Number 8. 1993 ISSN 0962-287X

# Association of Historical & Fine Art Photographers

St georges Hall windsor. before the great fire R.C.H.M. E.
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# JOURNAL

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with thanks to
Caroline Newman

BUCKINGHAM PALACE

26th November, 1992.

Dear Mr Asser,

I am commanded by The Queen to write and thank you for your kind letter about the fire at Windsor Castle sent on behalf of all members of the Association of Historical and Fine Art Photographers. Her Majesty has been very touched by the enormous number of messages she has received expressing sympathy and shared grief at the disaster that has struck such a loved and well known part of the Nation's heritage.

The Queen is only thankful there was no loss of life or serious injury and that most of the treasures in the Castle are safe, thanks to the quick thinking and courage of so many people.

I am to thank you again for your thought for Her Majesty and her family, which is greatly appreciated.

Yours sincerely,

Kenneth Scott.

(KENNETH SCOTT)

Roy Asser, Esq.



Stephen Croad
Royal Commission on the Historical
Monuments of England.

## The Windsor Castle Fire

**The disastrous fire which destroyed part of Windsor Castle on Friday 20th November 1992 has illustrated even more graphically the value of photographic records of historical buildings. The National buildings Record (now part of the R.C.H.M. ) was founded in 1941 when historical buildings throughout the country were at daily risk of destruction. The NBR's task was to bring together existing visual records, principally photographs, but including measured and other drawings, and arrange for photography where these were lacking. It was a job which had to be undertaken speedily and in hazardous circumstances before and after bombs had fallen.**

**After the second World war the work of compiling a national record continued and today the archive contains over 2.5 million photographs of buildings of all types and periods from cathedrals and country houses to factories and farms. In 1986 the NBR began a co-operative venture with the Property Services Agency(then part of the Department of the Environment) to record royal palaces. The NBR undertook pictorial photography of state rooms and private apartments, while the PSA arranged for detailed photogrammetry of interiors. The project began with rooms at Windsor Castle and by great good fortune included some of those destroyed or badly damaged in November's conflagration..**
**The best known of the apartments which has suffered the most is St George's Hall. The walls of this grand 185 foot long gallery survive from the medieval castle, partly Norman and partly 14th century. However, the interior was completely redesigned by Sir Jeffry Wyatville in the 1820s. The wooden panelled ceiling was covered with carved representations of the shields of the Garter Knights. All this was destroyed in the fire, but all had been recorded by photogrammatry. Copies of the survey are held in the Royal Library and by the PSA, which had commissioned the work, but the master copy is held by the NBR. It is from this that it will be possible to derive accurate measured drawings, upon which the restoration will depend.**

**The creation and curation of photographic records remains a vital part of NBR's work and when disasters like the great fire at Windsor occur their immense value is immediately apparent to all.**

NOTES ON SOME OF THE SPEAKERS AND SUBJECTS OF DAY ONE OF THE 1993 CONFERENCE

<u>Melvin Gambettie Davies;</u>
runs a small unit offering high quality B/W printing. The company, Master Mono, specialises, among other things, in modern phototoning techniques. Selective toning coupled with old-fashioned formulas on modern papers gives stunning effects. As a prelude to a workshop we hope to hold next year, he will show some of the effects he can obtain with his indomitable style of toning.

<u>Stephen Weeks;</u>
heads Time Machine Communications a company that has done much to investigate the use of sound in interpreting works of art. The use of sound is increasing as a primary way of communicating cointextural information on art displays, building or heritage sites. The paper explores how this is being done using current examples.

<u>The Periphery Camera of the British Museum;</u>
if unique in the fine art field. It is capable of recording around the full 360 degrees of an artwork by moving a strip of film past slits of varying sizes whilst synchronised to a revolving turntable. Ivor Kerslake, a member of the Photographic Department of the British Museum will explain the system.

<u>David Lambert of The Tate Gallery Photographic Department;</u>
will reveal the technique he has developed in duplicating colour transparencies with in-house equipment. Over the past few years he has saved his department many thousands of pounds.

<u>Richard Bayford of the Imperial War Museum;</u>
will complement the talk by showing the system used in his department.

The Imperial War Museum has a negative collection in excess of 5,000,000 dating back to the early part of the last century. Although the Museum has been aware for many years that conservation was a high priority very little had been achieved. Ron Brooker, the Chief Photographer will explain how after much research the programme is now under way.

<u>The Bridgeman Art Library;</u>
was started in 1972 as a photo library specialising in fine art subjects. It now covers a much wider range and represents over 500 museums, art galleries, institutions and private collections. With over 61,000 large format transparencies the collection is growing daily. Harriet Bridgeman will describe the functions of a photo library, its sphere of activities and the advantages of institutions and others contracting their photo libraries and marketing of their images to them. She will also talk on the impact and advantages of electronic digitalising.

## WHAT IS PHOTOGRAMMETRY?

An abbreviated version of a paper read to Association on 1 October 1992.

Ernie Wickens, Carl Zeiss (Oberkochen) Ltd.

Photogrammetry is defined as "the science or art of obtaining reliable measurements by means of photography". It is a non-contact form of measurement. Unfortunately, some photographers seem to treat photogrammetry with caution and even with an air of mystery. I suspect they fear the subject is highly mathematical and demands instruments and special cameras far too complicated for them to understand.

It is true that theoretical photogrammetry does demand a sound understanding of mathematics and, certainly in the past, precise and quite ingenious instruments have been required.

I speak as a practical photogrammetrist and not as a mathematician. I hope that I will demonstrate that the fundamentals of photogrammetry are really very easy to understand.

The primary application of photogrammetry is the making of maps from nominally vertical aerial photographs and I shall illustrate most of the principles in this context because generally people find this an application with which they can easily relate.

So why do we need photogrammetry? Why can we not just take a near vertical aerial photograph and use it as a map? Assuming that we want our map to be at a uniform scale, and also to give us some measurement of the differences of height on the ground, then there are two reasons why we can not do so. Firstly, the photograph will not be at a uniform scale for the simple reason that the ground at the top of a mountain will be nearer the camera and, therefore, will image at a larger scale than the ground at the bottom of the mountain. Secondly, because at the instant of exposure the aeroplane will almost certainly be tilted to a small degree the camera will not be pointing vertically downwards. The resultant photograph will not be at a constant scale because, in effect, a wedge shaped piece of ground will be imaged on the square format of the camera.

We see, therefore, that the only time we could use our basic photograph as a map would be if the ground was totally flat and the camera was pointing vertically downwards at the time of exposure. In fact what we are really saying is that the focal plane of the camera would need to be parallel to the plane of the flat subject.

