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A METHOD OF IMPROVING CONTRAST IN ILLUSTRATIONS OF COALIFIED FOSSILS

by

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ABSTRACT

A simple, economic method of enhancing the contrast and, therefore, improving the quality of certain palaeontological photographic illustrations is outlined. The technique, which involves the use of polarising filters, in no way alters the negatives or prints. In recommending this technique, it is hoped some of the confusion arising from inadequate illustrations will be removed.

INTRODUCTION

Real progress in palaeontology can only be made when it is clearly indicated what is both known and knowable about fossil specimens. This is made difficult by the fact that palaeontologists and their collections are spread rather thinly around the world, and the opportunity to become intimately acquainted with type specimens and collections is denied to many. This problem is exacerbated in the southern hemisphere, where the once united Gondwana is now distributed around the globe. Funding is often a problem, and intercontinental stratigraphic correlation is correspondingly hampered. Unambiguous descriptions allied with illustrations of the highest quality are not only desirable, but essential.

It is both a strength and a weakness of palaeontology that, in most cases, the only way we can present data adequately is in the form of a photographic print. This is a strength because a well-taken photograph records faithfully what is preserved on the rock surface, and any unconscious bias is eliminated at source - the fossil becomes the data. The weakness lies in the fact that, although the camera cannot lie, it may be reluctant to reveal the whole truth. Therefore many features can remain hidden or obscured either by a lack of contrast or by persistent glare from a shiny surface.

These photographic difficulties are commonly a problem in palaeobotanical and allied studies, where organic matter may be completely flattened by compression and then coalified (*sensu* Schopf 1976). Frequently, Gondwanan fossil plants are preserved in fine-grained, black carbonaceous shales, the colouring being caused by disseminated plant matter. A black fossil on the surface of a black sediment can be almost impossible to photograph. In other cases, the fossil may be partially or totally transparent. This is particularly true with insect wings which frequently occur in plant collections (Rayner and Waters 1989).

Yet another problem comes with the use of polyvinyl acetate cements which are sometimes used to reinforce delicate specimens. I have encountered this problem in fossils from a particularly significant locality, Orapa. The temperatures at the locality, which is a mine in Botswana, frequently reach into the upper thirties, and to protect the specimens from rapid desiccation, which would destroy them, they are impregnated with cement. However, this acts like a varnish and produces much unwanted reflection from the specimen's surface during photography (Rayner 1987).

In the case of the *Glossopteris* flora, studies have been unnecessarily plagued not only by problems of inadequate, loose descriptions, but also of wholly unacceptable illustrations. In a volume revising the Indian species of *Glossopteris* (Chandra and Surange 1979), the authors stressed that, in the past, "indifferent" illustrations of *Glossopteris* leaves have made the task of diagnosis and identification difficult and confusing. However, in their own revision, many of the photographic illustrations are less than helpful. To overcome the problem, Dr Shaila Chandra has produced some beautiful line drawings. However, drawings are necessarily interpretations and they may be subjective to varying degrees. They can only be considered adequate when a *camera lucida* is used.

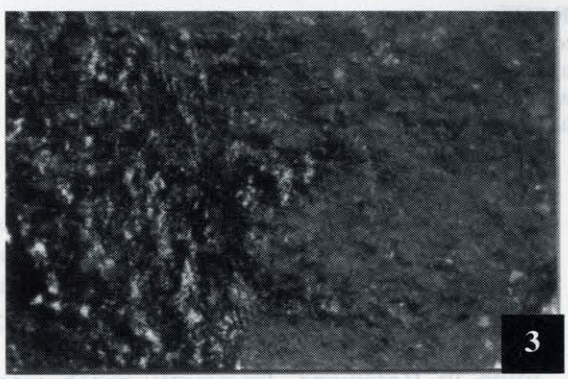
I sympathise with workers faced with the problems of faithfully recording these data, but have been quite astounded at some of the attempts to illustrate indistinct structures. Some examples involve actually drawing lines on photographic prints around certain structures which are otherwise obscure. Clearly, if the organ is that indistinct, then a disbeliever may be justified in suggesting that it is not there at all.

