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EXAMINATION OF PAPERS IN QUESTIONED DOCUMENTS

Differentiation by Chemical Tests

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Edwin H. Fearon is a recognized and well qualified Examiner of Questioned Documents and maintains office and laboratory in Pittsburgh, Penna. For several years he has been carrying on specialized research on methods for determining differences in paper composition. It has been his objective to devise simple, rapid tests which will demonstrate accurately differences between two similarly appearing but unlike papers. At the annual meeting of the American Society of Questioned Document Examiners, of which Mr. Fearon is a charter member, he presented this paper on a rapid method of differentiating between specimens by means of new application of standard chemical tests.

William R. McMillan (M. S. Illinois Institute of Technology) is pursuing graduate studies at the University of Pittsburgh. He holds membership in Sigma Xi and the American Chemical Society and saw naval service during the war. Mr. McMillan's training in physical chemistry and physics lead to his interest in the problem of which he writes.—Editor.

The tests used in the scientific examination of questioned documents are many and varied. One examination may concern a specimen of typewriting and the determination of the make and model and perhaps the year of manufacture of the typewriter. The tests used to establish this involve the precise measurement of the shape and size of the letters, and their comparison with known standards. The problem may involve deciding whether two samples of handwriting were made by the same person. In this case, the tests are those of comparing the skill of the writer, the formation of letters, etc. Another question may necessitate the proof of erasure, alterations, and substitution in important documents. The accomplishment of this may require photography to bring out the abraded surface, different colors of inks, etc. One of the most important matters is that involving the establishment of the difference or identity of two or more samples of paper stock. This question frequently arises when the document expert is called upon to determine the genuineness of contracts and wills which consist of more than one page. The tests to accomplish this include: (a) Examination of the physical characteristics of the paper, that is, thickness, weight, presence or absence of water marks, color, texture, etc. (b) Examination of the papers by photography using infra-red or ultra-violet illumination. This frequently brings out differences in papers which otherwise appear identical in white light. (c) Use of chemical tests to differentiate between the samples of paper. This last method is a quite

powerful tool in that differences in papers can be made obvious even when the samples are made from the same fibers and were treated approximately the same in their manufacture.

In the manufacture of paper, each of the various steps is controlled so that the proper results are obtained before the next step is taken. To this end, many tests have been devised to determine the degree of cooking and bleaching, the purity of pulps, and other characteristics of the constituent fibers. The compilations of these tests and techniques presented by Graff (*1*) and by Sutermeister (*2*) have been used in this present investigation. These tests have been used and adapted to the purpose of differentiating between samples of finished paper even though the original tests find perhaps more use during the manufacturing processes. It is not assumed that they will necessarily have the same significance in our work as they do at the paper mill. It will be sufficient if they succeed in bringing out *differences* in the papers due to slight variations in fiber content or in processing. The problem, of course, comes from the fact that the tests were originally designed to be used with a fairly generous sample of pulp, while a legal examination must of necessity be confined to a minute specimen of paper. Further, the physical state of the fibers in the paper being different from that in the pulp, often calls for the exercising of considerable patience and some experimenting to bring out differences in papers of different compositions.

Tests were performed with the Herzberg and the Lofton-Merritt stains, the modified Bright stain, the "A" or modified Sutermeister stain, and the "C" or Graff stain, as well as the phloroglucinol test and the reagent of Yoe and Jones (*3*). The differences in reactivity between two samples of paper, of 25% and 100% rag composition, toward the "A" stain and the Herzberg stain, prepared as directed, are apparent in Figure 1. A wide difference in composition was chosen to insure clear differences in the halftone reproduction of the photographs. This figure also shows the results of the specific test for groundwood fibers, phloroglucinol, which gives a red color. In the processing of pulp and subsequent manufacturing of paper, there is opportunity for the introduction of extraneous material. One of these, iron, is quite readily tested for with the reagent of Yoe and Jones. In the figure, the differences in iron content in three samples of paper of varying rag content from the same manufacturer are demonstrated.

