Ira S. Bowen, of the California Institute. Mr. George Eastman, and Dr. C. E. K. Mees, director of his research laboratory, have offered fullest co-operation in the study of special photographic problems. Dr. Ambrose Swasey, chairman of the Warrers-Swasey Co.; Mr. Gano Dunn, president of the J. G.

White Engineering Co., and recently chairman of the National Research Council; Dr. Frank E. Ross, of the Yerkes Observatory, and others equally well known, will aid in the work of design, and many other scientific workers especially qualified will be available for consultation.

Processes of Colour Photography.

By F. J. TRITTON.

COLOUR photography is one of the few branches of photography that has made relatively little progress of recent years; in fact, for the last twenty years there has been nothing fundamentally new to record, if a recent invention to be referred to later be excepted.

There has, however, been a steady improvement in technique and a series of variants on known processes, which have made plainer the limitations and possibilities of this branch of photography. Also, for some reason which is difficult to define, there has grown up a distinct re-awakening of interest in colour photography, which is perhaps best exemplified by the recent formation of the Colour Group of the Royal Photographic Society. Considering its youthfulness, this group has had a highly successful first year and seems likely to develop steadily. Possibly the undoubted popular interest in colour cinematography has had something to do with this revival of interest in colour among the photographic community.

The foundations of colour photography were laid by Clerk Maxwell, Ducos du Hauron, Chas. Cros, and a few others between 1857 and 1870, but practical applications could not be very successful since colour sensitive plates were unknown. The first step in this direction was the discovery of the colour sensitising action of certain aniline dyes by H. W. Vogel in 1873. From this the panchromatic plate has gradually evolved, and one of the most remarkable achievements of recent photographic manufacture has been the improvement in quality, speed, and trustworthiness of these plates, culminating just recently in the introduction of the Ilford Soft Gradation Panchromatic Plate, which seems to have been intended primarily for the portrait photographer, but should prove of particular value to the colour photographer when its capabilities are properly explored.

The first successful colour photographs on paper were made by the carbon process by du Hauron, and, despite the advances made, this process is still one of the best. Commercial carbon 'tissues' for trichrome printing were first introduced about 1906 and the formulæ were scarcely altered or improved until quite recent years, when three-colour carbros began to assume greater importance than its parent process. The first step in this direction was the Manly ozobrome process, but the real advance came when, in 1914, Manners introduced his Raydex process, which is now unfortunately extinct, although the inventor is very successfully using his process to produce commercial colour prints in America at the present time.

Meantime, the Autotype Company had introduced three-colour carbros, the materials for which were improved in 1926. In this process three bromide prints are made from the three separation negatives, and from these three carbros prints are made in the respective printing colours on transparent celluloid temporary supports. In this way the action of light is cut out, except in the making of the bromide prints, and a much greater degree of control is introduced. This control is not required for purposes of 'faking' the colour rendering, and, in fact, must only be used in strict accordance with certain set principles or else accurate colour reproduction is impossible. But it is found that with the straightforward carbon process it is frequently difficult to obtain accurate colour intensities owing to the negatives being of the wrong 'gamma' to suit the printing medium employed. With the three contrast grades of bromide paper always available, and with the control over contrast provided by the carbros process, this difficulty disappears. A further great advantage is the ability to enlarge to any convenient degree without extra trouble. The making of enlarged copy negatives was always fraught with many dangers owing to the probability of varying the contrast range of one or more of the negatives.

Provided reasonable care is taken at every stage and all the usual precautions are observed, there is not the slightest difficulty in retaining accurate register of the three colours in greatly enlarged three-colour carbros prints, and undoubtedly this process is now the one most favoured. It is of interest to note that it is now being commercially used in America, France, and England for the production of 'originals' from which three-colour blocks are being made.

In the processes so far mentioned the colours used are insoluble pigments dispersed in the gelatin layer, and in modern commercial 'tissues' or pigment papers they can be considered as completely stable and fast to light, so that the finished picture is permanent.

The other important class of colour prints is based on the use of dyes. The first commercial process was Pinatype, introduced in England in 1905, and still occasionally used. In this process, three 'print plates' coated with dichromated gelatin are exposed behind positives, prepared from the separation negatives, so as to produce differential tanning. When the excess dichromate has been washed out, the print plates are dyed up in the appropriate Pinatype dye, rinsed and squeezed into contact with a piece of damp gelatin-coated

paper. It is found that the untanned portions of the gelatin take up most dye and transfer it to the paper most readily, and, if the exposure has been correct, the tanned portions can be made not to transfer any dye. But in practice this is difficult to achieve, so that the high lights are nearly always stained and the process proved tedious. The dyes used are a special class only manufactured in Germany, the range appears to be limited, and they are not particularly correct as to colour. Compared to many dyes, their fastness to light is fairly good, but they cannot be described as permanent.

