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Ink and questioned documents.



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**Ink and**  
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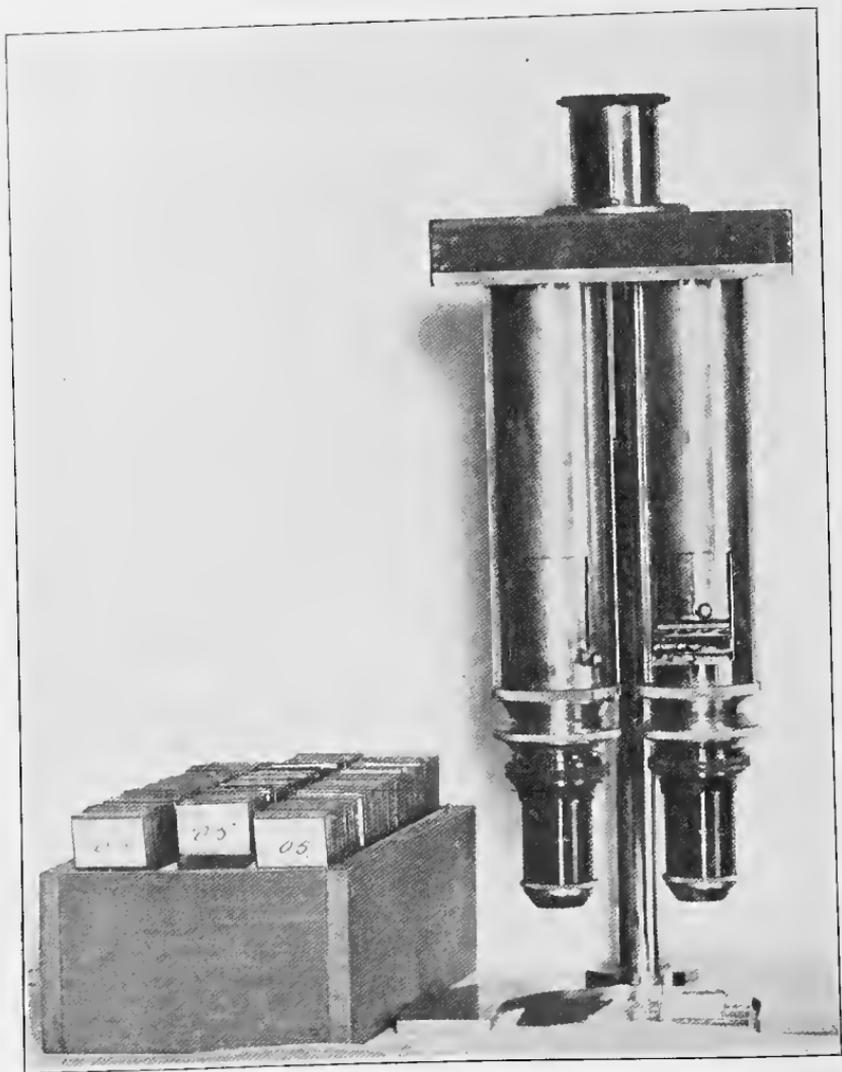


Plate I. The Color Microscope.

# Ink and Questioned Documents

BY

ALBERT S. OSBORN

Examiner of Questioned Documents



ROCHESTER, N. Y.

1908

E.V.

D.Y.

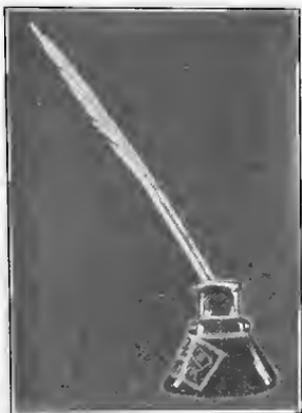
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## Introduction

Ink questions are often of the utmost importance in connection with the investigation of suspected papers, and especially the question whether the ink on an alleged old document is not too fresh to be genuine. There has long been great need of some means or methods by which ink colors could be definitely measured and recorded, and the method described herein is an attempt to supply that need. It is often positively known that the ink on a document purporting to be several years of age has actually matured or "turned black" after the paper has been brought into court, but such a statement without a record of the color of the ink when first seen, is based on a mere recollection and is of little value as evidence. In most cases it is an unwarranted assumption to make one examination of an ink and pretend to say just how long it has been on the paper, but by the method described herein anyone with good eyesight can ascertain positively whether an ink is still undergoing a change in color and can show just what the change is. The value of such evidence is manifest.

The main part of the article reprinted herewith first appeared in *The Chicago Legal News*, Vol. XL., No. 23. Illustrations and a few new paragraphs have been added.

## Ink and Questioned Documents



**F**ORTUNATELY, the ink in most common use, iron-nutgall ink, is that which goes through more changes on the paper than any other ink and is most affected by lapse of time. It is easy to understand how these facts may be of great importance in the investigation of a suspected or disputed document. To one who is confronted with a skillful forgery, it is intensely interesting to know that the ink color of such a document may be the means of showing that it is fraudulent. Suppose a writing of this kind, a will it may be conveying a million dollars, purports to have been written five years or ten years before, and it can be conclusively shown that the ink on the document has not yet matured but goes through those changes that are characteristic of ordinary ink during the first six months of its history. To prove this fact invalidates such a paper. This can be done in many cases if proper steps are promptly taken.

It is a matter of common knowledge that ordinary business writing ink changes color after it is on the paper. This fact has naturally received some consideration in the examination of questioned documents purporting to be some years of age, but there has been no means of making a definite and permanent record of the tint and shade of an ink for subsequent comparison with itself, so that evidence on the subject has been based almost entirely on mere recollection, and such testimony has but little if any weight.

The important fact is that the iron-nutgall inks in common use reach their fullest intensity of blackness by a con-

tinuous process of oxidation, and such chemical action cannot be arrested to be resumed and completed at a remote period of time. The problem, it should be understood, is not to look at an ink and by one examination attempt to say just how old it is, but to determine whether or not the ink of a questioned document is still undergoing a process of change of color inconsistent with the date it bears.<sup>1</sup>

In the natural course of events a fraudulent document is usually manufactured only a short time before it is actually brought forward. The conditions often require that such a paper be dated back a year or more and, as stated, if it can be shown that it could not at most be more than a few days, weeks, or months old, the document by this means alone may be utterly discredited. That ordinary writing ink is of an entirely different color when first written with than that which it finally reaches is well known, but this is about all that is generally known on the subject. It is important to know the rate of development and when such changes are completed.

After ordinary writing ink reaches its fullest intensity of color it remains in a practically fixed condition for some years, six to ten, and then it begins to show slight discoloration on the edges of the pen strokes that is the result of age. This discoloration or yellowing is progressive until after a sufficient lapse of time, depending upon conditions, the ink finally becomes a yellowish brown color.

American iron-nutgall inks are nearly all a distinct blue color when first written with. This initial color is produced by the addition of aniline blue to the ink solution which serves only the temporary purpose of making the ink more legible when first put upon the paper. The iron-nutgall

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<sup>1</sup> It is not usually possible by one examination to positively recognize and differentiate the various kinds of ink by the color test alone, but some inks have characteristic colors that usually can at once be recognized on good white paper. Ordinary Nigrosin ink, a so-called "Black Ink" much used for letter writing and by school children, as made by different manufacturers gives the following initial reading during the first hour, and no change can be observed after the lapse of one year's time: Red, 1.6; Yellow, .90; Blue, 3.6.

solution alone is a pale brown color and produces writing that is at first almost illegible and for this reason would be unfit for use. English inks, formerly much used in this country, are colored with indigo and their initial color on the paper is a shade of green. The color of the reaction of these inks under the hydrochloric test is green, while the American inks under the same reagent give a blue reaction or greenish blue. This initial color of the fluid inks is, however, somewhat affected by the age and exposure of the ink before being used, the tendency being for the blue inks when old to become a greenish blue color.

The development or blackening of ordinary iron-nutgall ink is very much slower during the winter months. The most rapid development is during the warm, humid months, the humidity undoubtedly affecting the change much more than the heat. In the months of July and August (see chart printed herewith), or during any warm, humid period, an iron-nutgall ink will reach a degree of blackness in ten days that will hardly be reached by the same ink on the same paper in ten weeks in winter in northern latitudes where artificial heat takes a large percentage of the humidity out of the air.<sup>1</sup> This varying rapidity of development is a fact always to be taken into consideration in such an examination. If a fraudulent paper is made during the winter months there is a much longer interval during which a color examination of the ink may be useful in ascertaining the actual date of the document.

The first steps in the darkening of these inks are much more rapid than the later ones. A good ink in summer under ordinary view will appear to be black at the end of from one to two weeks and in winter this same degree of blackness will be reached in from six to eighteen weeks, but

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<sup>1</sup> The change in new iron-nutgall ink in four hours on a warm humid August day, as recorded in one case, is as follows:

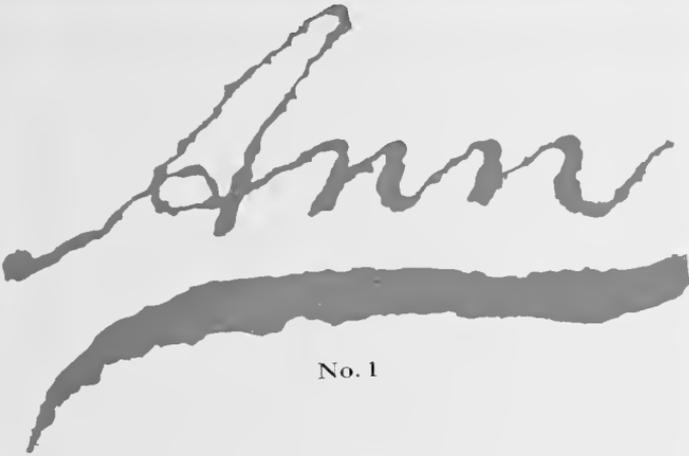
	Red.	Yellow.	Blue.
9.30 A. M.,	.5	.90	4.
1.30 P. M.,	1.3	1.4	4.6

## Explanation of Plate II

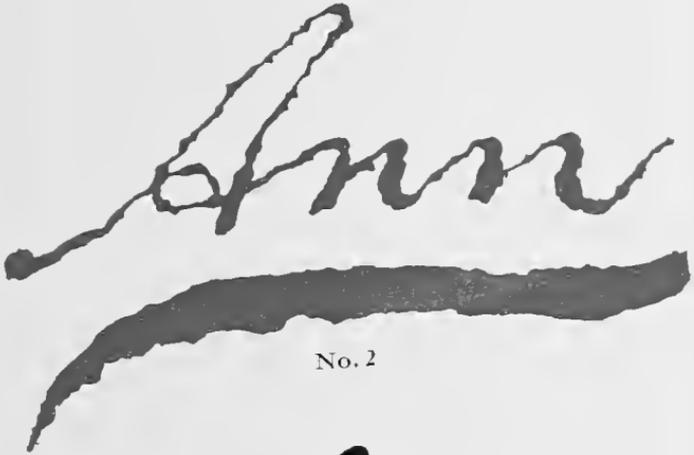
The changes in color on the paper of ordinary writing fluid or what is technically known as iron-nutgall ink, is as pronounced and distinct as shown in the illustrations on Plate II. It is not possible with printing ink to exactly match the actual writing ink colors, and those shown are only approximate, but the illustrations show about the same differences in color as are shown by the same ink of different ages. The illustration also shows the necessity of magnification of an ink line in order to see its color plainly. The fine lines of the illustration are the same color as the widest parts, but do not appear to be the same color, and if the lines were made still finer the actual color would not be recognized by unaided vision.

The first illustration, No. 1, approximates the color of ordinary iron-nutgall ink when first placed upon the paper. The second illustration shows about what color will be reached in a few months, and the third illustration shows the same ink when it has lost all tint or color and is a neutral black; this latter condition, under average circumstances, being reached in from fourteen to twenty-four months.

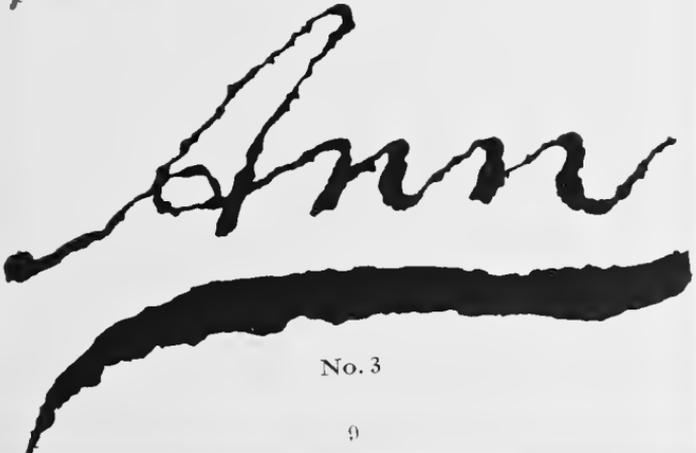
Plate II



No. 1



No. 2



No. 3

### Explanation of Plate III

It is well known that proper mixtures of the three colors red, yellow and blue in the form of pigments or printers' colors will produce the other three colors of the spectrum, green, orange and violet, and by changing the proportions of the colors first mentioned a great variety of tints and hues can be produced. The various colors of the spectrum can also be produced by the combination of the three colors red, yellow and blue as transmitted by colored glass. A colored glass, red for example, produces its color by absorption of the greater part of the other colors, so that only red is visible. It is a common error to suppose that a colored glass actually colors a beam of light. From the fact that colors by absorption are not simple, it becomes possible by the mixture of such lights to produce a marvelous number of tints by the use of graduated red, yellow and blue glasses.

It seems to be quite well established that the three primary colors of the spectrum are not red, yellow and blue, as has long been taught, but red, green and violet; but for the use of the artist who works in pigments, or for the matching of tints by colored lights produced by absorption, the practical colors are red, yellow and blue. Their use for these purposes is not in conflict with the modern view of colors for the reason, as already stated, that pigment colors and colors produced by absorption are complex colors containing within themselves, but not visible, all the elements of the spectrum.

