

SOME CONSIDERATIONS ON THE QUALITY OF MICROFILMS OF MANUSCRIPTS.

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During the twenty years of its existence the Institute of Medieval Studies has built up a considerable collection of 35mm films of manuscripts relevant to the research that has been and is carried out within the framework of the institute. As was to be expected with such a collection the quality of the films varies greatly. Some manuscripts are located in small libraries that have inadequate photographic skills and equipment at their disposal. Others are found in the monumental collections like the Vatican, Bibliothèque Nationale or the British Library where the taking of a microfilm is a matter of course and an order from abroad for a copy is a matter of routine.

The normal procedure of the institute is that films are bought when wanted for some specific purpose and, in principle, films are meant to be consulted on and transcribed from the screen of a microfilm-reader. As many readers of this journal will know, this is not a convenient way to work. The use of film, let alone microfilm is dictated by expediency and cost-considerations only. Working many hours a day in front of an illuminated screen is extremely tiring: The constant glare in one's eyes, the difficulty of refinding the line one is transcribing, the uncomfortable position and the consequent headaches are well known. Positive films are too bright to look at and negative ones are a nuisance. To this comes the impossibility of comparing pages in different manuscripts, the difficulty of finding individual pages in the roll and the damage done to the films as a given page is eagerly sought by rushing the film backwards and forwards through the machine, the loose end spilling on the floor. All this leads to an understandable desire to reconstitute the manuscript in the form of a set of bound prints where pages can be turned over and compared at leisure in ordinary light and in a convenient position. With this end in view the microfilm-readers of the institute are nowadays of the reader-printer type which, at the press of a button and at moderate price, will produce a fairly soft but toneless print. If the film is a perfect negative of high contrast of a clear original manuscript of high contrast, you get a reasonable print out instantly. As often as not, however, the film

is far from perfect, it may well be positive and manuscripts of venerable age have stains, discolourations, and faded ink to show for it.

During the past ten years, where I have been in one way or other following the work of the institute, a good many of these difficult films have been given to me to produce legible prints from. This is tiresome and unrewarding work from a photographic point of view, because most of the difficulties should have been dealt with when the film was exposed and are the results of human errors and misunderstandings. In fact, I know of few medieval manuscripts that would not be as legible on a good photographic print as they are in the original, if they were photographed with the care and understanding that they deserve. It goes without saying that detailed research into erasures, superimposed writing etc. will always have to be carried out on the original and/or with the help of specialized photography.

Shortcomings often met in microfilms of medieval manuscripts.

Lack of definition, i.e. failure to register fine detail, failure to separate fine lines from each other or simply blurred edges and lines that were sharp on the original.

Failure to separate different shades or colours in the original.

Failure to register detail in darkened areas, e.g. stains produced by humidity, where writing may be visible on the original but often disappears on the film and even more often on the print.

Burnt-out highlights typically caused by reflexions from glossy vellum in places where the page is not flat. This happens most often on the inside of a page towards the spine of the codex.

These shortcomings are found also in films that have clearly been exposed with the proper equipment and according to the normal standards of microfilms. As we shall see below (see also pp.99-100) some of them can be remedied when making prints from the film, others cannot. It is my hope through this essay to reach those scholars and librarians who are responsible for the work of photographers, as it is my experience that a good photographer will prefer to produce photographs of good quality, but may be unable to see what good quality is when dealing with originals that mean little to him.

Other imperfections are even more serious and are due to incompetence and/or lack of suitable equipment. Most common among these are:

Image out of focus. This is a fundamental error and there is no remedy, except that the receiving institution should return the film and refuse to pay for it. I expect that the cause may often be the shift of focus that occurs during the taking of a film as the pages of the codex are turned over. Sometimes the reason may be that an unsuitable lens was used and many photographers tend to stop down hard (e.g. f. 22) which increases the depth of field (unnecessary in reproduction of books) but will often create a fall-off of definition. If the camera is placed on an unstable support while the exposures are made the effect will be just as disastrous as if the image was out of focus.

Uneven lighting over the page, caused by unsuitable or incorrectly placed lamps or by using daylight from a window. This can sometimes be remedied by hand-shading the print in enlargement, which is time-consuming and therefore costly.

Uneven lighting over the film is presumably caused by the use of daylight on a day with wind and clouds. As long as the exposures are kept within the exposure-latitude of the film it just means that the printing will be much more laborious and that the average quality of the prints will be lower.

Overexposure is quite common, presumably because inexperienced operators want to make sure that the film at least shows something. The effects of overexposure are difficult printing, coarse grain, fall-off of contrast, loss of detail in highlights, and generally lowered image quality.

Coarse grain. Apart from overexposure the normal reason for coarse grain is the use of an unsuitable material. A middle-fast panchromatic film is a good choice for snap-shots but will appear intolerable grainy when used, as it does happen, for manuscripts.