A later and much more satisfactory process is the Jos Pé, which again originates in Germany and uses the same dyes, only under a different name. The difference is that the print plate does not consist of an even layer differentially tanned but of a true relief image produced by washing away the soluble portion in hot water. This enables much cleaner and brighter prints to be produced, and some excellent work has been exhibited. In addition, the use of daylight printing is eliminated, since the print plates are gelatino-bromide plates exposed through the back and tanned by the use of a pyro developer deficient in sulphite. This has proved quite successful, but in my opinion pyro tanning is never able to produce the clean sharp image obtainable by chromium tanning.

Further improvements and simplifications along well-recognised lines in both the carbon and imbibition types of processes are very probable, but it is unlikely that they can ever solve the problem of colour photography and make it a process for the amateur.

Undoubtedly, the most important development in this branch of photography is the Martinez patent as improved by Colour Photographs, Ltd. The process is not yet quite ready for marketing, but extensive experimental work is being carried on and a number of demonstrations have been given and prints exhibited. In outline, the process consists in sensitising thin cellophane films in solutions which appear to be based on the use of light-sensitive iron salts. When dry these are exposed under the appropriate separation negatives to daylight or strong artificial light, when they print out very much like P.O.P., but the three types of film produce images which on fixing approximate very closely to the three primary colours. The fixing is a matter of extreme simplicity, water and dilute acid being used for the blue print, which belongs to the common prussian blue class, while hypo is used for the yellow print, and mercuric chloride fixes the red.

An extremely useful part of the invention is that it has been found possible to reduce the colour intensity of all three images; consequently, the correct colour balance can be obtained from any three partial colour images which are approximately accurate and slightly over printed, without having to make fresh prints. This has never been possible with any other process of colour photography; it has always been necessary to start again from the beginning if the print obtained was not accurate.

The three partial colour images are not trans-

ferred as in the carbon process, but the cellophane films are mounted one on top of the other, using a dilute gelatin solution as a cement.

The cellophane used has nearly all the properties which could be desired for such a process. Despite the fact that when wetted it stretches badly, it goes back to its original shape on drying and, most remarkable of all, it is truly elastic, so that if desired it can be stretched to obtain register. Also it will not scratch readily. If the three cellophane films were just cemented together on paper and dried they would curl very badly; this has been got over by the use of a thin sheet of celluloid as a support, the cellophanes being on both sides and so tending to curl in opposite directions.

Some of the prints by this process which have been exhibited are very fine and show accurate colour rendering, but artistically they are spoilt by the sheen on the surface, which is a necessity, since the image consists of sheets of polished cellophane. It is reported, however, that it will be possible to overcome even this. The prints obtainable are not likely to surpass in quality the best three-colour carbros, for example, but there is evidence that they will be distinctly easier to prepare and consequently should prove much more popular. Evidence as to the permanence of these prints over a period seems to be lacking.

There is another aspect of colour photography which is also being exploited by Colour Photographs, Ltd., namely, the production of a commercial 'tripack' which shall take all three negatives at once with any ordinary camera. The idea of the 'tripack' is by no means new, having been fully described in theory by Ducos du Hauron so long as forty years ago. Many inventors have tried their hand at the problems involved and several packs have been commercially marketed, but none has so far lived for long.

Perhaps the greatest difficulty is to obtain three different colour-sensitive emulsions which with unequal exposure but equal development will give negatives of the same contrast range or 'gamma.' Without this it becomes almost impossible to obtain accurate colour balance in both shadows and high lights. But with the resources of the modern emulsion maker, great improvements can no doubt be effected, so that many workers are eagerly awaiting the day when these packs are first marketed.

Some very good colour portraits taken in an ordinary camera with this pack have been exhibited, and it seems probable that the pack will prove most suited to this class of work rather than to outdoor photography, where the requirements as to sharpness and colour rendering are much more exacting.