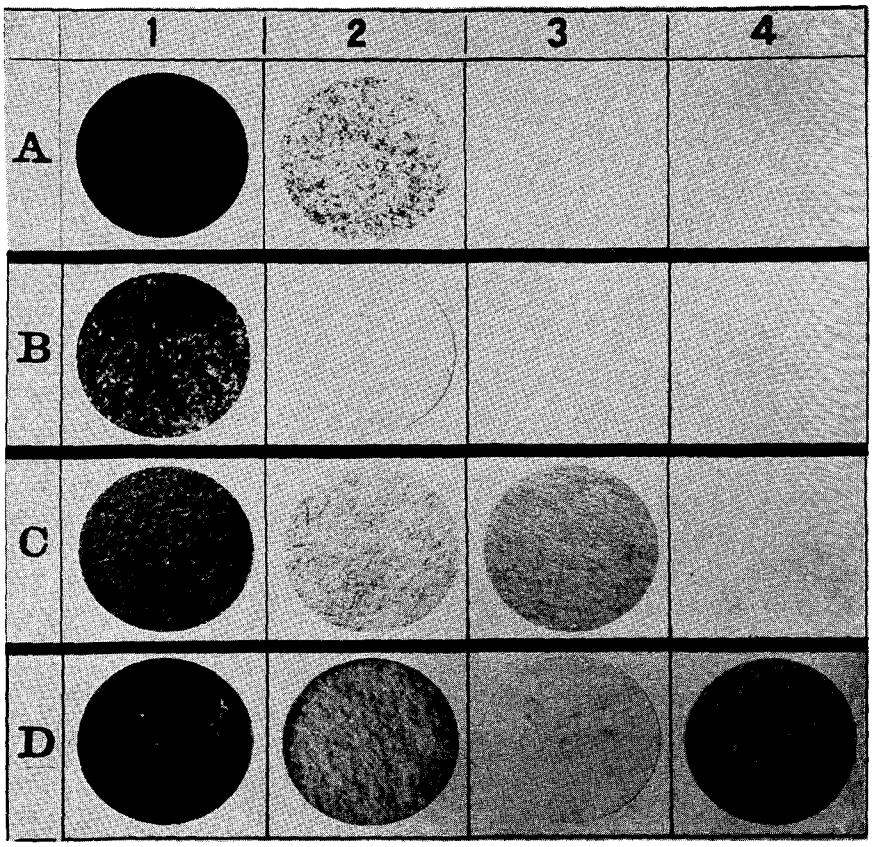

Figure 1.

SELECTED SPOT TESTS WITH VARIOUS WHITE PAPERS.

		Kind of Paper			
Row	*Test*	*Col. 1*	*Col. 2*	*Col. 3*	*Col. 4*
A	Herzberg Stain	Trojan Bond 25% Rag	Agawan Bond 100% Rag		
B	"A" Stain	Trojan Bond 25% Rag	Agawan Bond 100% Rag		
C	Iron Reagent	Groundwood 100%	Typewriting Paper, No Watermark	Trojan Bond 25% Rag	
D	Phloroglucinol Test	Esparto	Rag 100%	Trojan Bond 25%	Groundwood 100%

EXPERIMENTAL

Samples of the various kinds of paper were cut with a paper punch to obtain convenient pieces for testing. The solutions for each of the tests in the order and composition prescribed in the references cited, were placed in the depressions of a white, glazed color test plate, and the paper sample was im-

mersed. The times of immersion at room temperature (from five to thirty seconds) were controlled for all comparison runs. The resulting test papers were air dried and photographed on panchromatic film. A few of the photographs were selected as being satisfactory for halftone reproduction, and are presented as Figure 1.

With this procedure no pretreatment of the paper sample, such as the customary mastication before study is made of the component fibers, is necessary before the reagent is applied. While small samples were cut out for this experiment this would not necessarily be required as the procedure can readily be modified to be used as a spot test on the original sheet.

Satisfactory results were obtained in these tests in showing the variation among the resultant stains for papers of different composition. This technique proves to be quite valuable as a corroborating demonstration that specimens of paper from questioned documents are either similar or dissimilar.

References

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