Plate III

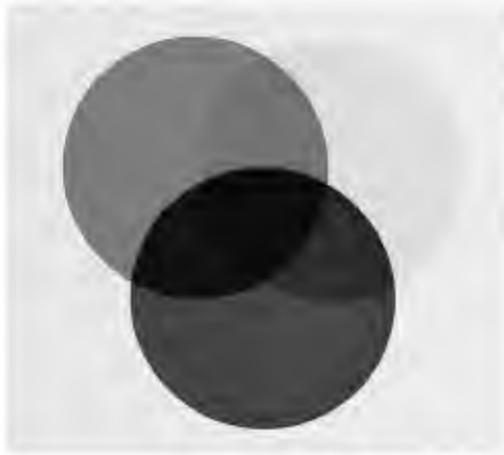
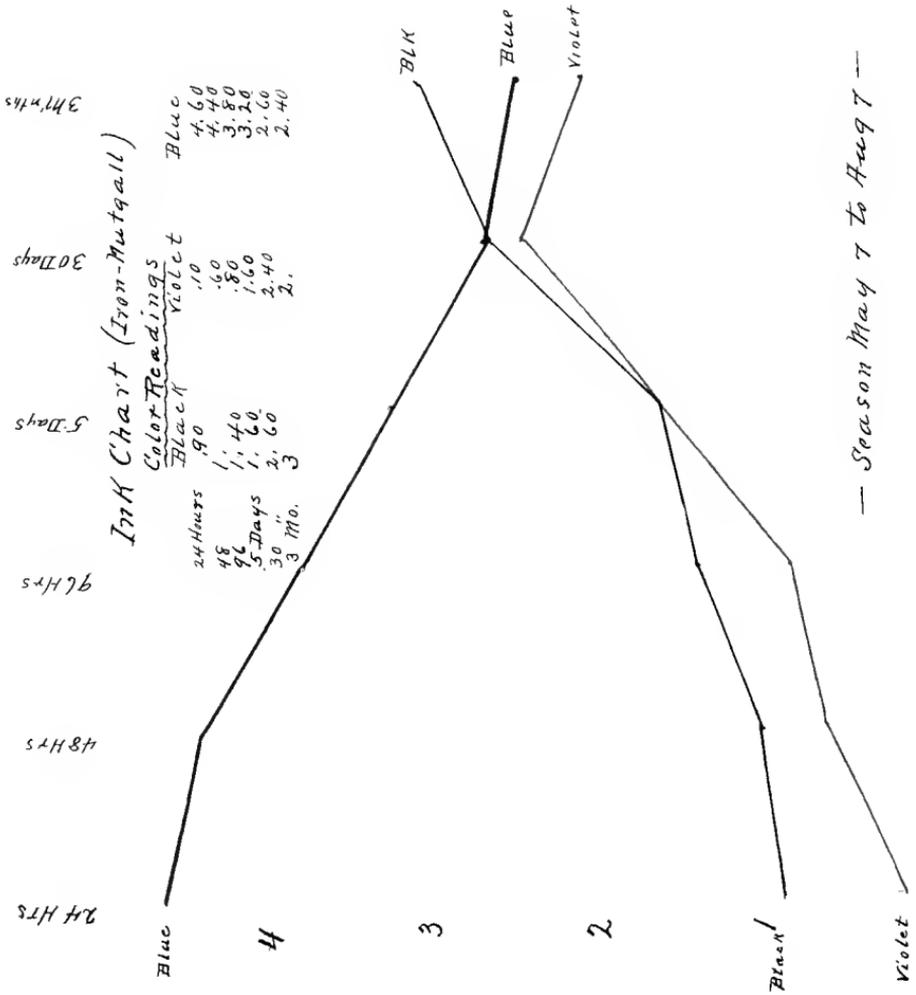


Plate IV



## Explanation of Plate IV

The readings of the performance of an ordinary iron-nutgall ink on pure white rag paper during summer months is illustrated on Plate IV. The readings were made during that time of the year when ink develops the most rapidly, but even during this season and after the lapse of three months' time this ink had gone through only about half of its regular scale of development.

In the readings tabulated only the visual result is shown, the first reading from the glasses being as follows: 24 hours, yellow, .90; red, 1.; blue, 5.60; which gives a visual result as shown in chart.<sup>1</sup>

Three glasses of the same value give not a tint but a shade, so the lowest in a combination of three is read as black. This leaves .10 red excess to combine with the blue, giving a violet of .10, and leaving an excess of 4.60 blue above the sum of the other visual results. The predominant color is of course blue tinged with violet and shaded or damped with the .90 of yellow which does not appear as a tint.

<sup>1</sup> It is difficult to realize that a color seen as Blue, for instance, may really be a combination of the colors red and blue, or yellow and blue, or red, yellow and blue, only one of which we see. Few of the countless and beautiful colors surrounding us are simple, but are made up of combinations of various colors, one of which is visually predominant. Under "Spectrum" in the Standard Dictionary is printed an excellent color chart showing forty-eight type colors with an analysis of each. A few of the more familiar colors, with the proportions of constituents, are as follows:

	Black	White	Red	Orange	Yellow	Green	Blue
Robin's-Egg Blue,		38				41	21
Baby Blue,		40				32	28
Nile Green,		25				45	30
Gobelin Blue,	40	17				13	30
Turquoise,		34				34	32
Sapphire Blue,	12					18	70
Antwerp Blue.		2				30	68
Russet,	40		24	20	6	10	
Olive Green,	13	18	17		8	44	

Many, no doubt, will be surprised to know that Robin's-Egg Blue is more green than blue, and that the same is also true of Turquoise.

in both cases the ink is then far from black and a very long way from the ultimate condition it will attain. This first apparent blackness is not blackness at all, but under proper magnification and good daylight is seen to be a rich purple color at its densest portions, shading off into distinct blue in the thin places. This blue gradually disappears and the purple gradually deepens until the ink line finally reaches a neutral black without any purple or blue color whatever. This latter process is quite slow and often covers many months, the time depending upon the surrounding conditions, the quality of the ink, and the kind and condition of the paper upon which it is placed. The time required to reach a neutral black is from about fourteen to twenty-four months.

This astonishingly slow rate of development is not generally understood and recognized for the reason that opinions on the subject are usually based upon the ordinary cursory view by unaided vision. Because of this slow development it is possible in many instances to make useful comparisons of inks that have been on the paper for a long time. Even under conditions producing the very slowest development iron-nutgall inks lose much of their distinctive initial color in a few months and, under some conditions, in a few weeks or days. The blue or green tints do not fade, but are gradually extinguished by the development of the darker colors of the iron-nutgall solutions. The process of oxidation is a continuous one until the ink has reached its fullest and final intensity of color. Even on the leaves of a tightly closed book ink oxidizes continuously until it reaches its ultimate color and light is not necessary to the process although it hastens it. If a book with writing in it is kept under great pressure and not opened, the air, with the moisture it always carries, may be sufficiently excluded to retard the oxidation slightly, but not to stop it.

In view of all these facts it is plain that if a disputed signature or writing purporting to be five years of age is a dis-

tinct blue or green color when it is first shown and then turns black in the course of a few weeks, or in a few days!, it is only necessary to prove this fact in order to show that such ink has not been on the paper five years. To show and prove this changing or developing color it becomes necessary to compare the ink with itself at successive examinations, and to do this a record must be made of the color. An entirely new method of making such a record is here described.

A color record of an ink can be made by means of an instrument that may be described as the Color Microscope, which is especially designed for the comparison, measurement and recording in fixed terms of ink tints and shades. Many occasions arise in the examination of questioned documents where other uses can be made of such an instrument and without some such assistance as it gives the facts in certain cases cannot be clearly shown. The instrument is useful in all ink investigations, but is especially useful for the purpose just outlined, that is, the early examination of a fraudulent document purporting to be much older than it actually is and on which the ink has not yet reached its ultimate intensity of color. If such a document is promptly examined and a definite color record is made of the exact tint and shade of the ink, as may be seen and verified by a number of observers if desirable, comparisons can then be made later of the first color with the later color and any change in the ink can be clearly seen and accurately recorded.

The Color Microscope brings the magnified image of two objects or fields into one microscopic eyepiece so that they may be observed side by side. This is accomplished by means of two parallel tubes surmounted by inclosed reflecting prisms which bring the rays of light from the two objects so that each image occupies one-half of the field as seen under one eye-piece. By the use of matched objectives the two fields of view are easily and accurately compared by being thus brought close together under high

magnification. Most ink strokes are so small and narrow that they lack a sufficient mass of color to show tints and shades in natural size by unaided vision, but under suitable magnification the most delicate distinctions, both in tint and depth of color, can readily be made.

The Color Microscope was designed to utilize the Lovibond tintometer standard color glasses for the purposes here described.<sup>1</sup> By interposing these finely graduated red, yellow and blue color scales in one tube any color can be exactly matched as seen under the other tube and a definite record made of it as the color value of each glass is etched upon it. The observation is made through the glass standards against a standard white background, pure sulphate of lime under uniform pressure being used for this purpose as with the regular tintometer instrument. In this manner the exact constituents of the most delicate tint can be determined and recorded and comparisons can be made that otherwise it is absolutely impossible to make. The regular Lovibond tintometer is an instrument with which color readings are made without magnification and cannot be used for the purposes here described. Unless the color conditions are very distinct and pronounced, it is almost always useless to attempt to make such comparisons without suitable instruments.

On the first examination and color reading of the ink of a questioned writing exact records should be made of the tint and shade of numerous parts of the writing. Definite description, illustrated by drawings, should be

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<sup>1</sup> The first attempts were made with coloured liquids in test tubes of equal diameters, and by these means some useful information was obtained. The liquids, however, soon changed colour, requiring frequent renewals; and there was always a little uncertainty concerning their exact reproduction.

Coloured glass was next tried, and long rectangular wedges in glass of different colours, with gradually graded tapers, were ground and polished for standards, whilst correspondingly tapered vessels were made for the liquids to be measured. These were arranged to work, at the end of the instrument, up and down at right angles before two apertures, side by side, with a fixed centre line to read off the thickness of each before the aperture when a colour match was made; but here also the difference of ratio between the thickness and colour depth of the different coloured glass and liquids proved fatal to the method.

—*Lovibond's Light and Colour*, p. 14.

made of the exact portion of the line examined so that at the second and all subsequent examinations the instrument can be replaced and the glass standards introduced that matched the ink color at the first reading when any change in the ink is at once apparent. If the ink has changed, then the standard glasses should be re-arranged until the color is matched again and a second record made of the glasses required to match the color of the ink.

If at the first examination the ink is apparently very recent the second reading in summer should be made not more than ten days later and the third a month later. In winter the second reading may be made two or three weeks after the first reading. If, when first examined, the ink is some weeks old, the second record may be made two or three months later.

The colors are matched by a combination of the red, yellow and blue standard glasses viewed by transmitted light. The most delicate difference in tint or shade can be shown. With fifty of the accurately graduated glasses of the appropriate depth of each of the three colors the number of possible combinations is very great. Each red standard can be combined with each blue standard, making twenty-five hundred combinations of these two. Each of these combinations can then be combined with each of the fifty yellow standards, making a total number of combinations resulting from fifty times twenty-five hundred, or one hundred and twenty-five thousand combinations.<sup>1</sup> These do not all represent visible distinctions, as many of the lighter tints are extinguished by the heavier colors, but with this number of

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<sup>1</sup> From such data he (Aubert) calculated that in a solar spectrum at least a thousand distinguishable hues are visible. But we can still recognize these hues, when the light producing them is subjected to considerable variation in luminosity. Let us limit ourselves to 100 slight variations, which we can produce by gradually increasing the brightness of our spectrum, till it finally is five times as luminous as it originally was. This will furnish us with a hundred thousand hues, differing perceptibly from each other. If each of these hues is again varied twenty times, by the addition of different quantities of white light, it carries the number of tints we are able to distinguish up as high as two millions.

—*Rood's Text Book of Color*, p. 40.

graduated standard glasses many thousands of actually visible tints can be matched. It is entirely possible to make more than a thousand visible blue tints and shades. This extraordinarily fine gradation of tints and shades makes it possible to match an ink color with remarkable accuracy and detect the slightest change.

In actual use it is possible to detect and match the changing color of an ordinary iron-nutgall ink every three or four hours during the first day after it is put upon clean white paper in the summer months; then every second or third day the change in the tint and depth of color can be seen and recorded for about one week. Later a recognizable change can be recorded every second week for about four weeks. Then there is a difference that can usually be seen and matched between two months and four months and between four months and eight months, and the difference in color and shade between eight months and twenty months or more is readily seen and recorded.

The changes that take place in iron-nutgall inks are so pronounced that they are unmistakable and cannot be

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For my own part, whatever theory of color sensations may prove to be the right one, I lean strongly to the idea that the cause of vision will be found in chemical action, induced by the impact of the different wave-lengths of light falling on sensitive matter. A white substance may absorb all the wave-lengths found in the spectrum, and if it have three sets of molecules, one of which has an atom or atoms vibrating with the same period as the waves of light which show a maximum for one sensation and another for another, and so on, the requirements for the color sensations are met. It may be that the sensitive part of the retina is like a photographic plate, but with this essential difference—that the sensitive material is constantly changing.

—*Capt. W. deW. Abney in Colour Vision, p. 198.*

The celebrated Thomas Young adopted another view: According to him, each minute elementary portion of the retina is capable of receiving and transmitting three different sensations; or we may say that each elementary portion of its surface is supplied with three nerve fibrils, adapted for the reception of three sensations. One set of these nerves is strongly acted on by long waves of light, and produces the sensation we call red; another set responds most powerfully to waves of medium length, producing the sensation which we call green; and finally, the third set is strongly stimulated by short waves, and generates the sensation known as violet. The red of the spectrum, then, acts powerfully on the first set of these nerves; but, according to Young's theory, it also acts on the two other sets, but with less energy. The same is true of the green and violet rays of the spectrum; they each act on all three sets of nerves, but most powerfully on those especially designed for their reception.

—*Rood's Text Book of Color, p. 113.*

denied. The change is so great between the color, for instance, of an ink after only a few days and after six weeks or two months that any competent observer will say that it is not the same color at all. If at the second reading the same glasses are replaced that matched the color at the previous reading, and the surrounding conditions are duplicated and exactly the same portion of line or spot of ink is observed and compared with the color in the opposite tube that at the previous reading was exactly the same color as the ink, and the colors are distinctly different and do not match, then the ink has changed in color. No one can realize how distinct these changes in color actually are without making the observations.

This method of examination takes the question out of the field of opinion testimony and makes it one which is simply the observation and interpretation of physical facts that are within the view and understanding of any one of average intelligence. The interests of justice are always promoted when means are provided that even in a slight degree assist in discovering and showing the facts in a court of law.

Rochester, N. Y., December, 1908.