Lack of contrast can in itself be remedied by printing on hard paper, but I have often found that it is a symptom of something more serious, like overexposure or an unsuitable film.

But let us shudder and then return to the professionally taken microfilms and the possibilities of improving their quality.

The microfilm process.

Equipment. The typical microfilm camera is a large, fixed appliance which accepts unperforated 35mm film in rolls of 100 ft. with room for well over 600 exposures of 24x36mm. These reels are mostly sent out of

the house to a laboratory for processing. The films are now mostly pan-chromatic (see pp. 95&101), slow and of medium-high contrast. Most cameras have non-visual, semi-automatic focussing and the area to be covered by the exposure is determined by measurement according to the scale of reproduction or vice versa. The lens opening is mostly fixed to the optimum and often the shutter speed is fixed also, so that exposure is regulated by a rheostat attached to the lamps. These are fixed in permanent positions to give flat, even light over the surface.

It is obvious that such elaborate apparatus and processing of film in such quantities is not done primarily with a view to ancient or medieval manuscripts. The cameras, like the whole process, are designed to save on storage space for business or official records (printed or typed). Thus neither the cameras nor the processing favour experiments with special lighting, filters, differently sensitized emulsions or variations in development (contrast).

Materials (i.e. films) and colour sensitivity.

As colour sensitivity is of great importance to the information we can draw from a black and white photograph of an old manuscript, I will explain it briefly though most of my readers will undoubtedly be familiar with the principles.

Black and white films fall into four categories of colour sensitivity, which I have illustrated in appendix 2.

Blue-sensitive or non colour sensitive films are sensitive only to ultraviolet and blue rays, i.e. only the areas in the subject that reflect blue or ultraviolet light will form a black image on the negative and thus appear white or light on the positive. All areas reflecting other colours will remain blank on the negative and appear black or dark on the positive. When photographing a black and white printed original there will be no difference between this type of film and any other, but in a print from a coloured original blue lines will be white (i.e. disappear on a white background) and yellow, green and red will all come out black. Today these films are almost exclusively used for copying, whether for making copy negatives of existing b/w prints or to make contact-copies of films (positive or negative) where colour sensitivity is unimportant.

Orthochromatic films are sensitive to all colours except red. These films have often been used for manuscripts and sometimes still are because they generally have very high power of resolution and fairly high contrast.

Their ability to render red as black is of course useful when photographing faint red ink on a white or yellow background. A serious drawback is that red ink, e.g. initials or elements of musical notation and variants, becomes indistinguishable from black or brown and though it is legible we may miss important points about the lay-out of the manuscript.

Panchromatic films are most commonly in use nowadays both for technical and amateur photography, and most microfilms taken now are panchromatic i.e. sensitive to all visible colours and ultraviolet. However, one must be careful if colour differences in the manuscript are important, for even a film recently ordered and just arrived may well be a copy of a film taken 20 or more years ago and the original exposures may have been made on orthochromatic film. The user has no way of finding out or of being warned except to go and see the original.

Finally one must mention *infrared films*. These are not used for microfilming but are used in larger formats for badly stained or blackened papyri. There is no doubt that infrared would sometimes give good results on difficult vellum manuscripts, but infrared photography needs more care and experimentation than photography with visible light and for commercial reasons only one emulsion is available. This is an extremely fast and consequently grainy film which is useless for critical work on 35 mm.

All films of whatever sensitivity that are used for commercial microfilming are of fine grain and good resolving power and are adequate for reducing even very large originals of print or typescript to storable size. Put to the use of medieval manuscripts, however, they often fall short of the ideal, not because the films are not good but because they are too small in size and are put to a task that is too difficult.

The photography.

Most microfilm photographers in museums and libraries are undoubtedly competent and well-meaning people. The reason for unsatisfactory results must, as with the equipment and the materials, be sought elsewhere. When a medieval manuscript is given to the library staff-photographer he will usually just be told to make a record of it and he will be expected to do this at roughly the same speed as he deals with a printed book or a batch of newspapers. Furthermore he will not be familiar with the problems involved in reading these manuscripts and their bulk is such that it is impossible for him, without prompting, to take an interest in what they

contain individually. Thus there will be no incitement to take extra care over difficult pages. Psychologically, I find it important that the photographer is unlikely ever to be asked to produce a legible print from one of his own films or that he will ever be in contact with the actual users of his films. While the photographer may be able to create special effects he will not be told what special effects are wanted by the users of the microfilms.

On the one hand, the librarian responsible for the book will be more concerned with its preservation than with the usefulness of the microfilm. Therefore, forcing the spine to get a proper view of marginal notes or flattening the pages properly in a vacuum-frame or a book-press is most likely forbidden for fear of damaging the book. On the other hand, diffuse lighting or other special effects to obviate glares and shadows and created contrast between ink and background are discouraged by the construction of the microfilm cameras and the bulk-processing of the films.

