

# The Heterogeneity of Handwriting

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The practice of handwriting identification has been criticized by the judiciary of late for not providing the empirical data in support of its claims for the uniqueness of writing and the significance of its discriminating elements. This investigation is an endeavor to satisfy the requirement by describing a study of a collection of nearly 1000 writers executing similar writing standards in which many of the normal variables have been controlled. With the exception of two writers who were professional penmen, no difficulties were encountered in discriminating between writers. Owing to the range of natural variation in some individuals, however, it is possible that there may be a few specimens in the collection having common authorship that have not been appropriately associated by the limited selection of discriminating elements employed in the study. Suffice it to say, this kind of error does not lead to inaccuracies in writer identification. The frequency of occurrence reported of the discriminating elements selected provides some indication of their relative significance.

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## Introduction

The history of questioned document examination will record that the years of the 1990s were critical points in time. The discipline was being constantly challenged to provide acceptable statistical proof to the legal and scientific communities for the claims that have been made regarding the uniqueness of writing on which handwriting identification has been predicated for a hundred years. Thought must now be given to the matters of:

- a) proving the uniqueness of handwriting, and
- b) compiling frequency statistics, by which reasonably accurate evaluations of writing habits can be made.

The paucity of published literature on these topics indicates that few attempts have been made to address these issues or that the attempts made have been unsuccessful. If the success rate of studies is low, there is no doubt that one of the reasons for it is the control of variables in the collection of standards. To prove the uniqueness of writing, the control of variables in the preparation and/or collection of standards is essential to the process of discrimination in order that deceptively similar writings within a population of writers are given every opportunity to reveal their existence.

The control of the variables affecting handwriting standards, however, means having at least:

- a) *Similarity in texts.* The comparison of writing habits necessitates having the same habits of form and other aspects of writing executed under the influences ensuing from the same level of habit hierarchy (i.e., letter, word or phrase). To reproduce the influence of one letter or letter combination upon another, one is compelled to duplicate the text.
- b) *Similarity in writing circumstances.* Variations in instruments, writing position and writer's condition can have considerable effect upon the written product that will complicate the identification process.
- c) *Similarity in writing purpose.* The nature of the document, the intent of that which is written and the audience to whom it is directed may make significant differences in the manner, care and deliberation of writing execution. Extreme diversity in documents, such as personal notes vs. handwritten business communications, may provide little by which they reveal their relationship.

While control of internal variables within the writing samples is desirable, wide variation in the population of writers and their writing backgrounds is equally desirable. In this respect, the objective is to duplicate the range of variation in individuals that may be encountered in any given population from which handwriting cases may issue.

When these studies were first contemplated many years ago, the task of procuring standards seemed insurmountable. It still does if the acquisition must be accomplished in the shortest time possible. But given an abundance of time—like 50 years—many things become possible.

Remarkably enough, a source of standards of the kind we seek lies before each of us, unrecognized and unappreciated: the mail we receive daily.

### Methods and Materials

In the address on every handwritten envelope we find:

- a) *A similarity in text.* For the most part, the envelopes we receive bear the same name and the same street and city address.
- b) *A similarity in writing circumstances.* To the extent that control of variables in “collected” writing can be achieved, these addresses are likely to be the best available. They are probably written in comfortable sitting positions, using instruments that have been selected by the writer as performing well and comfortable to use.
- c) *A similarity in writing purposes.* The name and address on an envelope must be a legible writing that can be read by more than one person, but of no greater significance than to serve as an instrument of transit.

These writings are likely to be as normal and natural as one can expect to obtain from any subject. While the sources of mail vary somewhat with the recipient, the variety of writers and writing styles can be extensive.

There are other virtues in collections of this nature. Postmarks, return addresses, and other aspects of the envelope, if such are encountered, can assist discrimination between deceptively similar writings. Furthermore, writings that exhibit considerable variation from one occasion to

another can be assisted in their association with the help of postmarks and return addresses.

The collection with which this author is currently working consists of some 2337 samples from nearly 1000 writers (968, in fact). As the collection and study is ongoing, the numbers are subject to constant change.