As this situation is extremely unlikely to exist, it is necessary to have a method of recording the information required for our map at a uniform scale and also to measure the differences of height on the ground so that we may depict relief on our map be means of contours, spot heights or colour layers. We need, therefore, to obtain three dimensional measurements from our photographs.

How do we obtain three dimensional measurements from our two dimensional photographs? In order to explain this let us depart for a few minutes from our aerial survey application and look at figure 1. This represents a plan view of a very basic land surveying problem. A surveyor is able to visit points G and H and needs to know the distance to an inaccessible point J. He can measure the distance between G and H using a tape or some electronic or optical means. He can use a theodolite (a precise instrument for measuring angles) to measure the angles GHJ and HGJ. Knowing two angles and one side of the triangle he may calculate the third angle and then use the sine rule to calculate the length of the other two sides and hence the position of point J.

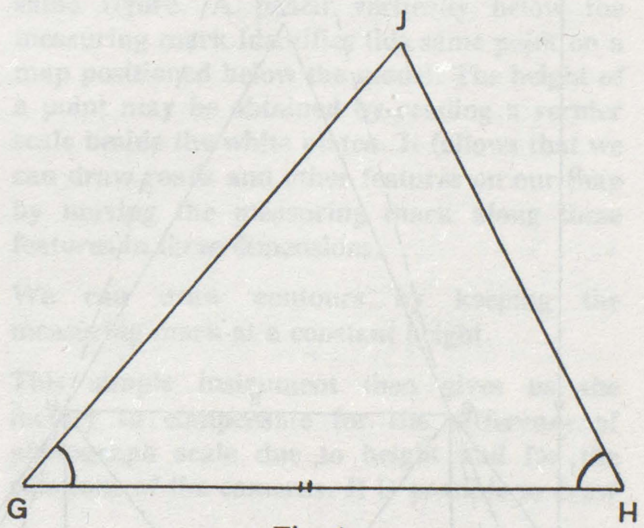
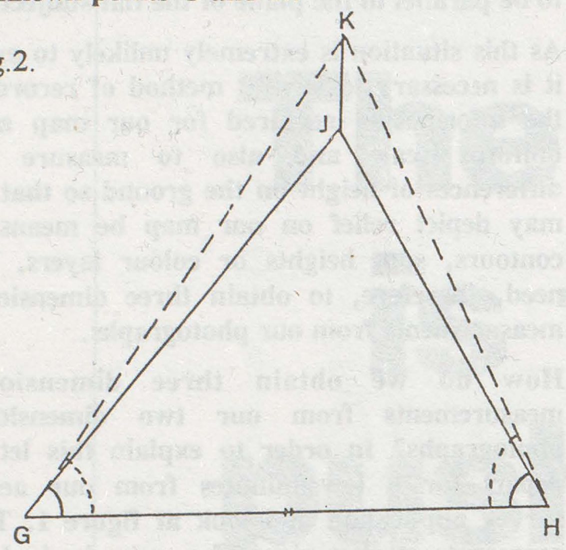



Fig. 1.

Looking at figure 2 we see that by measuring two more angles he may fix the position of a second inaccessible point K. He may than calculate the distance between points K and J.

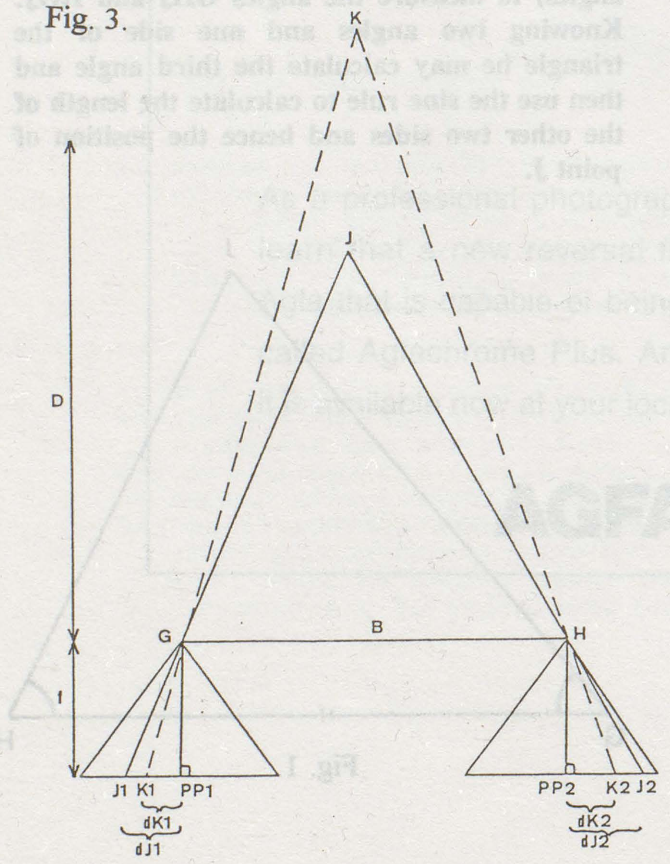
The difference of height of points K and J may be obtained by measuring vertical angles from the known points G and H.

Fig.2.




In figure 3 we see that we can obtain the same information by replacing the two theodolites by two cameras. Clearly we can not measure angles with the cameras but we can obtain the direction of the rays GJ, HJ, GK and HK in the following way.

Fig. 3.




In a photogrammetric camera we know the Principal Distance (approximates to the focal length) f very accurately from a factory calibration. We also know from calibration the position of the principle point (PP) which is the point on the format at which the principal ray intersects the focal plane at right angles. Using a precise measuring instrument, which will be described later, we may measure (Fig 3) the distance on each of the two photographs between the PP and the image of the point in question. ie dK1, dK2, dJ1 and dJ2. If we look on the left camera at the right angle triangle G, PP1, J1, we know the distance PP1 to J1 (dJ1 measured). We may then calculate the angles of the triangle and hence the direction of the ray GJ. Using a similar calculation for K1 on the left camera and J2 and K2 on the right camera we may calculate the direction of the other rays and hence the position of points J and K. In order to obtain the difference of height of points J and K, similar measurements must be made to obtain the distance of the image points from PP1 and PP2 parallel to the other axis of the photograph.

Let us now return to our aerial photographs and the map making application. Clearly, it would be very tedious and cumbersome to identify on the photographs each of the points required on our map and measure the necessary distances individually by some manual means. We have therefore designed instruments with which to speed the process. Figure 4 shows a very old and long obsolete instrument, which nevertheless illustrates the method we use very clearly.