Copying and using microfilms.

Normal practice in manuscript collections is to take one negative microfilm of every manuscript, and when a film is ordered a positive copy is made and sold. As some users prefer to get a negative film, some libraries provide negative copy-films which means that they must have the original negative film stored away for security and have a positive copy from which negative copies are drawn when ordered. Presumably, occasional orders for positive paper-prints are supplied from the original negative. This means a lot of copying and every time, even when the greatest care is taken, a little detail is lost and the contrast is raised, even if this is theoretically not necessary. I have already touched upon the damage done to films that are regularly consulted on microfilm-readers. Owing to the unfavourable scale of reproduction, where the image may have to be enlarged 15-30 times to become legible, both image grain and also flaws and scratches are enlarged to 200-900 times the area they occupy on the film.

When put this way it becomes easy to understand why microfilms often leave a good deal to be desired and the question arises:

Can the standard of manuscript-photography be improved?

As I hope to show, this is undoubtedly possible, but not without an increase in the price. As such price-increases are unlikely to have any effect on the sums made available for making and buying photographs, the

matter will have to be discussed in terms of quality or quantity. Arguments in favour of quantity are certain to be plentiful, and all I can hope to do here is to sharpen the sense of quality of the users of microfilms. If I can do this in a convincing way, I hope that my readers will, in future, think about the difficulties imposed upon them by microfilms, not as a law of nature but rather as an austerity-programme which has been carried too far and has become counter-productive.

If we take it for granted that the standard of photography is as it should be as far as focus, exposure and general contrast are concerned, there are two further ways in which to improve the photographic reproduction of a manuscript. It goes without saying that the two ways can be combined. One is what I have called special effects, like filters, special lighting etc. which is too complicated to treat here. The other way, which is by far the easiest, is to improve the scale of reproduction, i.e. to use a larger negative format to cover the same size of original. The larger the negative the less the image of the original has to be reduced and enlarged again to become legible. If the same film-material is used, a square centimetre of it will contain the same number of silver grains to form an image, whether a large or a small negative is used. But while a negative of 9x12 cm has all the silver grains of 108 cm² on which to record the details of a written page, a microfilm-frame (2.4x3.6 cm) has only the grains of 8.64 cm² to record the same number of details.

In the field of Greek papyri where letter-forms and lay-out is more capricious and physical damage and discolouration much more common than in medieval manuscripts, no one can hope to make a useful reproduction on a negative smaller than 6x7 cm (roll-film) and 9x12 cm negatives are often used. The use of microfilm to be read on a screen is virtually unknown with these exacting originals and where the original papyrus is not accessible the only acceptable substitute is a paper-print from a large, original negative enlarged to the size of the original papyrus.

This would undoubtedly also be the best way to reproduce medieval manuscripts, but it would also be expensive compared to microfilm because of the great quantity of medieval manuscripts.

Suggestion of a compromise.

Out of the total cost of microfilming a complete manuscript the labour is by far the largest item. The film material, though expensive, takes up very little room on the budget, and if the film is virtually useless both

the cost of labour and film are wasted. With the same labour and time involved one could just as easily use 70mm film and obtain negatives four times as big (56x72mm). But though 70mm film is used for this purpose in a few places this course was made difficult to choose when commercial micro-filming decided to use 35mm film and all cameras and readers were made to accomodate that format.

The best solution would be to photograph the bulk of medieval manuscripts on 70mm film and leave the really difficult or very large ones for treatment on 9x12cm or larger formats. In this way the difficult manuscripts could be photographed with the care they deserve and the worst pages could be remade until they were satisfactory since the use of flat films allows single negatives to be dealt with separately. Once the first difficult transition from original to photographic emulsion were made with the proper care the whole set of 9x12 negatives could be copied with reduction on 70mm or, if necessary, 35mm copy-film (positive) and negative copies of this film could be distributed to users. In this way only the initial stage would be appreciably more expensive than now while the subsequent stages would only be more expensive by the added cost of film material. The storage of the films would not take up four times as much room but, since few manuscripts take up a complete roll, more likely two or three times as much. The added quality should compensate amply. As an important fringe benefit it would also be possible to order top-quality paper-prints to be made from the original negatives.

Suggestions for improvement within the limitations imposed by 35 mm. film.

As I hope to have made clear I am convinced that most of the shortcomings of the good microfilms can be blamed on the small negative-format and the procedure around exposing and developing microfilms which tends to discourage experiments and to subject even difficult originals to standard treatment. I have outlined what I think would be the ideal procedure, but as I hold only small hopes that this will ever become standard practice, I shall make a few suggestions on how future microfilms may be improved.

