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# Probabilities and Human Pubic Hair Comparisons

Often, when testifying in court, forensic scientists will state that an unknown substance is similar to a known source and that it could have originated from that source or from some other source with similar characteristics. When the substance in question is something like paint or fibers, the courts will have an intuitive feeling for the probabilities involved. However, with pubic hairs it is difficult for the courts to determine the weight to be placed on evidence concerning similarities. If a pubic hair from the scene of a crime is found to be similar to those from a known source, they do not know whether the chances that it could have originated from another source are one in two or one in a billion. In an attempt to provide a "ballpark" estimate of such probabilities, this study was begun.

## Method

The method used was basically the same as that employed in a previous paper on scalp hair comparison [*1*]. Samples of approximately 30 pulled pubic hairs were obtained from 60 different individuals. From these, depending on the homogeneity of the sample, six to eleven mutually dissimilar hairs were selected both macroscopically and microscopically to represent the range of characteristics present in the 30 hairs. The average number of hairs chosen was approximately 7.5. The six to eleven hairs were mounted individually on labelled glass slides and observed under ×125 magnification on a comparison microscope.[2]

Some characteristics of each hair as viewed longitudinally were coded on punch cards[3] as before [*1*] (see Table 1). The cards were sorted and those that had all major characteristics similar and no more than five minor characteristics dissimilar were retrieved. The hairs which these cards represented were then compared directly under the comparison microscope and those still found to be similar were cross sectioned and coded as before; the cross sections were then compared directly. Those hairs which were indistinguishable longitudinally and in cross section were called similar. A total of 454 hairs were examined and compared in this way.

## Results and Discussion

With 454 hairs, the total number of comparisons made was 102 831 [(454 × 453)/2]. Subtracting 1463 comparisons (60[7.5 (7.5–1)]/2) between hairs from the

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[2] Laborlux, Ernst Leitz, Wetzlar, Germany.

[3] McBee Keysort® Cards.

TABLE 1—*Characteristics used for coding.*

| Group | Characteristic | Type | No. |
|---|---|---|---|
| A | length [a], in. | less than 1½ | 1 |
| | | 1½—3 | 2 |
| | | greater than 3 | 3 |
| B | proximal color [a] | yellow | 4 |
| | | yellow-brown | 5 |
| | | brown | 6 |
| | | red-brown | 7 |
| C | proximal pigment density [a] | light | 8 |
| | | medium | 9 |
| | | dark | 10 |
| | | opaque | 11 |
| D | medial color [a] | yellow | 12 |
| | | yellow-brown | 13 |
| | | brown | 14 |
| | | red-brown | 15 |
| E | medial pigment density [a] | light | 16 |
| | | medium | 17 |
| | | dark | 18 |
| | | opaque | 19 |
| F | distal color [a] | yellow | 20 |
| | | yellow-brown | 21 |
| | | brown | 22 |
| | | red-brown | 23 |
| G | distal pigment density [a] | light | 24 |
| | | medium | 25 |
| | | dark | 26 |
| | | opaque | 27 |
| H | pigment size [b] | fine | 28 |
| | | medium | 29 |
| | | large | 30 |
| I | pigment distribution [c] | uniform | 31 |
| | | peripheral | 32 |
| | | one-sided | 33 |
| | | other | 34 |
| J | texture [c] | smooth | 35 |
| | | medium | 36 |
| | | fibrous | 37 |
| | | granular | 38 |
| K | medulla type [c] | absent | 39 |
| | | opaque | 40 |
| | | translucent | 41 |
| | | mainly opaque, some translucence | 42 |
| | | approximately half opaque, half translucent | 43 |
| | | mainly translucent, some opaqueness | 44 |
| L | medulla distribution [a] | trace | 45 |
| | | fragmentary | 46 |
| | | continuous | 47 |
| M | medullary index [a] | less than 1/6 | 48 |
| | | 1/6 to 1/4 | 49 |
| | | greater than 1/4 | 50 |
| N | maximum diameter [a], mm | less than 1/6 | 51 |
| | | 0.10 to 0.15 | 52 |
| | | greater than 0.15 | 53 |
| O | cuticle [b] | smooth | 54 |
| | | slightly serrated | 55 |

TABLE 1—*Characteristics used for coding*—Continued.