Low-angled, unidirectional lighting is the usual solution to these photographic problems, where surface relief can be easily enhanced. However, with



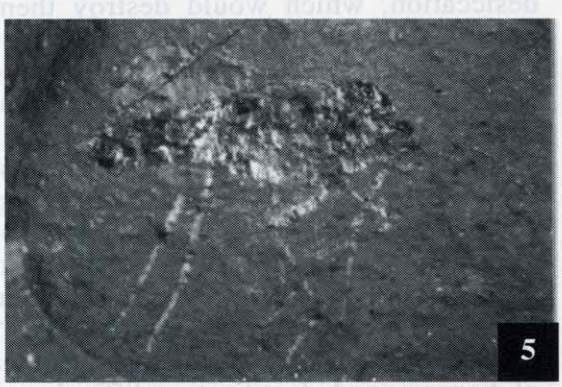


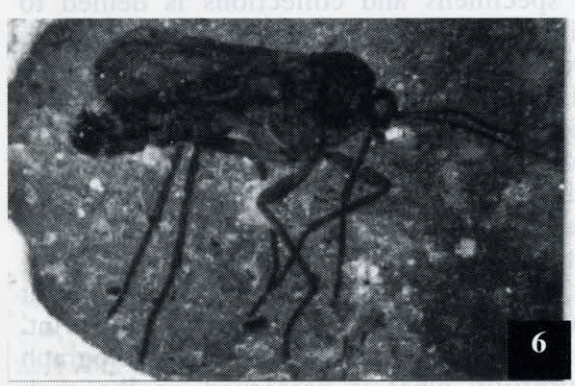
Figs 1 & 2. A middle Cretaceous insect with certain coleopteran affinities; Orapa. x2.5.



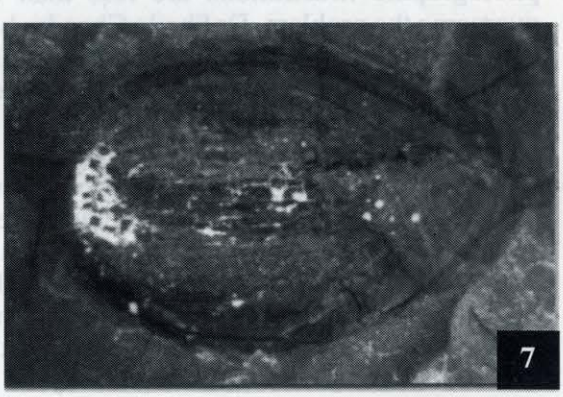


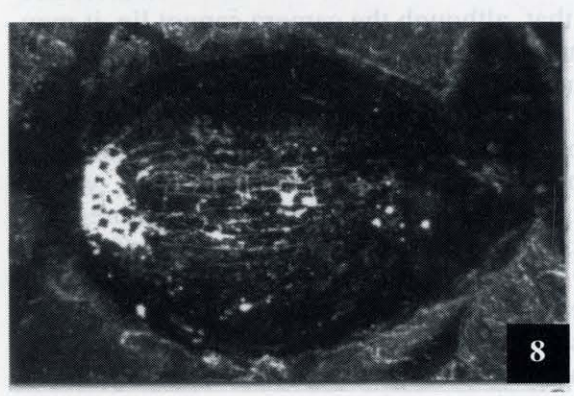
Figs 3 & 4. Enlarged posterior of the same specimen. x10





Figs 5 & 6. Cretaceous dipteran; Orapa. x10.