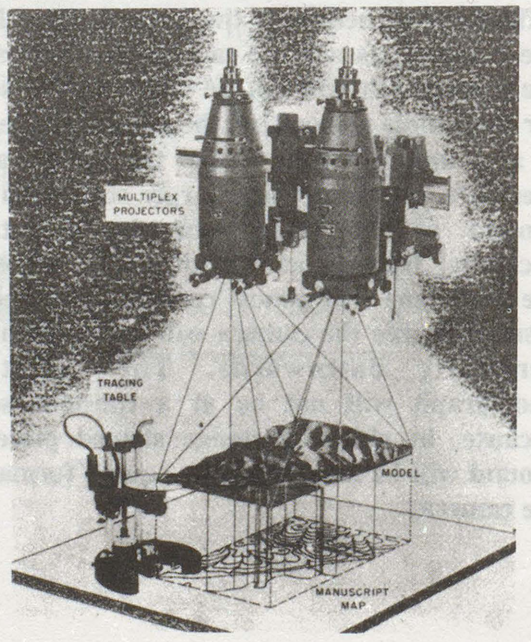



Fig.4.



The photographs are centred carefully in the projectors to ensure that the geometry of the camera is accurately reproduced. By doing this we are ensuring that our measurements are referred to the correct PP position. This process is called Inner Orientation.

The projectors are free to rotate about the three axes and to move lineally along the three axes. It is therefore possible by a method called "relative orientation" (which we will not explain in detail here) to position the projectors in the same relative relationship as that of the cameras at the instant of exposure. If this relative orientation is done properly then all the corresponding rays from the two photographs will intersect and the projected images from the two overlapping photographs will fit together to form what we call a "model" of the subject.

If we project these images, one in red and one in blue, and view the model through spectacles with corresponding coloured filters we may view the image in three dimensions. In fact we see a miniature "model" of the landscape.

However, this three dimensional model is at an unknown scale and attitude and can only be related to reality by comparing measurements taken on its surface with corresponding measurements taken actually on the ground. This process we call "absolute orientation", and it is achieved by the use of control points. Control points are sharply defined points of detail which can be clearly identified and measured both on the ground and on the photographs or model. In fact we often pre-mark these points with special markers before the aerial photography is taken. The size of the marker will depend on the scale of the photography. The scale of our "model" is calculated by comparing the given distance on the ground with the measured distance on the "model".

The orientation or attitude of the model is calculated by comparing the heights measured on the model with the corresponding heights measured on the ground of at least three control points near the edge of the model forming a well conditioned triangle. A table will not stand on less than three legs and then only if they are not in a straight line! Therefore, our minimum control point configuration is two planimetric points and three height points. Of course we would normally use more that this in order to give ourselves a redundancy of information with which to check against errors of identification and to assess the accuracy of our work. During the absolute orientation we may adjust the scale of the model by changing the separation of the projectors and we may change the attitude of the model by rotating the projectors together so that we do not disturb the relative orientation.

In order to carry out the absolute orientation it has been necessary to take measurements on the model. How do we actually achieve this? If we continue to refer to figure 4 you will see that there is a white disc or platen on the tracing table. In the centre of the platen is a small illuminated measuring mark which is sometimes referred to as a "floating mark". By moving the tracing table in plan, and also using a thumb screw to move the platen up and down, this measuring mark may be moved in three dimensions over the surface of the model. So if we wish to measure a particular point on the model, say a road junction, we view the three dimensional model through our coloured spectacles and position the measuring mark three dimensionally on the road junction. By doing this we have used stereoscopy to help us identify accurately the same point on each of the two photographs. For example, we might have identified accurately points J1 and J2 in Fig 3. Thereby measuring DJ1 and DJ2 in the same figure. A pencil vertically below the measuring mark identifies this same point on a map positioned below the model. The height of a point may be obtained by reading a vernier scale beside the white platen. It follows that we can draw roads and other features on our map by moving the measuring mark along these features in three dimensions.

We can draw contours by keeping the measuring mark at a constant height.

This simple instrument then gives us the facility to compensate for the difference of photograph scale due to height and for the rotations of the cameras. It is possible to draw a map at a constant scale with three dimensional information. The instrument is, in fact, a form of analogue computer.

This instrument was superseded by much more precise, versatile and easy to use binocular analogue instruments where the corresponding rays of light were reproduced by metallic rods. Modern, computer controlled, analytical instruments like that in figure 5 calculate the corrections for camera tilt etc automatically and, of course, the map is generated on the computer screen.

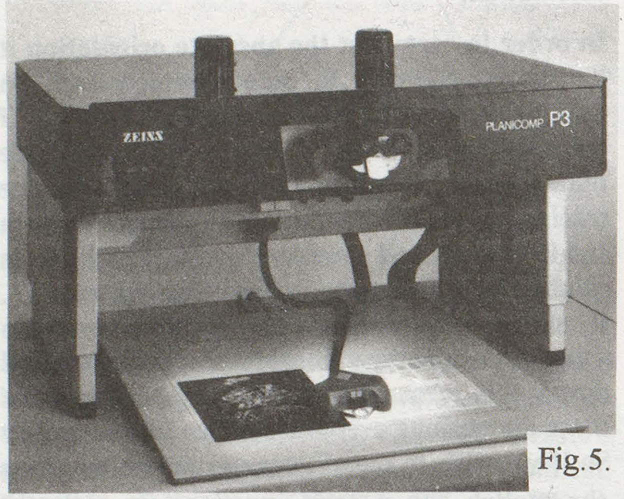


Fig.5.

We are now beginning to see the advent of fully digital systems where our photographs are replaced by digital images and the stereoscopic measurements may be made in a similar way on the computer screen. Indeed we are now even able to replace the operator and make many measurements automatically by image correlation techniques which calculate the three dimensional co-ordinates on the model by matching the density patterns on each of the two photographs. This method is fast and accurate but still has two major drawbacks as far as aerial photography is concerned. Firstly, the original photographs have to be scanned at high resolution which means huge amounts of data need to be stored. Secondly, although the shape of a surface and contours may be generated very efficiently, the system is still very restricted when interpretation is required. Is this a haystack or a house? However, it is clear that digital photogrammetry is still young and one day we will have an electro-optical aerial camera and the means to store the data more efficiently. We might also program the intelligence to carry out reliable interpretation.

