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A METHOD OF SUPERIMPOSED PHOTOGRAPHY APPLIED TO CRIMINALISTICS*

Jean Gayet

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A great number of problems in criminalistics involve the comparison of objects or their image. We compare for example the stria and the various marks left on shells or bullets in order to determine if they were fired from the same gun. We also compare bank notes or documents to verify if they are from the same origin and, consequently, genuine or forged. We likewise compare stamp impressions, etc.

In order to solve these numerous problems there has been constructed several optical apparatus, such as the comparison microscope which produces the image of two objects side by side—this apparatus is especially useful for the comparison of the origin of two bullets where we arrange the rifling of one as an extension of the other—and such as the American apparatus the Kopti-Kat which gives a superimposed image of the two objects and permits one to point out the differences between them.

But all of the laboratories, all of the experts, do not have such apparatus at their disposal. They are obliged to resort to other methods of examination. They can attain excellent results in utilizing the technique of superimposed photographs. There have been many cases where the optical apparatus discussed above is not usable and where the technique of superimposition is alone applicable.

Superimposed photography does not require complicated apparatus. It is sufficient to have a camera for macrophotography, utilizing large sized plates, 9 x 12 cm. (4 x 5 in.) or even in preference 13 x 18 cm. (5 x 7 in.) One cannot consider using motion picture film 24 x 36 mm. As for portrait films they give us deceptive results; their support, a base of cellulose esters (cellulose nitrate or cellulose acetate) undergoes changes in dimensions in the course of the developing and fixing baths. It is best to use glass photographic plates of the size 13 x 18 cm. (5 x 7 in.)

*Translated from the French by Ordway Hilton, Examiner of Questioned Documents, New York City.

Moreover, it is necessary to have a photographic enlarger. In fact, we shall see subsequently that the two plates made from each object under comparison are put together one on top of the other *emulsion against emulsion*. A thickness of glass is thus found interposed between the negative emulsion and the photographic paper on which we print the image. Thus, we should necessarily obtain a defused image in printing by contact. If we utilize an ordinary lamp (rather than a mercury vapor lamp) in the enlarger, it will be necessary to pay close attention so not to melt the gelatin on the plates. In fact, the two plates lying gelatin against gelatin do not enjoy the cooling effect of the emulsion in contact with the air.

METHOD OF OPERATION

Let us suppose that we must compare two objects A and B. We photograph each of them under the same conditions. From one of the negative plates obtained (A for example) we prepare a positive print on a glass plate.

The comparison is then obtained by superimposing the negative plate B on the positive A, and we make the two designs correspond as accurately as possible. To keep the two plates from slipping across each other during the comparison when we place them in the enlarger, we glue them very lightly one against the other. It is sufficient to let a drop of water fall from a pipette onto the edge of a plate. By capillary action, the water slips between the two plates, soaks the two gelatin coatings which upon drying stick against each other. We then put the two plates into the enlarger without any risk. After using them, we slip a safety razor blade between the two plates to separate them.

We are now about to describe the method of superimposition by subtraction. This is by far the most common case. In this procedure, the common portions of the two designs appear on the plates in one case as a positive, in one case, a negative. They will subtract themselves and give, after printing on paper, neutral gray color. On the other hand the different portions of the design appear as traces of black or white depending upon whether they come from one or the other design.

A superimposed photograph saves enumeration in the expert's report of the differences which are pointed out in the comparison of the two objects. We see at a single glance what the differences are and from which object they came. Arrows traced in red ink on the photograph are sufficient to show the differences in design which the expert has judged as important and which have led him to his opinion.

Superimposition by addition is obtained by superimposing purely and simply the two negative plates. This case is quite rare.

COMPARISON OF INKED STAMP IMPRESSIONS

In examining suspected stamp impressions, it is unnecessary for the expert to look for the comparison impressions from authentic stamps until he finds them in order to complete a satisfactory proof. It is sufficient for him to compare only the two suspected impressions which should have come from the same stamp to discover that it is a forgery and to establish the method of falsification.