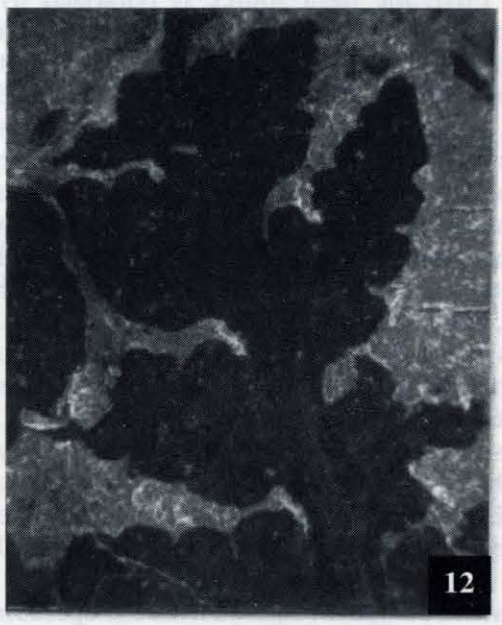
Figs 7 & 8. A dispersed Triassic seed; Little Switzerland. x3.



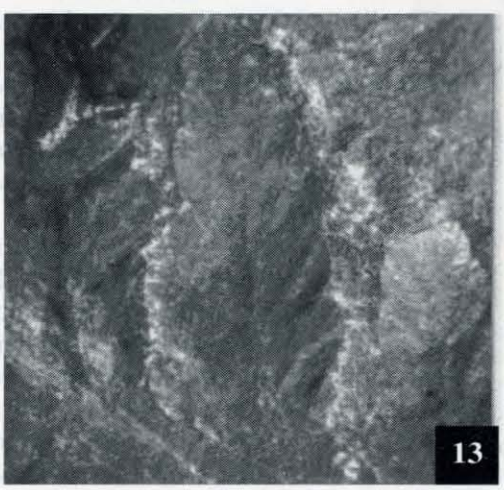


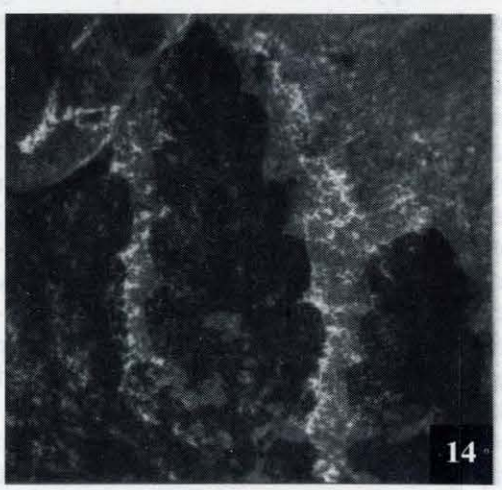
Figs 9 & 10. A cluster of lycopod sporangia; Hammanskraal. x6.





Figs 11 & 12. A portion of a Triassic fern; Little Switzerland. x2.





Figs 13 & 14. Triassic fern foliage; Little Switzerland. x2.

compression material, surface topography is sometimes a luxury, or the shadows cast on the specimen may unavoidably cause confusion. These difficulties, and the sometimes poor results obtained, drove me to seek a solution. The technique I suggest is an easy (and cheap) method of enhancing contrast without retouching the photograph, or altering the specimen in any way.

MATERIALS AND METHODS

The technique I suggest involves using polarised light. This is a tried and tested method of reducing glare (Schaarschmidt 1973), and an acceptable photographic tool. However, the method described here differs in using twice polarised light, similar to that used in transmission light microscopy by optical mineralogists. First, the light source is polarised by means of inexpensive plastic filter(s). Secondly, a filter is placed before the camera such that the light entering the lens is polarised at 90° to that of the original light source. In this way, all light that is directly reflected from the specimen (e.g. from the smooth surface of a coalified compression) will be in extinction, whereas the light reaching the camera from the surrounding matrix will be de-polarised and will pass through the second polarising filter. The latter will, therefore, appear as white light on the final print. The de-polarising of the light from the matrix is also enhanced by the anisotropic nature of the quartz grains which (often) form the bulk of the sedimentary matrix. However, these are the two extreme cases. Reality occurs somewhat in between the two, due mainly to the less than 100% efficiency of the filters, but also to the less than perfect reflectance of the coalified material and the partial reflectance of the matrix.

With this system, all that is required from the operator is the acquaintance of a manufacturer of polaroid sunglasses as a source of filters, and the patience to cut filters the right size and shape to suit the light source(s), and to orientate the filters at right angles to one another.