We can rely on the photographic industry to keep improving microfilm-cameras and emulsions. Even if such improvements may be towards even greater standardization and handling-speed, it is almost certain that lens-quality, size of film-grain and the definition of the films will be improved still further. Improvements as regards the care taken over the photography of difficult pages are more problematic. I can point to the

use of diffused light when photographing ostraca that are inscribed with ink. This method will no doubt also be useful to minimize the reflection and shadows on originals that cannot be flattened properly. In some cases a polarization filter is also likely to help. A red filter would often lighten dark stains or a blue one darken red or light-brown ink. But filters can only be used after evaluation of the problems posed by each page.

Sometimes two or more exposures to different densities would make legible both the very bright and the very dark areas of a page.

Many microfilm operators are now aware that one must not photograph more than one page at a time, not both pages of an opening, unless the book is a very small one that can be flattened well, but the point is still worth making.

One should also remind some operators that when pages are taken one by one they should all face the same way. Films where versos are turned 180° from rectos are most irritating for those who read them on a screen and, to a lesser degree to those who make prints from them.

Finally a suggestion to improve the copying and printing of microfilms as well as their usefulness to those who read them on a screen. On the title-frame of a film, where the name of the library and the shelf-number of the manuscript are usually given, it would be extremely useful if there was a colour-scale, a grey-scale and a metric scale. This would give information about the colour-sensitivity of the film used, the contrast of the copy compared to the original and the size of the original. See plate 3 and the section on colour sensitivity (p. 101). The user would thus know whether to expect to be able to see differences in shades and colours, the person copying the film would be able to imitate the contrast of the original film and the printer would know what he was doing, both to the contrast and the size of the original.

APPENDIX 1.

A complicated way of making do once the damage is done.

Laur.Marc. 310. fol. lv. (plates 1-2).

Here the microfilm was positive. The original manuscript is by all accounts very difficult to read and its legibility had not been improved in photography. The film, or the copy, is badly overexposed. Highlights are almost completely burnt out and letters there are impossible to read on the screen. In order to make paper prints from the whole film, we had

a negative copy made and I produced legible prints on photostat-paper (Agfa Copyline P 90) of all 160 pages, handshading every single one according to the uneven density. Folio 1r-v could not, however, be saved by shading. In both there is a dark spot in the middle with a very dark edge and a lighter centre. The outside top-corner is badly stained and both pages show areas so overexposed that writing barely shows at all. This could not be shaded with the two hands of a human and I had to take recourse to a photographic masking which, to the best of my knowledge, has never been used on manuscripts before. The positive image was enlarged to 9x12cm and a copy-negative was made on Agfa Gevatone N33p (blue sensitive film). In order to bring back some contrast to the burnt-out areas the negative was made as thin as possible with regard to the dark spots and developed to a fairly high contrast (3' in P.Q. Universal, 1+9) knowing that the mask would counteract the unwanted effects of this. A positive contact-copy of this negative was then made, again on Gevatone. It was exposed so as to show no image at all in the overexposed parts but a good deal in dark areas and developed to a much higher contrast than usual with masks (90" in P.Q. Universal, 1+9). Thoroughly dry the two films were placed together as when the contact-print was made and stuck together at the edges with cello tape. This must be done with the utmost care over a light-box. The sandwich-negative was then enlarged to a suitable size on normal paper (plate 2). For comparison I give a 'straight' print from the 35mm negative, plate 1. As can be seen from the two plates, the method is able to bring out writing in the same print which would normally have had to be printed on two different papers, as the dark areas demanded an exposure of 5" against 30" or more to bring out what details were left in the highlights. Into the bargain the mask also tends to cover scratches in the film.

It is obvious that this method is much too laborious to be used through an entire manuscript and I recommend it only for specimen-prints for publication when a good negative cannot be obtained.

For purposes of transcription I have often made do with providing two or three prints from the same negative, exposed e.g. 5, 20 and 60". The development times given for the internegative and the mask are not to be regarded as a standard, as they will depend on the state of the micro-film and the degree of correction wanted.

APPENDIX 2.

Illustrations of contrast and colour-sensitivity in black and white films, plate 3a-d.

The subject is the proposed contrast and colour-index and scale (cf.p.99). Grey scale and colour-patches as these are available everywhere as they are used in colour-reproduction. The grey scale indicates whether the film is correctly exposed and to which contrast it is processed. If there is no separation of the white and the light greys (0.00 and 0.10 or further) the film or the copy is overexposed. If the dark greys and the black (1.25-1.90) are not distinguishable from each other, the film is underexposed. If both ends of the scale lack separation, the film is correctly exposed but very contrasty, as in b). The colour patches are not ideal for our purpose, but I know of no other that are available commercially. As I cannot reproduce the colours here it is necessary to know that 3-colour is dark brown, cyan is prussian blue and magenta is blueish red.

a) Blue-sensitive film of normal contrast (Gevatone N33p). We notice that primary red turns black while magenta registers much brighter because of its contents of blue. No separation between green and yellow. Cyan and violet much too bright. In the right hand end of the narrow band above the figures of the grey scale one should notice that such a film is capable of separating white and yellow very clearly: The words 'Y Blue-filter Negative Yellow Printer' are not visible with the other three emulsions.

