essential substance, as, for instance, in astronomy, medicine, etc., and yet the fully deserved attention is not bestowed upon it. It seems to me that this subject, within certain limits, must be made an obligatory study.

Apart from schools, colour projection, accompanied by "living words," may constantly be demonstrated to masses of people in large centres where electric power is obtainable. I have often had the opportunity of convincing myself that great interest is taken in such lectures. This projection may be executed from negatives received from the schools, but generally monochromatic diapositives are made from each negative and are projected in large dimensions on a screen by means of a special lantern. This colour projection—real optical projection—leaves Autochrome and all similar methods far behind, and always calls forth the enthusiasm of the audience. By means of such a projection in suitable dimensions of the picture, real reproduction of nature and generally of all objects taken is made. There is no colour exageration, and the eye sensates real nature and not a picture.

Certainly, such an arrangement, *i.e.*, exact superposing—on one and all—of three pictures through three coloured screens is a slow process, but if it is done at once it serves continually, and therefore the most advantageous condition for such projection is a permanent hall where the apparatus is fixed and will not be moved. Wth such an optical apparatus colour projection was shown for the first time by Mr. F. E. Ives. This apparatus was modified by myself, and from the point of view of rapidity of arrangements and quality it gave better results, and, having shown my pictures in different parts of Russia by means of this apparatus, I had absolutely no competitors, not even Autochrome, which made its appearance long ago, and which remains within close limits of private circles. More than a hundred projections shown by myself plainly convinced me of the great interest of audiences, regardless of their composition. It is only necessary that the show be accompanied by verbal explanation; no lecture is essential, but just a simple explanation of what is being shown. The best thing is for the man who took the pictures to give the explanation, but in any case someone who understands the subject and not a layman, as an audience takes exception to this, and such a lecture will spoil half the work.

Neither cost of the apparatus nor wages of the small staff required can be a hindrance to these shows; at the very worst, a very small admittance fee can more than repay the purchase money.

In conclusion of this article on the utility of colour projection for schools and the public in general and the necessity for the same, I may add that many objects in ordinary monochromatic reproduction give not only a wrong impression, but often cannot reproduce at all. Ordinary photography is especially helpless in the reproduction of the vegetative world, in geology, ethnography, etc. It reproduces rather the shapes of the objects, and not the contents of it.

S. DE PROCOUDINE GORSKY.

LANTERN SLIDES FROM PAGET COLOUR NEGATIVES.—It is a good plan when making lantern slides from $3\frac{1}{2}$ by $2\frac{1}{2}$, or smaller negatives, by the Paget colour process, to provide the negative on its glass side with a narrow mask or safe edge. If this precautionary measure is not taken there is a tendency for the picture to be veiled for a considerable distance from its margin: due to reflected light round the negative. If any colour photographer is in doubt as to the truth of this assertion, he has only to make two transparencies, one from a masked negative, as suggested, and the other from one not so treated. I venture to predict a striking difference between the two. My own plan is to attach strips of lantern slide binding divided down the middle; to the glass side of the negative, for of course no attempt must be made to put anything between the plates that would prevent perfect contact and consequent correct "dot formation."— R. M. F.

which operations can be automatically effected in proper sequence by mechanically associating the plate-changing, filter-changing and shutter-operating gear.

In fig. 1 *a* is a disc pivoted at *b* and having four circular apertures formed therein; one aperture *c* is left blank and enables ordinary photographs to be taken when desired, for which purpose an ordinary iris *o* is employed in association with the optical system in the usual way, the iris *a* being maintained at full aperture when exposures through the filters are being made. The next aperture is provided with a blue filter *d*, and iris *e*, an iris-operating handle and pointer *f* and a scale *g* for enabling the diameter of the effective aperture through the iris *e* to be easily ascertained. The next aperture is provided with a green filter *h*, an iris *i*, an iris-operating handle and pointer *j* and a scale *k* for enabling the effective diameter of the aperture through the iris *i* to be easily ascertained. The last aperture of the series is provided with a red filter *l* which is also provided with an iris *m* an iris-operating handle or pointer *n* and a scale *z*.

