The instrument has a total height of 22 m and its weight is 430 tons. The primary mirror weighs 13 t and is made of glass ceramic Zerodur.

The instrument has meanwhile been dismounted and is being transported to Spain. The building has already been completed and it is expected that the instrument will become operational towards the end of 1983.

Optical Systems

Prime focus: focal length: 12.25 m; field diameter: with 2-lens corrector: 100 mm (28′), with 3-lens corrector: 243 mm (1°8′). *Ritchey-Chrétien focus:* focal length 35 m; field diameter 300 mm (30′). *Coudé focus:* focal length 122.5 m; field diameter 400 mm (11′). K. K.

Photographic Image Manipulation

Claus Madsen, ESO

Introduction

The Messenger No. 25 contained a short, general description of the non-atlas work being done in the Sky Atlas Laboratory. Briefly mentioned in the article were contrast manipulating methods ranging from masking—to reduce the contrast of a picture—to contrast enhancing methods used to obtain printable negatives (or positives). Here the procedure, the advantages and the problems connected with masking and image amplification, will be described in some detail.

Masking

Several ways of masking have been described during the recent years by Saxby and Dumoulin (1977), and Malin (1977). Yet, the subject does not seem to be exhausted. The masking method—which is capable of producing quite striking results with regard to extraction of information from high contrast plates—requires the application of a photographic mask (a reversed film copy of the original plate) of a somewhat lower contrast than the original.

At first, the masking film is exposed in contact with the original plate. Good results have been obtained by applying a diffuse light source and placing the masking film in contact with the *back* side of the original plate. Thus the mask becomes an unsharp, positive reproduction of the original photograph, the extent of unsharpness being determined by the thickness of the glass plate. After exposure the masking film is developed to a lower contrast (typically $\gamma \sim 0.6$) and then once again mounted to the original plate. The fact that the mask is unsharp makes superposition with the original plate less difficult, provided that the plate has been fitted with proper markings, and furthermore, the mask will not influence the finest details of the original. On the other hand, it tends to enhance the edges of the objects concerned.

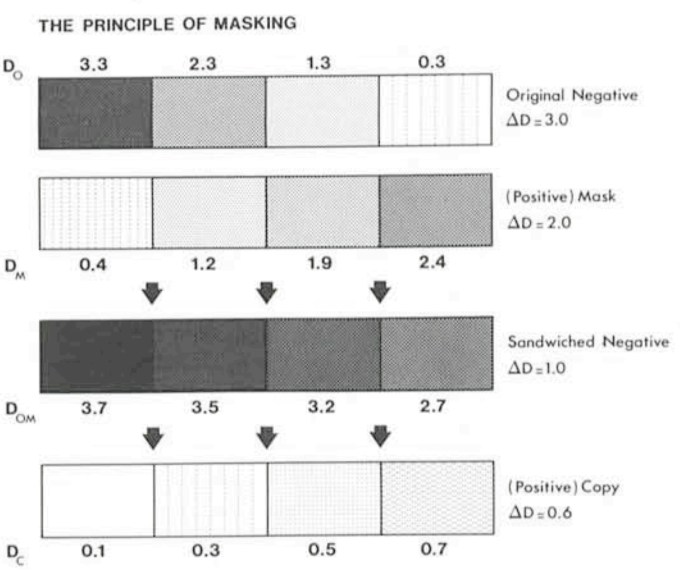

Fig. 1: *The principle of masking is illustrated by showing 4 densities in an original plate. The maximum density to be reproduced is 3.3, the minimum density 0.3. The non-linear response of the masking film is evident. The sandwiched negative plate/positive mask features a high overall density, but with a greatly reduced contrast.*

The sandwiched negative/positive is subsequently printed in a traditional way, either in a contact printer or by means of an enlarger, to get a positive film of a low contrast which still yields all the details of the original (Fig. 1). As almost any photographic emulsion the masking film has a non-linear response. In this case, however, this may be seen as an advantage, because accordingly, it does not exert its influence on the faint features of the original, thus securing a good reproduction of these, even if the density range as such is greatly decreased. It is to be noticed that the various (masking) film types will behave differently, thus having quite different effects on the final result, subject, of course, to the shape of their characteristic curves. Also the maximum density (D max) and the contrast of the mask is decisive with regard to its effect on the picture. Due to the fact that the developing has a vital influence on the density range of most emulsions, the characteristics of the mask are primarily controlled by the development, whereas the exposure plays a secondary role. (Apart from a few specialized emulsions, the effect of the exposure with regard to the contrast is secondary—but, by no means, unimportant—to that of the development.) Masked prints have appeared in the *Messenger* No. 25 (page 17) and in No. 26 (page 26).