b) Orthochromatic film of high contrast (Agfaortho 25). Gives excellent separation of brown, violet, magenta and red (all dark) from white and yellow (both light). Also reduces all dark grey and red or brown inks to black, thus making them easier to see on a light background.

c) Panchromatic film of normal contrast (Agfapan 25). All colours are rendered as a tone of grey which satisfies our normal concepts of colour, though we cannot tell whether the colour was cyan or magenta, violet or green.

d) Infrared film (Kodak H.S. I.R.) developed to a high contrast and exposed with ordinary lamps through an opaque filter (w 87) which allows only infrared light to come through. The most extraordinary results can be obtained with this technique. Notice that all the colour patches, including the brown, come out white. When used on manuscripts this means that properly black inks (carbon inks) or pencil can be made to stand out from almost any discolouration of the background whether this be caused by dirt, fire or humidity. Infrared films can also 'see through' a layer

of dirt of overlying layers of differently coloured ink that is opaque to the eye. As a rule of thumb, dye-inks are 'invisible' to Infrared and solid base inks (carbon or early iron oxide) become black.

APPENDIX 3.

The effects of various photographic techniques on a difficult original, with plates 4-8.

From one fragment of an original manuscript a series of negatives were made using all the photographic techniques available to me. The negatives were then printed on normal paper without any improvement, as they would be on a machine.

The original was a single leaf of a vellum-codex which was lent to me by Dr. J. Raasted. The leaf was selected because it presents a number of the problems so often met in the reproduction of medieval manuscripts.

The vellum is brown and the ink is dark brown. Each of the two columns shows four large initials in colour. Col. I has a very faint blue E, a faint red F, the lower bar of which is impossible to see with the naked eye. Below there is a faint blue V, the right-hand side of which is virtually invisible, and a faint P drawn in brownish red that has partially disappeared. In col. II there are four Es. The first and the third are drawn in brownish-red ink that seems to have bitten into the vellum in some places. The second and the fourth are faint blue. The page is generally waved and creased. Col. II is badly discoloured in places, possibly by smoke, especially the upper right-hand corner which is redish black. In col. I, 28 and in col. II, 22 there are letters and figures that appear lighter than the vellum. These were written in a red (?) ink different from that used for the initials. Their visibility now depends on their being lighter than the background not on the former colour of the ink. They can be read F(er)ia iiii and .II. Plate 4 shows the fragment photographed on a panchromatic material (Agfapan 25, 35mm). This is how the manuscript would appear on an ordinary good microfilm taken without special care for difficult pages. Normally, however, the film would reach the institute as a copy and the contrast would have gone up to obscure writing in the darkened areas. Plate 4 has a fair likeness to the original, but the blue initials have almost disappeared and the dark areas have become even darker. Note especially the upper right corner. The faded red ink of I, 28 and II, 22 is, if anything, clearer than on the original.

Plate 5 shows a print from a negative made on the same film (Agfapan 25, here a 4x5 inch. negative) but with a red filter placed over the lens. By this means the red and brown colours become lighter while the blues and greens become darker than on the original. Here the effect is to brighten the brown vellum and the brown and red discolourations while the dark brown ink is hardly affected. In this way the contrast between ink and background is generally raised without blackening the discolourations of the vellum. This method was the most successful on the upper right corner. The blue initials appear much clearer while the brown ones are less clear, though still visible. The faded ink in I,28 and II,22 is less clear than on plate 4 but still as visible as on the original. The introduction of a red filter is a device which one could realistically hope to see used on microfilms, but it cannot be used indiscriminately and its effect on the exposure may vary according to the condition of the original.

Plate 6 is from a negative on orthochromatic material, Agfaortho 25, here developed to its normal, full contrast. From suitable monochrome originals this method will produce very clear prints provided that the original is not stained. The ability of this film to bring out faded red ink cannot be illustrated on the material available to me, but should be kept in mind, provided that differences in colour are considered unimportant. The method is unsuitable for stained and uneven originals like the present one. The clear letters come out pleasantly contrasty but stained areas become much too dark and very light details are indistinguishable from the light background.

The more specialized technique of photography by ultraviolet fluorescence (plate 7) gave good results with this manuscript. The vellum is almost as light as on plate 6 and the ink is almost as uniformly black, but much better separated from the dark background in the stained areas. The very dark stain in the upper right corner and along the right-hand edge is too dark here as in most of the other plates. Notice how most of the initials are visible either as darker or lighter than the background.

Photography by this method would certainly often be useful on manuscripts, but the practical applications are limited by the unpredictability of the results and the extremely long exposures which are unacceptable in microfilming. The technique here was as follows: Four ultraviolet tubes in an otherwise dark room. Over the lens a filter (W 2B) was placed to exclude the ultraviolet light from the film (FP4 Professional, 4x5 inch.).