The disc *a* may be rotated by a spring and controlled by an escapement device of suitable form to enable a step-by-step movement to be made by the disc *a* for disposing the filters in front of the optical system in proper sequence. Starting from the position indicated in fig. 1 which shows the blue filter *d* in place, the first operation might expose a plate; the second operation might simultaneously change the plate and release the disc *a* so as to place the red filter *l* in position; the third operation might expose another plate; the fourth operation might simultaneously change the plate and release the disc *a* so as to place the green filter *h* in position; the fifth operation might expose another plate, and the sixth operation might change the plate and release the disc *a* so as to bring the clear aperture *c* in front of the optical system.

To enable the above series of operations to be repeated the disc *a* is rotated by hand backwards by means of the handle *p*.

Whatever may be the mechanism or the sequence of operations employed it is absolutely essential for good results that the exposures through the three filters should be made with the smallest possible time interval between them. To attain this result the actual exposure time period through each screen is made constant and the aperture for each exposure is suitably modified to enable this to be done.

The necessary modification is effected by varying the effective diameter of the iris *i* and the effective diameter of the iris *e* relative to the effective diameter of the iris *m*.

Assuming that a lens having 150 mm. focal lengths is employed, the manufacturers have marked the packet of plates 6, 9, 12, for the blue, green, and red exposures respectively, and it is decided to stop the lens down to *f*/8. The effective diameter of aperture

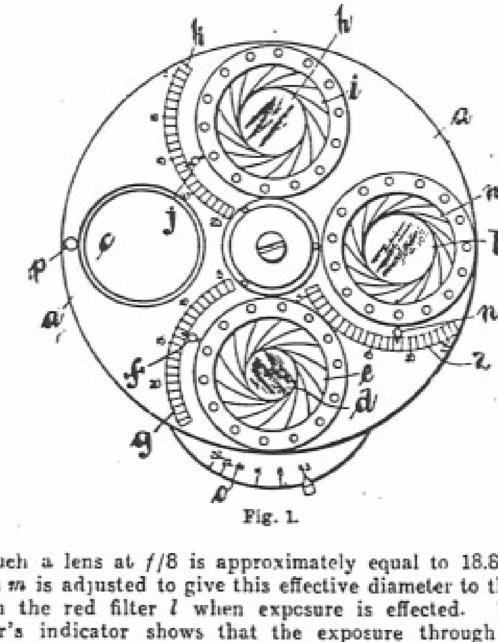
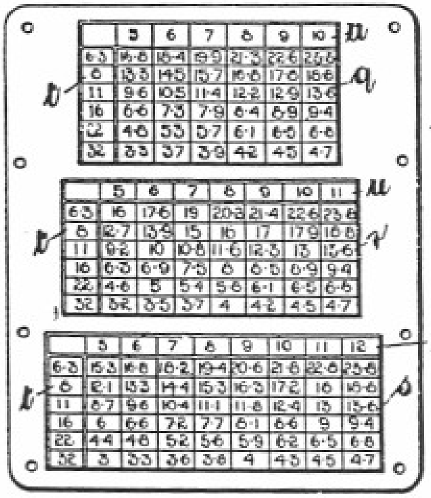


Fig. 1.

with such a lens at *f*/8 is approximately equal to 18.8 mm., and the iris *m* is adjusted to give this effective diameter to the aperture through the red filter *l* when exposure is effected. The manufacturer's indicator shows that the exposure through the green filter is to be three-quarters of that through the red filter, accordingly the area of the effective aperture of the green filter *h* is made three-quarters of the area of the effective aperture of the red filter *l* by moving the pointer *j* to a position on the scale *k* which indicates that the diameter of the aperture of the iris *i* is approximately 16.3 mm.