Whether we are using old analogue instruments, analytical or digital systems, our fundamental geometry remains the same. The geometry of our camera is paramount. In order to obtain acceptable accuracies in our measurements we need to use a metric camera. What do we mean by a metric camera? If we look at Fig 3 we see that the direction of the rays to points K and J is critical if we are to maintain the position of our intersection accurately. There are several constants in the camera which affect the direction of these rays and their values must be accurately determined by calibration and utilised in the measuring instrument. Calibration is usually carried out by the camera manufacturer but may be satisfactorily achieved by other parties using a suitably constructed range of targets. The values to be determined are the principle distance (f), the position of the principle point (PP) and the lens distortion. The latter value is the amount by which the rays are bent as they pass through the lens. The PP is defined by the intersection of lines joining crosses (fiducial marks) positioned at the corners or centres of

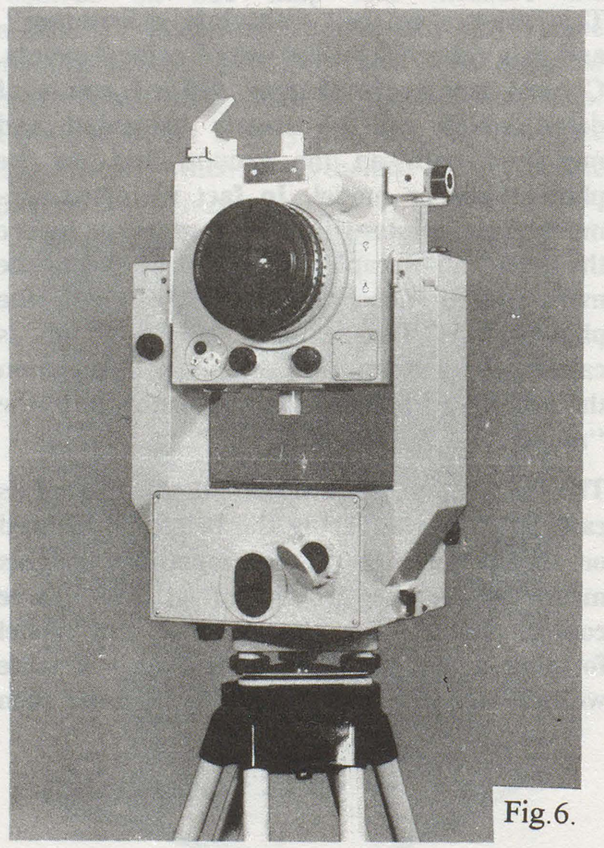


Fig.6.



the sides of the format. The fiducial marks are often illuminated by a light source independent of the shutter. The lack of flatness of the film is a variable and cannot be determined by calibration. A metric camera should be constructed with a proper film flattening device. To give an idea of the accuracy demanded of the calibration we would expect to know the value of f to the order of ±0.01mm. f is generally very small compared to D (fig 3) so a small error in f will make a significant difference to the position of our intersection at K or J. A Zeiss UMK metric camera is shown in figure 6.

So, apart from the camera, what other factors affect the accuracy of our final measurements? Firstly, we should consider the base to distance ratio. In Fig 3 this means the ratio between distances B (the separation of the cameras) and D (the average distance from the camera to the object). If this ratio is too small the cameras become too close together and our intersection becomes too acute to give us an accurate depth co-ordinate. If the cameras are too far apart a suitable overlap of the photographs may not be maintained or there may be difficulty in viewing the photographs stereoscopically. In general we should aim for a base to distance ratio between 1:1 and 1:12.

Secondly, accuracy is affected by the scale of the photographs which is governed by relationship of f to D (Fig 3). Scale = f/D.

Other factors affecting accuracy of the measurements are the image quality, the position and nature and co-ordinate accuracy of the control points, and the reliability and experience of the observer.

In terms of accuracy, depth is the critical dimension and the following simple formula puts a number (∂D) to the anticipated accuracy in a particular geometric configuration.

$$\partial D = \pm \frac{D^2}{fB} . dp$$

.dp is the estimated measuring accuracy on the photograph which we may assume is about 0.01mm. The other letters refer to Fig 3. As a rule of thumb we might expect the depth measurements to be good to approximately one part in 10000 of the camera to object distance.

So far I have referred mainly to the use of photogrammetry as an aid to map making. If this was its only application then it is doubtful if I would be here today!

Of course we can use photogrammetry as a non-contact method of measurement in many disciplines. It has, for many years, been a standard method of recording architectural facades and, as digital methods improve, is being used increasingly in engineering and medicine. The Royal College of Art hopes to conduct research which will demonstrate how photogrammetry, and other non-contact methods of measurement, may be applied to the recording of change in objects due to temperature and humidity fluctuations.

What use then may you as fine art photographers make of photogrammetry? First of all I would suggest that you be wise before the event. When you are photographing objects of value why not take photographs, with a metric camera if possible, suitable for measurement by photogrammetry at a later date? In this way an archive could be built up of photographs which may be used to help in the repair or reconstruction of an object which may one day be unfortunately damaged or destroyed. Reconstruction after the disastrous fire at Windsor Castle will be made easier by the use of metric photographs taken several years ago.

For major projects it is clearly better to employ an experienced photogrammetrist to do the photography for you, but for various reasons this is not always possible. I will, therefore, list a number of points which you should observe if you decide to do the photography yourself. Measurement is usually best left to the professional photogrammetrists.

1.Use a metric camera if at all possible and file a copy of the calibration certificate. If a non-metric camera is used note the make and model with the nominal focal length. Avoid using auxiliary lenses if you can. Record the serial number of the camera and lens.

2.The use of a polyestar based film is helpful but not essential.

3.Take the photographs at as large a scale as possible while still covering the subject in the minimum number of photographs. Use a variation of the above formula to calculate the object distance after estimating the accuracy you require on the subject.

4.Use a suitable base to distance ratio. Photographs do not have to be taken normal to the base but relative tilts in excess of about 15° are better avoided. If in doubt take lots of photographs so that the most suitable ones may be selected for measurement. Make sure you cover every part of the subject by at least two photographs. Do not forget that your subject has a top and bottom as well as a front and back.

5.Make sure you have adequate control points. If possible make use of rules and scales that are readily available. If repetitive work is to be done a special frame supporting scales or other control points might be constructed. At the very least make sure that you have an object of known size near the subject and ensure that it can be seen on two or more photographs. With the nature of the objects that you are likely to want to measure, the photogrammetrist needs primarily to be able to determine the scale of the photogrammetric model. The orientation is not as important as it is in the aerial survey case if dimensions of the subject do not need to be related to a particular external reference plane.

If the subject has few natural markings it can be helpful to attach a network of very small adhesive targets. This should only be done if there is no danger of damaging the surface of the subject. Such marks assist in joining together the measurements from various pairs of photographs.