Image Amplification

Perhaps of even more interest to many astronomers is the image amplification technique decribed by Malin (1981). The method which is used to enhance extremely faint objects on the original plates is based upon the fact that weak exposures are to be found in the uppermost layers of the photographic emulsion. Unfortunately, the density of a photographic film or plate is not exclusively determined by the exposure but also by the processing in which the development plays the most important—but by far not the only—role. The developer tends to react with the unexposed as well as the exposed silver halides, giving an overall density (fog). Furthermore, the carrier of the emulsion often has a density of its own. This is generally described as the base + fog density or the gross density. This "extra" density obscures the weakest images of faint stellar objects, leading to the apparent disappearance of these faint features in the overall density of the emulsion. In terms of photographic theory, these exposures are found in the area between the exposure threshold and 0.1 D above gross density (the "speed point", i.e. the point at which the speed of the emulsion is determined) on the characteristic curve of the emulsion in question. However, the silver halides which produce the fog are generally spread throughout the emulsion, which means that a separation between the weak exposures and the fog can be achieved by the printing method known as image amplification. As far as plates exposed to the sky background are concerned, it will often be found that the faintest objects are indeed not printable in traditional ways, because the density difference between the sky background and the faint object image is too small. The image amplification method, however, has proved equally efficient in this connection. By means of a diffuse lighting contact printer, a high contrast copy film is made. This printer, e.g. an Agfa-Gevaert SV-400, is the same as the one used for the masking. The diffuse light serves to suppress the base + fog density—insofar as this is caused by silver in the lower parts of the emulsion layers—without sacrificing the faint exposures in the top of the emulsion layer. These faint features thus become visible—and printable (Fig. 2). Of course, the method leads to a general enhancement of the grain in the upper layer of the emulsion and the contrast enhancement makes it difficult to distinguish

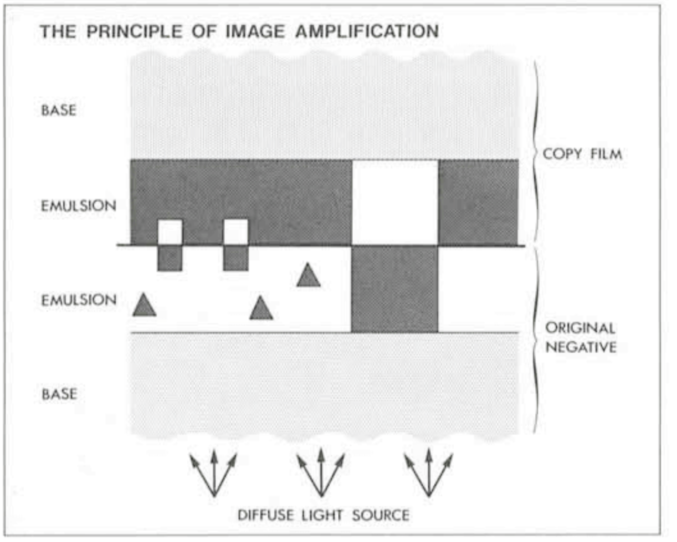

Fig. 2: *By using a diffuse light source, weak exposures (small squares) in the original plate are reproduced, whereas the fog (triangles) is reduced.*