THE GENESIE PRESS  
THE POST PATENT  
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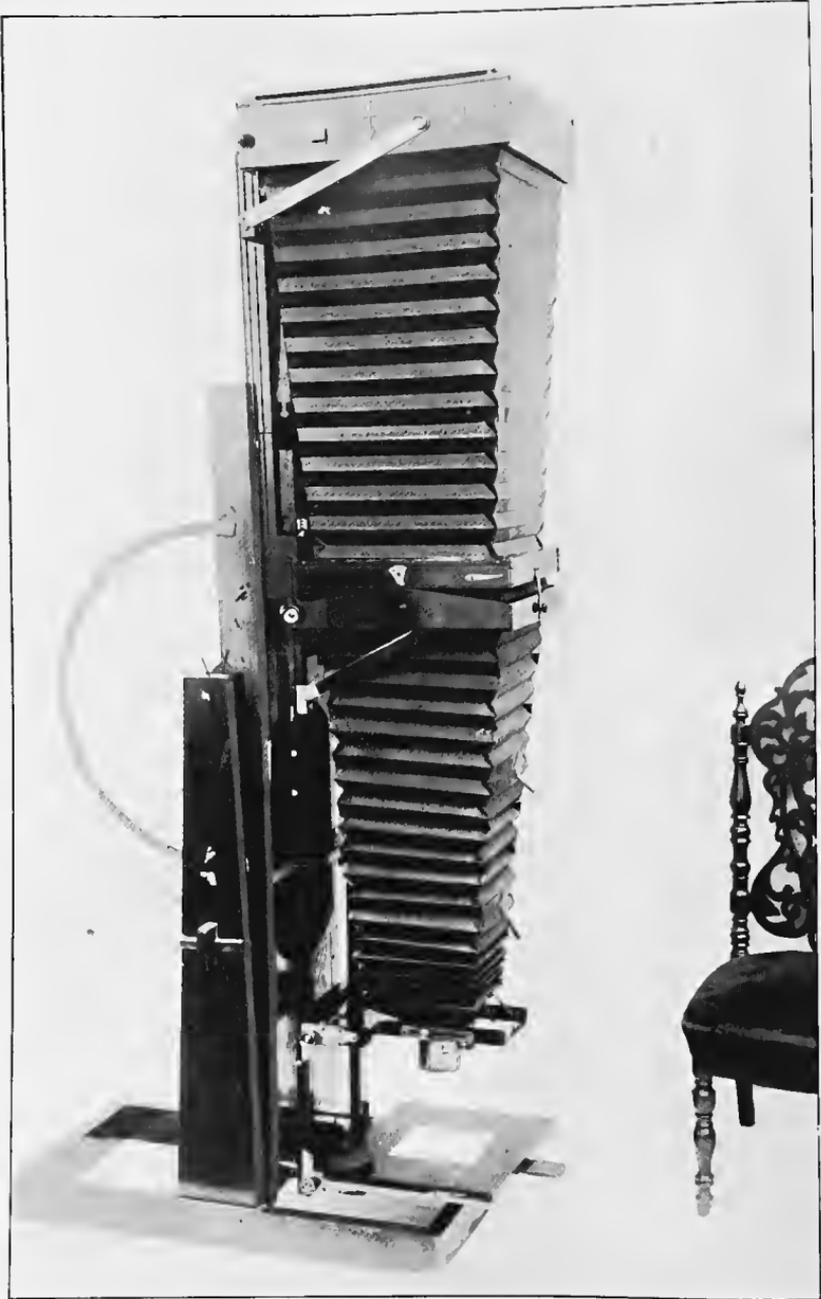
Questioned Documents











A SPECIAL DOCUMENT CAMERA.

# Photography and Questioned Documents

BY

ALBERT S. OSBORN

Specialist in Questioned Documents,  
and  
Document Photographer

A 'document' . . . is an instrument on which is recorded by means of letters, figures or marks, matter which may be evidentially used.

F. W. WHARTON, Law of Evidence.

1907

ROCHESTER, N. Y.

F.V.  
D.V.

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By ALBERT S. OSBORN

## PREFACE

In many cases it is of the utmost importance to those who are seeking to discover and prove the facts in an inquiry regarding a disputed document, that suitable photographs be promptly made. This article seeks to show the importance and necessity of having this done, and gives definite directions regarding the making of such photographs.

A lawyer is usually the first to take up the investigation of a questioned document, and to one with such a case actually in hand, who perhaps is unfamiliar with photographic processes, it is hoped that these pages may be of immediate assistance.

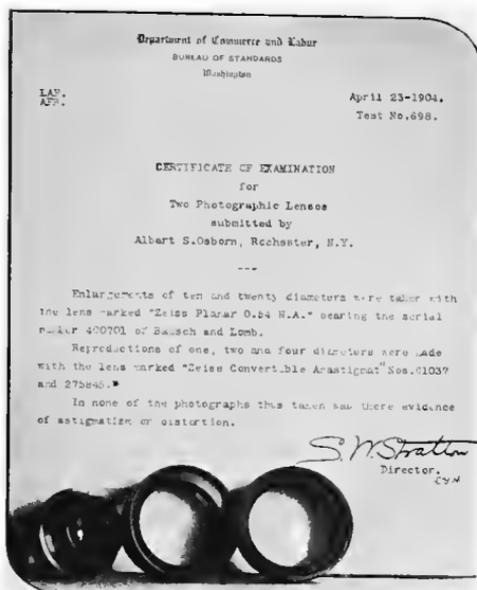
A part of this article was first printed in the Albany Law Journal, Vol. 63, No. 7. As reprinted here it has been much extended, and illustrations have been added which will increase its value. Some of the methods outlined, it is thought, are entirely new and the detailed directions and information regarding the various photographic processes have not heretofore been given in their relation to the important subject of questioned documents.

Rochester, N. Y.  
March, 1907

**U**PON principle therefore, as well as from the necessity of the case, proof of handwriting, under proper restrictions, is, as has been seen, everywhere admitted. Moreover, as has been well said, it seems that this kind of evidence like all probable evidence, admits of every degree of certainty, from the lowest presumption to the highest moral certainty.

American and English Encyclopedia of Law, Vol. 15, p. 283

## Photography and Questioned Documents



U. S. Bureau of Standards Lens Certificate. 2

**P**HOTOGRAPHY is frequently of great assistance in establishing the truth in a court of law. In a questioned document inquiry a tangible thing is under examination for the purpose of determining which of two conflicting interpretations is the correct one and, if such an investigation is to be thorough and complete, certain instruments and illustrations are necessary to bring into view and make plain and clear the physical facts which constitute the evidence upon which the final conclusion is based.

The photographic camera and the microscope most frequently render assistance in such cases, and presumptuous error may prevail because of the absence of these instruments. Like all complicated tools, however, they may be useless in the hands of those unfamiliar with their use, but properly employed they enable even the unskilled to see, to interpret, and to understand what otherwise might be effectually hidden. The legal procedure which not simply permits but encourages the clearest exposition of the physical basis of the final conclusion of a technical witness in such a case, just so far removes such testimony from the mere statement of an opinion and furnishes the facts which judge and jury can then interpret for themselves and thus be able to give full credit to clear and convincing testimony, or correct the errors of the ignorant and discount the exaggerations of the unprincipled.

Every questioned document should be photographed at the earliest possible stage of such an inquiry. This should be

## Photography and Questioned Documents

done primarily that a permanent and accurate record may be made of it and of its condition. Such a record is frequently of great value, especially in case of loss, mutilation, obliteration, or fraudulent changes in the document, or any changes due to natural causes.

In addition to their use as permanent records, photographs should be made of disputed documents for the additional and more important reason that they are often of great assistance in showing the fraudulent character of such documents, or in definitely establishing their genuineness, and may thus render valuable aid in promoting the ends of justice.

Those especially who question the genuineness of a document should insist on the right to have it properly photographed, and if such a request is refused an immediate petition to the proper tribunal for such an order should be made. Nor should the parties who do not have possession of a document be obliged to accept unsuitable photographs made by the opposing parties, but should insist on having the photographing done satisfactorily. Photographs of important documents may be of but slight value for the reason that many portrait photographers who are called upon to do this work do not have appropriate lenses and the necessary special apparatus for making document photographs except of the simplest character.

A photograph is not intended to take the place of the original document as a basis for a final conclusion, but is to be used to illustrate, test and interpret such original without danger of injuring or entirely destroying it. Even with the utmost care

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<sup>1</sup>The administration of justice profits by the progress of science, and its history shows it to have been almost the earliest in antagonism to popular delusions and superstitious. The revelations of the microscope are constantly resorted to, in protection of individual and public interests. It is difficult to conceive of any reason why, in a court of justice, a different rule of evidence should exist, in respect to the magnified image, presented in the lens in the photographer's camera, and permanently delineated upon the sensitive paper. Either may be distorted or erroneous through imperfect instruments or manipulation, but that would be apparent or easily proved. If they are relied upon as agencies, for accurate mathematical results in mensuration and astronomy, there is no reason why they should be deemed unreliable in matters of evidence. Wherever what they disclose can aid or elucidate the just determination of legal controversies, there can be no well formed objection to resorting to them.

FRANK VS. CHEMICAL NAT. BANK, 5 Jones & S. (N. Y.) 26.

## Photography and Questioned Documents

a disputed paper seldom goes through a protracted trial without being worn, soiled, torn and broken and, if the original document itself and it alone is to be handled, tested, measured and examined by court, jury and witnesses day after day, it is almost certain to be so injured and changed that its evidential value is almost if not entirely destroyed. After being carefully photographed while it is clean and new such a paper should in every case be placed and kept between two pieces of glass and a photograph of it can at any time be verified and tested by comparing it with the original.

Photographs are useful in such investigations in many ways. By this means any number of accurate reproductions of a document can be made, thus affording unlimited opportunity for study, comparison and investigation by any number of examiners which, as stated above, would not be possible by using only the document itself. Photographs also enable the court and jury to understand and weigh the testimony regarding such paper as it is being given, which cannot be done without such assistance. Photography is also especially helpful because by this means the writing in question can be accurately enlarged so that every characteristic can be clearly seen and properly interpreted. Much writing in natural size is too small for critical study and examination and even a slight enlargement is often of great assistance in showing the facts. In some inquiries the facts can be successfully denied if they are not shown by suitable enlarged photographs.<sup>1</sup>

Another most important reason for photographing a document is that photographs can be cut apart in any way

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<sup>1</sup>Enlarged photograph copies proven to have been correctly made, of the will and of the signatures of Philinda Terwilliger . . . were admitted in evidence. These copies were of great assistance and value to counsel in their arguments and have materially aided the court in its investigation in comparing and examining the different specimens of handwriting exhibited in the original document.

GREEN vs. TERWILLIGER, 56 Fed. Rep. 384, August, 1892.

The defense caused the signature of Governor Armijo to the alleged grant and one existing on one of the documents offered as a standard of comparison, to be photographically enlarged. After proving by the photographer by whom the photographs were made the accuracy of the method pursued and the results obtained by him, the enlarged photographs were tendered and were admitted in evidence over objection. The ruling was correct.

U. S. vs ORTIS, 176 U. S. Supreme Court, October, 1899.

## Photography and Questioned Documents

necessary for the purpose and the various parts classified and compared, as cannot be done without some means of making accurate duplicates of the original paper. The real significance of many writing characteristics cannot be properly appreciated and interpreted until similar or divergent parts to be compared are arranged and classified and brought all together within the angle of vision. Excepting with those specially skilled the eye is unable to carry form or color impressions to any considerable extent, and but few are able to properly note even the most conspicuous resemblances or differences in objects that cannot be examined at the same time and close together. Objects that are really different apparently differ more and more the closer together they are placed, or, if similar, appear to be more and more alike as they are brought together. In many instances the cumulative force of such grouped writing characteristics, in showing divergence or identity in two sets of

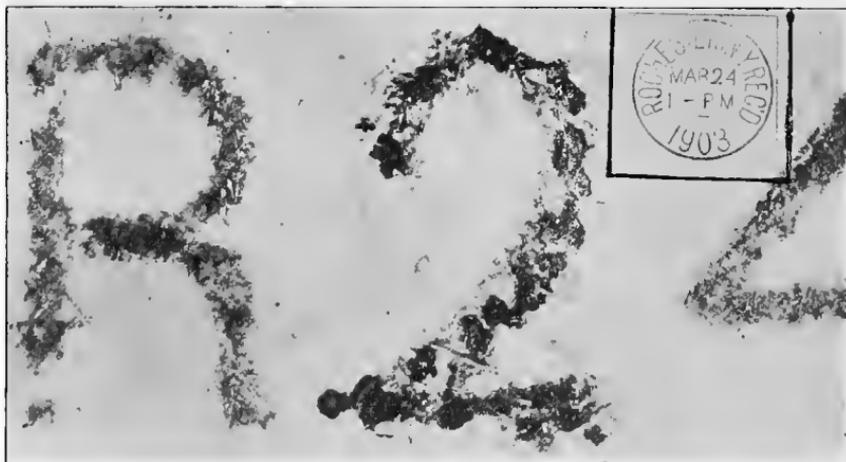


Photo-Micrograph of changed Post Mark.

3

writings, is absolutely irresistible. The sensible way to learn whether things are alike or different is to put them close together and see. In comparing disputed writings photographs make this possible.

There are certain microscopic conditions in connection with certain inquiries that cannot even be clearly seen except under proper magnification. Such facts may be vital, and are

## Photography and Questioned Documents

none the less facts notwithstanding their smallness, and need only to be seen to be appreciated. In jury cases especially it is sometimes difficult if not impossible to adequately prove such conditions because of the difficulty in showing them.

Here again photography renders great assistance. Properly made photo-micrographs of such parts puts into the hands of court and jury in permanent form the transitory view that can only be seen by one person at a time by the use of the microscope. Such enlarged photographs are often conclusive and unanswerable evidence. They cannot be disputed; they are silent but eloquent witnesses of fact and not of opinion.<sup>1</sup>



<sup>4</sup> Photo-Micrograph showing "100" changed to "900."

Many conditions may arise under which photography is equally useful. One of these is the necessity to decide whether a writing was continuously written throughout under the same conditions, or whether it contains an added fraudulent portion. The photographic lens and sensitized photographic plate will distinguish and make a permanent record of

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<sup>1</sup>Enlarged copies of a disputed signature or writing, and of those used as comparisons, may be of great aid to a jury in comparing and examining different specimens of one's handwriting. Characteristics of it may be brought out and made clear by the aid of a photograph or magnifying glass which would not be discernible by the naked eye. As well object to the use of an eye-glass by one whose vision is defective.

ROWELL VS. FULLER, 59 Vt. 688.

## Photography and Questioned Documents

differences in tint and depth of color that the human eye does not clearly see until they are illustrated in this way. A photograph in such an inquiry may thus be indispensable as a means of pointing the way to the truth.