Figure 1

Figure 2

Here are, for example,—figures 1 and 2—two stamp impressions appearing on the same passport. It seems almost at once that this is a matter of forgery. One cannot utilize optical equipment—the comparison microscope or the Kopti-Kat—for it would be necessary under these conditions to tear out the pages of the passport. On the contrary a superimposed photograph (by subtraction) will furnish us with all the necessary information without having needed to destroy the piece of convincing proof (the passport). We shall see in figure 3 the results obtained. We have marked with arrows the differences in design which have seemed to us important. We note that the rectangular

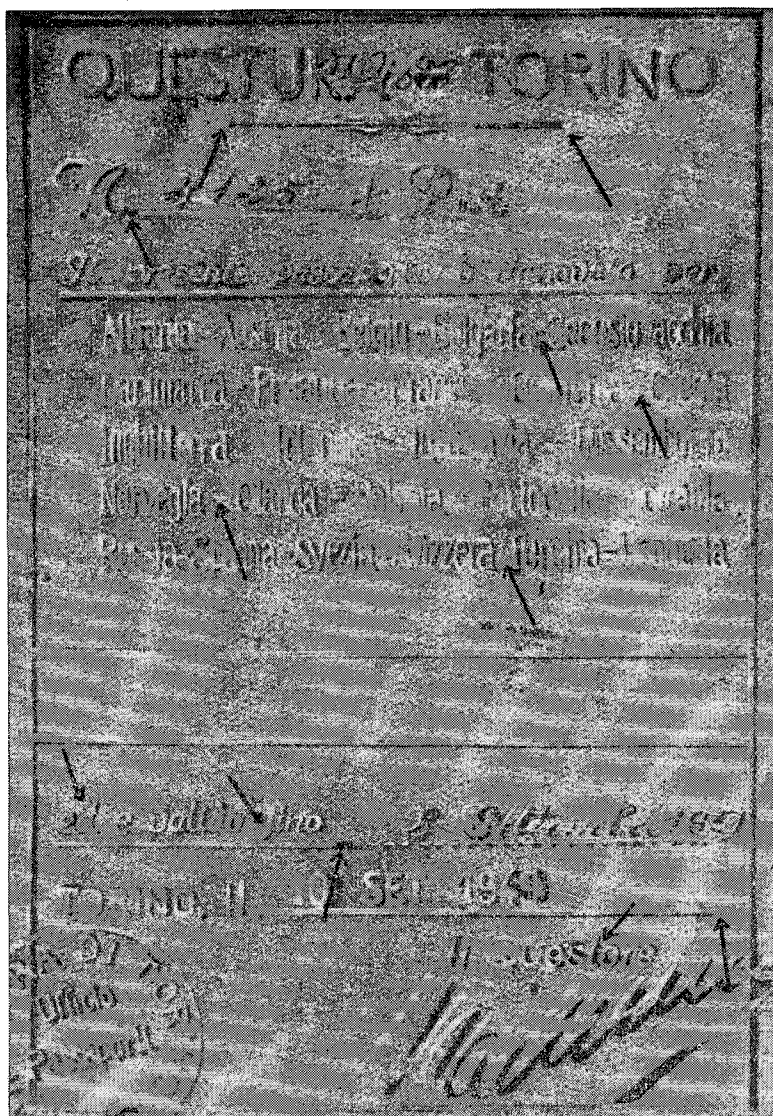


Figure 3

The Forged Stamps of Figure 1 and 2 Superimposed.

stamp shows these differences in design: In the horizontal underlining strokes in the dashes between the countries, and in the letters of the last line of the stamp.