| Group | Characteristic | Type | No. |
|---|---|---|---|
| | | serrated | 56 |
| P | shaft [a] | fairly straight | 57 |
| | | medium | 58 |
| | | very kinky | 59 |
| Q | vacuoles [a] | none | 60 |
| | | some | 61 |
| | | many | 62 |
| R | root [c] | bulb | 63 |
| | | flat | 64 |
| S | tip [c] | natural taper | 65 |
| | | tapered and rounded | 66 |
| | | rubbed round | 67 |
| | | rounded and frayed | 68 |
| | | other | 69 |
| T | cross-sectional contour [c] | round | 70 |
| | | elliptical | 71 |
| | | oval | 72 |
| | | kidney-shaped | 73 |
| | | triangular | 74 |
| | | irregular | 75 |
| U | cross-sectional color [a] | yellow | 76 |
| | | yellow-brown | 77 |
| | | brown | 78 |
| | | red-brown | 79 |
| V | cross-sectional pigment density [a] | light | 80 |
| | | medium | 81 |
| | | dark | 82 |
| | | opaque | 83 |
| W | cross-sectional pigment size [a] | fine | 84 |
| | | medium | 85 |
| | | coarse | 86 |
| X | cross-sectional pigment distribution [c] | uniform | 87 |
| | | peripheral | 88 |
| | | one-sided | 89 |
| | | other | 90 |
| Y | cross-sectional texture [a] | smooth | 91 |
| | | medium | 92 |
| | | granular | 93 |
| Z | cross-sectional cuticle [a] | narrow | 94 |
| | | medium | 95 |
| | | broad | 96 |

[a] Either major or minor characteristic depending on types exhibited (usually major between types two numbers apart and minor between types with adjacent numbers).
[b] Minor characteristic.
[c] Major characteristic.

same individual leaves 101 368 comparisons which were made by this method. From these, 16 pairs of hairs were found to be similar or indistinguishable (see Table 2).

The probability that a pubic hair taken at random from Individual A will be indistinguishable from a hair taken at random from Individual B in the population studied may be estimated at 16/101 368 or 1 in 6336. If an average of 7.5 dissimilar hairs are chosen to represent the pubic hairs of Individual B, the chance that the single hair from A will be distinguishable from all of B's is $[1 - (1/6336)]^{7.5}$ which is approximately $1 - (1/800)$. This means that the probability that in *at least one* of the six to eleven cases the two hairs would be similar or indistinguishable is about 1 in 800. Thus if one hair found at the scene of a crime or on the victim's clothing is found to be similar to a standard sample having six to eleven mutually dissimilar pubic hairs from

TABLE 2—*Similar hairs.*

| Initials | Hair No. | Sex | | Initials | Hair No. | Sex | |
|---|---|---|---|---|---|---|---|
| G.W. | 4 | M | and | J.K. | 7 | M | |
| B.B. | 1 | M | and | A.A. | 7 | F | |
| R.A. | 6 | M | and | L.G. | 7 | F | |
| W.B. | 6 | M | and | L.M. | 6 | F | |
| S.J. | 3 | F | and | L.M. | 2 | F | |
| P.J. | 7 | F | and | R.B. | 3 | M | |
| P.J. | 4 | F | and | P.A. | 2 | F | |
| M.C. | 7 | F | and | C.D. | 6 | F | |
| R.L. | 2 | F | and | D.J. | 4 | F | |
| G.D. | 8 | F | and | G.G. | 4 | F | |
| G.D. | 3 | F | and | G.P. | 5 | F | G.D. 3 = G.P. 5 = K.B. 6 |
| G.D. | 3 | F | and | K.B. | 6 | F | |
| G.P. | 5 | F | and | K.B. | 6 | F | |
| J.L. | 5 | M | and | B.J. | 5 | M | J.L. 5 = B.J. 5 = M.A. 2 |
| J.L. | 5 | M | and | M.A. | 2 | F | |
| B.J. | 5 | M | and | M.A. | 2 | F | |

the accused, the chance that it could have originated from another source is about 1 in 800.

The sample of 60 individuals consisted of 30 males and 30 females, all Caucasians of various ages. It is interesting that of the similar hairs (Table 2), there are eight pairs where a hair from a female is similar to a hair from another female but only two pairs where a hair from a male is similar to a hair from another male. One individual (G.D.) was involved in three similar pairs and seven others in two pairs. Thirty-seven individuals did not have any hairs similar to those of anyone else in the group. There were two groups of three mutually similar hairs. These findings would tend to indicate that certain individuals and certain types of hairs are more likely to be involved in similarities than others.

It should be emphasized that these results are for a Caucasian population. It is expected that the probabilities of similarity would be somewhat greater for the Mongoloid or Negroid races due to the fact that hairs of persons of these racial origins exhibit less variation in many of the characteristics.

The probability of pubic hairs being similar is greater than that found previously for scalp hairs. This finding, which agrees with the intuitive findings of experienced hair examiners, may be related to the fact that on the average a person will have considerably fewer pubic hairs than scalp hairs.

## Summary

By use of a card coding system for some macroscopic and microscopic characteristics of human pubic hairs, 101 368 comparisons were made between 454 hairs from 60 different individuals. Of these, 16 pairs were found to be similar. For a Caucasian population, it is estimated that if one human pubic hair is found to be similar to at least one of a group of six to eleven mutually dissimilar hairs from a given source, the probability that it could have originated from another source is small, about 1 in 800.

## References

[*1*] Gaudette, B. D. and Keeping, E. S., "An Attempt at Determining Probabilities in Human Scalp Hair Comparison," *Journal of Forensic Sciences,* Vol. 19, No. 3, July 1974, pp. 599–606.

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