The iris *e* of the blue filter *d* is similarly adjusted and its pointer *f* is moved to a position on the scale *g* which indicates that the aperture of the iris *e* is approximately 13.3 mm., that is to say the ratio of the effective areas of the apertures through the blue and red filters is as 6 is to 12.

Referring to fig. 2 the tables *q*, *r*, and *s* enable the required diameters to be readily ascertained. The table *q* is for use when the highest value in the manufacturer's indicator is ten, the table



	5	6	7	8	9	10
6·3	16·8	18·4	19·9	21·3	22·6	23·8
8	13·3	14·5	15·7	16·8	17·8	18·6
11	9·6	10·5	11·4	12·2	12·9	13·6
16	6·6	7·3	7·9	8·4	8·9	9·4
22	4·8	5·3	5·7	6·1	6·5	6·8
32	3·3	3·7	3·9	4·2	4·5	4·7

	5	6	7	8	9	10	11
6·3	16	17·6	19	20·3	21·4	22·6	23·8
8	12·7	13·9	15	16	17	17·9	18·8
11	9·2	10	10·8	11·6	12·3	13	13·6
16	6·3	6·9	7·5	8	8·5	8·9	9·4
22	4·6	5	5·4	5·8	6·1	6·5	6·8
32	3·2	3·5	3·7	4	4·2	4·5	4·7

	5	6	7	8	9	10	11	12
6·3	15·3	16·8	18·2	19·4	20·6	21·8	22·8	23·8
8	12·1	13·3	14·4	15·3	16·3	17·2	18	18·8
11	8·7	9·6	10·4	11·1	11·8	12·4	13	13·6
16	6	6·6	7·2	7·7	8·1	8·6	9	9·4
22	4·4	4·8	5·2	5·6	5·9	6·2	6·5	6·8
32	3	3·3	3·6	3·8	4	4·3	4·5	4·7

Fig. 2.

r is for use when the highest value in the manufacturer's indicator is eleven and the table *s* is for use when the highest value in the manufacturer's indicator is twelve and obviously more tables may be employed if desired.

The first column *t* of each table refers to apertures in focal units which are the effective apertures employed with the filter associated with the highest value the top row *u* of figures in each table refers to manufacturer's exposure indicators and the intersections of a horizontal line through the aperture in focal units employed with such filter and vertical lines through the particular indicators required will give the diameters of the apertures for the other two filters. The dotted lines in tables *s* refer to the actual settings referred to above.

The Gorsky Process of Colour Cinematography.—Particulars of a further stage in the development of the process of colour cinematography invented by Professor S. de Procoudine Gorsky are given in the December issue of our contemporary, "Conquest" (The Wireless Press, Henrietta Street, London, W.C.2, 1s.). These relate to the design of the camera, or rather of the optical device by which three separate images are obtained from a single viewpoint. Professor Gorsky divides his light before it enters the lenses, and uses for this purpose a system of three right-angled prisms. The longer sides of two of these are coated with bands of reflecting silver deposit. In the case of the prism which receives the light from the subject the bands occupy two-thirds of the space, each band being twice the width of the intervening bands. By this prism one-third of the light is transmitted and two-thirds reflected to the second prism, which in turn reflects one-third and transmits one-third. The three separate pencils of light, traversing different optical parallel paths, are taken up by three lenses, which form corresponding images on three separate bands of film, the gates of the films being placed in "staggered" fashion to the front surface of the prism block. Accessory non-refracting blocks form part of the system as means for equalising the absorption of light. It is claimed for this system, which we believe is a new device in making three-colour negatives, that it provides identical images. Our contemporary, "Conquest," reproduces a number of photographs of the cinematograph camera which has been built by Messrs. Cinechrome Instruments, Ltd., for carrying the system into effect. At the present time Professor Gorsky is at Nice engaged in making a series of films with the new instrument.

FORTHCOMING EXHIBITIONS.

November 4 to 11.—Bournemouth Camera Club. Particulars from the Hon. Secretary, 88, Old Christchurch Road, Bournemouth.