The writing samples in this study generally bear the inscription:

Mr. and Mrs. Roy A. Huber,  
56 Westpark Drive,  
Ottawa, Ontario,  
Canada, K1B 3E5

The study of large numbers of writing samples and the discrimination between large numbers of writers requires a method that will reduce the numbers of writing samples in any category, and the number of writers within any category to workable dimensions. Furthermore, if writing is unique to the individual, the method employed should, in theory at least:

- a) Bring all similar and deceptively similar writings together within the same category, and then
- b) Discriminate reliably between the products of different persons,
- c) Exhibit the consistency of any given writer from one occasion to the next over a period of perhaps many years.

All of these expectations for the method should provide substance in the form of empirical data to establish two of the most important premises on which handwriting identification is established, habituation and heterogeneity, and should demonstrate the reliability of each.

### *Cursive Writing Classifications:*

The method that evolved in this study has the following divisions (Figure 1):

- 2 categories of classification for the alliance of the letters “Hu”
- 4 categories of classification for the allographs (styles) of the “H”
- 4 categories of classification for the allographs (styles) of the “W”

- 2 categories of classification for the allographs (styles) of the "b"
- 2 categories of classification for the allographs (styles) of the "r"
- 2 categories of classification for the allographs (styles) of the "t"
- 6 categories for classifications that were uncertain (e.g., letters absent)

This breakdown provides a maximum of 256 categories into which a given sample might be placed. In fact, the 738 cursive writers presently in the collection (see Table 1) occupied only 85 categories. Another 6 categories house material not completely classifiable.

There are also as many as 184 persons using lettering in the addressing of 233 additional envelopes, the classification of which must be

