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Photo Enhancement By Film Sandwiches

An enhanced photograph and the regular print may be studied separately, or they may be viewed as a stereopair.

INTRODUCTION

A GREAT DEAL OF information is recorded by modern films, but only a small portion of it can be extracted through conventional methods of photointerpretation. Low-contrast, subtle features often escape detection due to the distracting presence of nearby prominent features. At other times these subtle features are simply left unrecorded because their boundaries are too uncertain to map. This is quite unfortunate because these subtle features may be of key importance. Crop diseases and changes in lithology and soil chemistry are often indistinct.

One means of detecting these commonly missed features is through photo-enhancement. Although the recently developed electronic techniques of enhancement yield excellent results, they still suffer serious drawbacks from a practical standpoint. Besides being time consuming and complex, these techniques are often beyond the financial reach of most individuals and small firms. There is another means of photo-enhancement, however, that not only produces fine results but also is inexpensive and simple. This method involves the use of film sandwiches. The purpose of this article is to introduce this technique and to present a detailed step-by-step procedure for enhancing photographs.

ABSTRACT: *An inexpensive and simple step-by-step procedure can be used for the enhancement of photographs. High-contrast negative and positive transparencies formed by contact printing are superimposed to create a sandwich which is then slightly offset. Contact printing the sandwich on regular photographic paper produces the enhanced print. A bas-relief effect and the enhancement of linear features results from the slight offsetting of the films. Enhanced photographs of terrestrial lava flows and lunar maria are included as examples. The technique is highly flexible and many useful variations are possible.*

FILM SANDWICHES

Photo-enhancement involving film sandwiches is both mechanical and photographic in nature. In one of the most useful techniques, a high-contrast film, such as Kodalith Ortho, is used to make negative and positive transparencies from the original negative by contact printing. The film sandwich is then formed by superimposing the negative transparency over the positive and then offsetting the films slightly. This displacement creates a thin, partial outline around features which allows light to pass through the sandwich. Contact prints are then made on regular photographic paper using the sandwich as a negative.

One of the most noticeable effects of offsetting the films is the reduction of tonal values. The blacks and grays vanish; only the contacts between areas of different tone remain. The contrast between dark shadows and brilliant highlights disappears. Features of harsh contrast no longer stand out; high- and low-contrasting features are simply outlined. Rock outcrops, roads, lakes, and

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changes in soil and vegetation are traced by fine lines. As a result, the emphasis is removed from tone and placed on shape.

Another interesting result is the creation of *shadows*. The slight displacement of the negative causes the features to be heavily outlined on one side. This gives a bas-relief or false three-dimensional appearance to the contact lines. This shadow effect creates a textural appearance and especially emphasizes linear features.

The following is a recommended step-by-step procedure for making these enhanced photographs using slightly offset film sandwiches.

MATERIALS

- Contact printer or sheet of heavy duty glass with beveled edges and a light source (enlarger or lamp with 50 watt bulb)
- Aerial photographic negative
- Package of 5 by 7-inch Kodalith Ortho sheet film
- Red safe light
- Paper developing trays
- Paper developer (Dektol), stop bath, and fixer.

TEST STRIPS

As in any photographic printing, there is a need to determine the correct exposure time. Kodalith film may be treated as a fast photographic paper, but the development and exposure times are much more critical due to the high contrast of the film. Fix the development time at 3 minutes at 68°F to simplify matters. With the red safe light on, cut several one-inch wide strips of Kodalith film and make contact prints with exposures of 1, 2, 4, and 8 seconds of the aerial negative. Develop the strips for 3 minutes, stop, fix, and wash. Examine the strips to estimate which exposure is best. If the strips are overexposed, cut down on the light source and run more test strips.

POSITIVE TRANSPARENCY

With the red safe light on, place the aerial photographic negative on top of the Kodalith film, emulsion to emulsion in order to prevent light diffusion. The dull side of the negative should be in contact with the dull (light-colored) side of the unexposed Kodalith film. Place the glass sheet over the films and hold it down firmly during printing to insure tight contact (Figure 1). After printing, develop 3 minutes, stop, fix, wash, and dry carefully to avoid scratching the film.

NEGATIVE TRANSPARENCY

After the positive transparency has dried, use it just like the aerial photographic negative and make another contact print on Kodalith film, emulsion to emulsion again. The dull surfaces of both films should again be in contact. Use an exposure of about the same period as the one used in making the positive transparency. Develop for 3 minutes, stop, fix, wash, and dry.

