

# How Long Can a Fingerprint Persist on an External Surface? – A Case Study

#### Simon Bunter BSc, FFS

#### **Summary**

This case study addresses various misconceptions which are held by some Crime Scene Investigators and shows that when the fingerprint evidence was holistically scrutinised, it indicated that a thumb print had persisted on an external drainpipe for approximately ten years and had not been placed during a recent theft as alleged.

# 1. The Prosecution Allegations

In January 2011 a theft was reported to police. During this incident a substantial amount of lead flashing had been taken from above a kitchen window at the rear of a residential mid-terraced house in North-West England. It was alleged the offender had climbed up a drainpipe to reach the top of the window and steal the lead flashing. A CSI attended and recovered one fingerprint lift from a drainpipe adjacent to the right of the window. The lift was forwarded to the local Fingerprint Bureau where the digit impression was electronically searched against the fingerprint reference forms held on the national database. This resulted in a hit between the only digit impression in the lift and a male's left thumb print.

# 2. First Interview with the Male

The identified male was interviewed in relation to the case and asked to provide an explanation for the presence of his thumb print on the drainpipe. He explained that 10 years earlier he was part of a large scale renovation project that involved carrying out work on several houses in the area, one of which was the house in question. He detailed that this work involved him and a colleague fitting all the drain and waste pipes to the property (for the purposes of this case study, both drain and waste pipes are hereby collectively referred to as drainpipes). This was later confirmed by his former employer.

The male maintained that he had not been back to the property in the intervening 10 years and his fitting the drainpipes was the only reason his thumb print would be present. Investigating officers informed him that they had spoken to the CSI who "confirmed that the print was not in the paint but on the surface".

### 3. The CSI's Statement

The CSI provided a statement in which she made several observations and concluded by opining that the male's thumb print would not have persisted for the 10 year period suggested by him.

In her statement, the CSI first described the process of recovering the thumb print; she used aluminium flake powder to cause any latent fingerprints to become visible and lifted the mark with low tack adhesive tape, placing the tape on a clear acetate sheet. She went onto explain that the drainpipe was attached to the rear wall of a mid-terraced house between the rear kitchen window and the rear door. She made the following comments (3.1 to 3.4) to explain her conclusion (closely paraphrased from the CSI's statement):

#### 3.1 The drainpipe was in an easily accessible and unsheltered area that was open to the elements.

Previously published articles [1-5] and the author's own experiments have shown that, although some fingerprints on a surface exposed to the elements are lost, others may persist in an identifiable condition for significant periods of time. The properties of the substance in which the fingerprints are formed appear to affect how long they can survive. This did not appear to have been considered in the CSI's observations and she did not record carrying out practical research of her own.

3.2 The Fingerprint Development Handbook by the Home Office Police Scientific Development Branch (2005) states that most fingerprints consist of sebaceous and eccrine sweat and that, with fresh fingerprints, the aqueous component contributes significantly to the adhesion of powders. Water is the first component to be lost from most fingerprints, therefore, for fingerprints more than a few days old, processes which primarily detect water are therefore generally less effective.



This appears relevant to fingerprints placed in sebaceous sebum and eccrine sweat. It does not refer to fingerprints in other substances. If the statement "most fingerprints consist of sebaceous and eccrine sweat" is assumed to be correct, then this would show an acceptance that some fingerprints are not.

Aluminium powder (as used by the CSI in this case) is not a test for water nor does it adhere exclusively to moisture. It can visualise fingerprints in other substances and even show fine detail in the substrate itself. For instance, fingerprint development powder can be used to visualise a fingerprint deposited in wet paint that has then dried [2]. Consequently, the development of a fingerprint in aluminium powder does not demonstrate that it contained water and, therefore, does not give any indication of its possible age.

3.3 If the male's thumb print had persisted for ten years, the CSI would have expected to find a substantial number of fingerprints on the drainpipe. The male's thumb print was the only print found.

The number of fingerprints on a surface has no correlation to how long a particular fingerprint may have lasted. As fingerprints placed in robust substances may persist for considerably longer than fingerprints placed only in sweat, transient fingerprints may be destroyed leaving only robust fingerprints on the surface. The number of fingerprints remaining on the surface would depend on what type of substance each was deposited. Indeed, a previous case study relating to fingerprints in paint recorded that only one identifiable hand contact was found on a frequently contacted door in a rugby club [2].

It was unclear whether the CSI was referring to a lack of 'identifiable' fingerprints or a complete lack of skin contact marks. It is normal practice for a CSI to only recover the 'identifiable' quality fingerprints from a crime scene and not those that may be deemed to be of 'insufficient' quality. In her statement, the CSI did not specify which other areas of the premises she examined and whether she found any other poorer quality marks. In addition, it was unclear whether the entire drainpipe was examined or only the areas that the CSI could easily access. As such, there remains the possibility that other 'robust' contact marks were present at the scene but not recovered by the CSI.