In this 'tripack' three thin celluloid films are employed, the front one having a thinly coated blue sensitive emulsion and a dye which absorbs all the blue, the second a green sensitive coating and a dye which passes only the red rays, which fall on a special type of rapid red sensitive film. Theoretically this arrangement is quite simple and is the one which has been most frequently used, but it has the

(Continued on p. 701.)

great disadvantage that the red sensitive film or blue 'printer' is at the back and must therefore of necessity lack definition, both on account of the thickness of the films and still more because of the scatter due to the silver grains of the two emulsions through which the red light has had to pass. This defect is quite noticeable in the negatives and still more in the prints, since it is the blue printer which mainly defines the contours of the subject. It is true, however, that this difficulty is nothing like so serious as it was in the earlier packs, because it is now possible to make relatively transparent emulsions which will retain their high speed, and also the rapidity of modern panchromatic emulsions make short exposures quite feasible.

The collection of colour prints on exhibition at the seventh International Congress of Photography recently held in London showed that a high degree

of skill has been attained by various workers, but, except among a very few, there is still a tendency to photograph objects because they have 'colour' rather than because of their artistic beauty, so that a collection of colour prints frequently has an appearance of crudity and brilliance which the exhibits taken individually do not justify.

This, however, is a stage which will be got over as colour photography becomes more popular, as there is every reason to believe that it will. With the increasing number of inventors now concentrating on its problems, and with the parallel advances in colour cinematography, it is evident that colour photography may confidently look forward to a brilliant future, and perhaps some day the inventor's dream may be realised of a grainless colour negative from which paper prints in full colour may be obtained by a single exposure.

On the Study of Popular Sayings.¹

By Prof. EDWARD WESTERMARCK.

WHEN I set out to gain some personal experience of native customs and beliefs and made Morocco my field of research, Sir James Frazer's "The Golden Bough" directed my attention to many facts that otherwise, in all probability, would have escaped my notice. It offered suggestions and explanations, which were none the less valuable because they were not always applicable to the particular data that came under my observation; and it brought home to me the great lesson, never to rest content with recording the mere external modes of native behaviour without endeavouring, so far as possible, to find the ideas or sentiments underlying them. For this reason I desire to render homage to my great teacher by stating some general results of my experience as a field anthropologist.

It has been said to be a difficult or hopeless task to try to discover why people perform rites and ceremonies, that directly one approaches the underlying meaning of rite or custom one meets only with uncertainty and vagueness. This view is not confirmed by my own observations in Morocco, where I generally found the natives to have quite definite ideas about their rites. But the direct inquiry into these ideas is not the only way in which they may be ascertained. The most convincing information is often obtained, not from what the natives say *about* their rites, but from what they say at the moment when they perform them. To take a few instances. That the fire-ceremonies practised in Morocco, as in Europe, on Midsummer Day or on some other particular day of the year, are purificatory in intention is obvious from the words which people utter when they leap over them or take their animals over the ashes. The Moorish methods of covenanting, which always imply some kind of bodily contact, for example, by the partaking of a common meal, derive their force from the idea that both parties thereby expose themselves

to each other's conditional curses; and the idea that food eaten in common embodies such a curse is very clearly expressed in the imprecation addressed to a faithless participant.

These customs, and the sayings connected with them, have led me to believe that the very similar methods—such as a sacrificial meal—used by the ancient Hebrews in their covenanting with the Deity were intended, not, as has been supposed, to establish communion, but to transfer conditional curses both to the men and their god. That one idea underlying the Moorish custom of tying rags or clothing to some object connected with a dead saint is to tie up the saint, and to keep him tied until he renders the assistance asked for, is directly proved by words said on such occasions. Some similar idea may perhaps be at the root of the Latin word for religion, *religio*, if, as has been conjectured, this word is related to the verb *religare*, to tie. It might have implied, not that man was tied by his god, but that the god was in the religious ritual tied by the man.

While a saying uttered on the occasion when a rite is performed is apt to throw light on the meaning of the rite, there are other sayings that can themselves be explained only by the circumstances in which they are used. This is the case with a large number of proverbs. It has been said that the chief ingredients which go to make a proverb are 'sense, shortness, and salt,' but the most essential characteristic of all is popularity, acceptance and adoption on the part of the people. Figurativeness is a frequent quality, but there are also many sayings recognised as proverbs that contain no figure of speech. On the other hand, there is scarcely a proverb that does not in its form, somehow or other, differ from ordinary speech. Rhythm, rhyme, and alliteration are particularly prominent features.

The proverbs of a people may be studied from different points of view. In many cases their study has been the pursuit of philologists, who have been mainly interested in the linguistic aspect of

¹ From an evening discourse, being a Frazer Lecture in Social Anthropology, 1928, delivered at the British Association meeting at Glasgow on Sept. 7.