FILM SANDWICH

After the negative transparency is dry, trim a half-inch wide strip off both ends of the film, making it shorter than the positive transparency. Also cut several one-inch long pieces of masking tape and keep them handy. Place the positive transparency with the dull side (emulsion side) up on a light box or clean sheet of glass with a light source below. Now

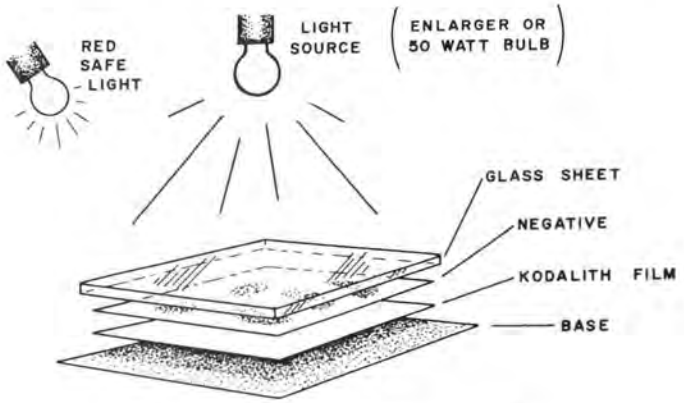


FIG. 1. Basic set-up for contact printing.

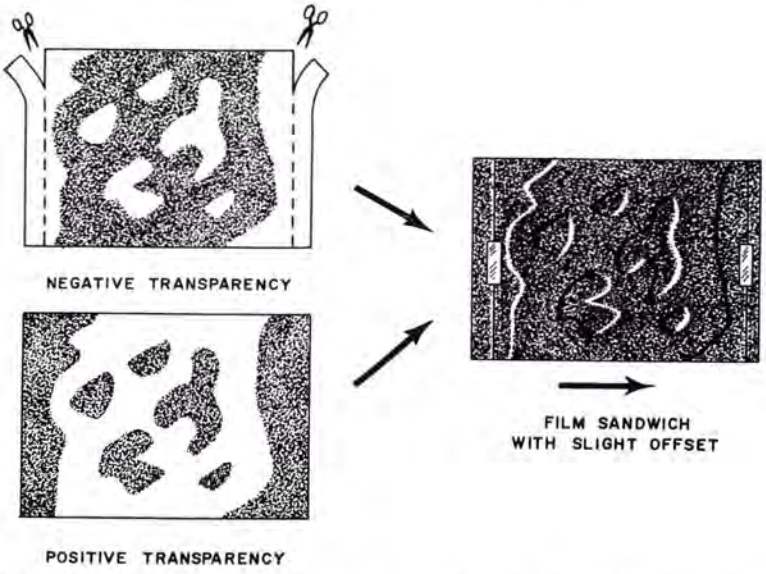


FIG. 2. The combination of high-contrast negative and positive transparencies into a film sandwich of slight offset.

place the negative transparency directly over it so that all of the features match up and no light comes through the sandwich. Carefully shift the negative transparency one tenth to one-half millimeter in the direction of the *length* of the film, making sure no rotation of the film occurs. Any rotation can be easily detected, however, because it produces a concentric pattern of light and dark bands. Make sure that the displacement is uniform across the film by checking the maximum width of the lines created. With one hand hold the film in place and use the other to tape the negative transparency to the positive one at the ends of the film (Figure 2). Obtaining uniform displacement may be difficult at first, but with practice few difficulties are encountered.

FINAL PRINT

Carefully clean the fingerprints and dust off the film sandwich and then use it as a regular negative to make contact prints on photographic paper. After making as many prints as needed, disassemble the sandwich, return it to the light box, and reassemble it there with displacement in the direction of the *width* of the film. This is done to insure the enhancement of linear features in all directions. Afterwards, the sandwich may be disassembled and reassembled any number of times to vary the amount and direction of displacement. A small displacement emphasizes fine features, whereas a slightly larger displacement enhances the more massive ones.