3.4 In the CSI's professional experience, fingerprints do not persist on external surfaces that have been open to the elements, namely forms of moisture and heat.

The CSI offers this opinion based on "professional experience" yet CSIs attend a crime scene after contact has occurred and, therefore, do not know when the fingerprints were placed. As they often attend a crime scene within 24 hours of the offence, it is likely that many of the fingerprints they recover will be 'fresh' and may have been placed by the offender(s) during the offence. It follows, however, that some of the fingerprints CSIs recover will be older. It is common for fingerprints found at a crime scene not to belong to the person later convicted of the offence, e.g. fingerprints of the householder, members of their family or other unknown persons. A CSI's "professional experience" at crime scenes, therefore, would not normally include determining the age of a fingerprint.

# 4. Second Interview with the Arrested Person

The male was re-interviewed and the CSI's statement was read to him. He said that he didn't know why his print had persisted for 10 years or why it was the only print lifted by the CSI. He described using glue, silicone grease, WD-40 and other various greases when fixing pipes together. He also explained that he may have welded certain parts of the pipe and that when pinning the pipes up he would have had to hold them in place. He went on to suggest that the grease may have caused his thumb print to remain on the surface for a prolonged period of time.

Investigating Officers put it to the male that pinning up the drainpipe would require multiple contacts and asked him why, therefore, there was only one print lifted. The male countered this point asking officers why, if he had climbed up the drainpipe as alleged, his fingerprints were not found higher up the pipe.

The male was subsequently charged with the offence. Defending solicitors instructed the author to examine and interpret the fingerprint evidence in this case and provide a report. The solicitors were not provided with any response that the CSI may have made in relation to the issues raised in the male's second interview. There was no other evidence provided in support of the prosecution allegations other than the thumb print.



# 5. The Author's Examination of the Fingerprint Evidence

The author attended the Fingerprint Bureau and the premises from where the lift was recovered. The fingerprint lift, the premises, the drainpipe, the CSI's photographs of the scene and other relevant documentation were examined.

# 5.1 Examination of the Fingerprint Lift

Although the lift contained traces of aluminium powder, the thumb print could not be seen under normal viewing conditions (see circled area in Figure 1). It could be seen, however, if a strong white light was shone at an oblique angle from underneath the lift in a darkened room. This allowed a photograph to be taken for comparison purposes.

It is not normal for a fingerprint in aluminium powder to fade, especially to the point where it is almost invisible to the naked eye. At least part of the impression in the lift appeared to be 'negative' or 'reverse colour', i.e. the furrows were visible and the ridges were void areas.

The reasons for the thumb print fading are unclear, however, it would appear that the print in the lift was not in aluminium powder, otherwise it would still be easily visible (as aluminium is opaque in all its forms). This appears to suggest that the lifting tape did not lift much, if any, of the aluminium powder from the print on the drainpipe. One possible explanation is that the lifting tape recovered a three dimensional impression that embossed the adhesive side of the tape rendering it initially visible but fading as the adhesive softened over time. Potential reasons for this include: i) the lifting tape did not contact the areas of aluminium powder when the impression was lifted from the drainpipe (i.e. the powder lay in the grooves of the 3D thumb impression on the drainpipe and the tape only touched the peaks) or ii) the aluminium powder adhered to the thumb print on the drainpipe more strongly than it adhered to the lifting tape and, as such, was not lifted off.







# 5.2 Examination of the CSI's Scene Photographs

The CSI's photographs showed the rear yard of the property with one black drainpipe to the left of the kitchen window and two black drainpipes to the right, one of which bore the thumb print (see green circle in Figure 2). The drainpipe that bore the thumb print had a greyish layer covering some sections of the otherwise black drainpipe, possibly due to environmental degradation. There was a 'drip' mark in this layer. The drainpipe to the left of the window did not appear vertical, possibly having been damaged at some time.





# 5.3 Examination of the Scene

Upon examination of the layout of the rear of the premises, it became apparent that the drainpipe bearing the male's thumb print was not the only possible route the offender(s) could have taken to reach the kitchen roof (see Figure 3). The drainpipe to the left of the window (that which appeared off-vertical in the CSI photograph Figure 2) appeared to offer the easiest and most practical way to reach the kitchen roof, e.g. the offender could have used that drainpipe for support to climb up and stand on the wall. Indeed, the complainant's father explained that he had to remove that particular drainpipe because people kept climbing up it to steal the lead flashing. The drainpipe had been removed prior to the author's examination and is, therefore, not visible in Figure 3).

Figure 3 – The author's photograph of the kitchen window. Note the drainpipe to the left is missing and the 'drip' mark is still visible some nine months later.





The drainpipe was examined and it was found that the thumb print was still present on it, some nine months after the CSI's original scene examination (see Figure 4). The print appeared 'positive', i.e. the ridges were formed in a substance that contrasted to the black surface of the drainpipe, whereas the impression in the lift recovered by the CSI appeared 'negative'.

