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# REAPPRAISING INFRARED PHOTOGRAPHY'S WORTH IN DECIPHERING ERASED WRITING

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There are indications or suspicions that pencil or typewriting has been erased. How can the erased matter be retrieved? Simply make an infrared photograph.

This statement is an over simplification of published decipherment methods,[1] but an answer that is quickly given by many with only casual experience in this field. Possibly it represents a document examination myth. Unfortunately, this simple formula does not work with clockwork regularity. After some years of careful and comparative investigation both with experimental and actual case problems involving erased pencil, typewriting, and infrared absorbing inks, it is clear that infrared photography has little, if any, advantage over other photographic decipherment techniques.

In theory infrared photography, or examination with infrared viewing equipment, should hold an advantage in deciphering erased pencil or typewriting because carbon and other metallic substances absorb infrared, while paper and dye inks do not. It is this absorption-reflection differential which originally suggested infrared photography's special value and is the basis for its utility. Furthermore, certain dye inks are completely transparent to infrared, and for this reason it is of some unique importance in document examination. But with erased carbon based material there seems to have arisen an assumption that the absorption of carbon is greater in the infrared than in the visible portions of the spectrum. Thus, infrared photography should be highly efficient in picking up particles of carbon which have penetrated into the paper fibers.

In the case of typewriting or pencil erasures, and in a measure with carbon based inks, such as India inks, the original writing substance does not penetrate the paper fibers. Unerased fragments of the original writing remain on the surface, most likely wedged into the crevices between the paper fibers. They can all be viewed visually or with magnification. Consequently, we are not confronted with the problem of revealing fragments hidden within the fibers. Therefore, infrared's advantage, if any, must result from greater sensitivity than panchromatic or other emulsions. Comparative testing does not substantiate this assumption (figure 1).

There are several different infrared emulsions avaliable. As with orthochromatic and panchromatic photographic emulsions, manufacturers have built different contrast and resolving power characteristics into infrared films and plates. (In this country the Eastman Kodak Company is the sole producer of infrared films and plates, except for Polaroid infrared film and for Thermofax (infrared) office copying machines. Accurate information on European manufacturers is difficult to obtain in the United States.) Contrast, speed, and wave length sensitivity differ.[2] Experimentation with erased pencil writing and typewriting using various available infrared emulsions reveal that some give better results than other, but none consistently outperforms standard films, such as Eastman Panatomic-X, Eastman Contrast Panchromatic (or Orthochromatic) Process, or Ko-

[1] An example of published references to the use of infrared in deciphering erased writing can be found in J. A. RADLEY, PHOTOGRAPHY IN CRIME DETECTION, Chapman and Hall, Ltd. (London, 1948), p. 158. Also PHOTOGRAPH IN LAW ENFORCEMENT, First Edition, Eastman Kodak Company (1948), p. 195.

[2] Eastman Kodak Company supplies the following infrared sensitive materials: Infrared film, Infrared plates, and Spectroscopic Infrared plates, type I-N and type IV-N. These last are available only on special order and must be purchased in quantity.

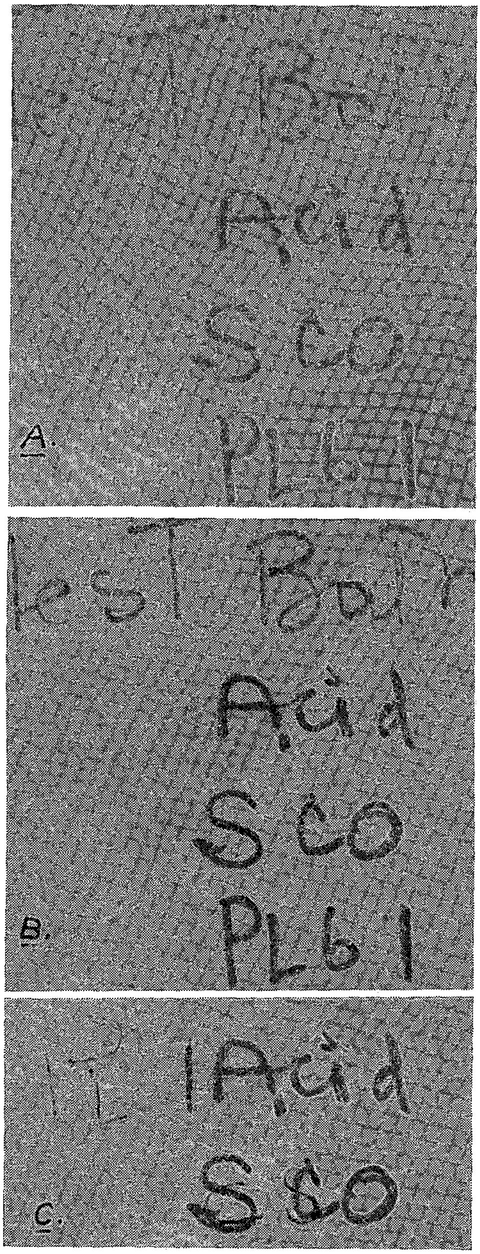


FIGURE 1
Comparison of Infrared and Panchromatic Photographic Decipherments

The subject matter under examination consisted of a series of chemical formulas involved in a patent litigation. These formulas on laboratory worksheets, were brought forward to substantiate claims of early use and actually had been substantially altered.

The upper section. A, represents decipherment by infrared photography. The erased pencil writing adjacent to the word "acid" consisted of both indentations and pencil residue. The second, more significant erasure occurred under the letters SCO. The original writing here was not readily visible in the infrared photograph.