On the other hand, the round stamp is found in the two cases in exactly the same position in respect to the rectangular stamp. In fact, the stamps appearing on the passport have been prepared by tracing an outline with carbon paper. The carbon outline so obtained has

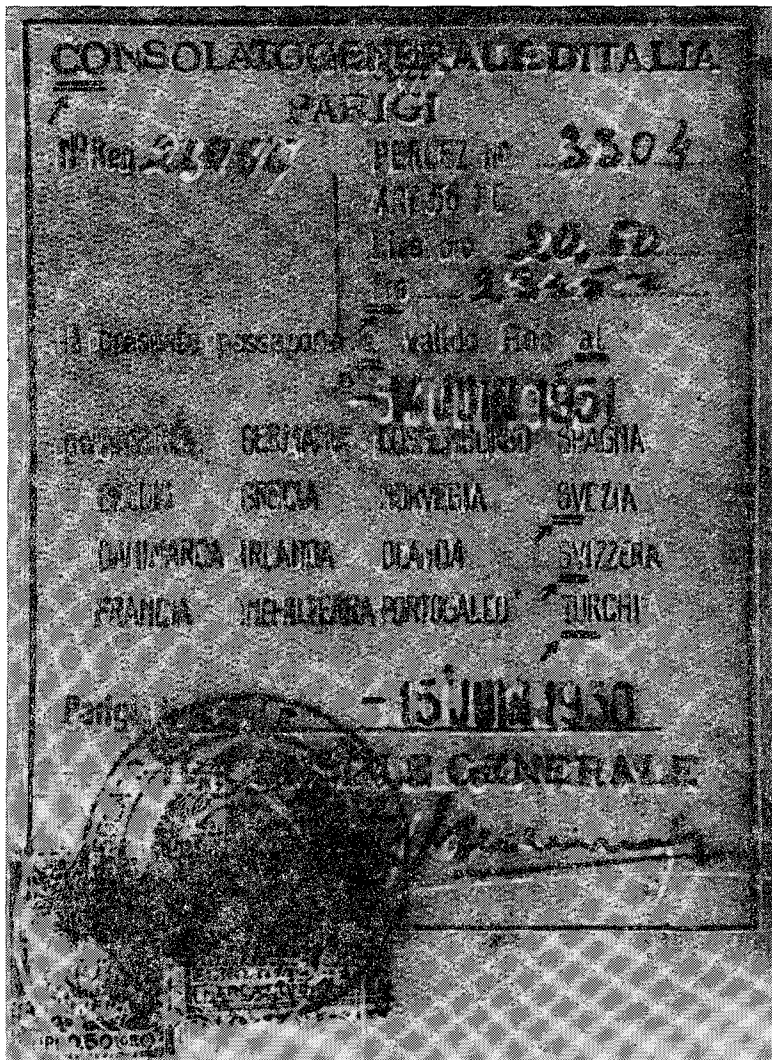


Figure 4

The underscores indicated by arrows are points at which the 2 forged stamps were set in coincidence.

been traced over with ink. The forger did not take the precaution to modify the position of the round stamp.

Figure 4 also shows the superimposed image of two stamps appearing on another passport. To obtain the rectangular stamp impression the forger had recourse to a small "commercial printing press," that is to say, with movable rubber type which could be assembled to form the desired text. Only the horizontal, vertical, and border lines had been drawn by hand. The forger composed his stamp when he had a

need for it, then he tore it down each time. When he had a new need for a stamp impression, he reset as accurately as possible the rubber characters in imitation of the first impression which he had made in his passport. Superimposing the two impressions show that the resemblance which he had obtained was only relative. In such a case the expert in his demonstration limits himself by underscoring in ink the portions of the design that superimposed perfectly, and which showed that the two photographs had been made under identical conditions.

Here is now an example of superimposition by addition. Two pages of a document (a passport) were found accidentally adhering one to another. At the time of inspection the police service had separated the two sheets, but roughly. In spots a piece of film from one sheet had remained affixed to the next page damaging the inked stamp impression which had been placed on this sheet. We were requested to reconstruct the stamp impression as it had been first imprinted. It was particularly important to reconstruct the date which had been printed in the center of this impression. We then photographed the stamp impression and the portion which had been transferred onto the next page under exactly the same conditions. We put together the two plates obtained and placed the assembly in the enlarger. Thus, we were able to reestablish the date requested.