December 9 to 31.—Rochdale Amateur Photographic Society. Particulars from the Hon. Secretary, W. Lord, 10, Derwent Street, Rochdale.

1923.

February 5 to March 3.—Northern Photographic Exhibition, City Art Gallery, Manchester. Latest date for entries, January 12. Particulars from the Hon. Exhibition Secretary, Walter Johnson, 30, Hartington Road, Chorlton-cum-Hardy, Manchester.

March 1 to 8.—Birmingham Photographic Society. Latest date for entries, February 15. Particulars from the Hon. Secretary, J. E. Breeze, 178, Broad Street, Birmingham.

March 2 to 31.—Pittsburgh Salon of Photography. Latest date, February 5. Secretary, Charles K. Archer, 1,412, Carnegie Building, Pittsburgh, Pa., U.S.A.

March 13 to 16.—Exeter and West of England Photographic Exhibition. Particulars from the Hon. Secretary, Frederic G. Tutton, 9, Union Road, Pennsylvania, Exeter.

March 15 to 24.—Photographic Fair, Holland Park Hall. Secretary, Arthur C. Brookes, Sicilian House, Southampton Row, London, W.C.1.

Patent News.

Process patents—applications and specifications—are treated in "Photo-Mechanical Notes."

Applications October 16 to 21:—

Film-Holders.—No. 28,577. Holders for photographic film. C. F. Abbott and Kodak, Ltd.

Printing Frames.—No. 28,017. Method of manufacturing photograph printing frames. P. G. Henry.

Projection Apparatus.—No. 28,181. Micro projection apparatus. F. N. Davidson.

Ferro-Prussiate Papers.—No. 28,430. Production of sensitive ferric film photo papers or bearers. H. L. Shawcross.

Photographic Surveying.—No. 28,507. Photographic surveying. J. W. Gordon.

Automatic Projection.—No. 28,293. Automatic machine for projection of a number of photographic slides, etc. I. O. Bullock.

Cinematography.—No. 28,555. Cinematograph films. E. T. Perken.

COMPLETE SPECIFICATIONS ACCEPTED.

These specifications are obtainable, price 1/- each, post free, from the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.

The date in brackets is that of application in this country; or abroad, in the case of patents granted under the International Convention.

Prism Lens System, for Three-Colour Cameras.—No. 185161. (April 30, 1921.) This invention consists of an arrangement of three prisms, mounted in such a manner that the incident ray, striking the first prism face, is split up into three separate images before entering the lens system. A series of rhomboidal prisms are cemented together, to form one combination prism, which is then mounted in front of three lenses. The coplanar faces of the prisms are partially silvered or rendered partially reflective so that each prism face reflects separate image rays. These are then passed through three lenses on to the sensitive film or plate surface. As the distance traversed by the image forming rays varies in each instance, the lenses must be mounted in such a manner that each will bring the rays to a sharp focus in the general focal plane, when only one sensitive surface is used. The lenses have their focal lengths corrected for use with light-rays of a definite wave-length, corresponding to a region of the spectrum occupied by the rays passed by the colour-filters used.

A variation of the system allows three films or plates being used, the lenses being then placed at equal distances from the prism face. In the case of a cinematograph camera, the film gates are placed in parallel planes to each other, but at different distances from the central axis of the combination prisms. Various methods are provided for correcting distortions of the images. One method is to equalise the path of the light-rays, in the media through which the rays pass, while another for use when ordinary photographic lenses are used, is to place a sphere parallel lens or lenses, in front of the system of prisms or each objective. Serge Michael de Procoudine Gorsky, The Dell, Croft Road, Sutton, Surrey. (Particulars of the construction of the system are given on another page, in the "Colour Photography" Supplement.)

New Books.