6.Carefully record on a diagram the position from which the various photographs were taken. If a large number of photographs are involved it is always helpful to identify photographs by a number placed in the field of view before exposure.

I hope that this short description has taken the mystery out of the subject and will stimulate more of you to use photogrammetry as a measuring tool. Do not fear to use photogrammetry and, above all, do not fear to seek advice from an experienced photogrammetrist. We are really quite an understanding and friendly fraternity.





Good Ideas

A Light Diffusion Tent

Terry Buchanan

A Wendy House framework is the starting point for a portable unit for lighting reflective objects.

The highly reflective surfaces of precious metal vessels can create many problems in the attempt to light them or subdue existing reflections of the unwanted light sources.

The light-tent is a well tried method for screening unwanted reflection and providing a diffuse light source in studio conditions, outside the studio the primary consideration is portability.

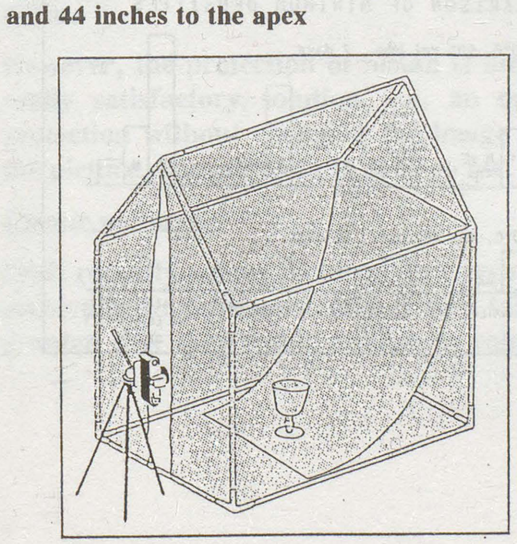
A light- tent that can be easily erected and dismantled on location is readily constructed from the basic plastic tubed framework of a childs toy, the Wendy House.

Most toy shops can supply the framework at a very reasonable cost and the covering material is easily replaced by white sheeting. Apart from its lightness,ease of carriage and simplicity of use, the additional advantage is that subjects can be carefully arranged before the light tent is lowered over them. By attaching an extra cross-member a curved paper background can also be introduced.

Lighting can be made with portable electronic flash guns and where the level of ambient light, is low enough to allow long exposures, the outside of the light-tent can be painted with light from one flash gun.

This light-tent could also provide a standard method of diffusion in the museum environment where the photographer has to photograph the artefact *in situ* especially in thoes areas to which the public must have constant access and the least amount of disruption is desirable.

The overall size of the erected framework is appproximately 40 inches long by 30 inches wide and 44 inches to the apex



## IMAGE STABILITY AND PROCESSING

**Dr Gunter Kolf, Agfa-Gevaert, Business Group Photo, New Systems**

### Introduction

Once Image quality had been perfected in the first half of the last decade, the main objective of the colour paper manufacturers in the second half of the 80's has been to improve substantially the stability of dyes in order to compensate for one of the most important shortcomings of colour prints against black and white prints, i.e. the stability and resistance against light, temperature and humidity. In this field excellent results have been achieved during the recent years.

However, man is fortunately never content with what he has achieved. I said "fortunately" because this discontent with achievement is the main-spring of progress.

New aims have been defined, aims dictated by economy as well as by ecology. These are:

reduction of chemical consumption;

reduction of water consumption;

shortening of processes.

It is important, however, that in pursuing new aims, the achievements are not jeopardized and that a step forward in one area has not to be paid for dearly with a step backward in other areas. That means in our case, by reducing the processing time and saving water, the image stability must not deteriorate.

In the professional laboratories one principle is especially valid, that is to process carefully and extensively in order to guarantee highest possible image stability, to achieve lasting colours and to avoid the development of a stain by ageing. The concern is quite justified as shown by evidence from the past.

At the end of the 70's when polyethylene or resin coated base was first introduced for black & white paper it was initially welcomed as a great progress; processing time shrank from approximately 1 hour to a few minutes.

### Table 1

Very soon, however, a strange phenomenon showed up. The photographs became brownish very quickly; especially murals on display outdoors where the surface broke and layers came off.

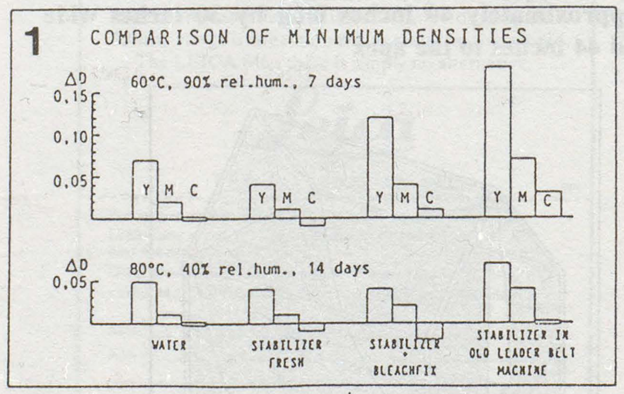
Resistance to these materials formed under the slogan: "To RC or not to RC that's the question!" Fortunately, the emotional discussion has made room today for a more realistic matter-of-fact discussion.

A few years ago the so called "super stabilizer" was introduced to replace the final wash, primarily for minilabs, which resulted in substantial savings of water and of energy to heat this water. The inventors showed that the stability of the "super-stabilized" pictures was as good as that of normally washed ones, even slightly better.

In 1986, Wernicke reported at the "Third Symposium on the Preservation of Photographic Images" that he checked this statement in practice. He collected prints world-wide from laboratories which used "super stabilizing" and examined them by accelerated ageing, dark-fading and light-fading tests. The results were varied but unequivocal in the fact that stabilized pictures changed more than normally washed ones.

An explanation was given by Meckl at the "Fifth SPSE Symposium on Photo-finishing Technology" in Chicago in February 1988.

Figure 1 shows an original example from his lecture: the increase of the stain of a print with freshly prepared stabilizer is indeed lower than with a water-washed print. This condition, however, cannot be maintained. Carry-over of bleachfix and ageing of the stabilizing bath reduce the stability significantly. This deterioration cannot be avoided in practice.






### Black-and-white paper

How a black-and-white print is processed to its highest stability has been intensively investigated. Detailed instructions have been worked out in order to achieve archival permanence; these instructions have been published in books, e.g. "Conservation of Photographs", an Eastman-Kodak publication, and in ANSI-ISO-DIN standards.