COMPARISON OF IMPRESSED STAMPS

It is easy to make an expert study of inked stamp impressions which are printed with an aniline or printing ink. The problem is much more difficult when the question is concerned with "dry" stamps which are only impressed in relief into the paper. The classic method consists of photographing these stamps under an oblique light, and the shadows give us the particular design. Actually, the image obtained is really imperfect and certain portions are lighted in the direction of the illuminating rays and do not give any shadow.

On the other hand impressed stamps are generally found with a printed text or on a photograph where the image is added to that of the stamp and renders certain regions unsuited for examination.

We have been experimenting at the Lyon Police Laboratory with another technique of which the principle is the following. We pass over the relief portion of the stamp a small rubber roller charged with "an invisible ink" containing a product highly fluorescent under ultraviolet radiation. The raised portions are touched by the roller and receive the fluorescent ink while the lower portions will remain obscure. By photographing under ultraviolet, we will obtain the image

of the stamps while the printed text or the photograph on which the seal is found is invisible or nearly so.

The ink which we use is composed of a polyvinyl alcohol and of carboxymethylcellulose dissolved in water. To these products is added a fluorescent produce soluble in water and also glycerine which prevents the ink from drying too rapidly. This ink is stored in a tube to protect it from the air.

Here is the method of operation. We turn on the ultraviolet generator and under the control of the emitted ultraviolet illumination, we place a small portion of this ink on a glass plate. We then take a rubber roller similar to that which is used to spread the ink for finger-print impressions. With this roller we spread the fluid fluorescent paste. When the distribution of this paste on the roller is uniform, we pass the latter over the impressed stamp. The ultraviolet illumination immediately shows us the results obtained and allows us to stop the operation at the time when we judge it most favorable.

Of course, the image obtained is not perfect and certain regions of the stamp will not yet have received ink or will form a blot. The results obtained however are clearly superior to examination under oblique illumination.

When we will have made a fluorescent photograph of the stamp, we will be careful to determine if the portions which show less visibly actually comes from the stamp or if they are due to the operations of the expert.

We will see in figure 5 an impressed stamp appearing on a check. The image was made by photographing with oblique light. Figure 6 shows the same stamp only obtained by the method which we have

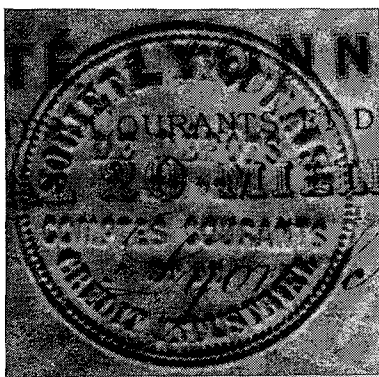


Figure 5



Figure 6

An Impressed Stamp on a Check.

Figure 5 is a photograph with oblique lighting. Figure 6 is a photograph under ultraviolet illumination after treatment with fluorescent ink.

discussed. The text appears very legible and the imprinted notations of the check have almost disappeared.

The fluorescence of the stamp is still weaker in parts where the stamp is found on a dark support, but the design of the stamp, however, is still visible.

The expert examination of impressed stamps are very rare. However, we might encounter it in the course of examination of identification cards or passports. Certain malefactors in fact obtain (or steal) authentic personal identification papers. They remove the photograph which is found there and place their own there. They change some letters in the name of the first owner for the fact or theft would have been apparent to the police. Thus, they are found to possess authentic documents, but falsified. To prevent the fraud from being recognized too easily, the forger marks on the back of his photograph an image as much like the impressed seal as possible. With the help of a metal stylus, he follows the outline of his design which also appears in relief on the photograph, which gives the illusion of an impressed stamp. To demonstrate the fraud, we can superimpose by photographic subtraction the impressed design from the true stamp.