Photographs may also be of value in showing delicate discolorations, due to chemical erasures or other fraudulent changes, which otherwise might be overlooked, denied or misinterpreted. Ordinary photographic plates render yellow tints as distinct shades of black and, as many discolorations have a yellow tinge, a photograph will show them with great clearness. This photographic tendency to make black of pale yellow is of great value in photographing old and faded yellow writing or fraudulent writing made to simulate such writing. In such a case the photograph, although reproducing the original with absolute accuracy of form, is much more distinct and legible and gives an opportunity for study and comparison that the original document itself does not supply. In some cases the indistinctness of a forged writing is its strongest defense and as soon as it is clearly photographed, and especially if it is suitably enlarged, it immediately becomes vulnerable from many points. In these cases also photographs are not simply desirable they are necessary if the facts are to be clearly shown.

Photography is also useful in determining whether erasures by abrasion have been made in a document. If such erasures have



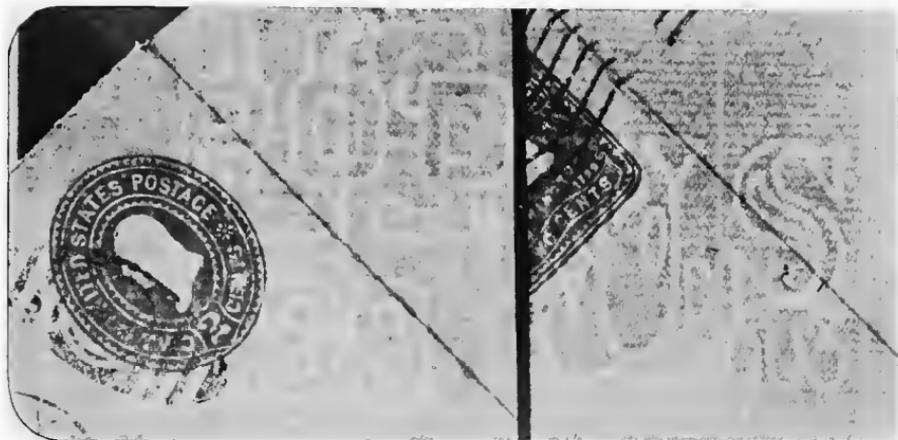
Transmitted Light photograph, showing erasure by abrasion.  
"Mar. 4" on opposite side of sheet.

been made and the paper afterwards rubbed down and resized, it may be difficult to show the fact. By this process of erasure a portion of the paper itself is removed, rendering the

field in which the erasure has been made more transparent, and a photograph of the document by transmitted light,

## Photography and Questioned Documents

with the lighting all through the paper itself, may show conclusively that such an erasure has been made. Erasures by abrasion or by an ordinary rubber may sometimes be shown very clearly in a photograph taken with the paper placed obliquely to the plane of the lens and plate and inclined at just the right angle to show differences in the reflected light from different portions of the paper surface.



Dated Water-marks in Government Envelopes. A transmitted light photograph. <sup>6</sup>

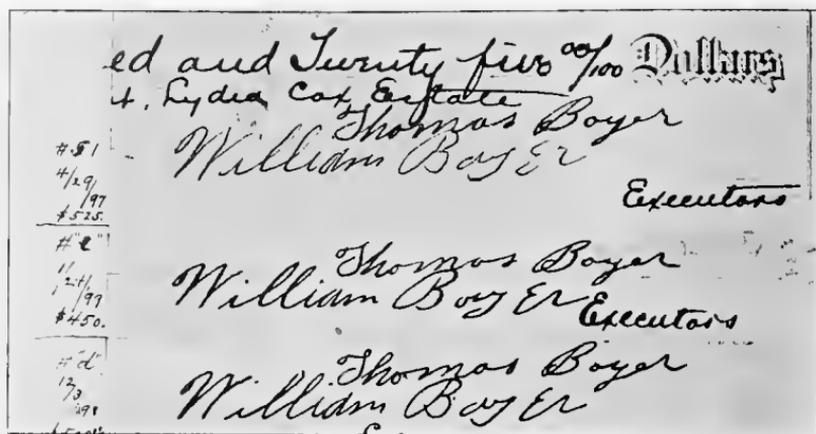
Transmitted light photography is a valuable aid in the examination of water-marks and also furnishes one method of determining the identity or difference in paper, as it is possible by the use of such photographs suitably enlarged, to show arrangement of paper fiber and markings of wire gauze and dandy-roll impressions in the paper itself and with such distinctness as to render examination and comparison easy that otherwise it would be very difficult if not impossible to make.

Where the question is one of continuity of stroke or of retouching of the writing, a photograph by transmitted light will show plainly the uneven distribution of ink in interrupted or broken strokes and the presence of the added ink film in retouched strokes. In retouched writing the added ink, which may make a line twice as thick in that place, may not change the color of the writing in the least when viewed by direct light, but will simply change its thickness, which difference will be plainly discernible in a transmitted light photograph as the

## Photography and Questioned Documents

added ink film will make the line just so much more opaque at that point.

Photographic illustrations are sometimes very useful in showing the identity or suspicious similarity of a traced forgery and the model signature from which it was made, or significant and unnatural identity in two or more fraudulent signatures



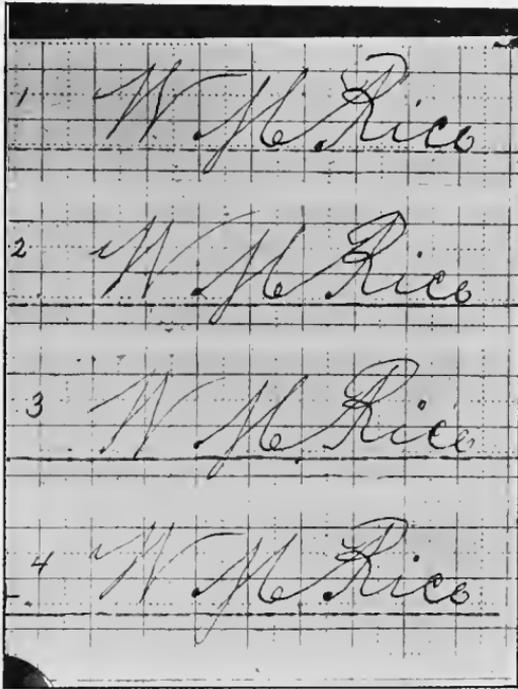
A genuine signature, "No. 51," and two "traced" forgeries. Note identities in size proportions, spacing and alignment and many other particulars. Matter of the Lydia Cox estate.

which were traced or reproduced by some process from the same model. As is well known no two genuine signatures are exactly identical in size, proportions, position and length of every stroke, so that one will superimpose or exactly cover the other, and such entire identity between a disputed signature and a genuine model is proof of forgery.

Several photographic methods may be employed to show this unnatural identity. One method is to photograph the two signatures to be compared with a glass plate, ruled with squares, all of the same size, placed in the same position over both signatures. By this means it is easy to compare every part of every signature with the same parts of the other signature, by simply observing how the parts cut the squares in which they appear. Such an illustration thus makes it possible to make comparisons by inspection without measurements or the use of instruments of any kind.



Composite photograph of the four disputed signatures appearing at the bottom<sup>8</sup> of each of the four pages of the Patrick-Rice six-million-dollar will. Same size as original. Same exposure to each signature.



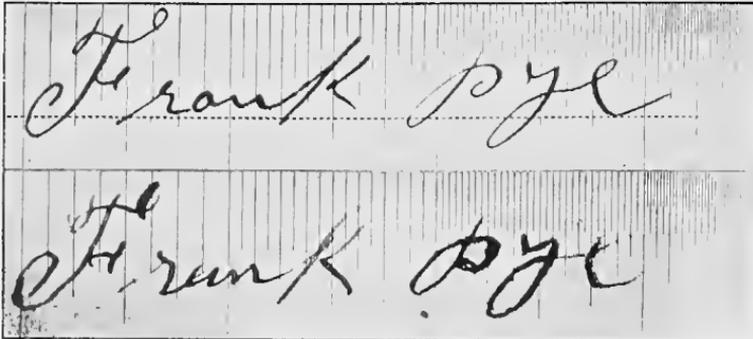
The same four signatures photographed with superimposed squares, showing extraordinary and significant similarity. See length, "i" dots, and beginning points. These signatures contain many evidences of a lack of genuineness besides the extraordinary similarity. They were declared to be forgeries by the Surrogate of New York County, and by unanimous decision of the Appellate Division and the Court of Appeals of the State of New York.



Composite of two genuine signatures written on same day it is alleged disputed signatures were written, showing ordinary and average divergence in size, spacing, slant and position.

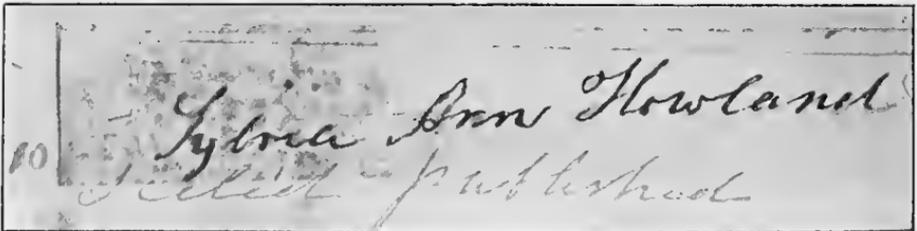
## Photography and Questioned Documents

Another photographic comparison can be made by photographing the signatures with a superimposed glass scale or measure, by which means all the identical measurements are shown in the photograph. This method may be used in connection with and to supplement the method already described, in which the glass plate with the squares is used.



12  
Model and traced forgery with superimposed glass rule showing actual measurements and points of identity. The last name entirely retouched or overwritten.

A third method of making such comparison is by making a composite photograph of the two signatures to be compared.



11  
Composite photograph of genuine signature "1" and disputed signature "10" in the celebrated Sylvia Ann Howland case. Prof. Pierce, the noted mathematician of Harvard, testified in this case as to the mathematical probability of two signatures by this writer coinciding in every downward stroke. The basis for his calculation was the average coincidence of the genuine signatures.<sup>1</sup>

This is accomplished by focusing the images of the two signatures on exactly the same place on the camera ground-glass and giving one-half of normal exposure to each signature.

<sup>1</sup>The product of the relative frequency into itself expresses how the coincidence of a characteristic line 1 is combined with that of line 2; the cube

## Photography and Questioned Documents

The photograph will show the signatures superimposed, with only such divergencies in minor parts as the process of tracing may have produced.

Traced forgeries are always fundamentally bad on account of the drawing process by which they are produced, which leaves an irregular, hesitating, broken, and, in most cases, patched and retouched line very different from a genuine signature. These indications of forgery are shown by an enlarged photograph, and the photographs showing suspicious identity, as described above, point to the method by which the fraudulent signature was produced. Two or more spurious signatures produced by some rubber stamp or duplicating process, purporting to be and made to imitate actual writing, if not retouched or overwritten would of course be identical. Such complete identity in two signatures, alleged to have been pen-written, would be conclusive proof that they are not genuine.

The principle of stereoscopic photography, as applied to the microscopic investigation of questioned documents, has not, as far as known, been employed hitherto, and the methods of illustration described below have not actually been presented in a court of law, but there cannot be valid objection to a method that would certainly tend to promote the ends of justice.

The principle of the stereograph is that of the two-eyed view or binocular vision, by which means things are seen

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of the relative frequency of coincidence shows how often there will be the simultaneous combination of the coincidences of the three first lines, and so on. Finally, the relative frequency must be multiplied into itself as many times as there are characteristic lines to express how often there can be a complete coincidence in position of all the lines of the signature.

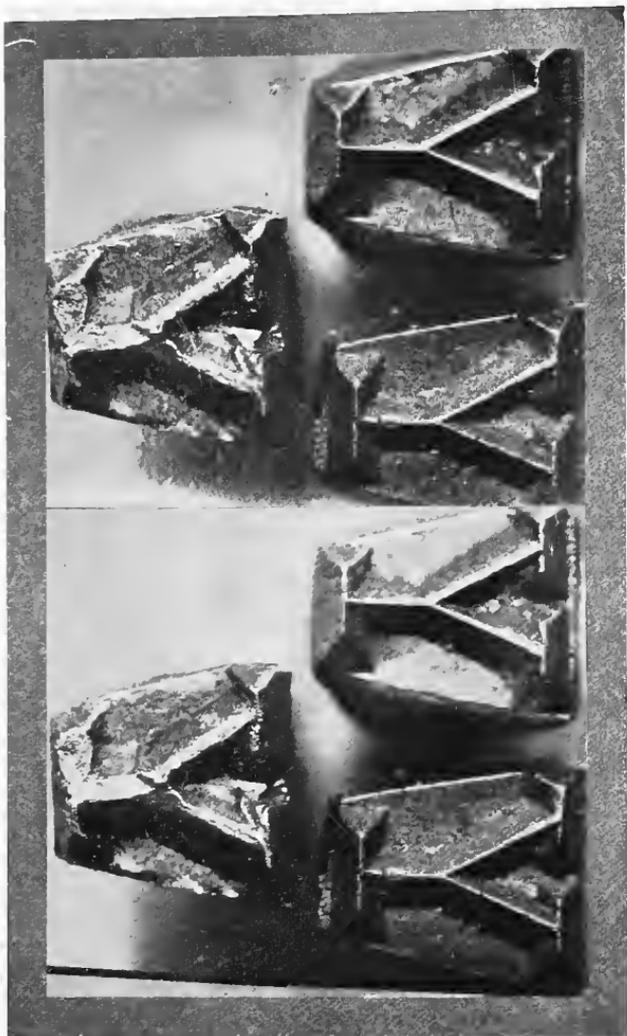
In the case of Sylvia Ann Howland, therefore, this phenomenon could occur only once in the number of times expressed by the thirtieth power of five.

This number far transcends human experience. So vast an improbability is practically an impossibility. Such evanescent shadows of probability cannot belong to actual life. They are unimaginably less than those least things which the law cares not for.—PROF. BENJAMIN PIERCE, in case of ROBINSON VS. MANDELL, (*Sylvia Ann Howland Case*).

[The printed report of this case gives the probability as once in 2,666,000,000,000,000,000 times, but there is evidently some error in the report as the thirtieth power of five is even more than this vast sum.]