Nevertheless, even in museums and archives B & W pictures are more than ever in danger of being attacked by various chemical influences.

Industry and civilization have demanded a high price from the air we breathe. Acid rain, dying forests and corroded sculptures at our gothic cathedrals are only the most spectacular results of this air pollution. One of the less spectacular consequences is the slow deterioration of B & W photographs. One of the most harmful gases in this context is formaldehyde.

Together with oxygen in air, the smallest traces of this gas make the silver grains dissolve. The silver salt of formic acid is formed, diffuses into the adjacent areas and, since it is extremely light sensitive, it decomposes again into colloidal silver; for example, the results are brown rims around the contours of a subject. The pictures can be fully protected by toning. However, this changes the image tone. To a certain degree also bathing in a Sistan solution protects the image. Sistan is an auxiliary processing product, marketed by Agfa. Its mechanism is as follows:

The soluble silver ions are, immediately after they originate, transformed by Sistan into a colourless, completely light insensitive compound. It avoids further decomposition and forms a protective coat around the silver grain.

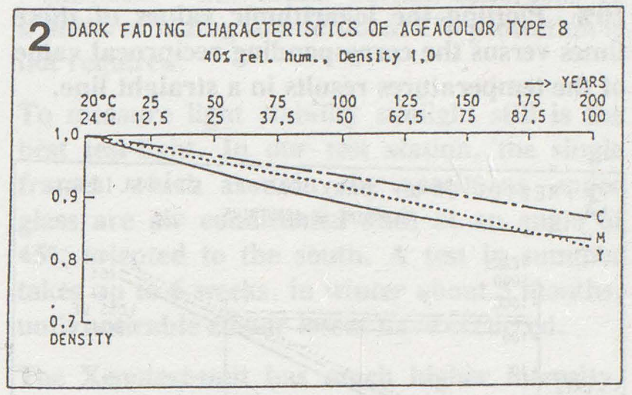
However, the protection of Sistan is limited. A really satisfactory solution, i.e. an optimum protection without changing the image tone of the picture, doesn't seem to exist so far.

### Colour pictures

Until recently colour pictures were regarded as archivally impermanent and it was taken for granted that they would change in colour and age to brown or red, and slowly but surely fade.

### Dark-fading stability

The situation changed completely when in 1984 the new generation of colour paper was introduced, claimed by the manufacturers as lasting 100 years or longer.




On Figure 2 you can see, how slowly - we believe - a print would change its colour if it was kept in the dark. A print on Agfacolour Paper Type 8 which was kept in the dark, in an album e.g. may change its colour with less than 20% loss of density in 100 years at 24° and 40% rel. humidity, or at 20° the same change after 200 years.

The result poses some basic questions:

1. Why do colours decompose at all, when kept in an album?

When there is no light to bleach the colours.

2. 20% loss of colour density is considerable. How can we claim that after 100 years in an album the picture still looks good?

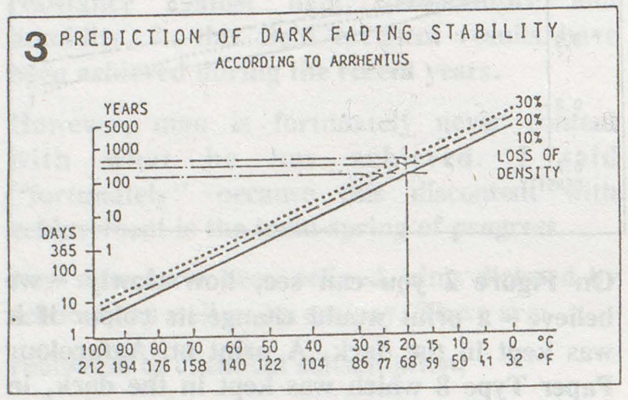
Are not lower limits for the colour loss necessary?

3. I have just told you that the new papers have been in the market for not more than 6 years. How can I know what the pictures will look like after 100 years?

Light is not the only source of energy that may decompose colour dyes; heat, indicated by the ambient temperature, acts upon dyes and cracks them slowly. The higher the temperature, the higher the energy, the more dye molecules are broken in a certain period of time.

The dependence of this chemical reaction on the temperature is explained by a well founded physico-chemical law, the so-called Arrhenius equation (Svante Arrhenius, Swedish physicist and chemist 1859-1927).

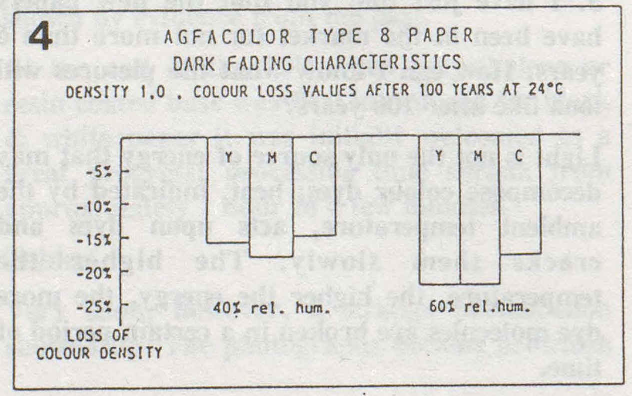
As a measure of the chemical reaction of the dye composition, the times are taken after which the colour densities have lost 10% or 20%. Plotting the logarithmic values of these times versus the corresponding reciprocal value of the temperatures results in a straight line.




In practice the colour loss values are measured between 70° and 100°C; this takes more than 100 days. The resulting straight lines are extrapolated to the lower room temperature and thus we can predict how long it will take for the test samples to have faded for 10% or 20% at 20° or 25°C.

This procedure was used to produce all the stability curves which you can find today in literature or manufacturers' publications.

High humidity favours the colour loss thus it is recommended that archives keep their colour prints at low relative humidity values of 25% to 30%. See Figure 4.




You can also see from the Arrhenius-equation that the life of a picture can be considerably extended by cool storage.

As a rule of thumb: cooling down for 4 to 5°C doubles the life time.

<u>Table 2</u>

| Temperature | Life in years for 20% colour loss at 40% r.H |
|---|---|
| 25°C | 100 |
| 20°C | 210 |
| 15°C | 450 |
| 10°C | 1 000 |
| 5°C | 2 200 |
| 0°C | 5 000 |

Table 2 shows that by cooling down from 25°C to freezing point a 50-fold stability, i.e. 5 000 years can be achieved. It also shows that an archive which keeps its colour documents at +5°C i.e. in normal cool stores will encounter a hardly measurable fading rate of only 1% after 100 years. Colour pictures have truly reached archival permanence when stored properly.

