Joseph Almog,[1] *Ph.D. and Abraham Marmur,*[2] *D.Sc.*

Chemical Reagents for the Development of Latent Fingerprints. IV: The Charring Process

REFERENCE: Almog, J. and Marmur, A., **"Chemical Reagents for the Development of Latent Fingerprints. IV: The Charring Process,"** *Journal of Forensic Sciences*, JFSCA, Vol. 26, No. 2, April 1981, pp. 393-397.

ABSTRACT: Latent fingerprints on paper were developed by baking them under controlled conditions. The quality of the charred images was found to depend strongly on the age of the latent prints. Results are discussed in terms of "donor quality" and rate of migration.

KEYWORDS: criminalistics, fingerprints, reagents, charring

Application of heat to paper items to reveal the presence of latent fingerprints on them by charring[3] is a well-known technique although experts do not consider it practical [*1*]. In spite of the rare use of this method by forensic sciences laboratories, we conducted a series of "baking" experiments with paper strips bearing latent fingerprints to elucidate some of the factors of this process. The research focused on two points: the potential use of the charring method in police work and charring as a means of estimating the age of latent fingerprints on paper.

Experimental Procedure

An Electric Multiple Unit® furnace was used for baking. In each one of the baking experiments time and temperature were set to achieve the best results. The paper samples were kept until the development at room temperature (22°C) with no special protection from daylight.

Experiment 1

Latent fingerprints were collected on commonly used groundwood free paper [*2*]. Each one of the different fingerprints was cut into two halves, providing 20 strips for each person, each strip bearing half of the latent fingerprint. Half of each fingerprint (10 strips per person) was developed immediately after the stamping by baking it under controlled conditions. The other halves were developed by the same method at various ages, from 30 min to twelve

Received for publication 16 July 1980; revised manuscript received 15 Sept. 1980; accepted for publication 19 Sept. 1980.

[1]Deputy head, Research and Development Division, Israel Police Headquarters, Jerusalem, Israel.

[2]Senior lecturer, Department of Chemical Engineering, Technion-Israel Institute of Technology, Haifa, Israel.

[3]Though not a reagent, charring is undoubtedly a chemical process and therefore is included in this series.

days. This procedure eliminated the possible effect of variations in amount and constitution of the perspiration even more than a previous technique based on comparison of different whole fingerprints from the same hand [2].

Experiment 2

Latent fingerprints were collected and divided as above. The right halves (ten per person) were developed at various ages by baking and the left halves were simultaneously developed by the standard ninhydrin technique for comparison.

Results and Discussion

Fair images were obtained only when the age of the latent prints did not exceed a few days. Baking of very fresh samples (up to one day) gave results comparable with those of ninhydrin. Best results were achieved at a temperature range of 260 to 275°C and baking times of 20 to 30 s. The charred images were quite persistent. No fading has been observed over a period of six months.

A background coloration appeared in all the samples that were baked.

A gradual degradation in the quality of the developed prints was observed as the age of the latent prints increased from one day to four days. Latent prints older than four days generally showed up as unresolved stains. (As anticipated, the ninhydrin-developed prints did not show any remarkable age-dependence.[4])

The quality of the charred prints varied from person to person. Usually there was a good correlation between the quality of the charred prints and that of the ninhydrin-developed prints for the same person: "good" donors for ninhydrin were found to be good donors for the baking method and "poor" donors for ninhydrin were poor donors for the baking method as well.

Figure 1 shows typical pairs of prints obtained by baking at various ages, and Fig. 2 demonstrates the difference in quality of prints developed by baking and by the standard ninhydrin method.

Charring can be regarded as a universal developer for the organic constituents of perspiration. Amino acids, fats, fatty acids, and urea are all charred under the above conditions as was proved in an independent experiment (baking strips of paper bearing marks made by dilute aqueous solutions of these compounds).

The standard reference method for comparing various techniques for developing latent fingerprints is the ninhydrin method. However, since the perspiration of some people may have a relatively high or low amino acid content, the validity of always using the ninhydrin method as a reference becomes questionable. This is particularly true since some of the other methods are not at all sensitive to amino acids. The correlation between the quality of the charred and of the ninhydrin-developed prints for the same person may therefore indicate a connection between the total content of organic ingredients and the level of amino acids in the perspiration, and hence ninhydrin can serve not only as an indicator for the level of amino acids but probably also for the general character of the fingerprints of a person.