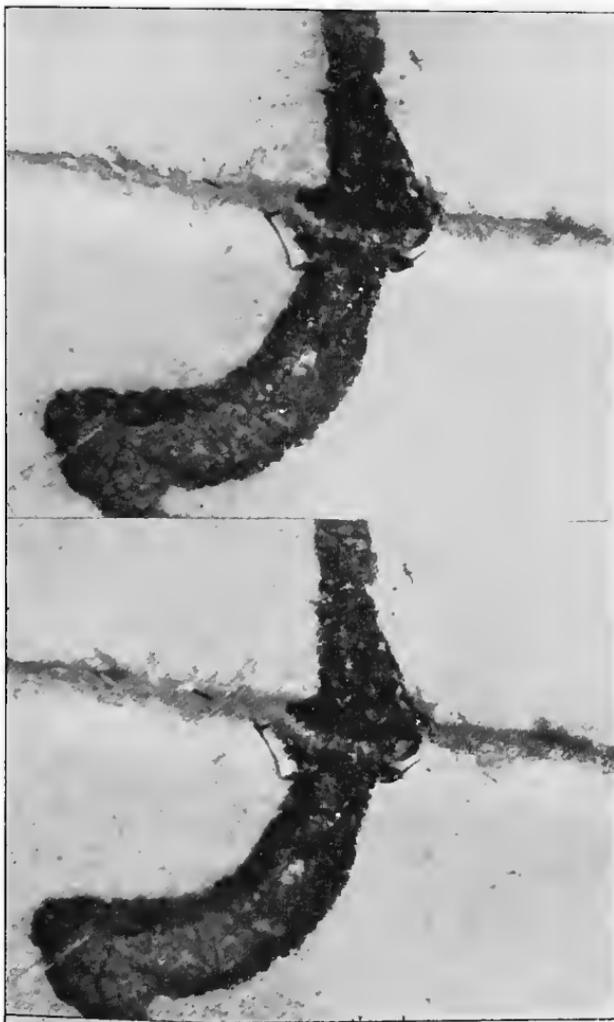
## Photography and Questioned Documents

Stereoscopic photo-micrograph of the faces of typewriter type, showing the effect of wear and accidents, by which the work from such a machine can be positively identified. One letter new and unused, one showing one "scar" and one much battered. — The stereoscopic effect can only be seen by viewing the illustration with a stereoscope, when it is shown with startling distinctness even in this half-tone illustration. Some detail is lost in the process of engraving. Remove sliding view holder from ordinary stereoscope and hold cut in hand in proper position.



## Photography and Questioned Documents

Stereoscopic Photo-Micrograph of an ink line, one one-hundredth of an inch wide, over a paper fold, showing unmistakably that the folding preceded the writing. To be observed in the stereoscope. Without the stereoscope a stereoscopic view of any kind does not show stereoscopic effect. Fold back the leaves of this book and hold the cut exactly in front of the stereoscope in position occupied by an ordinary view.



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## Photography and Questioned Documents

exactly as they are. Depth, or the third dimension in a stereophotograph, is shown by taking two views of the same object or scene from a slightly different point of view, just as the two eyes see, and then by looking at these two views at once, as coalesced in the stereoscope, there is carried to the brain the same sense of depth and distance as is conveyed when the two eyes see the actual scene.

The stereographic photo-micrograph shows conditions in connection with certain questioned document cases with startling distinctness. In any inquiry where it is desirable to show depth or solidity, such a photograph is of very great value. Such questions arise regarding the sequence of crossed lines, or which was last written, and also as to whether a writing across a fold preceded or followed the folding of the paper, which is sometimes a question of vital importance. Certain questions regarding paper fiber and relation of ink thereto, also changed conditions in paper surface due to erasures and changes, may be effectively illustrated in this manner; also the question whether typewriting was done on a certain machine, the letters of which show certain bruises and imperfections. Seals and impressed designs of any kind can by this same method of illustration be shown very clearly. These are all microscopic questions and in the absence of the necessary instruments or of appropriate illustrations, it may be impossible to show the existing facts.

To be of any value for these purposes, stereoscopic photographs must be made in greatly enlarged form and the ordinary stereoscopic camera cannot be used. The special apparatus necessary carries only a single lens, with which two views from a slightly different point are made of the same object, by which means the same result is obtained as in simultaneous views with the two lenses of the regular stereoscopic camera. Two lenses cannot be used for this work, as it would be impossible to bring the lenses close enough together under the required magnification. The degree of enlargement desirable naturally depends upon the conditions, but ranges from twenty-five to seventy-five diameters for practical work. It cannot be understood without actual trial with what realism certain delicate microscopic conditions can thus be shown.

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Several highest courts of appeal have answered affirmatively the question whether stereoscopic photographs, and the stereoscope to view them, may be used in court. These decisions relate to ordinary stereoscopic photographs, but the principle is the same as in the new application of the stereoscopic idea just described.<sup>1</sup>

Objections to the use of all classes of photographs in a court of law are based upon the theory that they may be distorted and not true representations of the original and it is also often claimed that the original affords the best means for study and comparison and, therefore, that no reproduction of it is necessary.

Photographs may be distorted and may be dishonest and if they cannot be properly proved or verified by comparison with the original they should be excluded. If there is any doubt about the accuracy of photographs they can be made by both parties and the question of their accuracy determined, and in questioned document cases they can easily be verified by comparison with the original which is at hand. On account of the latter fact, there is not the legitimate objection to photographs of a questioned writing that may arise over photographs of a different nature that cannot be compared and verified by judge and jury and opposing counsel.

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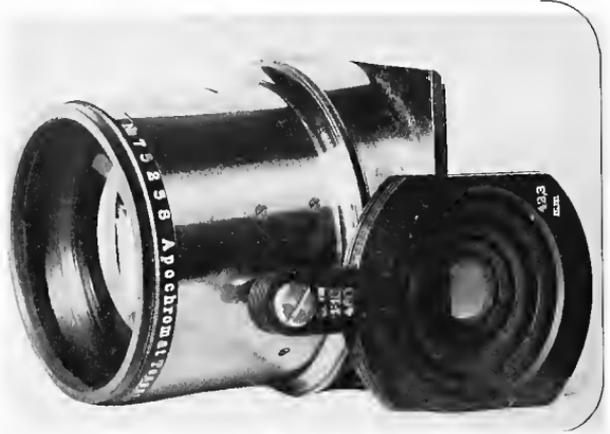
<sup>1</sup>“ The next contention of the appellant is that the court erred in admitting in evidence a stereoscopic view of the south side of the bridge and the embankment; also one of State St. west of the bridge showing the surface of the roadway or street and west end of the bridge. The court also allowed in evidence a stereoscope to aid the jury in the examination of the views. . . .

A. C. Burnham testified that he was a photographer and had been for ten years; and after examining the views through the stereoscope testified that the “effect is very material, and if the view is properly taken, looking through the glass at the picture, the effect is that of nature viewed with two eyes.”

There was no error in this action of the Court. It is a common practice to admit a plan or picture shown to be a correct representation by preliminary proof, to aid the jury in a proper understanding of the case, and we do not see any difference in the application of the rule whether the picture is made by hand or by the art of photography, the real question being whether the view be a correct representation.”—9 Ill. 229.

## Photography and Questioned Documents

The best modern lenses will make photographic reproductions with the utmost accuracy, rendering straight lines as such and with the field all in focus at one time. By this means involuntary distortion is entirely eliminated and an objection to photographs is removed that might have been valid in the early days of the art. Lenses are now made so accurately that they are certified by the government Bureau of Standards as "making reproductions without distortion." There



15  
A Three-Color Lens, bringing red, yellow and blue to sharp focus at same distance from object.

are as good reasons for objecting to the use of an ordinary magnifying glass or a microscope as to an enlarged photograph, as such photographic reproduction is simply the microscopic view in permanent form.

The answer to the objection that the original alone affords the best means for study and comparison and therefore no photographs are necessary, is that this is not true. Photographs are absolutely necessary in very many cases if the facts are to be adequately shown and their exclusion is an injury to the cause of the party in the right.<sup>1</sup>

The real objection to photographs in most cases is that they will do just what it is intended they should do, that is, assist in showing the facts. Some old legal opinions recite a

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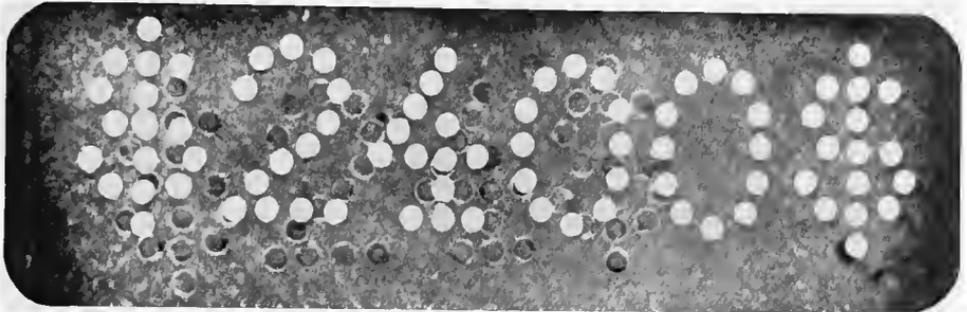
<sup>1</sup>It would seem that the photographic enlargement of both or all of the signatures to be compared would materially aid the work of comparison and that it would not be inconsistent for a court to admit such magnified copies, even while it rejected copies which were of the same size as the originals.

Photographic copies which are of the same size as the originals are secondary evidence in a sense in which magnified copies are not. So much aid is to be derived from enlarged copies that if they are to be rejected it

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long array of conditions that may make photographs dangerous in courts of law, but not one of the objections is well taken when applied to properly proved document photographs. They can be made correctly and it can be shown that they are made correctly and that disposes of all objections. Photographs are now rarely excluded.

The making of document photographs, especially if enlargements are required, is a somewhat unusual task for the average photographer. Even if he has the necessary apparatus



Transmitted Light Photograph showing original check punch characters \$24<sup>s</sup> filled up and \$2,400<sup>s</sup> punched over. 16

he is but seldom called upon to do such work, and some technical directions may be of assistance and will suggest some further uses for photographs in such inquiries.

For document photographs any regular photographic plate may be used, but the best results can usually be obtained by using a comparatively slow plate. Exposure should be ample and development carried to the point where detail is brought out in the writing line or stroke itself. Negatives should not be retouched in any manner whatever, but may be intensified or reduced if necessary.

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must be because the magnifying glass is an efficient substitute for them. It seems doubtful if that is the fact.

The mere momentary enlargement of the signatures one by one by each juror for himself with the aid of a magnifying glass, giving different effects according to the place where he holds the glass, must be regarded as a poor substitute for the permanent enlargement of all the signatures alike by magnified copies which are the same to all the jurors and do not vary on different examinations.

Editorial Comment by B. A. R. in *Lawyers' Reports Annotated*, 35: 813.

## Photography and Questioned Documents

Prints should be made as carefully as the negatives. They should not be printed so dark that detail in the line or pen stroke is lost and care should be taken that in printing the paper is in actual contact with the entire surface of the negative. There are many kinds of photographic papers that may be used for such photographs. If the utmost detail is desired the glossy printing-out paper is probably best, but for most purposes the excellent modern developing papers are entirely suitable. Papers with rough surface should not be used.

For court use photographs mounted simply on photographic backing paper are preferable in many ways. They lie flat, they take up but little room, they are convenient to handle and they do not warp or buckle. Large prints may be hinged in the middle or if quite long may be hinged in two places with binding tape. Even if prints are to be pasted in an exhibit book they should first be mounted on backing paper so that they will lie perfectly flat

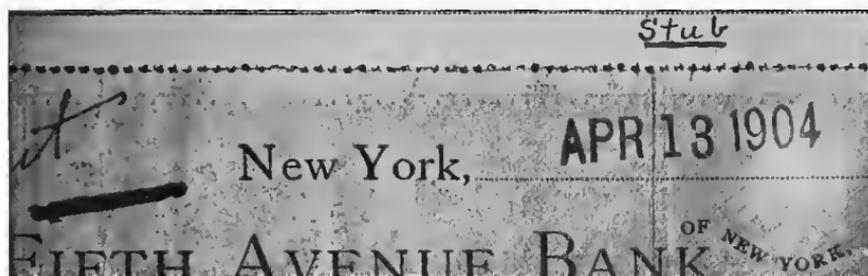
The various parts of a document are reproduced in exact natural size, or enlarged or reduced in exact proportions, when the object, the lens and the photographic plate are in parallel planes. The position of the lens is mechanically provided for in the camera, and the plate and object should be at right angles to the axis of the lens and in exact vertical position. The photographer should be able to testify that these conditions existed when the photographs were taken. In a regular document camera these conditions are all secured by mechanical means, but if such an instrument is not available, the required conditions can be secured by giving careful attention to these particulars. When it is desirable to make an enlargement of several diameters it becomes quite difficult to enlarge to a definite scale and at the same time get the object in sharp focus unless the object-board is connected with the camera itself. Such an enlargement can be made, however, without a special camera if sufficient care is exercised.

Questioned document photographs that fully serve their purpose are not the same in every case but must be made in such a way as best illustrates the fact in dispute. Varying conditions call for photographs in great variety and careful thought should be given to the matter, and experimental photographs should be taken until the fact in dispute is

## Photography and Questioned Documents

illustrated in the clearest and most effective manner. Only those photographs most frequently of use are here described and brief suggestions are made regarding their preparation.

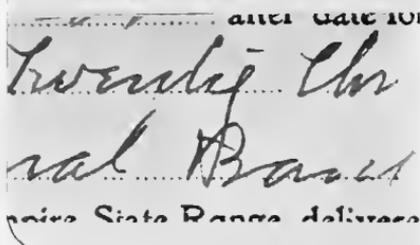
For reasons already given a document in question should usually be photographed complete in natural size. As stated above, questions may arise in the course of such an inquiry that will render such a photograph very useful. In making a comparison of classified parts this first photograph, of the same size as the original, may be used to be cut apart as is desirable, but, as a rule, photographs to be used for purposes of comparison should be enlarged if only in a slight degree. An enlargement of only from twenty-five to fifty per cent. in length, or one and one-fourth to one and one-half diameters,<sup>1</sup> will show character-



Check Stub and part of Forged Check, showing, by the torn perforated line, the unmistakable connection between the Forged Check and this Stub Book.  
The Stub Book was found on person of accused.

<sup>1</sup>In photography, as in microscopy, it should be remembered that two diameters indicates two times the length of the original. As enlargement is in both directions a two-diameter enlargement indicates four times the area of the original and a ten-diameter enlargement would equal one hundred times the area.