Lenses in Use.—No. 187 of the "Photo-Miniature" is a practical guide to the choice and use of lenses, for different branches of photographic work. Some workers do not realise the importance of the lens, or its possibilities and limitations, imagining that one type of lens should be capable of dealing with all classes of subject. That the expert photographer is able to turn out good work even with indifferent tools cannot be denied, but it is readily understood that, given the very best of suitable materials, he would be able to do even better. But with the finest anastigmat some photographers would fail to produce good work, because their knowledge of the instrument they are using is scanty and insufficient. It is with the idea of educating the photographer to the possibilities of his lens, that the present volume is issued, and a careful study of its pages will do much to improve the worker's knowledge, and through that, his work. Lenses of all types are considered very fully, and their possibilities and limitations explained. Portraiture in the studio demands certain qualities in the lens, which qualities are not always found in the modern anastigmat, but the author advises the use of the modern portrait anastigmat, as he considers it a great improvement upon the Petzval type of lens. Soft-focus lenses are not dealt with in this volume, their qualities being explained in No. 184 of the series. To the worker who is endeavouring to get the best out of his apparatus, we commend the present volume for careful study. The "Photo-Miniature" series of booklets are obtainable from Messrs. Tennant & Ward, 103, Park Avenue, New York, price fifty cents, or Messrs. Houghtons', Ltd., 88, 89, High Holborn, London, W.C., price 1s. 8d.

La Technique Cinematographique.—Perhaps the most complete treatise ever published upon the details of the manufacture and display of cinematographic pictures is this volume, in the French language, bearing the above title, from the pen of M. Leopold Lobel. Throughout the 354 pages of profusely illustrated text M. Lobel gives his readers the history of cinematography and the apparatus involved, together with its very latest applications. The mechanism of all the most popular types of projector is most fully explained, and many excellent illustrations and diagrams are given. The illuminant is carefully discussed, and various types of electric arc lamps and machinery for generating the necessary current are described.

The oxy-acetylene system of illumination, which is extremely useful under conditions where electricity is not available, is very fully described, methods of manufacturing and purifying the gases being given. The arrangement and setting of the studio claims a chapter to itself, while the methods of artificially illuminating the studio are very fully described. Many types of cameras are discussed and their advantages explained, while the great variety of camera stands, with their numerous and intricate adjustments, are given very full attention. The chapters upon development and printing of both the negative and positive film are ably written, and should prove of great interest to photographers who cater for this class of work.

A chapter deals with the toning of the positive film, and formulæ are given for both chemical and dye toning. The book is full of good advice for the production of the cinematograph picture, and will commend itself to all workers in this direction. The volume is obtainable from the Librairie Dunod, 47-49, Quai des Grands-Augustines, Paris (VIe), price 32 fr.

Photographs of the Bank of England.—A correspondent writes to say that the work of heightening the Bank of England is to be commenced this month, and that photographers who wish to secure a last negative of this world-famous corner of London should lose no time in securing an exposure.

ordinary acid fixing bath to remove the silver compound. Too long in this bath is not advisable, as the bath attacks the image left, and gradually dissolves it away. After well washing, it should be placed for one or two minutes in a 1 or 2 per cent. solution of hydrochloric acid; the colour is converted by this into a brilliant greenish-blue. The plate should now be washed in repeated changes of boiled or distilled water and dried.

To produce the yellow image, a positive transparency from the blue filter negative is made with films, using either the roll film variety or one of the flat films now on the market. If dried after fixing and washing, it should be thoroughly wetted and placed in the following bath:—

Stock Solution.

(A)	Potassium ferricyanide	124 grs.
	Water, boiled or distilled	$3\frac{1}{2}$ ozs.
(B)	Lead nitrate	124 grs.
	Water, boiled or distilled	$3\frac{1}{2}$ ozs.

Working solution A 1 oz. 6 drs., B 95 mins. Acetic acid, a few drops. This bath should be filtered if it becomes turbid.

The film should not contain the slightest trace of hypo, otherwise spots will form. The image will bleach out white, and then appears to be intensified to a notable extent, and for this reason the transparency should not be developed too strongly. When bleaching has penetrated through the emulsion, well wash until all trace of yellow stain has disappeared, then place in the following bath for a few seconds:—

Stock Solution.