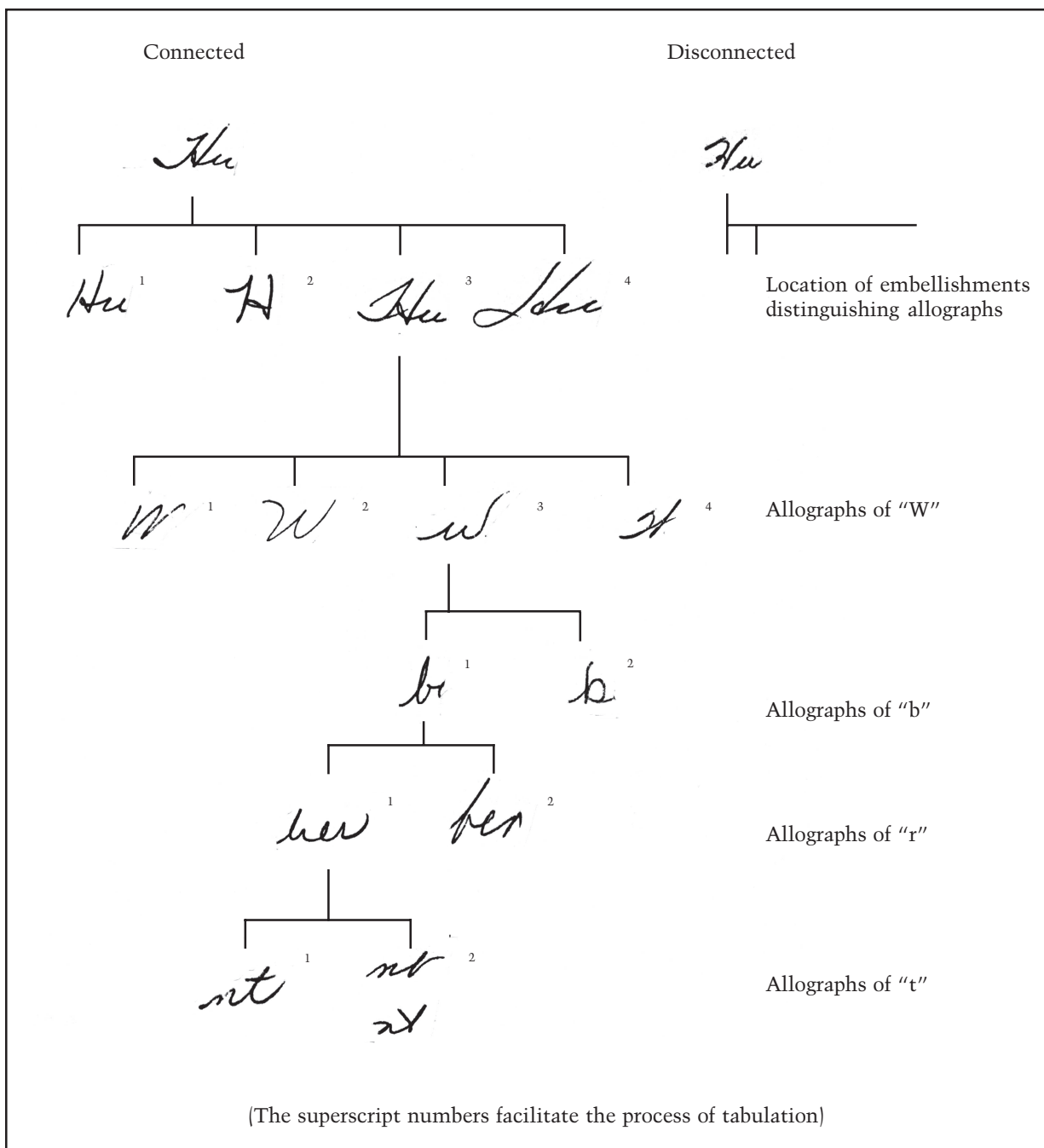


Figure 1. System of Cursive Classification (breakdown similar within each subdivision)

| Connected "Hu"                        |   |   |   |   | Number of Writers |
|---------------------------------------|---|---|---|---|-------------------|
| H                                     | W | b | r | t |                   |
| (Number refers to allograph category) |   |   |   |   |                   |
| 1                                     | 1 | 1 | 1 | 1 | 111               |
| 1                                     | 1 | 1 | 1 | 2 | 40                |
| 1                                     | 1 | 1 | 2 | 1 | 10                |
| 1                                     | 1 | 2 | 1 | 1 | 36                |
| 1                                     | 1 | 1 | 1 | 2 | 4                 |
| 1                                     | 1 | 1 | 2 | 1 | 16                |
| 1                                     | 1 | 1 | 1 | 2 | 6                 |
| 1                                     | 2 | 1 | 1 | 1 | 15                |
| 1                                     | 2 | 1 | 1 | 2 | 1                 |
| 1                                     | 2 | 1 | 2 | 1 | 3                 |
| 1                                     | 3 | 1 | 1 | 1 | 35                |
| 1                                     | 3 | 1 | 1 | 2 | 4                 |
| 1                                     | 3 | 2 | 1 | 1 | 3                 |
| 1                                     | 3 | 2 | 1 | 2 | 1                 |
| 1                                     | 4 | 1 | 1 | 1 | 14                |
| 1                                     | 4 | 1 | 1 | 2 | 4                 |
| 1                                     | 4 | 1 | 2 | 1 | 1                 |
| 2                                     | 1 | 1 | 1 | 1 | 24                |
| 2                                     | 1 | 1 | 1 | 2 | 12                |
| 2                                     | 1 | 1 | 2 | 1 | 3                 |
| 2                                     | 1 | 2 | 1 | 1 | 2                 |
| 2                                     | 2 | 1 | 1 | 1 | 19                |
| 2                                     | 2 | 1 | 1 | 2 | 4                 |
| 2                                     | 3 | 1 | 1 | 1 | 15                |
| 2                                     | 3 | 1 | 1 | 2 | 6                 |
| 2                                     | 3 | 2 | 1 | 1 | 2                 |
| 2                                     | 4 | 1 | 1 | 1 | 22                |
| 2                                     | 4 | 1 | 1 | 2 | 8                 |
| 2                                     | 4 | 1 | 2 | 1 | 3                 |
| 2                                     | 4 | 1 | 2 | 2 | 2                 |
| 2                                     | 4 | 2 | 1 | 1 | 1                 |
| 3                                     | 1 | 1 | 1 | 1 | 29                |
| 3                                     | 1 | 1 | 1 | 2 | 2                 |
| 3                                     | 1 | 1 | 2 | 1 | 2                 |
| 3                                     | 1 | 1 | 2 | 2 | 1                 |
| 3                                     | 1 | 2 | 1 | 1 | 1                 |
| 3                                     | 1 | 2 | 2 | 1 | 2                 |
| 3                                     | 1 | 2 | 2 | 2 | 1                 |
| 3                                     | 2 | 1 | 1 | 1 | 16                |
| 3                                     | 2 | 2 | 1 | 1 | 1                 |
| 3                                     | 3 | 1 | 1 | 1 | 21                |
| 3                                     | 3 | 1 | 1 | 2 | 9                 |
| 3                                     | 3 | 1 | 2 | 1 | 6                 |
| 3                                     | 3 | 2 | 1 | 1 | 5                 |
| 3                                     | 4 | 1 | 1 | 1 | 17                |
| 3                                     | 4 | 1 | 1 | 2 | 7                 |
| 3                                     | 4 | 1 | 2 | 2 | 1                 |
| 3                                     | 4 | 2 | 1 | 1 | 1                 |