Is 20% colour loss a reasonable limit?

Is a photo with 20% colour loss acceptable at all?

<u>Table 3</u>

| | density loss | colour loss | | | | | |
|---|---|---|---|---|---|---|---|
| | | yellow | blue | magenta | green | red | cyan |
| limit of acceptance | 25% | 10% | 15% | 10% | 15% | 10% | 15% |

A few general rules can be derived from that test:

- The eye is much less sensitive to a change in the overall density than to a shift of the neutrality.

- Shifts of neutrality up to 10% are accepted for aged photographs.

- A shift to warm colour (-B, -G, -C) is tolerated better than a shift to cold colours.

If we compare these results with the stability data of Figure 2 and Figure 4, we see that the requirements of max. 25% density loss and max. 10% imbalance in colour are still met after 100 years.



<u>Light fading stability</u>

Everybody knows that light bleaches colours. Light fastness or light fading of dyes and colours is a phenomenon of daily life. But who knows <u>why</u> light impairs and destroys dyes?

It is, for example, a common error to believe that only ultraviolet-light damages colour pictures, that in direct sunshine they fade so quickly only because sunlight has a high portion of UV, and only an effective UV protective coating or lamination is required to make them lightfast.

This is not so.

To explain this I have to use some physics. The single atoms and elements of a molecule, e.g. a dye molecule, are not absolutely fixed but connected to each other elastically and they oscillate against each other. The frequences at which they oscillate are characteristic for the molecules and are responsible for the different colours of the dyes.

When energy is absorbed the amplitude of the oscillations increases. The energy may be heat, we talked about the result when we dealt with darkfading, or it may be light. The precondition for an effect is that light is absorbed by the molecule. A dye molecule preferably absorbs light of a frequency that determines its colour,

cyan dye absorbs red light

magenta dye absorbs green light

yellow dye absorbs blue and violet light.

In most cases the molecule receives the light without suffering harm. Occasionally, however, the oscillations become so intense that the bondings in the molecule break and the molecule decomposes. UV light is absorbed in appreciable amounts only by the yellow dye and a little by cyan. That means that a UV filter layer mainly protects the yellow. Visible light can only be stopped by visible colour filters. However, to protect the colours with colour filters means to take away from them their colour. It is the fate of a dye that it is destroyed by the light that it needs for life.

However, the chemists have found an answer, they have developed substances which are able to take away from the excited, heated molecules their oscillation energy and to cool them down. These stabilizers are called "quentchers". These are mixed to, for example, the magenta layer and they act as good body-guards and sacrifice themselves for the lives of the dyes.

We have incorporated in our colour papers a well balanced combination of UV absorber and "quentcher" that under normal conditions ?? a uniform fading so additional UV protection is not required.

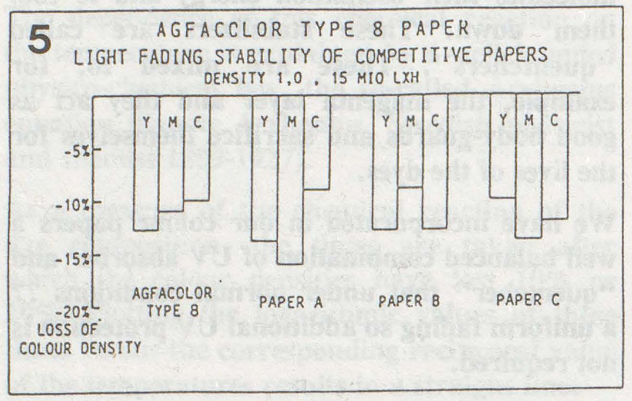
To measure light stability sunlight still is the best test-light. In our test station, the single frames which contain the specimens under glass are air conditioned and, at an angle of 45°, oriented to the south. A test in summer takes up to 6 weeks, in winter about 3 months, until noticable colour losses have occurred.

The Xenotest-unit has much higher intensity, about 10 times higher than average sunlight. In a spherical test chamber, the test strips rotate around a Xenon high pressure burner of 1500 Watt and 200 kilolux, reversing the specimen after each circle (half the time light and half the time dark). A Xenotest of 15 million lux hours takes only 6 days. The spectrum is similar but, unfortunately, not equal to the sunlight spectrum.

A third kind of light source it is possible to use is the fluorescent tube although these tests take several months, such a light box is inexpensive and easy to handle in a normal lab, very similar to the sunlight spectrum with the appropriate tubes and close to practice because fluorescent tubes are a very common light source for illuminating large rooms, exhibition halls etc. and the predominant light source used for display.

What is the result of those tests? What is the state of quality of today's products?

In figure 5 you see how many per cent the colour density of different colour papers fades after 15 million lux hours exposure to sunlight in the test station described above. The loss values are 10 and 15% maximum, the difference between the 3 layers being not more than 5%.




**What does 15 million lux hours mean? What does that represent?**

**Unfortunately, there is no simple answer to that question. It depends greatly on the lightness of the place where the pictures are displayed.**

**I said before that in the summer sun 15 million lux hours are only 6 weeks, the light intensity is 20,000 to 25,000 lux. Even in well illuminated rooms the intensity never exceeds 1000 lux, a 25th of the daylight outdoors.**

**According to a study by S. Anderson and G. Larson (J. of Imaging Technology Vol. 13 p. 49), who investigated the environmental conditions in American homes over a whole year, the average light indoors ranges from 30 to 600 lux. The overall average during this study was 214 lux during the day, and 54 lux at night with artificial light.**

**Let us calculate with 12 hours daylight plus 3 hours lamp light and 365 days,**

**12 hours x 214 lux = 2,568 lxh**

**+ 4 hours x 54 lux = 216 lxh**

**2,784 lxh per day**

**x 365 days**

**1,016,160 lxh per year**

**then the total light exposure per year is 1 million lux hours, i.e. 15 million lxh corresponds to 15 years.**

**If we take the limit of acceptance at an overall density loss of 25% and a colour imbalance of 10% (see Table 3), that means, double the colour loss values shown on this graph are just tolerable, i.e. colour prints last, under interior light condition, roughly 30 years.**

**The stability of the display film is even higher, double that of prints, with about 5% colour loss after 15 million lxh exposure. We can briefly estimate how long a transparency on a light box would last.**

**The light intensity of a lightbox is approx. 2500 lux. To reach 15 million lux the light box must burn 250 days 24 hours. Only 5% are lost. If we allow for 20% loss, a display film transparency will last up to 3 years.**

**I hope I have been able to show you that the colour materials of today have reached a pretty high state of image stability which deserves to be defended and safeguarded against modern trends towards short processes and all meritorious efforts of saving chemicals, water and energy.**