There is a more elegant procedure for demonstration and which permits showing on one hand that the design of the stamp is not the same, and on the other hand that the location of the stamp is not exactly the same as that of the stamp which appears on the identification paper. For this we pass the roller charged with fluorescent ink over the photograph—where the stamp appears in relief—and on the surface of the document—where the stamp appears depressed. We pierce the document with two small pin holes. Under ultraviolet radiation and in the same conditions we photograph the front and back of the document. On the front the stamp appears white on a black background (as in figure 6); on the back it appears black on a white background.

We put the two negatives obtained together gelatine against gelatine. We set them in such a manner that the pinholes superimpose perfectly. We make a photograph with the enlarger. The image obtained proves the non-coincidence of the two stamps.

We separate the two plates and then superimpose the two stamp designs. The photograph obtained in the enlarger proves the differences in design. The two photographs have been made by superimposition "by addition."

It has not yet been possible for us to apply the procedure which we have indicated above to an actual case investigation.

SUPERIMPOSED PHOTOGRAPHS AND TYPEWRITING EXAMINATION

The method which we are indicating also has its use in typewriting examination.

1. For the comparison of the design of characters. This comparison is necessary either to determine the make of machine which typed an incriminating document (we then compare the writing of the document with type specimens taken from known makes of typewriters), or to identify the typewriter itself (we then compare the writing of the incriminating text with that of the comparison texts).¹

This method is very precise. It presents a single inconvenience of requiring a good deal of heavy work, in as much as the expert must photograph on a plate each of the letters which he uses to establish his diagnosis.

2. To set forth certain forgeries by addition, when the addition is contained on a document made up in duplicate (an original and a carbon copy).

In certain cases it happens that the forger has taken care to readjust the two copies and to introduce them together in the typewriter. The addition is then less apparent to the untrained eye since they harmonize, the original text having been typed through the ribbon and the copy typed through the carbon. At first, we were able to examine each document separately, we then demonstrate that the suspected addition is not in alignment with the rest of the text.

This however does not demonstrate in an absolute manner that it is a matter of forgery. We can in fact admit that the typist has committed an error in the course of typewriting the document and that he had immediately corrected it without taking the paper from the typewriter; if the line spacing ratchet is poorly adjusted, the correction may not be aligned.

Under these conditions the expert has an interest in superimposing (by subtraction) the original and the carbon copy. It is then demonstrated that the additions do not correspond because the forger is not able to replace the two documents in the same position as when they were first typed. It is not necessary to photograph the entire text for only the areas showing the suspected additions and its surroundings are used for the demonstration. Besides in a typewritten text we usually notice a very slight slipping of the original with regard to its carbon

1. We have already recommended this method in our article which appeared in the *International Criminal Police Review*, March 1949, page 16.

copy, which causes the two documents to superimpose perfectly only in the adjacent regions.

The demonstration by superimposed photography is more evident to a jury than the use of typewriting test plates which necessitate long explanations on the escapement of the typewriter and the theoretical location of the letter impressions. It is also very practical when the addition is very short and when the typewriter is in a poor state of repair so that the letters print out of alignment.

Here is an example of an expert examination where this method is necessary. An insurance company has made in triplicate a typewritten insurance contract: A copy is kept by the home office, another copy for the regional agency, and a third copy is given to the insured. The latter has properly signed the three copies of his contract, but he has taken advantage of the fact that the insurance company has trusted him by allowing him to take home the contracts instead of signing them at the agency, to change the date from which this insurance took effect. Instead of being valid from the first of December, his insurance was valid from the first of November. For this it was sufficient to change the three letters *dec.* to *nov.* Nobody perceived the fraud except when the insurance company is asked to pay for an accident occurring in the month of November. At first the fraud was difficult to demonstrate for the changes contain only three small letters. It has been done on an Underwood machine just as the document had been typed. (The Underwood machine is very common in France.) We were not able to consider an analysis of the typewriting ribbon ink, and the paper was of a very poor quality so that it was not possible to demonstrate what was erased. The superimposing of the two documents that the insurance company possessed revealed the evidence of falsification.