| Connected "Hu" (continued)            |   |   |   |   | Number of Writers |
|---------------------------------------|---|---|---|---|-------------------|
| H                                     | W | b | r | t |                   |
| (Number refers to allograph category) |   |   |   |   |                   |
| 4                                     | 1 | 1 | 1 | 1 | 5                 |
| 4                                     | 1 | 1 | 1 | 2 | 2                 |
| 4                                     | 1 | 2 | 1 | 1 | 1                 |
| 4                                     | 1 | 2 | 1 | 2 | 2                 |
| 4                                     | 2 | 1 | 1 | 1 | 1                 |
| 4                                     | 3 | 1 | 1 | 1 | 1                 |
| 4                                     | 3 | 1 | 1 | 2 | 2                 |
| 4                                     | 4 | 1 | 1 | 1 | 1                 |
| 4                                     | 4 | 1 | 1 | 2 | 1                 |
|                                       |   |   |   |   |                   |
| Disconnected "Hu"                     |   |   |   |   | Number of Writers |
| H                                     | W | b | r | t |                   |
| (Number refers to allograph category) |   |   |   |   |                   |
| 1                                     | 1 | 1 | 1 | 1 | 64                |
| 1                                     | 1 | 1 | 1 | 2 | 12                |
| 1                                     | 1 | 1 | 2 | 1 | 3                 |
| 1                                     | 1 | 1 | 2 | 2 | 2                 |
| 1                                     | 1 | 2 | 1 | 1 | 20                |
| 1                                     | 1 | 2 | 1 | 2 | 4                 |
| 1                                     | 1 | 2 | 2 | 1 | 4                 |
| 1                                     | 2 | 1 | 1 | 1 | 7                 |
| 1                                     | 2 | 1 | 1 | 2 | 2                 |
| 1                                     | 2 | 2 | 1 | 1 | 1                 |
| 1                                     | 3 | 1 | 1 | 1 | 7                 |
| 1                                     | 3 | 2 | 1 | 1 | 1                 |
| 1                                     | 3 | 2 | 2 | 1 | 1                 |
| 1                                     | 4 | 1 | 1 | 1 | 4                 |
| 1                                     | 4 | 1 | 1 | 2 | 2                 |
| 2                                     | 1 | 1 | 1 | 1 | 10                |
| 2                                     | 1 | 1 | 1 | 2 | 4                 |
| 2                                     | 1 | 1 | 2 | 1 | 1                 |
| 2                                     | 2 | 1 | 1 | 1 | 4                 |
| 2                                     | 3 | 1 | 1 | 1 | 7                 |
| 2                                     | 3 | 2 | 1 | 1 | 1                 |
| 2                                     | 4 | 1 | 1 | 1 | 1                 |
| 2                                     | 4 | 1 | 1 | 2 | 2                 |
| 2                                     | 4 | 1 | 2 | 1 | 1                 |
| 3                                     | 1 | 1 | 1 | 1 | 2                 |
| 3                                     | 2 | 1 | 1 | 1 | 1                 |
| 3                                     | 3 | 1 | 1 | 1 | 5                 |
| 3                                     | 4 | 1 | 1 | 1 | 1                 |
| 3                                     | 4 | 1 | 1 | 2 | 3                 |
| 3                                     | 4 | 2 | 1 | 1 | 1                 |
| 3                                     | 4 | 2 | 2 | 1 | 1                 |