The minimum exposure was found by a series of trials to be four minutes at f 16. With this technique, which is fundamentally different from that used for plate 9, one photographs the visible effects of ultraviolet light which is itself invisible, while a filter excludes the ultraviolet light from the film which would otherwise react to it.

For plate 8 the opposite technique was used. In ordinary tungsten light a black filter (W 18A) was placed over the lens. This filter excludes all light-rays from the film except ultraviolet. The film was again FP4 Professional in 4x5 inch. format but this time it was developed to a very high contrast (P.Q. Universal 1+9, 4 min.) because the images formed by rays of a wavelength shorter than the visible spectrum appear on the film with a very low contrast. The exposure was unpredictable but was found to be 10 min. at f 8. With white fluorescent tubes or daylight the exposure would have been appreciably shorter. The print obtained is not useable as the only record of a manuscript page but can give interesting information about changes in the surface of the vellum whether they are caused by visible ink, by ink that has now disappeared or by scratches (ruling). Plate 8 gives the clearest rendering of the faded initials and ink in col. I, 28 and II, 22. The method can be useful in detecting erasures, palimpsests and forgeries.

For the sake of completeness I must mention that Infrared photography was useless on this fragment as it reduced both vellum, discolourations and most of the ink to a light grey.

As I hope to have shown in these examples there is no single technique which can be recommended for ancient and medieval manuscripts in general. The use of ultraviolet and infrared techniques will clearly have to be limited to a few manuscripts where interesting readings are suspected but not visible. For ordinary photography and microfilming the choice is between orthochromatic, panchromatic and panchromatic with a filter, and for each of these three there is the choice of low, medium or high contrast. On the manuscript surveyed here panchromatic with red filter and medium contrast provided the most useful general record.