In order to test the robustness of the mark, it was sequentially i) wiped with a gloved finger, ii) rinsed with water and wiped hard with a cloth, iii) wiped hard with a wet cloth applied with Fairy liquid. None of these removed or damaged the impression. The mark was then vigorously rubbed using hot soapy water and a scourer (a rough kitchen cloth). This scraping effect removed the impression along with the greyish substance on the drainpipe, i.e. this effectively cleaned the drainpipe taking off the thumb print and the top layer of whatever substance lay on the pipe. This revealed the original black colour of the drainpipe.







This indicates that the thumb impression on the drainpipe was robust and difficult to remove. This could be due to the impression being placed in a robust substance that was on the drainpipe and/or the thumb prior to contact occurring.

The greyish layer on the drainpipe appeared to be some kind of environmental degradation that had built up over time and was not the aluminium powder applied during the CSI examination. The 'drip' mark in the greyish layer, visible in the CSI's photographs, taken more than nine months before the author's scene visit, was still present. This indicates that the drainpipe was conducive to retaining different types of marks over long periods.

A further point of note was that the position and orientation of the thumb print was consistent with it being deposited when the male was stood on the ground and holding the drainpipe in his left hand. It did not necessarily demonstrate that he had climbed up the drainpipe and indeed its position was fitting with his explanation that he held the pipes in place whilst pinning them up.

## 6. Conclusion

The author's examination of the fingerprint evidence showed that there were several indications that the male's thumb print was not related to the theft of the lead flashing and may well have persisted for ten years as he maintained. Specifically:

- The thumb print on the drainpipe was extremely robust and difficult to remove, surviving all but the most thorough scraping.
- The thumb print had effectively 'disappeared' from the lift. This may be due to the circumstances in which the mark was deposited, i.e. it was not a 'regular' sweat mark but essentially a 3D impression in a robust substance which was then 'cast' by the lift.
- The position and orientation of the thumb print was consistent with holding the drainpipe as the male described, it was not in a position that necessarily demonstrated climbing up or down the pipe. Indeed, there was evidence to suggest that the offender(s) may have climbed up a different drainpipe to access the roof above the kitchen window.

It was these factors that were relevant to determining how long the thumb print could have lasted and not those relied upon by the CSI in her statement. It was only by considering the evidence specific to this case that the findings could be correctly interpreted. Upon provision of the author's report, prosecuting lawyers decided not to proceed with the case.

Some similar case studies regarding fingerprints persisting for long periods of time at crime scenes have been published [2-5], however, none report the prints persisting for ten years as indicated in this case.

# 7. Discussion

The finding of a male's thumb print at a crime scene led to his arrest. This was the only print found and nobody else was considered as a suspect. The male provided a confirmed explanation for his presence at the property some 10 years earlier, however, this was thought implausible and was not accepted by the CSI who recovered the print. The male's version of events, although not an expert or Forensic Scientist himself, was scientifically cogent and could be sustained when the fingerprint evidence was holistically analysed and interpreted. The CSI's suggestions that environmental conditions and other factors would not have allowed the thumb print to persist, appear to have been based on the assumption that the print was a 'regular' sweat mark. This assumption was shown to be incorrect and was not scientifically sustainable when the overall findings were interpreted.

It is not uncommon for some CSIs and/or Fingerprint Officers to assume a fingerprint would be fragile and easily removed. Although this may be true of some fragile 'sweat' fingerprints, it is not true for all prints and it is often difficult to determine in what substance a fingerprint is formed. As such, CSIs and Fingerprint Officers should thoroughly examine the factors specific to each case before providing comment. It is dangerous to assume that because a mark is easily raised, of good quality and on an outside surface, that it has been recently deposited. These assumptions may lead to the fingerprint evidence being incorrectly interpreted and wrongful charges or convictions being made.



# References

[1] Catherine Tweedy, How long can Fingerprints Survive on – Plastic bags? FDIAI News April – June 2010 18-21

[2] Simon Bunter, Fingerprints in Paint, Fingerprint Whorld, Vol 34, No 130, December 2007, 21-23

[3] Yaron Cohen, Eran Rozen, Myriam Azoury, David Attias, Beni Gavrielli, Michal Levin Elad, Survivability of Latent Fingerprints Part I: Adhesion of Latent Fingerprints to Smooth Surfaces, Journal of Forensic Identification, 62 (1), 2012 \ 47-53

[4] Yaron Cohen, Myriam Azoury, Michal Levin Elad, Survivability of Latent Fingerprints Part II: The Effect of Cleaning Agents on Survivability of Latent Fingerprints, Journal of Forensic Identification, 62 (1), 2012 \ 54-61

[5] Sgt Dean Greenlees, Age Determination – Case Report, Fingerprint Whorld, April 1994, 20(76): 50-52