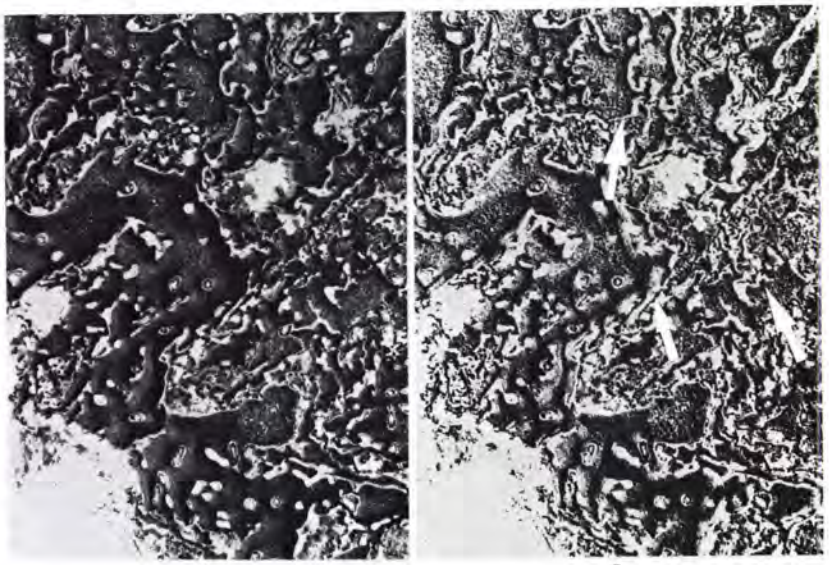
DISPLAY

A regular contact print should also be made from the original negative to provide a basis for comparison. The enhanced photograph and regular print may be studied separately, or they may be combined as a stereo pair or stereogram (Figures 3, 4, 5, and 6). In spite of both prints originating from the same negative, a false three-dimensional effect is created if the prints are viewed stereoscopically. This false three-dimensional effect causes the fine features to become even more noticeable.

EXAMPLES

Before going on to the variations and modifications of this technique, a few examples of enhancement will be presented.

Figure 3b was created by specifically following the step-by-step procedure just outlined. The area consists of several superimposed lava flows and small collapse depressions which are still quite fresh and show little weathering. In fact, surface cooling cracks can be observed on the larger smooth flows in the enhanced print. Also emphasized are at least four systems of lineations which not only dissect flows but also appear to have the original growth of the flows. One interpretation for these lineations is that they are expressions of rejuvenated fault systems in the older underlying rocks. The existence of these linear features has been verified by other smaller-scale photographs of this same area.

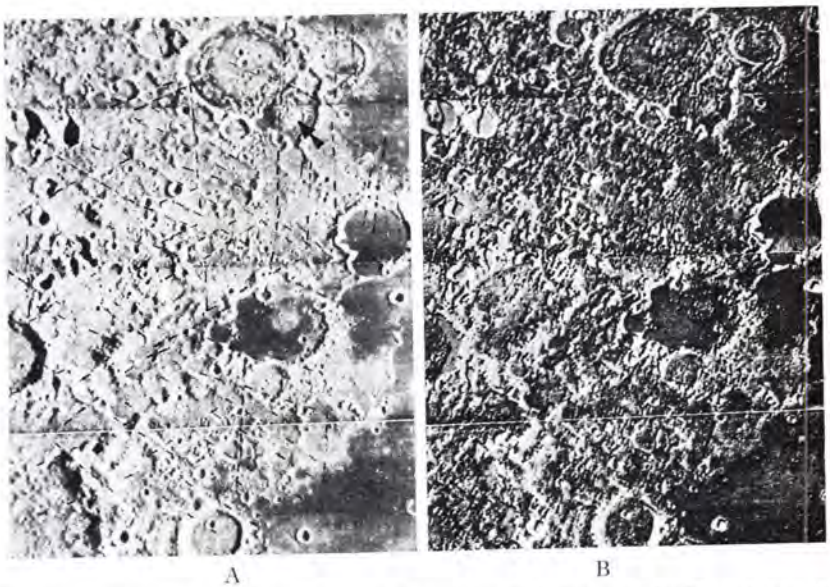


A B

FIG. 3. Regular (A) and enhanced (B) contact prints from an aerial photographic negative of the Journada del Muerto lava flow, Soccorro and Sierra Counties, New Mexico.