THE SUPERIMPOSED PHOTOGRAPH AND THE EXAMINATION OF HANDWRITTEN DOCUMENTS

Until now the comparisons which we have made have been carried out with two different objects. We have compared two stamps, two characters of a typewriter, two typewritten documents suspected of containing additions.

The superimposed photograph finds important utilization in the examination of handwritten documents when we desire to make apparent an erased text. Under these conditions the comparison is not carried out with two objects, but with the same document which we examine in two different states.

We know that the text which has been effaced chemically can be made visible under ultraviolet illumination where it fluoresces. By utilizing proper filters, we are able to photograph this weak fluorescence and with a photograph to render visible that which is not sufficiently bright to affect our retina. The fluorescent *photograph* is then a great improvement in comparison with *the visual examination* of this fluorescence. But we are still able to improve the technique by comparing the image of the document obtained under ordinary light and that obtained under ultraviolet illumination. Of course, the two photographs are made under the same optical conditions so that the two images may be superimposed.

A photograph with ordinary light shows the text as it actually appears and the fine safety lines of the background when we are dealing with a check. The photograph with ultraviolet illumination shows, besides, the original text partially covered by the actual writing.

The original text appears incompletely, and it seems that the ink of the overwriting has destroyed the fluorescence. In reality, this is not so, in the zones covered by the actual writing the fluorescence is not cancelled, it is simply diminished (let us say to settle these concepts that it is 100 to 500 times weaker). Such a difference in intensity registers on a photographic plate (the latter registers ranges of intensity of 1 to 2,000), but it is not apparent on the print.

We proceed then with the photographic subtraction. We subtract the photograph taken with ordinary light from that taken with ultraviolet illumination. By superimposing the positive of the first on the negative of the second, we diminish very decidedly the contrast of the plates and the fluorescent text can then be printed on a photographic paper. The original text will then be entirely legible.

Photographs 7, 8 and 9 illustrate this method. Figure 7 shows the

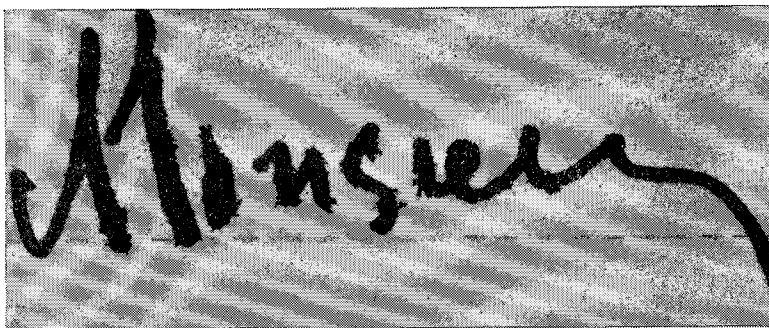
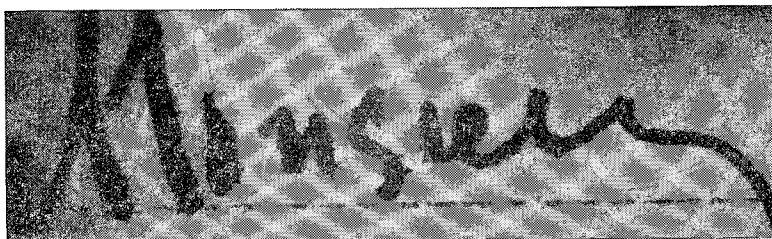
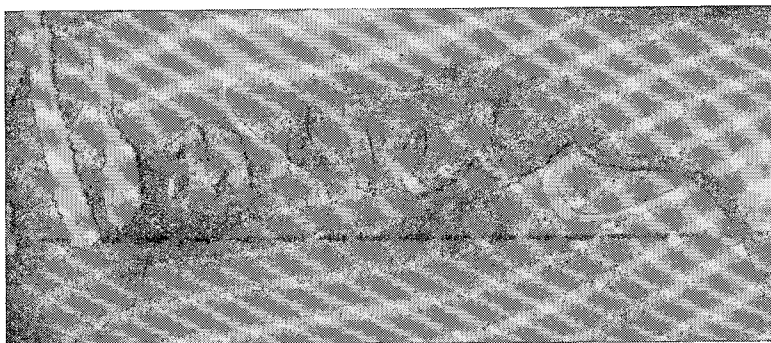


Figure 7

*Figure 8*

actual text. Figure 8 shows the document seen under ultraviolet illumination; the original text only appears in regions which have not been covered by the ink overwriting.