The center section, B, represents a low angle ligh photograph made on Panatomic-X film and developec for full contrast. Here the indentations of the letter "CS" under the present letters "SC" could be decip h ered from the photograph as they have been indicat ec by tracing over in section C below. The significance ir the formula change which occurred repeatedly throu h out these records was a change of chemical ingredi n from CSO to SCO.

dalith. In this writer's opinion, slightly bette results are obtained with Eastman Spectroscopi Infrared Plates, type I–N, than with other in frared films and plates, but no direct compariso has been made with the newer Polaroid infrare film. However, with pencil and typewriting era sures infrared photography rarely produces superio decipherments to those which can be achieved b using ordinary emulsions of comparable contras and resolving power.

Lest one may contend that these results hav been derived from repeated use of the same in frared process, several facts should be pointed out Continuous experimentation has been carried ou for some years, especially on case material. I addition to the use of a variety of infrared emul sions,[3] different filters have been used with infrare material. Some workers simply use a deep re filter (Wratten A or F); such photographs utiliz part of the red spectrum to which infrared ma terials are sensitive, as well as the near infrare These filters give as good results as Wratten 87 o 88A, or a Corning 7-57, which cut off at the end c the visible spectrum and pass mostly infrared ra diation.[4] This writer, however, has also used filter which cut off well into the infrared, 8800 or 9000 A with emulsions which record beyond this point. Decipherment was not improved. Compariso photographs made with different subjects fail t show any advantage in using a particular combina tion of infrared (and possibly a deep red) wav lengths to decipher erased pencil or typewriting Other emulsion characteristics, contrast and re solving power, play a more significant role. It i

[3] All of the materials listed in footnote 2 have bee utilized at one time or another and in comparativ photographs.

[4] Kodak Wratten Filters with infrared transmissio include both 87 and 88A which transmit some smal amount of far red, 89B which transmits visible ligh from 7000A, and 87C which eliminates all visibl light.

Corning 7-57 Filters have transmission character sitics comparable to Wratten 87 and 88A. Corning als supplies a 7-56 filter which does not transmit belov 7500A.

[5] By hypersensitive Eastman Spectroscopic Plates type Z, the emulsion is made sensitive up to 12,000A A Polaroid XRX10 filter was used to limit the rang between 9000 and 12,000A.

FIGURE 2
An Effective Infrared Decipherment
The change in a time group in a ship's log from 0516 to 0505 could be easily read from an infrared photograph of the area. Much of the success in this decipherment resulted not particularly from the use of infrared material, but from low angle illumination which helped to emphasize the writing indentations as well as the fragments of partially erased pencil. An equally effective decipherment was made using panchromatic material.

recommended, consequently, that each worker select a standardized process or combination of infrared emulsions, filter, and development which works best for him, if he plans to use infrared on this class of problem.

To be able to control or modify contrast by exposure and development can lead to improved results with difficult problems. Infrared emulsions do allow some control of these factors, and procedures are comparable to other classes of films.

But the basic premise of this paper is that deciphering mechanical erasures of infrared opaque inks, typewriting, or pencil strokes, infrared sensitive emulsions are not a cure-all. They are not *the* method. While decipherment can be made from such photographs (figure 2), they are normally no better than those made with panchromatic or orthochromatic films. Infrared films and plates require special care in handling and storage[6] none of which is needed for standard emulsions. Furthermore, shelf life of infrared materials is shorter. Since erased pencil and typewriting can be deciphered successfully without the use of infrared film, many may prefer to avoid it. In fact, if infrared in the vast majority of instances does not improve results, then why not forget the process entirely? Would anything be lost?

Infrared cannot be entirely discarded. Certainly there are a few cases in which it will work far better than any other photographic process. But these special cases can generally be recognized early. If there has been overwriting in the erased area, and this overwriting is with an ink or other marking substance which has a high infrared transparency, the use of infrared is imperative. The interfering writing can be substantially weakened or eliminated by photographing entirely in the infrared spectrum. Yet the erased carbon based writing can be photographed as efficiently as with any emulsion. Here is a tremendous advantage, for now all writing fragments can be carefully studied to the fullest advantage without interference from the overwriting. You may say that this is rare since changes in pencil and typewritten documents generally are made with the same class of writing instrument after erasure. True, but what about the erasing of a carbon outline in a traced forgery which is inked over with a pure dye ink. The process allows the fullest demonstration of the remaining outline, a highly significant element of proof.

Can we summarize this way. With virtually all pencil and typewriting erasures infrared photographs hold no advantage over any other class of photograph. Often other kinds of photographs do a much better job, but generally there is not much choice. The infrared materials require greater care in handling and storage, and for this reason most workers prefer standard emulsions. Infrared is not the sure answer, and its applications in this field have been overrated. But there are erasure problems, as we have seen, when it is superior. It has other significant applications to document work not considered in this paper—differentiations of inks, penetration of obliterations by overwriting, and infrared luminescence to mention a few. But probably its oldest use, decipherment of pencil and typewriting erasures, does not really require its employment at all.

Does the author consistently work these problems without turning to it? No, even though it is clear he could. Undoubtedly, because of the eternal hope that the case at hand is the real exception in which infrared is going to save the day. But we are deluding ourselves when we consistently turn to it. Erased pencil and typewriting can be efficiently deciphered in the vast majority of cases without any need for infrared photography.

[6] Not all film holders are infrared lighttight. Films and plates have a longer shelf life if stored under refrigeration.