**Since the beginning of last year, a new color-paper generation is being introduced, having a very short process. I am talking of Agfacolour Paper Type 9 and process AP 94, or equivalent types of other manufacturers. The processing time, including drying, has dropped to 4 min, compared to 10 min of the former and still available paper process**

**A large number of big amateur photofinishing labs as well as minilabs have switched to the new process. Professional finishers are a little slower and more careful in switching. This is justified.**

**- Processing time doesn't play the same important role as it does in amateur photofinishing labs.**

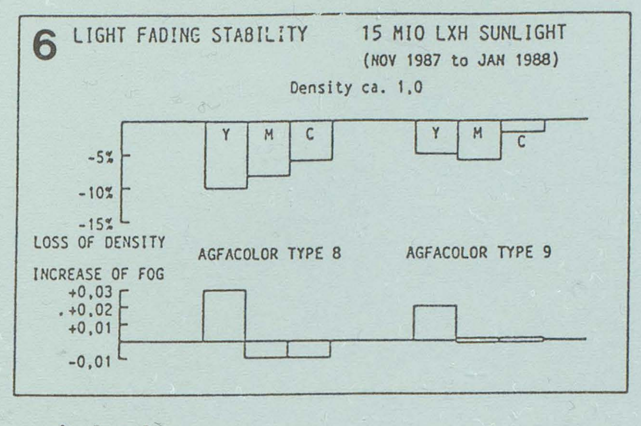
**- The new printing products have to cover a wider range of specifications, especially with respect to reciprocity and latent image.**

**- The full range of professional printing products, including display films, have to be available. These special products are beginning to appear, so your negatives will sooner or later be printed on these new products.**

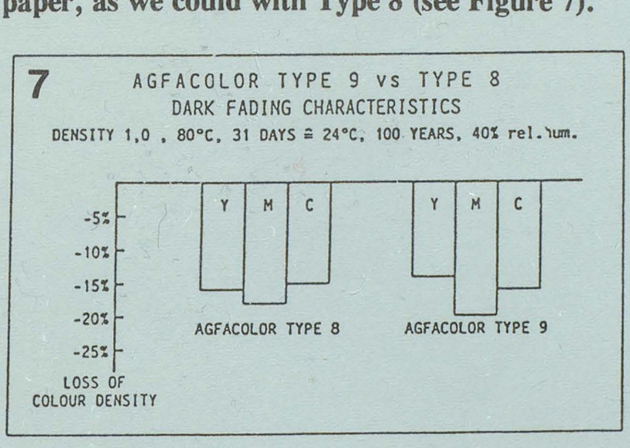
**Figure 6 demonstrates that in spite of the short mean regression in image stability.**

**The process version was 45 seconds for CD and BX each and 90 second wash.**

**The Xenon-test as well as the sunlight-test (figure 6) prove that the light fading stability of Type 9 paper is approximately 50% higher than of Type 8 paper. This holds true for the loss of density as well as for the increase of stain level.**




**Accelerated ageing tests show that the overall dark-fading stability has not become worse and we can talk about Type 9 paper as a 100-year paper, as we could with Type 8 (see Figure 7).**




**As mentioned before, stabilization cannot yet compete with a good wash with regard to image stability. Especially the stability of the whites and the fastness of the yellow dyestuffs suffer from inactive stabilization.**

**This looks different with the new stabilizer of AP 94 and substantially better. The yellowing of the whites with an aged stabilizing bath is even lower than with normal wash.**

**The same holds true for the stability of the yellow dye which was adversely affected by former types of stabilizers and which is as good as for normal wash with 94SB.**

**A very important condition for the application of the stabilizer is a cascade of several tanks.**

**- One tank is ineffective.**

**- Even a cascade of 2 tanks is not sufficient.**

**- Only with 3 tanks and more a well maintained stabilizing excels the quality of a water wash.**

**I hope your processor knows of all the new developments and serves you with the best products and the best processing conditions, so that the prints you receive last as long as I promised you and as long as you expect them to last.**

**Moreover, I hope I was able to convince you that the conservation of the photographic image is one of the major concerns of the photographic companies.**

## CONSTITUTION

That the Association shall be called "The Association of Historical and Fine Art Photographers".

That it shall exist for the furtherance of photography in the field of History, Fine Art, Archaeology, museum and gallery display and related fields.

To encourage the interchange of ideas and general support amongst photographers practising in these fields and to promote access to departments thereby increasing wider opportunities for experience.

The membership shall be available to those who predominantly practise in the above fields of photography.

The business of the Association shall be conducted by a committee comprising a Chairman, Secretary, Treasurer, plus up to seven other committee members with a facility for co-opting other members as required.

That this committee be voted to serve for a thirty-six month period for the officers and twenty-four months for committee members. The officers shall be elected at an annual meeting open to all members.

That the management committee require a forum of five members, two of whom shall be office bearers to convene a meeting.

That the Chairman shall have the power of vote and that he shall have also the power of casting vote.

A quorate committee shall have the power to dissolve the Association upon notice of one month, with any funds being held, distributed to a charity or organisation named with in the same notice to dissolve.

# KODAK EKTACHROME PANTHER PROFESSIONAL

## A NEW FAMILY OF COLOUR REVERSAL FILMS

Pin-sharp images. Superb colour saturation. Accurate flesh tones. These are the headlines in the story of KODAK EKTACHROME PANTHER Professional Film. But what are the chemical and technological secrets that make this a truly revolutionary colour reversal film?

1. Kodak T-GRAIN technology in every imaging layer for the first time ever in an E-6 film. Improved optical characteristics set PANTHER film apart when it comes to sharpness.

2. PANTHER incorporates THREE new chemical technologies which complement each other to offer greatly improved colour and sharpness.

### SUPER SCAVENGERS

Enhance colours and purity by preventing 'crosstalk' between the imaging layers.

### SOLID PARTICLE FILTER DYES

Provide better light protection from blue and green light penetrating other film layers. The result is purer, more accurate colours.

### INTER-IMAGE AMPLIFIERS

Give increased sharpness and vibrant, saturated reds, greens and blues – with no flesh tone compromise.

### THE FAMILY GROUP

At the UK launch in September of KODAK EKTACHROME PANTHER only 100 and 100x films will be available (in 120 and 135) followed swiftly by 200x, 400x and 1600x. The family will be completed in January with 50 for the studio and 50x for location work. Sheet film will be available later in 1994.

### PROCESSING

E-6. For best results use a Q-LAB Laboratory.

Kodak