Potassium bichromate	37 grs.
Water	$3\frac{1}{2}$ ozs.

Take one part of above to one part of water.

Wash again until all yellow stain has gone from the high lights, and dry. Varnishing this film with one of the transparent varnishes on the market renders the image more transparent.

It is in printing from the green filter negative for the red constituent image that rather more skill is required. Old and useless films should be fixed out in hypo with a little potassium ferricyanide to clear the emulsion from fog, well washed, and dried. They are then immersed for two minutes in the following solution at 60 deg. F.:—

Ammonium bichromate	27 grs.
Strong sulphuric acid	6 drops.
Water	2 ozs., 1 dr.

Rinsed in clear water and dried in the dark.

Printing is carried out in daylight until the image is well seen in a brownish colour; it is then removed from the printing frame, well washed for half an hour in frequent changes of water—not running water. The film should then be immersed in the following solution:—

Magenta-red dye	16 grs.
Hot water	4 ozs.
Acetic acid	10 mins.,

for about twenty minutes, so as to give the chromated image plenty of time to take up the dye. Rinsing in water made acid with acetic acid until the high lights are clear of the dye completes the operation for the red film.

We now have three positives in their respective three colours, namely, blue upon the glass, and a yellow and red film, and all that now remains is to superimpose the three images on top of one another to complete the picture in all its natural beauty.

The blue slide is first placed in a retouching desk with the film uppermost; upon this is laid the yellow image, and moved about until the two images are in register; a little touch of seccotine is placed on the underside of each corner of the film, and the two pressed well into contact, a cover glass is laid over, and the whole put under pressure for about 24 hours for the glue to dry. Laying the yellow image should be done in daylight, as it is very difficult to see the yellow image during artificial light. We now have the picture in two colours, and if carefully superimposed no fringing of the colours will show. It now remains to fit the red over the green-image, which is done in exactly the same way as with the yellow film, but in this case the picture will be seen in all its original colours; after cementing the corners and leaving to dry under pressure for 24 hours, the picture is masked and bound between a cover glass with lantern strips.

Anyone making these transparencies for the first time will be astonished at the results—shadows are transparent, high light with colour, and the resulting picture more or less under the control of the worker.

The above operations sound more difficult than the operation really is, and the author trusts that it may be the means of inducing many others to take up this branch of photography. The difficulties, if any, are easily overcome with a little practice and patience, and when once a fair start has been made, and the subject thoroughly grasped, there are but few who will have any desire to abandon the work.

FREDERIC G. TUTTON.

THE GORSKY CAMERA FOR COLOUR CINEMATOGRAPHY.

[The patent specification, No. 185,161, for the optical system of a camera for colour cinematography, invented by Professor S. M. de Procoudine Gorsky, and previously mentioned in the Colour Photography "Supplement" of January 6, 1922, p. 4, has now been published. This system consists of three rhomboidal prisms, cemented together to make one combination prism, which is arranged in front of three separate lens systems. Two of these prisms are coated with a reflecting band of silver, and thus three separate pencils of light traverse parallel optical paths, and are then taken up by the three lenses. As the distances which the rays travel are not equal, correction has to be made, either in designing the objectives or in adjustment of their focal lengths, but in a suggested modification to suit a camera taking three separate bands of film this is unnecessary. Three films in this adaptation are fixed at unequal distances from the prisms, so that the optical distances become equal. In a further modification of the system, two prisms only are used, as in fig. 3, and by this means it is claimed that a greater volume of light is allowed to reach the films. The novelty of this optical system is that the original image, received by the first prism, is split into three separate images before entering the lens system, and the corrections which are made for distortion, caused by the prisms, enables three identical images to be recorded on the sensitive surface.]