Table 1. Cursive Writers Per Category

treated differently. The phrase "as many as 184 persons" is used because, for several reasons, the association of letterings with the same author, or with an author cursive writing, proved to be more difficult than first expected. Indeed, the system

of classification had to be modified significantly for letters (see Table 2). At this point, then, we are working with the products of as many as 968 individuals (see Table 3).

| Style of Letter                                     | Size        | Design of "W"    | No. of Writers          |
|-----------------------------------------------------|-------------|------------------|-------------------------|
| <b>Single Samples As Yet Unrelated to Any Other</b> |             |                  |                         |
| Uppercase                                           | Single size | Short center "W" | 31                      |
|                                                     |             | Tall center "W"  | 15                      |
|                                                     | Two sizes   | Short center "W" | 22                      |
|                                                     |             | Tall center "S"  | 12                      |
| Upper & lowercase                                   | Printed "M" | Short center "W" | 15                      |
|                                                     |             | Tall center "W"  | 10                      |
|                                                     | Cursive "M" | Short center "W" | 19                      |
|                                                     |             | Tall center "W"  | 13                      |
| Mixtures of lettering styles                        |             |                  | 20                      |
| TOTAL                                               |             |                  | 157                     |
| <b>Two or More Samples Having Common Authors</b>    |             |                  |                         |
| Uppercase                                           | Single size | Short center "W" | 17 samples/6 writers    |
|                                                     |             | Tall center "W"  | none                    |
|                                                     | Two sizes   | Short center "W" | 11 samples/5 writers    |
|                                                     |             | Tall center "W"  | 2 samples/1 writer      |
| Upper & lowercase                                   | Printed "M" | Short center "W" | 11 samples/3 writers    |
|                                                     |             | Tall center "W"  | 12 samples/2 writers    |
|                                                     | Cursive "M" | Short center "W" | 16 samples/7 writers    |
|                                                     |             | Tall center "W"  | 7 samples/3writers      |
| TOTAL                                               |             |                  | 76 samples/27 writers   |
| TOTAL OF ALL LETTERINGS                             |             |                  | 233 samples/184 writers |

**Table 2.** Letterings: Number of Writers in Each Category

|                                        |            |
|----------------------------------------|------------|
| Classified cursive samples and writers | 2048 / 742 |
| Classified letterings and writers      | 233 / 184  |
| Unclassifiable samples and writers     | 40 / 32    |
| Material not yet classified            | 16 / 10    |
| TOTAL                                  | 2337 / 968 |

**Table 3.** Summary of Data

Of this data, we note that:

- 19 categories contain 10 or more writers
- 66 categories contain 9 or fewer writers

### *Lettering or Handprinting Classification*

None of the classification divisions used for cursive writing proved applicable to the organization of lettered material. A completely different approach had to be taken to deal with the approximately 235 samples received of lettered envelopes, that represent the printings of as many as 184 individuals. Only 76 of these envelopes representing 27 persons were found to be two or more products of the same individual (see Table 2).

All lettered envelopes fell into one of three categories: (1) Uppercase lettering, (2) Uppercase/lowercase lettering, and (3) Mixtures of lettering and writing. In the Uppercase lettering, a further breakdown was made on the strength of size: some writers using a single size, while others used two letter sizes, the larger employed particularly for the first letter in a name.

In the Uppercase/lowercase lettering, material could be separated on the strength of the printed form of "M" and a more cursive design, or the absence of a capital "M" at all.