Figure 9 shows the text obtained by photographic subtraction; the original text is entirely reconstructed. The subtraction photograph permits us then to improve on the image obtained. It permits moreover taking out the fine safety lines of the background which may run the risk of causing errors in interpretation when the fluorescent text appears only very weakly.

*Figure 9*

In other cases it is necessary to utilize a chemical reaction to make the effaced text reappear.

We photograph the document before using the chemical reaction and after. We subtract the two photographs. In this case, the photographic subtraction presents the same advantages as those which we had indicated for the examination with ultraviolet illumination.

THE SUPERIMPOSITION OF POSITIVE PRINTS

The procedure which we have been describing consist in superimposing—by addition or by subtraction—two negatives on glass plates.

The subtraction is very easy because we place gelatine against gelatine the positive and the negative of the objects to be compared.

Photographic addition is only possible when we superimpose two objects of which one is the reverse of the other, otherwise the two photographic emulsions would be placed in the enlarger one upon the other, a thickness of glass separating the emulsions.

When we must add two non-inverted images, we must use another method of operation, much more simple than the preceding but less precise. We photograph each object in the same condition, and of each of them we make a positive print—on paper for one, on photographic film for the other. The film which we use offers the same qualities—color sensitivity, speed, and contrast—as the paper. For our part we used with success Pathelith emulsion (corresponding to Kodalith in the United States), thin support, non-ortho, manufactured by the Kodak Company.

Of course we shall not obtain as good agreement in design as with the method of superimposing plates, for the film and the paper suffer different changes in dimension in the washing and fixing baths, but frequently the results obtained will be satisfactory. We then place the two images—on paper and on film—in register, the film on the paper, and we verify whether the designs are identical.

1. *Reconstruction of Postmarks.* It is often used in an investigation to establish with precision at what date a letter was mailed. Generally the postmark furnishes the proof, but it also often happens that the mark is poorly imprinted and that the date is not legible. Fortunately on the letter two impressions appear, each one of them is incomplete, but by addition of the two we are able to establish the desired date.

We proceed as we have indicated before: One of the stamps is printed on paper, the other on film. We place the film over the paper in the position where we obtain coincidence of designs, and we apply a strip of cellophane adhesive at the top of the film. We thus obtain a hinge which permits examination of each stamp separately or the two assembled. To examine the stamp imprinted on the film we find it advantageous to slip under it a sheet of white paper which we can later remove.

We can use a staple in place of a strip of cellophane.

2. *The Restoration of Overwritten Documents.* It happens that certain accounting records should be made in duplicate: an original and its carbon copy. If a forger changes some numbers on the two documents by simple overwriting, we can easily reconstruct the original

numbers. Actually it is very rare that the forger has followed exactly the outline of the numbers which he wishes to modify; there still appears some portions of the original numbers. By adding the portions of the reconstructed numbers on the original to those of the reconstructed numbers on the carbon, we are able to determine the original numbers.

3. *The Comparison of the Design of Typewriter Characters.* We have indicated before that we are able to compare the design of typewriter characters by the process of superimposition by subtraction. But there exists a much more rapid procedure, and experience has proven that it is sufficiently accurate.

We photograph under the same conditions the incriminating text and the comparison one, and we print the letters of which we are able to compare the design at a great enlargement. The suspected letter is printed on paper, the comparison letter on film. Thus, two photographic plates are enough, when according to the first method we must print as many pairs of plates as we desire to compare letters. The distortion of the photographic lens does not present too great inconvenience.

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