For photomicroscopy, I cut two small polarising discs which are then placed on the condensing lenses of a fibre optic light source. A polarising filter is also attached to the microscope objective (many microscopes, however, have such filters as accessories). All three filters can be rotated to the optimum position when necessary. Before the specimen is positioned for photography, a highly reflective surface (e.g. a mirror) is placed under the microscope, The filters are calibrated two at a time. When all three filters are correctly positioned, the light from the mirror will be in extinction. The system is now ready for use. Where a single microscope light source is used, the calibration is, of course, much easier.

I have also used this method successfully in macrophotography. Here, there are difficulties with the amount of available light. This is overcome by using long exposures, or a powerful ring-flash unit (or both). I use the latter with a cardboard box which fits closely over a ring-flashlight dish. One end is made up of a 25 cm^2 polarising filter. This distances the plastic from the monitor and flash bulbs and protects it from melting under the heat of the light. The second filter is fitted to the end of the macro lens (again such units are supplied for most cameras). The two are aligned using a mirror (as before) with the monitoring light of the flash. The mirror is removed, and the specimen inserted into the system. I find it necessary, at this stage, to use a second light to focus on the specimen, but this is extinguished during exposure. All ambient light is removed (I find my best results are obtained at night). The camera shutter is locked open, and a series of flashes (the number is of course dependent on the film and light characteristics) completes the exposure.

The lighting arrangement can obviously be used as in normal observation in addition to the production of high contrast photographs. The image produced may sometimes be a little flat. This situation can be improved either by adjusting the light source and producing a shadow effect, or by mis-aligning the filters a little. The greater the intensity of light that is used on a difficult specimen, the more the contrast is enhanced. With plain polarised light, however, increasing the intensity reduces the contrast, and produces more glare. The illustrations (Figures 1-14) were taken, as far as possible, under identical conditions, except for the use of polarising filters in the even numbered ones. It was found, however, that the high light intensity required for the polars produced unnecessary glare, and this was therefore reduced in an attempt to obtain the best results for plain polarised light. All micrographs were taken on a Zeiss SV8 stereo-microscope with Ilford Pan F (50 ASA) film. Films were developed in fresh Ilford ID 11, and printed on Iflospeed glossy paper (grade 3). All photographs were taken and processed in one session to minimise variation.

RESULTS

The illustrations are arranged in matching pairs, the first (i.e. Figures 1,3,5,7,9,11 & 13) has been taken under plain polarised light, the second (i.e. Figures 2,4,6,8,10, & 12) under crossed polars.

Figure 1 is a Cretaceous insect. The specimen has a naturally reflective surface, since the original cuticle remains virtually unaltered. It is the insect equivalent of a coalified compression (*sensu* Schopf 1976). Using polarised light (Figure 2) details of the wing venation are clear - this is essential for reliable identification. The results indicate certain coleopteran affinities, but close examination of the venation, only possible with polarised light, argues against this (McKay 1990). Figures 3 and 4 are an enlarged view of the posterior of the animal. Details of the second wing are revealed only under the cross polars.

Figures 5 and 6 show a small dipteran, probably a bibionid. The specimen is preserved in lateral view,

and details are virtually invisible in the plain light photograph due to excessive reflection. The contrasts between the two photographic methods are obvious. Figures 7 and 8 are of a Triassic dispersed seed, Figures 9 and 10 of a cluster of a Permian lycopod sporangia, and Figures 11, 12, 13 and 14 show parts of Triassic ferns. In each specimen, the black fossil (coalified compression) is preserved on the surface of a dark grey-black carbonaceous shale. The contrast and detail are greatly improved in the polarised photographs.

CONCLUSION

The thick continental accumulations of Gondwanan sediments contain abundant plant remains. Nevertheless, the stratigraphy is currently based on tetrapods. The problems of geography (in that collections are widespread) and of recording difficult data, have combined to retard progress in intercontinental stratigraphy. This technique offers a means to improve the standard of illustrations, and assist an understanding of the complexities of the fossil floras and allied fossils.

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