## Photography and Questioned Documents



13  
Crossed Lines in Raised Note Case, showing that upper line "Twenty" was written last. Nigrosin ink, original lines, 1-100 inch wide. Case of People v. Walker.

istics much more distinctly than the original. After such classified illustrative exhibits are made up, they can then be enlarged two to four diameters, depending upon the size or delicacy of the characteristics illustrated. Such final photographs are sometimes offered and used in the trial of a case simply as illustrations of the testimony given and are employed in the same capacity as a blackboard or chart would be used. They are illustrations, however, from which the personal equation has been eliminated and are simply testimony of an ocular nature.

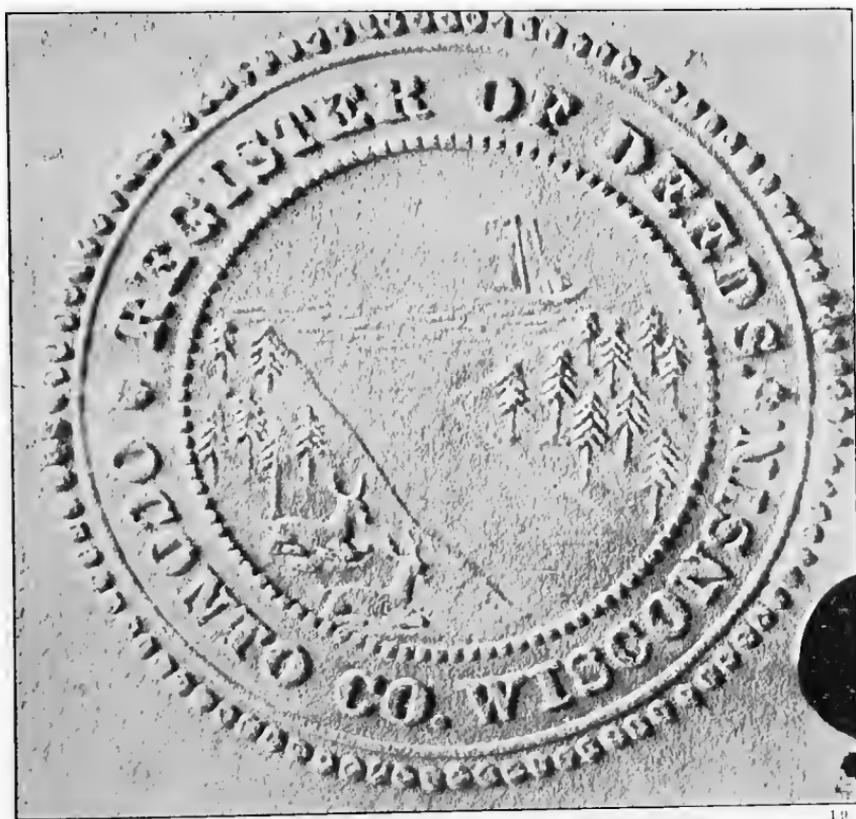
The fraudulent character of a signature is sometimes effectively shown by simply making an enlargement of it of from two to five diameters. Such a photograph, when compared with genuine signatures similarly enlarged, is sometimes almost conclusive proof of forgery. If a signature is unnaturally and slowly drawn, or is patched and retouched or shows hesitation and stops at unusual places, as is often the case, such enlarged photograph is of very great value in showing these facts. In a critical examination of questioned typewriting it may be

impossible to show clearly actual similarities or differences in letter designs or sizes, unless the separate specimens for comparison are placed close together in enlarged form, but,

## Photography and Questioned Documents

when this side by side comparison can be made, many significant differing or identical characteristics are immediately apparent.

Enlargements should be made directly on the plate from the object itself. This can be done by the use of lenses of proper focal length and the use of a camera with adequate extension of bellows. Direct enlargements, properly made,



Enlarged Photograph of impressed seal on white paper, taken by side light.  
Case of Hunt v. Peshtigo Lumber Co.

show the minutest characteristics of the original. An enlargement on bromide paper from a small negative, although sometimes useful, is not as desirable as a direct enlargement on the photographic plate.

Enlargements above ten diameters are necessary only when what is to be shown is of a somewhat microscopic

## Photography and Questioned Documents

character and such photographic reproductions of the higher magnifications are described as photo-micrographs. They are often

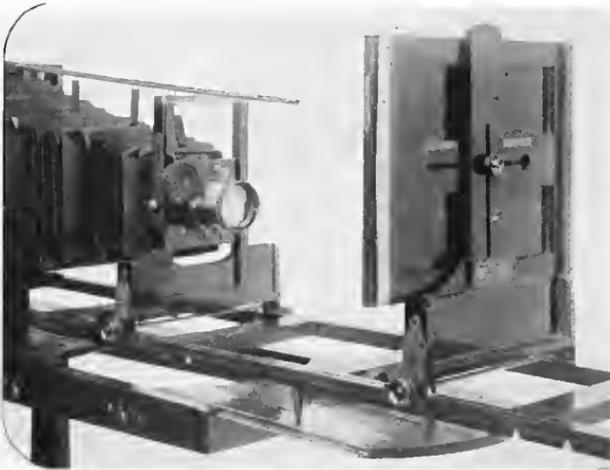
very effective illustrations. In crossed line inquiries and questions regarding retouching, line quality, writing over folds in paper and certain classes of erasures and changes, such photographs are essential if the facts are to be properly shown.

Ordinary photographic apparatus will not permit direct enlargements

on the plate of more than three or four diameters, and for

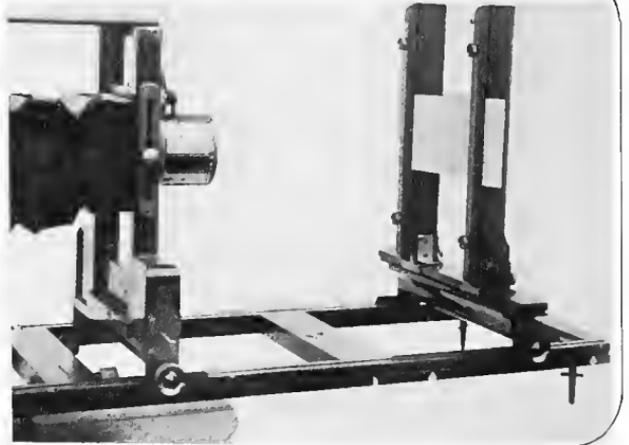
photo-micrographic work comparatively short focus lenses are required unless a very long bellows is available. Photo-microscopic lenses, for use with an ordinary copying camera, are made of as short a focus as three-fourths of an inch, permitting enlargements to be made up to more than fifty diameters with a comparatively short bellows extension. In making such photographs,

it is almost imperative that the object-board be connected with



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Special Object-Board for Document Camera. Actuated by rack and pinion and having vertical, horizontal and oscillating movements.



21

Special-Object Carrier for Transmitted Light Photography.

## Photography and Questioned Documents



22

Special Tilting Camera Stand in position for transmitted light photographs.

the camera itself, and that the plate, the lens and the object-board be actuated by rack and pinion if enlargements are to be made to a definite scale. With such an instrument, photographs of this character can be made almost as easily as ordinary enlarged photographs. Such an enlargement directly on the plate makes it possible to produce as many exact duplicate prints as may be desired, and if necessary the plate itself can be produced in court for verification. In making an enlargement, above ten diameters, the object

must be illuminated by direct sunlight or intense artificial light in order that the enlarged image on the ground-glass may be accurately focused. Care should be taken that there are no shadows and no reflections, and the object should be illuminated in such a manner as will best show the fact to be illustrated. A tilting camera stand is very useful in this work, as it is in making the various kinds of photographic enlargements herein described.

An easy method of determining the degree of enlargement, and also of making a permanent record of it, is to provide an accurately divided scale, printed on thin paper, which is placed on the object-board close to or upon the document, and is focused on the ground-glass and photographed with it. By the use of an ordinary measure, the degree of enlargement desired can be determined by measuring



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Special Tilting Camera Stand in position for side window lighting.

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the image on the ground-glass and the image becomes a part of the negative and can appear, if it is desired, at one side of every print.

As a means of determining accurately, whether the utmost detail of the original is reproduced in the photograph, a gray scale may be provided to be photographed on one side of the plate. Such a scale consists of narrow, graduated shades of gray, numbered from one to five, the lightest shade being so delicate as to be almost pure white. If the photograph shows the numbered shades of the scale then it is certain that all the detail of the object photographed is faithfully reproduced. The gray scale is not essential in photographing ordinary objects.

In signature inquiries it is usually desirable to photograph the original and the standards together, in order of date, on one plate. This can be done unless the original documents are too thick and bulky. The dates, amounts and a brief description of the several papers can be written in condensed form on a separate piece of paper, at places just opposite the several signatures, and this can be photographed and will appear on the prints as a description of the several signatures.

In making a photograph of an unevenness like a pencil indentation without color, or a seal impression on white paper, or any similar object, the light must be arranged so that the lighting and the shadow shows the outline of the object. The space between the lens and the object should be partly covered, and light should be admitted mainly or entirely from one side, and should fall on the object at just the proper angle, by which means a perfect outline can be obtained. It is not advisable in photographing pencil writing to enlarge it more than from one and one-half to about four diameters,



Post Mark and Embossed Impression, without color, on enclosed letter, photographed by side light. <sup>24</sup>

## Photography and Questioned Documents

because under great magnification the line becomes so thin as to be illegible unless the photograph is overprinted, which produces a line result differing from the original.

To show lack of continuity, or an unnatural order of writing, several

negatives should be made of the matter in question of different lengths of exposure by both direct and transmitted light. If three negatives are made the first should be given one-half, the second normal exposure and the third about twice normal exposure. Prints of varying degrees of exposure from all three negatives should be made, some of which will be likely to show any unnatural order or lack of continuity in the writing. This same fact may sometimes be more clearly shown by a series of prints of varying depths from a carefully timed negative. Several prints should be made under different lengths of exposure from one-fourth of normal up to full exposure. It is desirable to make several exposures in both processes, as the distinction may be very slight between the parts to be compared, and it is necessary to secure just the right density or depth of printing to show the contrast.

These methods may show differences, even in pencil writing, that are not seen by direct view. The transmitted light photographs and prints made of varying depths of printing, measure and compare the character and density of pencil strokes, which can hardly be effectively compared in any other manner.

In photographing certain tints and colors, appropriate colored screens are necessary if the best results are to be obtained. In order to produce contrast and make a color show distinctly against a white background, it is necessary to reduce the actinic quality of the color or its chemical effect on



Colored Screens and Ray Filters.

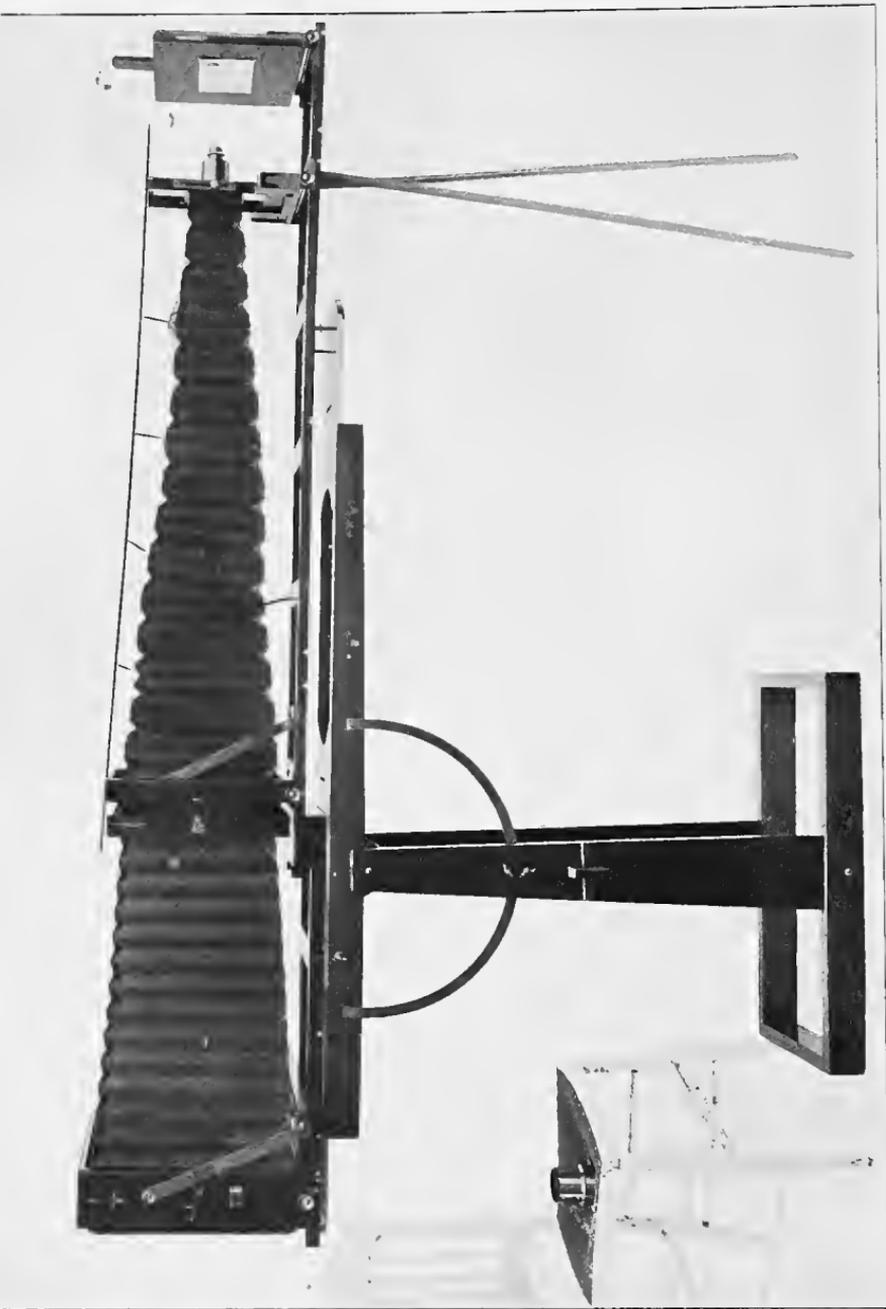
## Photography and Questioned Documents

the sensitive plate. This is accomplished by using a colored screen or ray filter, which is complementary to the color photographed. For example, blue should be photographed with an orange screen. By the use of appropriate filters it is also possible to show very clearly distinctions in ink colors that cannot be seen by unaided vision. Two apparently black inks, one of which however has a purple hue under magnification, if photographed with a purple screen, are shown to be distinctly different. For this purpose it is simply necessary to use a screen of exactly the same color or tint found in one of the inks to be compared, but not in the other.





## APPENDICES



DOCUMENT CAMERA AND ADJUSTABLE STAND.