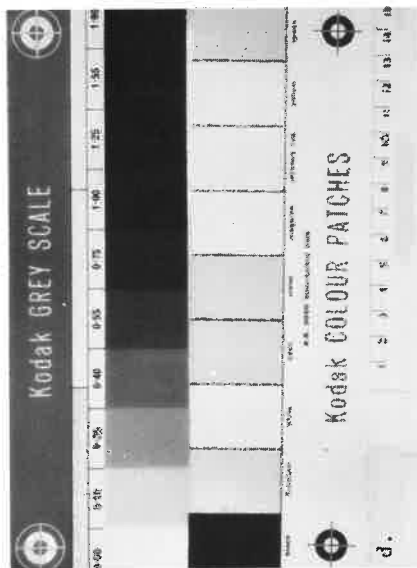
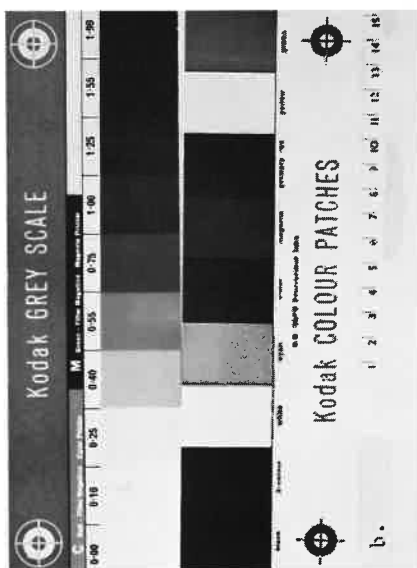
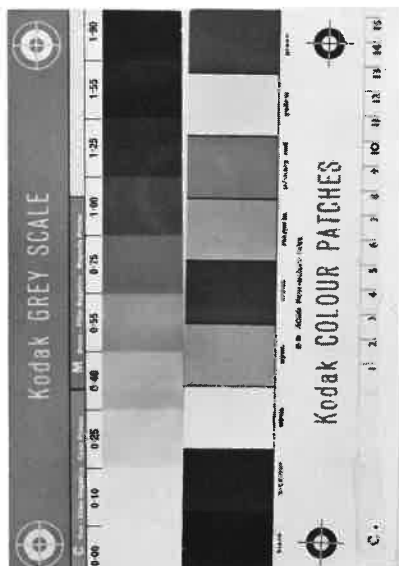
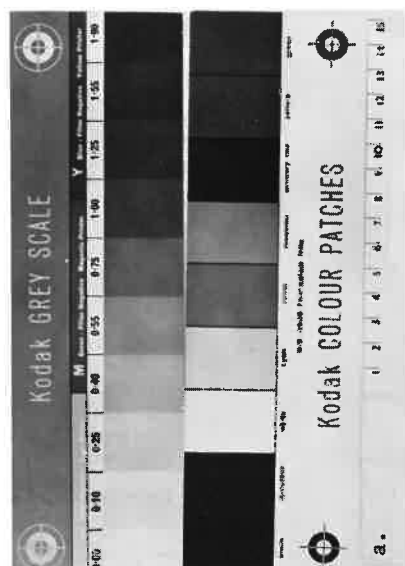
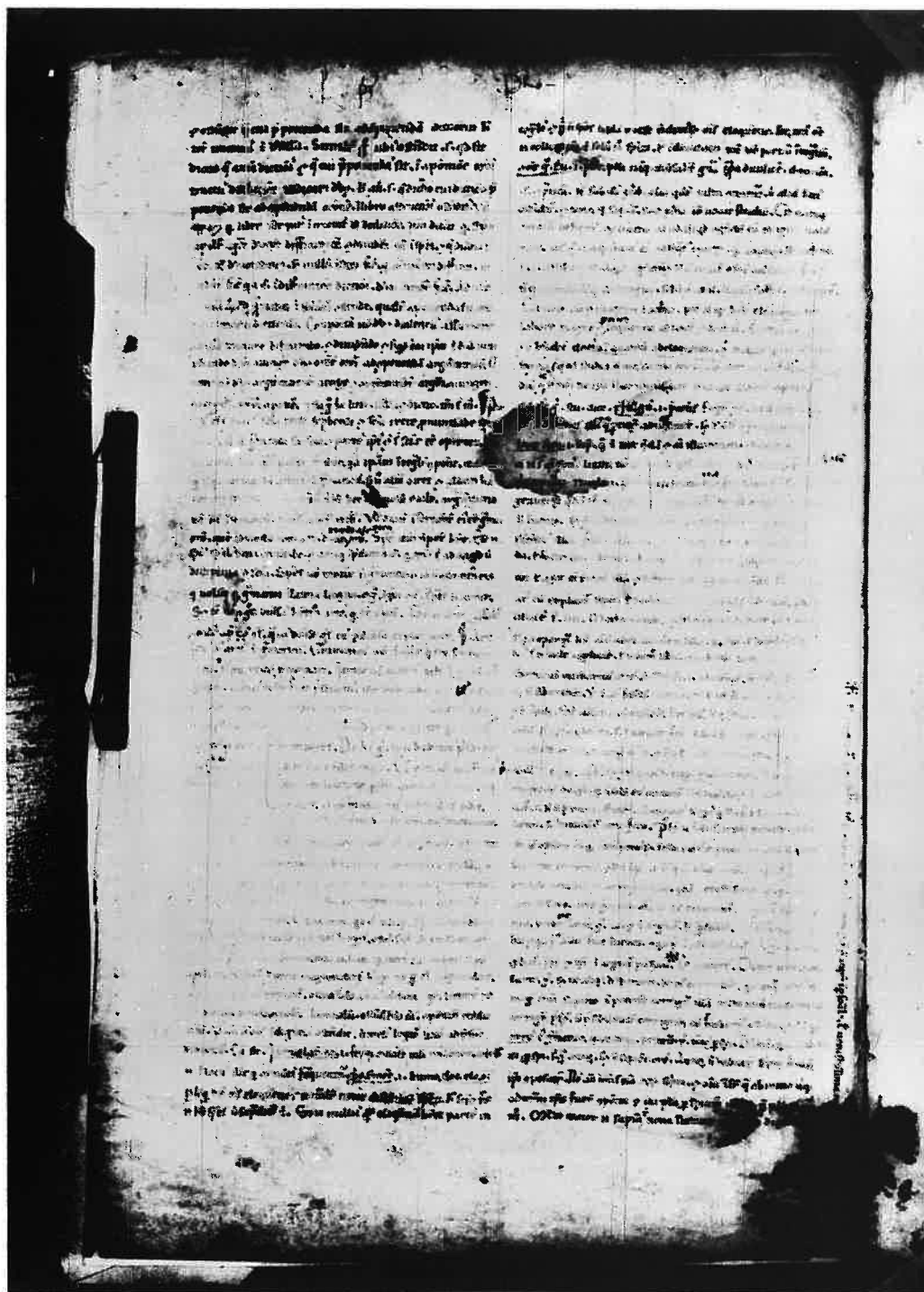


Plate 1.



[illegible]

if the vector were different, however, the two states with same energy would be

Plate 5. Panchromatic with red filter.

amplius. Et in diebus illis
loquar uerbu[m] & faciam illud.

factus est sermo dñi. ad me dices.
fili hominis. domi nst dicentium.
Visto quia hic moritur. in dies multos. &
in tempe longa hic pphetar. Propterea
dixi ad eos. Non ptingabit ultra omis
sermo mñ. uerbu quod locutus fuer
complebitur dicit dñs.

in hominibus uacillare ad prophetas
ut qui prophetant. et dicunt prophetam
tibus de corde tuo. Audite uerbum dñi
hec dicit dñs. Ne prophetis insipientibus
qui secuntur spiritum suum et nichil uident.
Quasi uulpes in deserto. prophetare uoluerunt.
Non ascendunt ex aduerso in. et opponunt
inimicum per domum in. et ut staret in sp
lio. in die. in.