For most of the fingerprint reagents the decrease in the quality of the visual impressions as the age of the latent prints increases can be explained by either lateral migration of certain ingredients, such as in the case of the reagent 4-dimethylamino-cinnamaldehyde [2,4], or complete disappearance of other ingredients, as in the case of iodine [5]. In the charring process the nature of the decrease in quality—a gradual blurring as the age of the latent prints

[4]One of the outstanding features of the ninhydrin method compared to other processes for paper is that the amino acid traces do not appear to migrate with age and consequently can be developed over long periods of time. One explanation for this stability is the apparent affinity between the amino acid traces and cellulose [3].

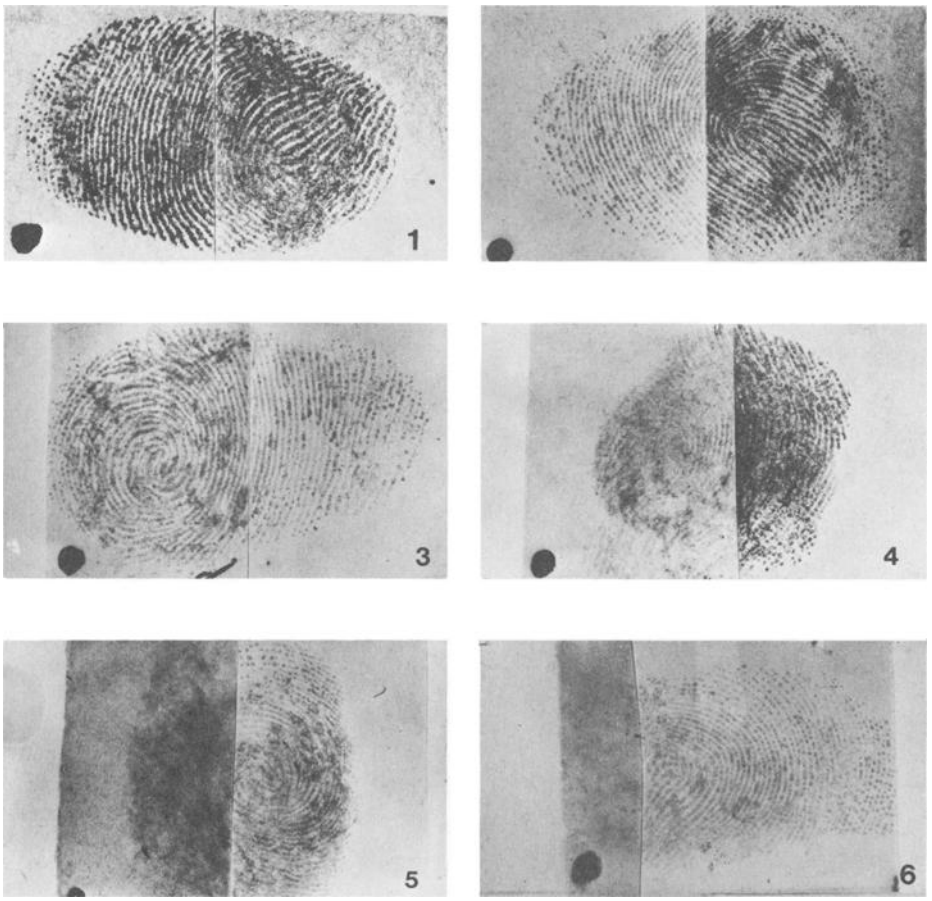

FIG. 1—*Typical pairs of half fingerprints obtained by baking them at various ages. In each pair the right half was developed immediately after stamping. For Pair 1, the left half was developed after 1 h; for Pair 2, after 3 h; for Pair 3, after 24 h; for Pair 4, after 45 h; for Pair 5, after 115 h; and for Pair 6, after 117 h.*

increases—most certainly indicates the diffusion of organic constituents from the ridges to the valleys [*3*], which apparently takes about four days.

Conclusions

Charring seems to be a convenient method for the elucidation of some aspects of the aging process of latent fingerprints on paper. However, from an operational standpoint it is quite clear that the charring method is inferior to ninhydrin as a developing reagent.

Acknowledgments

The authors thank Mr. M. Gendler and Mrs. C. Levi for their careful performance of the experimental work.