Equipment: Bellows Extension, 76 inches; Plates, 11 x 14 to  $3\frac{1}{4}$  x 4; Lenses, 2-inch, 6-inch, 8-inch, 9-inch, 14-inch and 18-inch Focus; Ground Glass, Lens and Object-Board actuated by Rack and Pinion; Camera Stand adjustable at any angle from vertical to horizontal.

## Principles of Handwriting Comparison

The principles which underlie all proof by comparison of handwritings are very simple, and, when distinctly enunciated, appear to be self-evident. To prove that two documents were written by the same hand, coincidences must be shown to exist in them which cannot be accidental. To prove that two documents were written by different hands, discrepancies must be pointed out in them which cannot be accounted for by accident or by disguise. These principles are easy to understand, but to exemplify them in observation is by no means always easy. It is not their merely having bodily eyes which enables any one to see in two documents either discrepancies or coincidences. In the words of Epicharmus, which are the motto of this work, "Mind sees, and Mind hears; all things else are deaf and blind." . . . . It is idle for an unpractised volunteer to look at two documents, and to suppose that he sees what is in them. He does not know what to observe. He may fancy that two handwritings are similar, when their essential differences are numerous; or he may pronounce them to be wholly unlike, when, radically, they are identical. . . . .

Finally it is to be remembered that the evidence of the identity of Junius and Francis as handwriters is cumulative; that is to say, the force of the evidence depends not on any one single coincidence, but on numerous coincidences varying materially in their individual strength, which, when viewed in connection, lead irresistibly to one inference alone, though each by itself may be inconclusive. A common fallacy in dealing with such evidence is to take each coincidence separately, and to show that a similar coincidence exists in some other writer. This would be a perfectly legitimate mode of reasoning, if any one coincidence so dealt with were adduced as in itself conclusive; but it fails to meet the requirements of the case, when the argument is based on the combination of many such coincidences collectively, and not on the separate existence of any one of them.

—Honorable Edward Twistleton, in *Handwriting of Junius*, pp. LXXV, LXXVII.

## Handwriting Testimony Susceptible of Demonstration

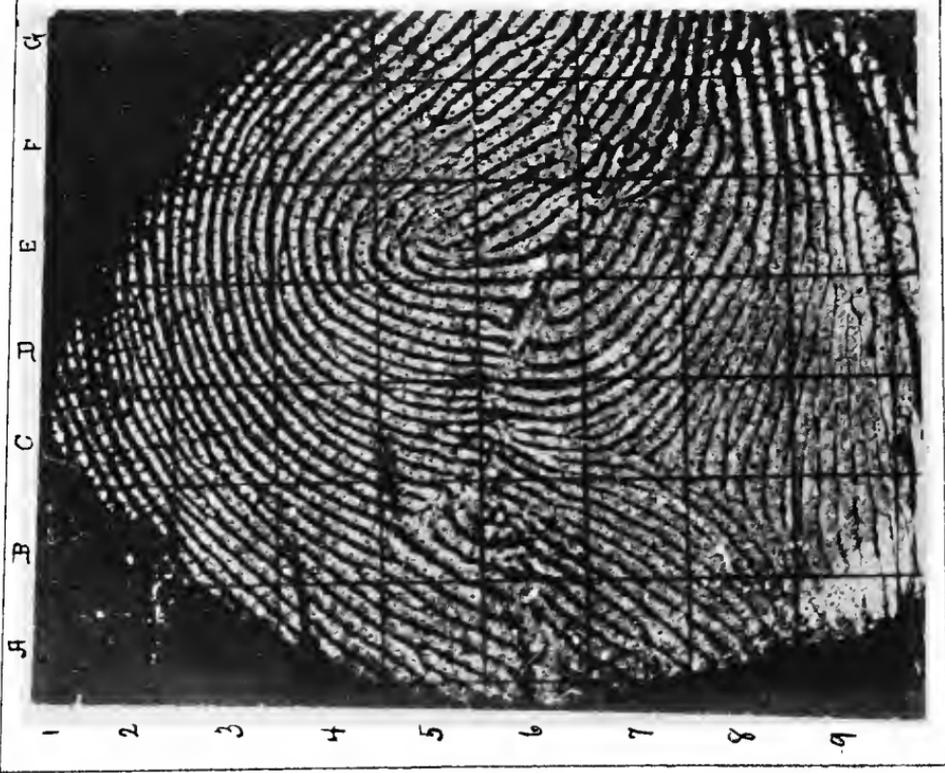
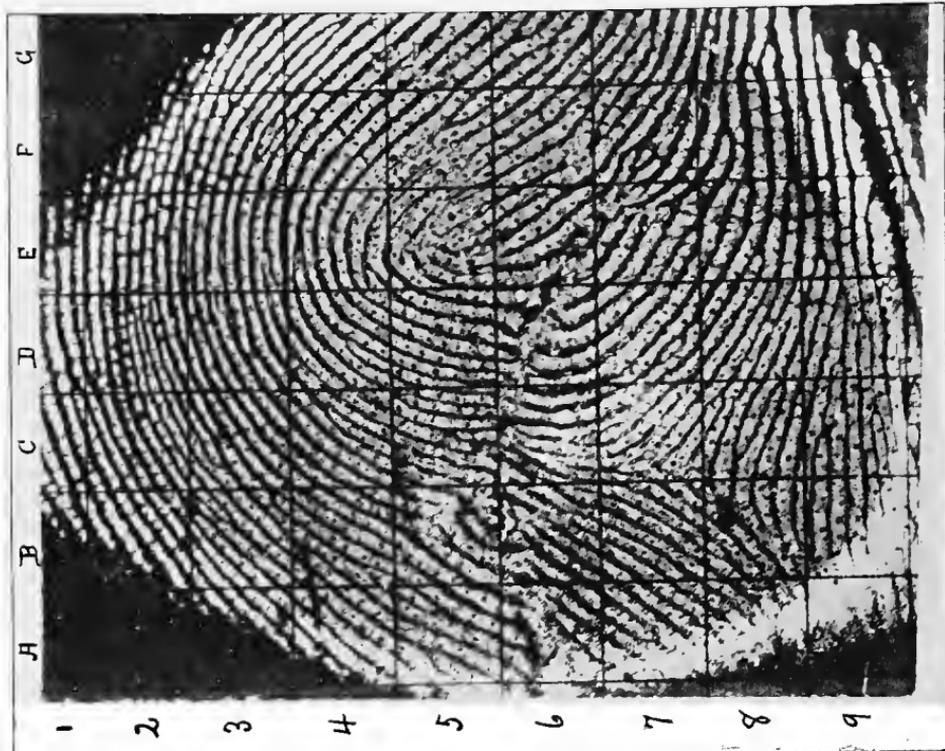
Handwriting is an art concerning which correctness of opinion is susceptible of demonstration and I am fully convinced that the value of the opinion of every handwriting expert as evidence must depend upon the clearness with which the expert demonstrates its correctness. That demonstration will naturally consist in the indication of similar characteristics or lack of similar characteristics, between the disputed writing and the standards, and the value of the expert's conclusion will largely depend upon the number of those characteristics which appear or are wanting. The appearance or lack of one characteristic may be accounted to coincidence or accident, but, as the number increases, the probability of coincidence or accident will disappear, until conviction will become irresistible. Thus comparison is rated after the fashion of circumstantial evidence, depending for strength upon the number and prominence of the links in the chain. Without such demonstration the opinion of an expert in handwriting is of a low order of testimony, for, as the correctness of his opinion is susceptible of ocular demonstration, and it is a matter of common observation that an expert's conclusion is apt to be influenced by his employer's interest, the absence of demonstration must be attributed either to deficiency in the expert or lack of merit in his conclusion. It follows that the expert who can most clearly point out will be most highly regarded and most successful.

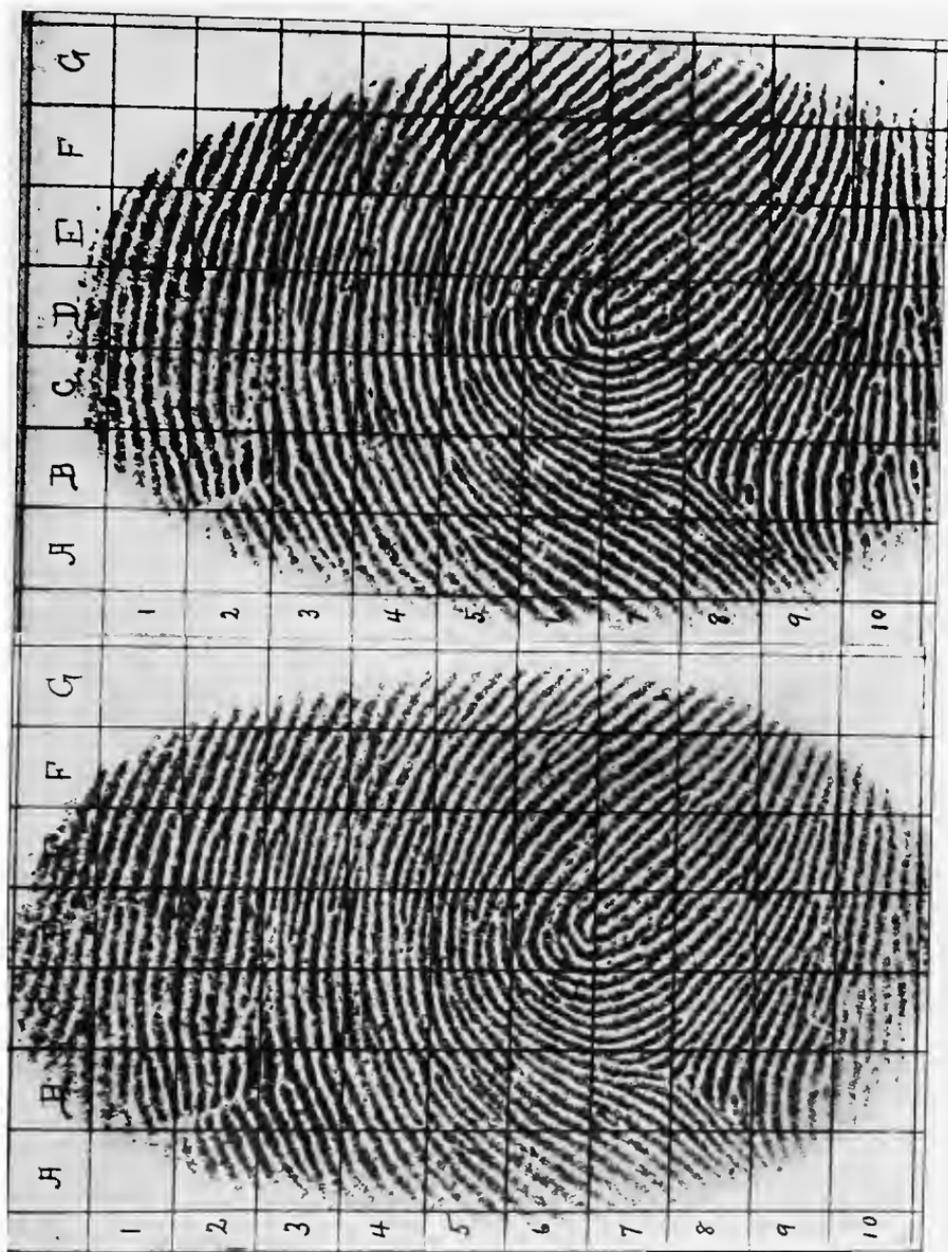
—Gordon's Case, 50 N. J. Eq. 397, 26 Atl. 268. Feb. 21, 1893.

## Finger Prints

Photography is quite essential as an aid in identifying finger prints. On the following pages is illustrated a new method of making such comparison. This is accomplished by photographing the imprints to be compared with a superimposed glass plate ruled with uniform squares. By making a suitable enlargement and then numbering and lettering the squares, as is shown in the illustrations, it becomes possible to compare the characteristics as they appear in any similar squares, and it is also possible to describe definitely the square to which reference is made. Thus attention can be directed to square "7-D," or any other square on the photographs of different prints, to discover whether or not the impressions were by the same hand.

One of the illustrations shows black on white, the other white on black. It will be observed that the impressions are not quite identical in size, but after a little study it cannot be doubted that the two impressions must have been made by the same hand. Not only this, but it is clear that no two human hands in all the world can be just alike in all these complex particulars.





— IV —

Not the Amount but the Weight of Testimony  
to be Considered

It is urged that we will find as many experts testifying upon one side as upon the other. That may be true, and it is also true that we will find as many lay witnesses upon each side in litigated cases, giving different versions concerning a fact or circumstance. But this does not signify that the evidence of those witnesses must be disregarded because they disagree. Nor is it important specially which side has the greater number of expert or lay witnesses sworn in his behalf. It is the nature or character of the testimony given by the witness which is important. In the case of expert witnesses, their opinions are valuable only in so far as they point out satisfactory reasons for the ultimate conclusion of the witness. If the witness simply testifies that he believes the signature genuine or not genuine, as the case may be, and gives no reasons for reaching his conclusion, his opinion is valueless and the court will not consider it. If he gives reasons for his opinion, then it is the duty of the court to examine into and analyze those reasons and determine the correctness or incorrectness of the opinion and not simply consider the conclusion of the witness alone.

—Matter of Burtis. 43 Miscellaneous Reports.

## Nature, Custom and Habit Individualizes Handwriting

Experts, in determining the genuineness of handwriting, or its falsity, seldom confine themselves solely to the appearance of the similitude or dissimilitude of the individual letters. An analysis of the signature as a whole is, or should be, always made. Experiments, observation and experience have disclosed the fact that there are certain general principles which can often be satisfactorily relied upon in determining the genuineness of handwriting. In nearly every person's manner and style of writing there is a prevailing and distinct character, which is more or less independent of the writer's will, and unconsciously forces the writer to stamp the writing as his own. By nature, custom and habit, individuals as a general rule, acquire a system of forming letters which gives to their writing a fixed character, as distinct as the features of the human face, which distinguishes their own handwriting from the handwriting of every other person.

—Green v. Terwilliger, 56 Fed. 407. Justice Thomas P. Hawley.

## The Molineux Case

No recorded case afforded better opportunity for handwriting comparison than this celebrated case, and it also illustrates the great value of photography in conducting such an inquiry. The two following pages show only a few of the hundreds of comparisons made between the disputed and admitted writings. Such exhibits need no testimony; they speak for themselves. At the second trial all photographic comparisons were excluded, a procedure almost if not quite unprecedented in such a case.