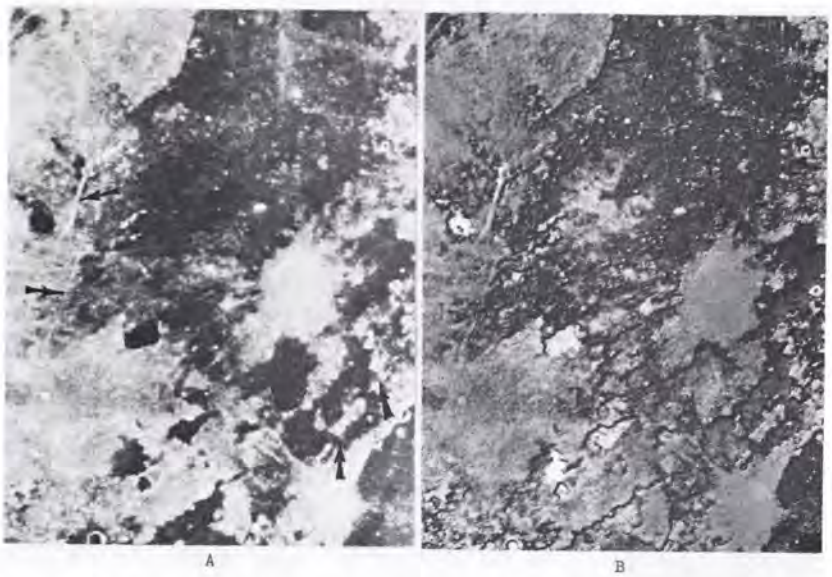
so these lineations are not patterns created accidentally by the shifting of the films. Comparison with the regular print reveals that these features exist there also, although more highly subdued.

Figures 4, 5, and 6 show some of the flexibility inherent in the film sandwich technique of photo-enhancement. Instead of making the positive transparency as a contact print, a 35-mm. negative was placed in an enlarger and projected onto the Kodalith film. Figure 4 is a closeup view of a large Lunar Orbiter photograph whereas Figures 5 and 6 were taken from a screened print in the *Rectified*



A B

FIG. 4. Regular (A) and enhanced (B) prints of the western limb region of the Moon taken from a small portion of a medium resolution Lunar Orbiter IV photograph (frame 188). The area shown is on the western shore of Oceanus Procellarum which appears as the dark, smooth material at the right. North is up.



A B

FIG. 5. Regular (A) and enhanced (B) prints of a high sun angle, earth-based photograph of the central area of the front side of the Moon. The dark area is Mare Vaporum and the streaked light areas to the lower right are the Haemus mountains. North is to the right. The regular print is from the *Rectified Lunar Atlas*, edited by G. P. Kuiper.

Lunar Atlas. In spite of the high degree of enlargement and the screening dot pattern, many subtle features were uncovered.

Three of the major lunar lineament systems can be seen in Figure 4. The lineaments of the northeast and northwest systems are numerous on the left hand portion of the photograph but are short and broken up. The north-south lineaments, on the other hand, are relatively few in number, fairly long, and intact. The most pronounced one dissects a large domed structure in the upper right hand corner. Several other north-south lineaments are located near the northern rim of the large, mare-flooded crater to the far right. One of the most widely accepted explanations for these particular lineaments is that they are great fault systems resulting from planetary-wide stresses that acted on the Moon in the past.

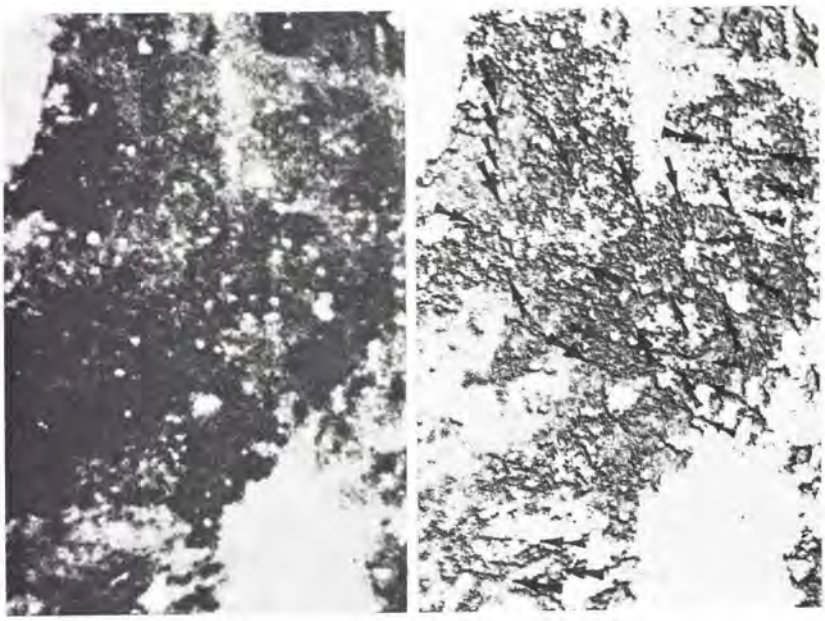
Figures 5b and 6b also display lineament systems. In Figure 5b the Hyginus and Ariadeus rilles appear as long gouges on the left-hand side of the print. The light crater rays that extend across the mare differ in texture from the fine darker lineaments. The polygonal nature of the Haemus mountains is also emphasized, suggesting block faulting. The most noticeable enhancement, however, is that of the darkest areas of mare material; these areas are now quite distinctive and may even be classified as prominent.