ident uana. & dominant in eorum a
nima dicentes. ait dñs. cui dñs n
misericordia. & p̄f̄erretur. & confirma
re sermone. Propter ea hec dicit dñs.
Fecit manus mea signa p̄ph̄is. qui in uer
bana. & dominant in eorum anima. Inconci
lio p̄ph̄. mei non. runt. & in ierusalem
domus ista n̄ scribent. Nec in gradibus
in terra ista. & ierusalem. q̄a ego dñs.

rophie ay ther si dunnant
mandat dienes per e noue per
A edificauit alle parietē iph ar tūm
claur cū luro abq; pūlāst orōis m
me Die ad os q̄lūmū abq; tangunt
ad osium de fīr cūmūmūmūm

[illegible][illegible]

Plate 6. Orthochromatic, high contrast.

amplius. f. in ore ut is domus
loquar ut bñ & faciam illud.

et factus est sermo dñi ad me dicens.

Silbermanns Dom ist dicendum.

Unio quia hic moritur: in dies multos: &
in tempe longa hic phetatur. Propterea
dic ad eos. Non perueniatis ultra omnes
sermo meus: uerbum quod locutus sum
complebitur dicit dominus.

de hominis uacuatione ad phis

ist qui pphetant. & dies pphā

tibus de corde tuo. Audire uerbum dñi
hereditat dñs. Ne pphas insipientis
qui secunt spm sñi & nichil uident.
Quasi uultus in desert. pphere tui est.
Non ascendi ex aduerso neq. opposuit
manu p domo isrl. ut faciens in p
hio in die dñi.

ident nam: & duranti men: a

etiam dicentes. ait dñs. cū dñs fñ

misericordias eius. & plebs inuenerit confirmacionem sermonis. Propter ea hec dicit dominus. Erigam manum meam super populum istum. & dominum tendentem. Inconculcabili populo. ne non erunt. & in terra domus illius non scribentur. Nec ingredietur in terram istam. licetis. quia ego dominus deus.

rophie tuu ther hēi diuue re

mandatū dicitur, *ux & non ē ux.*

Et edificauerunt ille parietes. Ipsi autem lim-
bant eum luto absque pulvis. Et dixit
me. Dixit ad eos quoniam absque temperantia
ad altissimum non ferat cum munus ym-

et il l'a pu.

donc de voir

temperament.

CONCLUSIONS

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— *Edmund Wilson.*

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amplius. Et in diebus illis
loquar uerbum & faciam illud.

Et factus est sermo domini ad me dicens.
Fili hominis. Domini uerbum dicentium.
Uno quia hic moratur in dies multos. &
in tempora longa hic uisitat. Propterea
dic ad eos. Non prolongabit ultra omnes
sermo meus. uerbum quod locutus sum.
Et complebitur dicit dominus.

Illi hominis uaticinare ad prophetas
ut qui prophetant. & dices prophetam
tibus de corde tuo. Audite uerbum domini
hec dicit dominus. Ne prophetis insipientibus
qui fecerunt spiritum suum & nichil uiderunt.
Quasi mulieres in deserto. prophetare uoluerunt.
Non accedebant ex aduerso neque opposuerunt
mihi a pro domo in terra. ut staret in pro
lio. in die domini.

Idcirco uana & diuinant mentes
eorum dicit dominus. Et ait dominus. cum dominus si
uiderit eos. & perueniet ad confirmare
sermone. Propterea hec dicit dominus.
Erit manus mea super prophetas qui uolunt
uana & diuinant. In concilio
prophetarum non erunt. & in congregatione
domus non habebunt. Nec in gradibus
in terra uisus. & uisus. quia ego dominus deus.

Prophete uisus thesaurum diuinitatis
in mentibus dicentes. & non est pro.
Et confirmat ille pariter. prophetas. & hinc
clamat cum lucis. &; putas si dicit dominus ad
me. Dic ad eos qui loquuntur absque temperantia.

erit. Lapidem per
tione & deprimam
temperamentum & ad

Et complebo indignum
pariter. & in his qui
absque temperantia
fili hominis. prae
has prophetarum. que prophetas
& uaticinant super eas &
deus. Ne qui committunt pe
culum inanis. faciunt
pure unguere oculum.

Et factus est sermo
dicens. Fili hominis.
immundicias in uero
iniquitatis sine fine
sua. Propterea loquere
eos. Conuerimini a recte
& ueritate ad hominatem
tute faciet uias.

Et dixit dominus ad me.
enigmata. & narra
mum ut dices. Aquila
alio. longo membro
mis & uirum. ne
lit medulla cordis. Sed
enigmata. & in uisum
& in uisum negotiorum
in terra per semper.

Plate 8. Ultraviolet reflection.