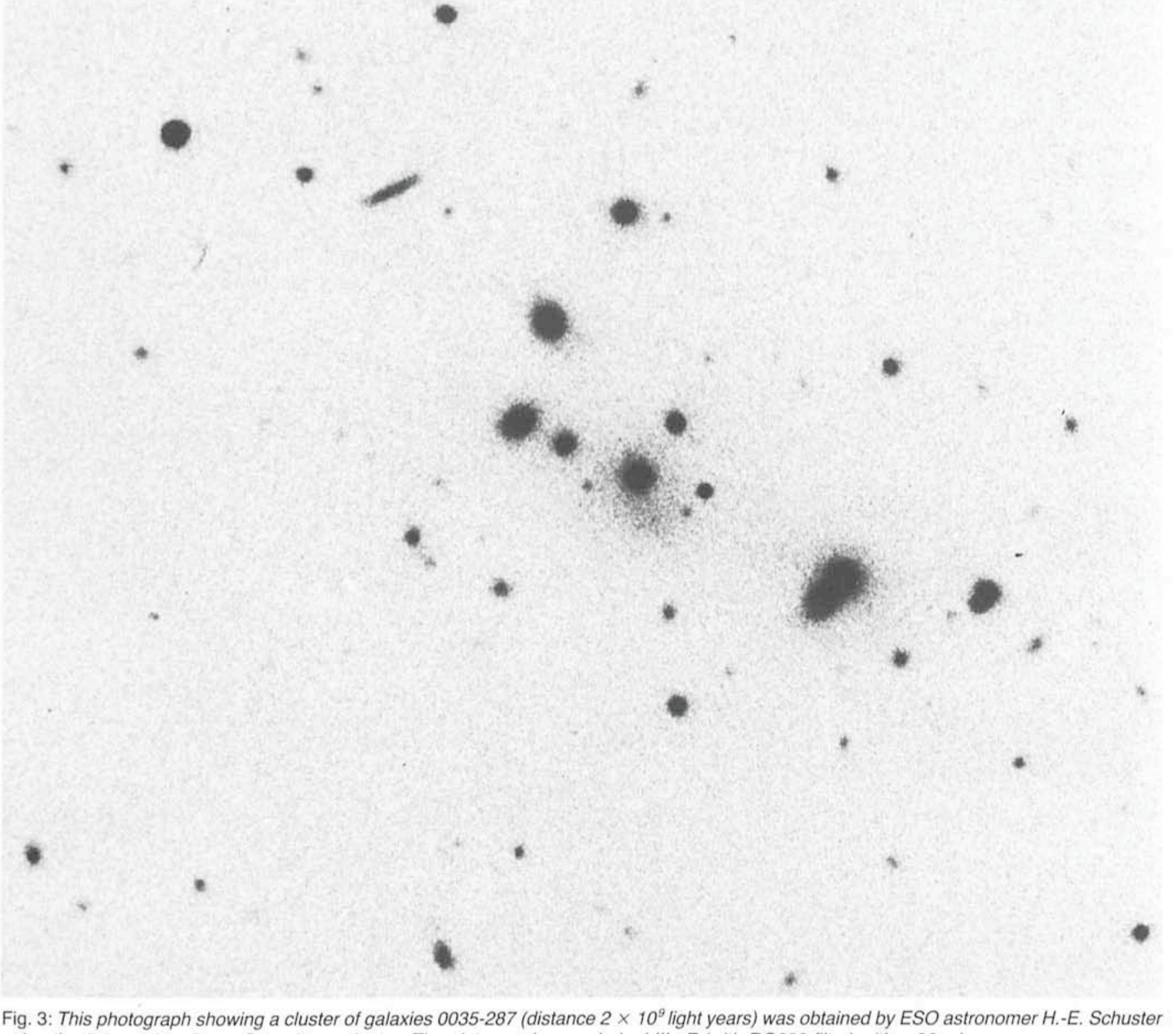

Fig. 3: *This photograph showing a cluster of galaxies 0035-287 (distance 2×10^9 light years) was obtained by ESO astronomer H.-E. Schuster using the 3.6-m prime-focus Gascoigne adapter. The plate used was a baked IIIa-F (with RG630 filter) with a 90 min. exposure.*