THE invention consists of an optical system for a photographic camera, comprising a series of rhomboidal prisms arranged in such manner that the light-rays from the object are reflected so as to form three identical images on three picture areas of a sensitive surface. The parallel faces of the prisms, which are coplanar, are provided with a substance having a refractive index differing from that of the glass, or a partially-silvered surface to act as a partial reflector. The reflected rays are passed through lenses situated at varying distances from the prisms and the sensitive surface of the film or films.

Fig. 1 illustrates a method suitable for the simultaneous production of three identical images upon one cinematograph film;

Fig. 2 illustrates a method suitable for the simultaneous production of three identical images upon three separate cinematograph films;

Fig. 3 is a modified form of the invention illustrated in fig. 2.

In fig. 1 the film passes through a gate frame, A, of the usual form having three apertures, A_1, A_2 and A_3, each corresponding to a picture area of the standard cinematograph film, and arranged to expose three successive picture areas. The film, B, is moved forward by intermittent mechanism, which is adapted to move the film forward at each shift a distance corresponding to three picture spaces. A suitable objective, C, is placed in front of each aperture, and in front of the objectives a prism, D, is provided comprising

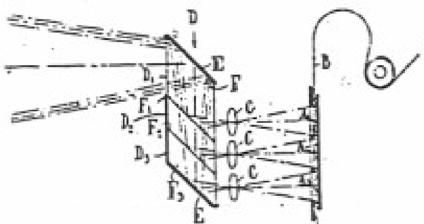


Fig. 1.

three separate prisms, D_1, D_2 and D_3, of rhomboidal section mounted in one frame, E. The separate prisms, D_1, D_2 and D_3, have one pair of their parallel faces coplanar. The rays of light radiating from the object, O, strike against a primary reflecting surface, F, of the prism and are reflected on to secondary reflecting surfaces, F_1, F_2 and F_3, which in turn reflect a certain proportion of the light-rays through the objectives, C, on to the film B. The secondary reflecting surfaces, F_1, F_2 and F_3 are situated at the face of each separate prism, D_1, D_2 and D_3, remote from the primary reflecting surface, F. In this manner three images are produced on the film, B, without lateral parallax.

As the distances the rays travel to each section of the film are not equal, corrections should preferably be made and the linear inequality or longitudinal parallax be compensated. By allowing for the correction of this distortion when designing or calculating the objectives, C, or by the adjustment of the focal length of the objectives, images of the same size are obtained, at the expense of clearness. One of the images may be probably of colour sensations not so accurately focussed while the others important in colour photography are slightly indistinct. It is obvious that owing to the necessity of compensating for longitudinal parallax the objectives, C, will move different distances when focussing, but always in definite relationship to each other. If desired this definite relationship may be maintained by mechanical means. Another form, illustrated in fig. 2, is an apparatus suitable for the simultaneous production of three identical images upon three separate cinematograph films. An optical system is provided of similar construction to that described. The difference is, that the objectives, C, and their corresponding gate frames and gates, A_1, A_2 and A_3, for the three films are arranged in planes parallel to each other, but at different distances from the central axis, G, of the combination prism. This arrangement enables the length of the path of the light-rays from the object to the films to be the same in each case

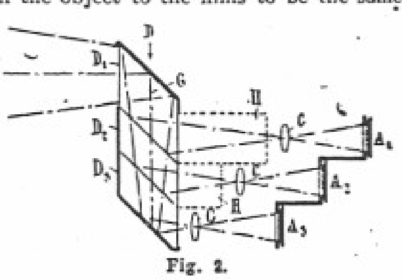


Fig. 2.

and thus eliminate errors due to longitudinal parallax. Another advantage is that objectives, C, of the same focal length may be used to produce identical images. The films are moved forward by intermittent mechanism, which in contradistinction to the previous example, is adapted to move the films at each shift a distance corresponding to one picture space.