Figure 6b is a highly blown up portion of Mare Vaporum displaying the screening dot pattern used to print the picture. In spite of this granular texture it is still possible to detect two major lineament systems on the mare which are not related to the grid pattern of dots. This is a particularly good example of an instance where the subtle features would have remained undiscovered without photo-enhancement.

VARIATIONS

The great potential of photo-enhancement film sandwiches lies in its extensive flexibility. Many controllable variables exist which can be altered to control enhancement in the final print. Figures 5b and 6b demonstrate this principle for both were derived from the same negative with only the exposures used in making the positive transparencies different. The sharp change in character between the two prints can be attributed to the high contrast of the film being used.

Varying the contrast of the film will also alter the final print. In the step-by-step procedure just given, it was recommended that Dektol or another paper developer be used because this slightly lowers the extremely high contrast of Kodalith film and allows more features to be enhanced. The lower contrast, however, has the undesired effect of softening the boundaries of the enhanced



A B

FIG. 6. Regular (A) and enhanced (B) prints of a closer view of Mare Vaporum. Both Figures 5 and 6 were made from the same 35-mm. negative but the exposures were varied. North is to the right.

features. If more contrast is desired, then Kodalith *A* and *B* developers should be used. For less contrast, other films such as Kodak Plus-X or Panatomic-X should be tried.

Transparencies of different contrast may also be combined. A Panatomic-X positive may be combined with a Kodalith negative to add detail to an otherwise simple print. Another useful suggestion is to print the negative transparency slightly darker than the positive one. The denser negative will be more effective than the positive one and some hint of the original tonal values will be seen in the final print.

Negative and positive transparencies of different exposure may also be combined. Using Kodalith film, an underexposed positive may be combined with a negative obtained from a slightly overexposed positive (Figure 7). No offset of the films is necessary because the outlines are created by the shifting of borders that accompanies a change in exposure on high contrast film. The maximum shifting occurs where the tonal change is most

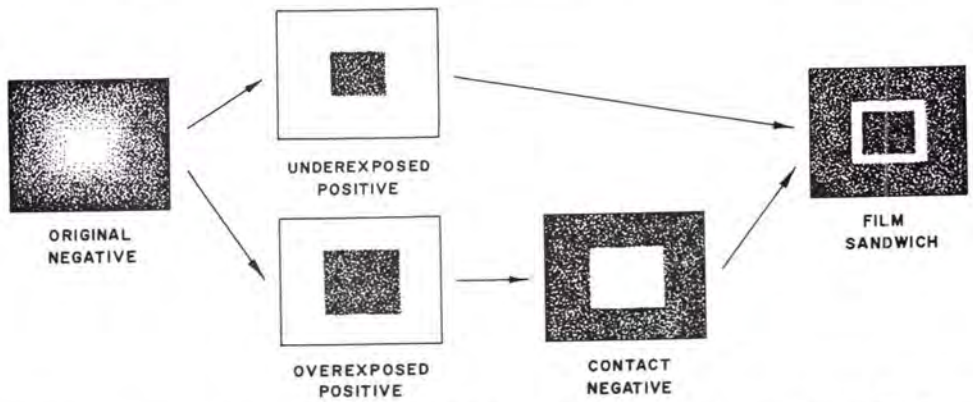


FIG. 7. Basic procedure for the creation of a sandwich in which different exposures are used. Final outline around feature is created by shift in borders that accompanies a change in exposure.

gradual on the negative, and so the borders of sharp features of high contrast show little displacement. Therefore, the thickness of any outline on the final print is a measure of the contrast of that feature. Subtle, low-contrast features will have the thickest and most noticeable outlines.

One variable which will not be discussed in detail here, but which is nevertheless quite promising, is color. By adding color to the variables of contrast and exposure, a number of new enhancement types could be devised. For example, by printing a color negative on panchromatic Kodalith film with the aid of filters, an entire spectrum of offset film sandwiches could be created. Furthermore, these negatives and positives might be mixed and then combined to enhance color differences. The careful selection of particular combinations of filters, contrast, and exposures might even lead to the development of an ore detection technique involving the color characteristics of specific ores.

It is recommended that the reader attempt at least a few deviations from the prescribed step-by-step procedure offered, in order to appreciate more fully the flexibility and variety of this technique. Quite often, even a slight change alters the print and emphasizes different details. To enhance a specific type of detail often requires only a little experimentation.