Fingerprints and Factors Affecting Their Condition

Kostadin Bobev

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Sofia, Burgaria

Abstract: The origin of latent fingerprints represents a physico-chemical process on the border or contact area between the skin relief and print receptive surface. In this sense the mechanism of latent fingerprint origins depends on a number of surface phenomena. This report presents observations made on different surfaces under different physical conditions.

I. Mechanism of Fingerprint Deposition (Sweat and Fatty Substances)

The perspiration-fatty secretion (i .e., secretions from perspiration or sweat and from fatty substances like lipids) on the surface of the hands can be described as follows. Fat covers almost the whole surface of papillary lines without penetrating into the space between them and into the channels of sudoriferous glands. The fat retention on the skin relief of hands is conjectured here to be due to the physical phenomenon of adhesion, the force of attraction between molecules of solid, liquid or gaseous substances which manifests itself on contact between objects. At the same time the sweat, periodically excreted by the sudoriferous glands in the form of clear drops, is conjectured here to be kept in the pore hollows by surface tension.

What happens to the sweat and fats when the fingers touch a solid surface? The fat as well as the perspiration which comes in contact with the surface often get transferred to the surface according to the following schemes:

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A. Glass and Porcelain

Perspiration-fatty secretion remains fora long time on non-porous surfaces such as glass and porcelain, but it dries because of water evaporation. Freshness of prints on such materials is due to fat, which does not evaporate, and whose process of combustion and dissociation is slower.

B. Metal

If perspiration-fatty prints have been left on non-porous metal surfaces such as iron, nickel, aluminum, copper and metal alloys, after some time corrosion processes take place on them, especially if the amount of sweat is considerably more than the quantity of fat. It is obvious that these processes take place between the particular metal or alloy and some salts and acids of sweat. This phenomenon has been observed on aluminum and brass, an alloy of copper and zinc. On two objects from the materials listed above, experimental prints have been made, then stored for a month in a dry and dark area. Totally dried prints were examined under a microscope and it was found that all characteristics necessary for a comparative analysis were preserved. An attempt to delete these prints with a cotton pad soaked in a fat-dissolving solvent was unsuccessful.

One feature observed for some compounds of copper and aluminum was their coloring-characteristic. Prints on brass had a green tint and those on aluminum were dark grey. Hence, between some components of sweat like salts and acids and the print receptive metal surface (in this case aluminum and brass), chemical processes have occurred which change the compositional quality of print-originating substances.

C. Plastics

Latent prints on different plastic objects undergo some interesting changes. Since plastics are the main materials in the production of so many commonly used items. they have made their way into everyday life in the last 25 to 30 years. Offenders often touch plastic articles in their criminal activities. These articles may be objects of interest or items touched or moved to clear the way to the object of interest. Hence, those objects carry or support prints of fingers or palms which have to be developed, fixed and collected for identification purposes.

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are concerned, there is a continuous movement of surface particles as a result of relaxation processes.

2. *Fingerprint Stability*

Bearing this in mind, one can easily explain the fact that on bakelite, as a typical representative of thermosetting plastics, more aged prints can be detected as compared to those left on polyethylene, polystyrene or other thermoplastic articles. Moreover, one could hypothesize that if a thermosetting object is kept at a constant temperature, i.e., the relaxation processes are kept at a minimum, the possibility of detecting prints increases even more.

In support of the above hypothesis, experiments with poly-vinylchloride, used in the production of artificial leathers, have been carried out. Fingerprints were placed on such artificial leathers and retained for four days under various conditions. Some of the samples were put into a thermal chamber at 18° *C* and the rest of the samples were kept at 18° to 30° C for the four days. At the end of the fourth day the samples were treated with "Loctite" superglue. On the samples stored at the constant temperature, the fingerprints appeared usable for comparison; those samples stored at varying temperatures only produced stains.

3. *Plasticizers*

Another factor hampering the detection of prints on plastic objects is the presence of plasticizers. When plasticizers are present, migration processes produce a permanent thin layer on the object surface. On the other hand, the molds in which the articles are cast are previously lubricated to eliminate sticking. These lubricants usually are stearates or palmitinates. When these lubricants are squirted on the article, the lubricants cover its surface, penetrate into the microscopic holes of its structure grains and become components of its surface.

Plasticizers and greases on the surface of plastic articles dissolve the fatty component of perspiration-fatty secretion of fingerprints based on the physical principle, "dissolving of a similar into another similar." Hence, if it is necessary to detect aged fingerprints on plastic objects, the method of developing amino acids which dissolve more slowly and migrate less into the plastics must be applied. This is usually done with the help of previously fixated and washed out photographic paper

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