Conceded

Disputed

Conceded

Disputed

<sup>13</sup>  
West West

<sup>13</sup> W W W W

<sup>15</sup>  
enclose enclose

<sup>15</sup> enclose enclose

<sup>53</sup>  
enclose

<sup>26</sup> City City

<sup>29</sup>  
enclose

<sup>4</sup> n. l. City

<sup>4</sup>  
employ employ

<sup>19</sup> send send

<sup>0</sup>  
Allen

<sup>39</sup> send send

<sup>24</sup>  
Please

<sup>G</sup>  
case

<sup>2</sup> send send

<sup>6</sup> send send

<sup>25</sup> send send

<sup>53</sup> send send

<sup>40</sup> send send

<sup>4</sup> # 16 20 # 16 20

<sup>D</sup> # 16 20

<sup>11</sup>  
Please

<sup>F</sup>  
case

<sup>40</sup>  
Please

<sup>M</sup>  
case

<sup>20</sup>  
Harry

<sup>M</sup>  
Harry

<sup>3</sup>  
Harry

<sup>20</sup>  
Harry

It was not disputed that all questioned writings in the case were by the same hand, and testimony to this effect was given by the defence as well as the prosecution. These grouped photographic comparisons were excluded from the jury at the second trial.









THE RELATION  
OF LIGHT TO  
THE PROOF OF  
DOCUMENTS.

*By*  
ALBERT S. OSBORN

## THE RELATION OF LIGHT TO THE PROOF OF DOCUMENTS.\*

By ALBERT S. OSBORN, Examiner of Disputed Handwriting and Documents, New York; author of "Questioned Documents."

I CAN think of no association that bears a name which affords such a temptation to the manufacture of figures of speech as an Illuminating Engineering Society. The name at once suggests the dark places that need your assistance. Every department of human activity does indeed need illuminating engineers and what we all want everywhere and all the time is more light.

Light is an important factor in the proof of documents and light engineers can promote justice by making it easier to prove the facts regarding disputed documents. Anything relating to the subject of illumination that affects the quality of human vision is of vital importance in all forgery investigations. Justice has been defeated many times because court-rooms like cathedrals have been lighted with a dim light somewhat in harmony with some of the hampering old legal precedents. Partly because of poor illumination, judges and jurors in many instances have not been able to see properly, where the case depended chiefly upon visible evidence. This partial blindness in the past has been due in some degree to an ancient legal procedure that threw a twilight gloom around legal investigations, weaving such a network of restrictions about them as made it difficult to prove a physical fact. Strange to say, objections are still made to the use of the microscope, to photographs, and aids of every kind, and these objections, even in these days, are now and then sustained. All these old restrictions have been intensified by poor lighting and improper physical surroundings as well as by individual but unconscious deficiencies in seeing ability, for there is in fact a form blindness akin to color blindness.

When the necessity arises for proving a somewhat obscure physical fact by visible evidence this whole question of human vision with its defects and limitations becomes a question of vital interest. In the first place, it is important to realize that seeing ability is not by any means the same with all observers. It is an encouragement to improve our sense of sight to realize that only part of our skill comes by nature and that much comes from study and experience.

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\* A paper read at the eighth annual convention of the Illuminating Engineering Society, Cleveland, O., September 21-24, 1914. Reprinted in Law Notes, November, 1914; Reprinted in Scientific American Supplement, October 17, 1914.

It is also helpful to consider just how it is that we actually see what we think we see. We all know that when we hear sounds we perform a mental operation and from these sounds infer certain things. From arbitrary combinations of sounds, for instance, we get an English word which conveys an idea, or from another combination a German word, and from still another combination we infer that a man is walking or a horse is running. When we see things, however, we are inclined to assume that we are receiving directly in the brain positive information instead of certain sensations which we must mentally interpret just as we have interpreted the sounds.

In much greater degree, therefore, than we are inclined to admit it is no doubt true that we really see but little more than we are able to compare with some experience or standard that we already have in the brain. The savage does not really see a steam engine, or a watch, or a city, and in some degree we are all in the savage class. The thoroughness of this mental comparison and the final accuracy of sight depend upon two things, the force and clearness of the sensation that reaches the brain and the experience which the brain already possesses. The necessity for seeing clearly, therefore, is that we may interpret accurately.

This whole question of human vision and the aids that perfect and intensify it is naturally closely related to the question of discovering forgery and the numerous other physical conditions that may point to fraud of various kinds in connection with disputed documents, and is of special importance in connection with the showing and proving of these facts in a court of law, often against prejudice and usually with untrained men who must be made to see and understand. It is therefore essential that sense impressions of all kinds be clarified and intensified in every way possible, and the arrangement, distribution, and management of light has a most important bearing on the subject.

Under the old legal practice, now happily but all too slowly passing away, expert testimony regarding forgery and documents, involving as it does many technical interpretations of visible evidence, was mainly the giving of bare oral opinions on a contested question in courts of law. This practice, much criticized and discredited, still continues in certain cases relating to insanity and some other subjects that the ordinary man, no matter how assisted, is unable to pass upon intelligently. A new practice, however, has developed in most jurisdictions in connection with proof of physical facts relating to documents, by which referee, judge, and jury are actually shown the basis for whatever opinion is given, so that with the assistance of reasoning testimony, now admitted in almost all courts and with

the aid of instruments and enlarged, properly grouped photographic illustrations, they can finally reach their own conclusions regarding the disputed fact. Testimony is not simply oral, as in the past, but visible as well.

With the new and enlightened procedure and a court-room where seeing and hearing are possible, numerous surprising verdicts in cases of this class have been rendered. Three recent New York cases are conspicuous examples. In the first, four alleged eye-witnesses, two of them of irreproachable character, testified to the execution of a will, and a jury decided it was not genuine; in the second, six witnesses testified that they saw a certain contract signed, and a jury decided the document was a forgery; and in the third, a jury convicted a distinguished member of the bar of forgery of only two short words in typewriting that, by comparison, were shown to be written on his own typewriter.

It will readily appear that this change of practice regarding visible evidence makes necessary such an illumination of court-rooms or trial chambers as makes it possible to see with the utmost distinctness. To the end, therefore, that visible evidence in cases of this class, and in all kinds of cases, may be presented with the utmost clearness and force it is highly important that an illuminating engineer be consulted in regard to the arrangement and lighting of every court-room.

Another reason why court-rooms should be properly arranged and lighted is to enable judge and jury to see witnesses with the utmost distinctness as testimony is being given, as well as to hear them. That this result may be attained it is necessary that witness-box, jury-box, and judge's bench be arranged in proper relations to each other and near together. Fortunately, there is in all of us a kind of instinct, enforced by conscious and unconscious training, by which we judge whether or not those who speak to us are telling the truth. This important faculty is dependent upon both the senses of sight and hearing. We recognize at once an insincere tone; even dogs and children judge us in an occult and unknown manner. By the use of the eye as well as the ear, we unconsciously interpret all messages that come to us as exaggerated, true or false. That ancient requirement of the law that "the accused must be confronted by the witnesses against him" was no doubt in some measure based upon this important faculty by which truth is separated from falsehood. A witness should be placed close to and nearly, if not quite, facing the jury or the judge who is to decide upon the truth or falsity of his testimony, and the room should be so lighted that his attitude, appearance, and every changing expression is distinctly seen. Few of us have ever analyzed the

evidences of sincerity and of untruthfulness as shown by hearing and sight, but we can understand how, at least to some extent, it can be done.

A visit to many a court-room is sufficient to show how such a room should not be arranged and should not be lighted. Artistic and architectural considerations, in many cases, would seem to be the only ones that had been consulted in the arrangement. In many a city of our land, of all places, the court-room is the one place where it is most difficult to hear and the most difficult to see, and the administration of the law could be greatly aided by the lighting engineer, the ventilating engineer, and the acoustic engineer. Trials should be held where every word spoken can be heard distinctly and where every piece of visible evidence can be clearly seen for exactly what it is.

There are many court-rooms so dimly lighted and so improperly arranged that it is almost impossible in them to prove forgery when such proof must be based upon the correct interpretation of delicate but highly significant visible evidence. In some few cases court and jury leave their accustomed places and in an informal and sensible manner gather around some low-placed, clean window where all can see and all can hear.

In connection with the proof of many different questions relating to disputed documents correct and adequate illumination is absolutely essential if the facts are to be proved. Vital evidence is sometimes based entirely upon the interpretation of indistinct stains, or delicate tints or colors which, under the dim light provided, all become a dull and indistinct gray. In cases involving chemical erasures, in which certain indistinct yellow stains are of the utmost significance, such evidence is practically invisible under the yellow, flickering artificial light or the dim daylight of the average court-room. In many court-rooms the effective use of a microscope is simply impossible.

In many cases involving the identification of paper, where sheets have been interpolated in disputed documents, the case could be positively proven out in the court-yard, but under the conditions provided, intensified by the bad acoustic properties, injustice may triumph or the guilty may escape. Many a city in this land has spent millions of dollars on a court-house without one properly lighted and well-arranged court-room where clear seeing and distinct hearing are possible. Darkness and evil have always been associated and still are associated in many a court-room. The modern laws of some states happily require a certain amount of properly placed light in every school house, but such laws, it would seem, have not yet been applied to the law houses.

Light is also a great aid to justice in connection with the sub-

ject of photography as now applied to the investigation and proof of disputed documents. To the modern examiner of disputed handwriting and documents the photographic camera bears a relation to the business similar to that of the compass to the mariner. The relation of light to this question of photography is as close as the etymology of the word itself suggests. It writes out in a universal language its unmistakable interpretation of many things. Many disputed document cases are hastily settled as soon as they are properly illuminated by the photographic camera.

The camera assists us to see certain things which without its aid are too small for us to recognize in their true significance and force. It is one of the natural but erroneous human assumptions that we see all that exists before us, but we know that this is not true, and thus arises the necessity in connection with many questions of properly enlarging the thing to be observed. Many forgeries are perfectly apparent when enlarged a few diameters. The photograph also makes it possible to cut apart, group, and arrange the parts of a disputed document for effective study and comparison.

As is well known, the whole photographic art is based upon the arrangement and control of light, and certain hidden facts in a forgery can be clearly shown in a photograph by certain special arrangements of light. In a laboriously perfected forgery in which the lines have been carefully retouched and overwritten so that under ordinary vision the result seems to be perfect, a transmitted light photograph under proper enlargement is often sufficient to prove the fraud. By this means the varying thicknesses of the ink film itself are measured by measuring its ability to transmit light. If a line is retouched skillfully so that the edges are not broken or disturbed such additions under ordinary vision may be invisible even under magnification, but a transmitted light photograph of such a stroke, enlarged from four to ten diameters, will show in permanent form with the utmost distinctness every added stroke. In making a photograph of this character the document is lighted partly from the front, but with the strongest light from the back so that the light which makes most of the photograph is actually transmitted through the paper itself.

The transmitted light photograph is often more effective than the microscope to show retouching, but for preliminary investigations of this kind and also for direct demonstrations in court the following special application of light is of great aid. A microscope table with a glass top having a strong light close underneath is provided. This combination is very useful, especially when employed in connection with the stereoscopic micro-

scope. An arrangement of this kind in the leading banks of the land, available for instant use, would save thousands of dollars every year, as by its aid an experienced observer, in many cases, is literally able to "see through" a forgery. By this means light is literally thrown on the subject.

Another condition under which special illumination is of great value is in the interpretation of certain kinds of erasures, especially erasures of pencil lines. The disposition of thousands of dollars may depend upon the interpretation of a few words or even a few figures and the determination as to whether or not they have been changed. Unlike an ink line, an ordinary pencil mark is made by sufficient pressure on the writing instrument so that a certain amount of graphite is worn off against the surface of the paper. If a mark of this nature is carefully erased so that the coloring matter is removed, it may become entirely illegible, although the depression still remains but is so shallow that it is invisible even under the microscope. If, however, such an erasure is photographed in enlarged form with a strong illumination through a narrow slit on one side with the rays of light almost parallel with the surface of the paper, the shallowest depression, where a word or figure has been so effectually erased that it is totally invisible under any other examination, then produces a shadow which, in a photograph of this kind, sometimes shows with absolute distinctness what was originally written.

Another class of cases under which the question of perfect illumination is of vital importance is in all ink investigations either to determine age or to discover whether two or more ink writings are identical or different. Some of these questions can no more be answered under the illumination of certain court-rooms than they could be answered in the light of the average cellar, while the same investigation if conducted under properly diffused white light shows a result that can be seen and appreciated by any intelligent man. It is easy to understand how desirable it may be under certain circumstances to show that writing is not as old as it purports to be, or to show that an addition or interlineation in ink is the same or different from other parts of the same document. The interpretation must be based mainly upon the recognition of certain colors. Under suitable conditions and proper lighting this recognition is possible with the average observer. In many court-rooms such facts cannot be proved.

All ordinary commercial ink of the present day is a chemical solution to which a temporary blue color is added so that the writing may be legible when first written. Fresh writing of this kind, as we are all aware, is of a distinct blue or bluish

green color, which color gradually disappears as it is submerged or masked by the development of a stronger color from the chemical constituents of the ink, until it finally reaches a black or neutral gray. When used during the winter months modern ink, under the usual conditions under which writings are kept, requires many months to lose all its initial blue color, so that examinations like those described, to show that the ink is not as old as it purports to be, may be made a long time after the actual date of the writing. Wills and documents representing hundreds of thousands of dollars are brought into courts of law, purporting to be many years of age, on which the ink color has not yet reached its ultimate degree of blackness or intensity.

By the use of a special color microscope with two objectives and the Lovibond tintometer glasses it is possible to match and record this changing ink color with great accuracy. For example, it is easily possible to match more than a thousand variations in the color blue alone. If an ink of this class is accurately matched and recorded as it first appears on a document purporting to be several years of age and then the same portion of ink is observed under the same conditions a few days or weeks afterwards and the ink has distinctly changed from a blue or distinct purple to a black or a much darker color, this is positive proof that such document is not as old as it purports to be. Most persons can recognize colors under favorable conditions, but the recognition and matching of colors in an investigation of this kind in the ordinary court-room under the conditions ordinarily provided is simply impossible. If evidence of this class is to be made use of, it is necessary that the ink should be observed under diffused white light of the proper intensity.

Another most interesting special application of light that promises to assist in disputed document cases makes use of those strange new rays of the spectrum out beyond the violet. By the use of a suitable screen and appropriate illumination it is possible to photograph totally invisible stains resulting from a chemical erasure so that the original writing becomes entirely legible.

Thus we see the advancement of knowledge in every field supplements that in every other field, and light engineers may be of great service in illuminating unexpected dark places in various divisions of human activity.