As in the first example, the lengths of the paths of the rays in the prisms are different for each image, but in this case and a modification thereof, the degree of distortion is corrected by equalising the lengths of the rays in the substance of the prisms, D_1, D_2 and D_3, and the air in such manner that the length of the medium passed through is the same for the three images. This may be done by placing a correction component. H, between the prisms, D, and D_2 and the objectives, C, this component, H, preferably comprising a prism of suitable length and of the same material as the reflecting prisms, D_1, D_2 and D_3. In this case all three objectives, C, having the same focal lengths can have the same correction due to prism distortion. In cases, however, where absolute correction is not essential the correction of the objectives, C, for prismatic distortion can be neglected and ordinary photographic lenses may be used.

In a modified form, as illustrated in fig. 3, the prisms, D, may comprise two separate prisms, D_2 and D_3 of rhomboidal section mounted in one frame, J, and having one pair of their parallel faces coplanar. The prism, D_1 bearing the primary reflecting surface F (figs. 1 and 2,) may be eliminated and the prism, D_2, which corresponds to the first of the secondary prisms shown in figs. 1 and 2 may be adapted to permit rays to pass through the first of the series of objectives, C, on to the first film area, K. In addition to this a proportion of the rays from surfaces L and L_1 are reflected through the second of the series of objectives, C, on to the second picture area, K^1, and a second prism, D_3, which reflects by the surface, L_2, the rays through the third of the series of objectives, C, on to the third picture area, K_2. By reason of the surface, L, which corresponds to the primary reflecting surface, F (figs. 1 and 2), permitting rays to pass one of the secondary reflecting surfaces is eliminated, and thus more light reaches the sensitive surface of the films K, K_1, K_2. The regulation of the amount of partial reflection from the secondary reflecting surfaces and the penetrability of a proportion of the rays through the secondary reflecting surfaces may be carried out, by the provision at the reflecting surfaces of a substance having a refraction index differing from that of the glass, or by ruling a metallic or other suitable partial reflecting surface on the secondary reflecting surfaces. Thus a portion of the rays of light may penetrate the mirror, while others are reflected. The total reflecting surfaces of the prisms are, of course, plane

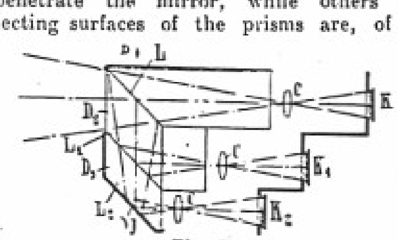


Fig. 3.

mirrors, and may either be silver-plated or simply blackened on their surfaces. When using ordinary photographic objectives the correction of the distortion of the images may be effected either by placing a sphere parallel lens or lenses in front of the system of prisms or in front of each objective so that the images are distorted, the distortion being such that when combined with that due to the system of prisms they will counteract each other. The lens which is referred to as a sphere parallel lens has curved surfaces which, if extended, would form concentric spheres.

Specially designed objectives may be used which correct distortion due to the prisms. In this case the three objectives used are calculated so that their focal lengths are corrected for use with light-rays of a definite wave length, corresponding to those rays passed by the light-filters used. Functions are also introduced for the compensation of chromatic aberration of the rays of the spectral area corresponding to the colour of the light-filters, but the general chromatic aberration of other rays is neglected. The prisms may be attached to each other by means of Canada balsam, which has a refractive index equal to that of the material of the prisms. The partial reflecting surfaces are protected and the light-filters are situated in suitable positions.

COLOUR PHOTOGRAPHY IN SMALL SIZES.

Since owing to the present high cost of colour screen-plates there is a tendency to work a smaller size, the $3\frac{1}{4} \times 2\frac{1}{4}$ size may now be regarded as quite satisfactory. The picture, if cut down slightly, is quite useful for colour slide-making. Colour photography in these smaller sizes demands some precautions, and some notes upon these may perhaps be of service.

The $4\frac{1}{2} \times 6$ cm. or vest-pocket size is almost too small for colour photography, while the saving in cost is not great when compared with the $3\frac{1}{4} \times 2\frac{1}{4}$ size. Perfectly good work may be done with a vest-pocket Kodak adapted for plates, but there