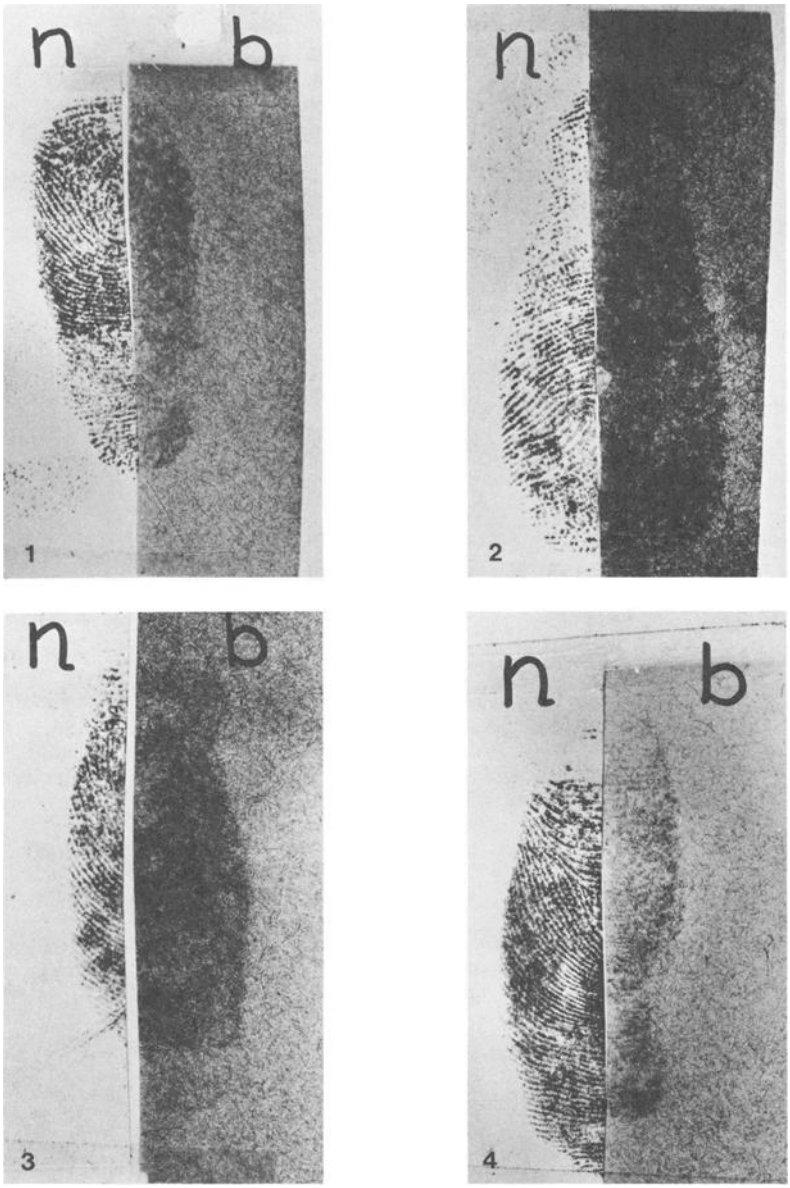

FIG. 2—*Comparison of the impressions obtained by developing latent fingerprints a few days old by baking* (b) *and by ninhydrin* (n). *Pairs 1 and 2 were seven days old: Pair 3, nine days old; and Pair 4, twelve days old.*

References

[1] Olsen, R. D., *Scott's Fingerprint Mechanics,* Charles C Thomas, Springfield, Ill., 1978, p. 259.
[2] Sasson, Y. and Almog, J., "Chemical Reagents for the Development of Latent Fingerprints. I: Scope and Limitations of the Reagent 4-Dimethylamino-Cinnamaldehyde," *Journal of Forensic Sciences,* Vol. 23, No. 4, Oct. 1978, pp. 852-855.
[3] Caton, H. E., "Physical and Chemical Aspects of Latent Print Development," in *Proceedings of the Conference on the Science of Fingerprints,* Police Scientific Development Branch, Home Office, London, 1974, pp. 174-183.
[4] Knowles, A. M., "Development of Latent Fingerprints on Paper and Fabrics," in *Proceedings of the Conference on the Science of Fingerprints,* Police Scientific Development Branch, Home Office, London, 1974, pp. 137-154.
[5] Almog, J., Sasson, Y., and Anati, A., "Chemical Reagents for the Development of Latent Fingerprints. II: Controlled Addition of Water Vapor to Iodine Fumes—A Solution to the Aging Problem," *Journal of Forensic Sciences,* Vol. 24, No. 2, April 1979, pp. 431-436.

Address requests for reprints or additional information to
Joseph Almog, Ph.D.
Research and Development Division
Israel Police Headquarters
Jerusalem, Israel