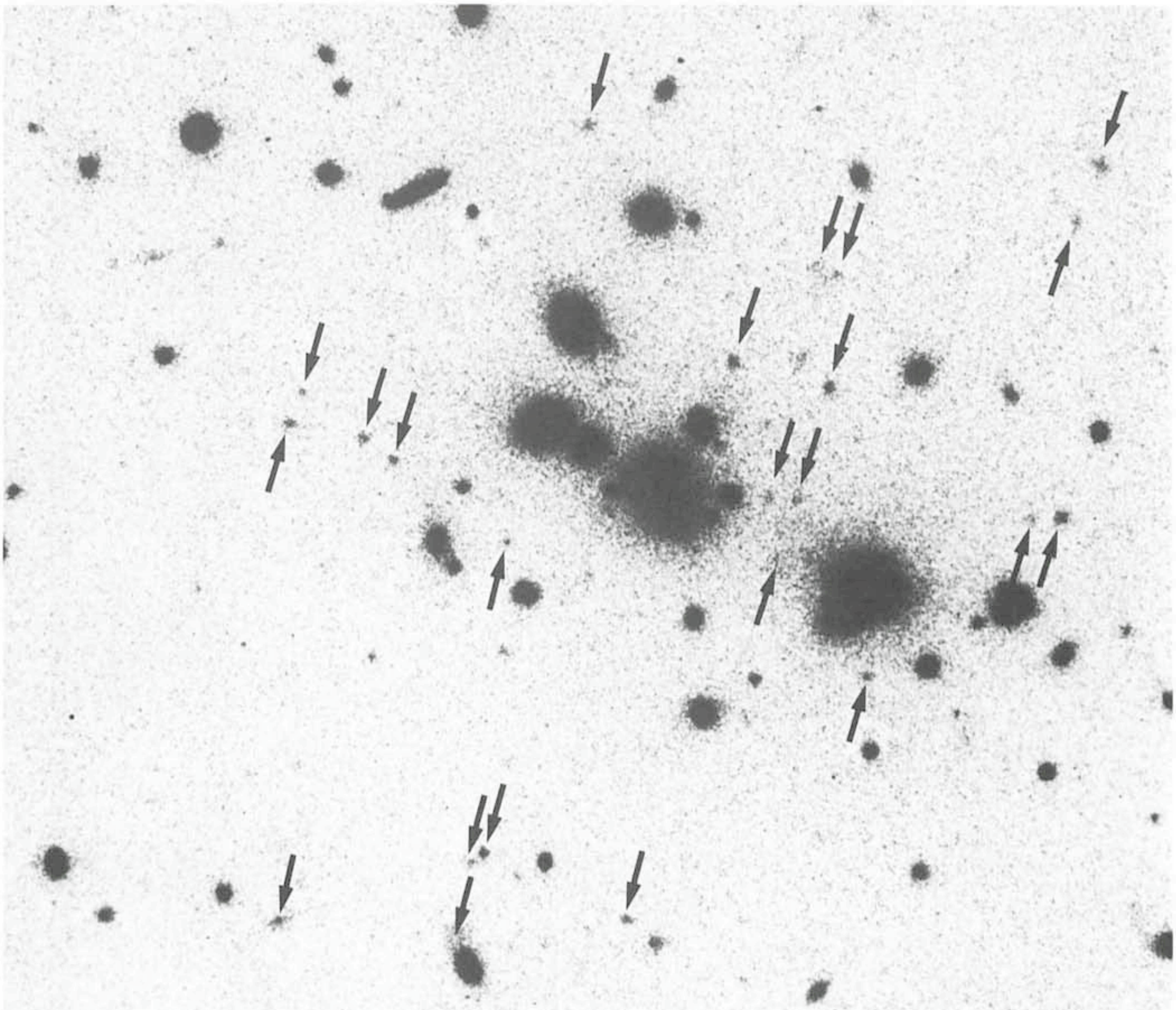

Fig. 4: *By means of the amplification method, a number of faint objects is revealed including some which cannot be determined as objects on the original plate. The tendency for the larger objects to "grow" is due to the limited exposure latitude of the high contrast copy film.*

density differences in brighter objects. Nevertheless, the method has proved to be quite effective when it comes to the reproduction of faint object images. An example of what can be achieved by this technique is shown in Fig. 3 and 4.

Conclusion

Masking as well as image amplification can be applied without big investments in sophisticated equipment. Without requiring unreasonable time, both methods still provide excellent opportunities to extract a maximum of information from the astronomical plates through individual treatment of each plate.

References

Malin, D. F., *AAS Photo-Bulletin* No. 16, 1977.
Malin, D. F., *Anglo-Australian Observatory Preprint, 1981.*
Saxby, R. and Dumoulin, B., *The Messenger,* December 1977.

ESO Workshop on "Ground-based Observations of Halley's Comet"

The ESO Workshop on "Ground-based Observations of Halley's Comet" took place at the Institut d'Astrophysique de Paris on 29 and 30 April 1982.

The aim of the workshop was to encourage cooperation between theoreticians and observers to get the best from all available observing facilities during the next apparition of comet Halley in 1985–1986 and especially of the optical telescopes on La Silla.

Comet Halley will indeed be best observable from the southern hemisphere and a large proportion of all telescopes in the south are concentrated at the ESO observatory in Chile.

The need for good astrometric measurements and accurate