The final division of all categories of lettered addresses was made on the strength of the height of the centre section of the letter "W" which proved to be either short or full height.

### **Observations**

The sorting and classification of cursive writing samples has resulted in the distribution seen in Table 1.

Groups of 30 writers or less were found to be manageable for writing studies. Five categories contain more than 30 writers and warrant consideration of an additional discriminating element to reduce a group's size to a manageable level. The one category containing 111 writers certainly requires further division. In further divisions, the connection of the "M" and "r" in "Mr" and "Mrs" may serve well. A category of this size, however, does say something about the commonality of the writing elements involved.

The method of classification employed permitted a number of observations to be made respecting the frequency of occurrence of certain writing attributes. Of the 742 cursive writers in the collection:

- a) Some 119 writers (16%) used the clockwise "b" form.
- b) Some 68 writers (10%) used the Palmer style of "r," but few employed it in a medial position.
- c) Some 149 writers (20%) used the angular (Palmer) termination to the "t," executed in a fashion indicative of a particular system, or crossed the staff without lifting the instrument.
- d) Some 31 writers (4.2%) using the clockwise "b" exhibited any correlated use of the Palmer style "r," and 18 writers (2.4%) exhibited an inclination to use the Palmer style "t." Only 7 writers (less than 1%) combined these styles of the 3 letters.
- e) The unembellished style of the "H" (resembling lettering) was disconnected from the following letter "u" more often (30.25%) than other styles of the "H" (18.6%, 11.1%, 13.3%).
- f) The statistics respecting the various divisions of the classification system are reported in Table 4.

### **Discussion**

A principal point of this study is to demonstrate that there is material available on which some statistical or frequency of occurrence comment may be made. The combined endeavors of many examiners may provide valuable data from which broader and more accurate evaluations of significance may be made. As an ongoing practice of many persons, each reporting their results to a central consolidating office, the accumulation of the empirical data needed to support the identification process is an achievable goal in a reasonable time.

Unusual features can and will appear in these collections. For example, in this study only one writer of the 794 executed a "t" with an undulation at the foot, but the individual did so consistently (see Figure 2).

The classification method was not elaborate or complex. Judgements of a writing could be made with a minimum risk of error. Classification is a tool that facilitates the sorting of writers and letterings into groups small enough for many or

|                      | Unembellished<br>"H" |      | Embellished<br>Upper Left |              | Embellished<br>Upper & Lower<br>Left |      | Embellished<br>Lower Left |      | Totals |      |
|----------------------|----------------------|------|---------------------------|--------------|--------------------------------------|------|---------------------------|------|--------|------|
|                      | Qty                  | %    | Qty                       | %            | Qty                                  | %    | Qty                       | %    | Qty    | %    |
| Connected "Hu"       | 324                  | 69.4 | 121                       | 79.6         | 124                                  | 89.8 | 16                        | 100% | 563    | 75.8 |
| Disconnected "Hu"    | 143                  | 30.6 | 31                        | 20.4         | 14                                   | 10.2 | 0                         | 0    | 179    | 24.2 |
|                      |                      |      |                           |              |                                      |      |                           |      |        |      |
| Connected "Hu"       |                      |      |                           |              |                                      |      |                           |      |        |      |
| Style of "H" and "W" | W <sup>1</sup>       |      | W <sup>2</sup>            |              | W <sup>3</sup>                       |      | W <sup>4</sup>            |      | Total  |      |
| H <sup>1</sup>       | 223                  |      | 19                        |              | 43                                   |      | 19                        |      | 301    |      |
| H <sup>2</sup>       | 41                   |      | 23                        |              | 23                                   |      | 34                        |      | 121    |      |
| H <sup>3</sup>       | 38                   |      | 17                        |              | 41                                   |      | 26                        |      | 122    |      |
| H <sup>4</sup>       | 10                   |      | 1                         |              | 3                                    |      | 2                         |      | 16     |      |
|                      |                      |      |                           |              |                                      |      |                           |      |        |      |
| Disconnected "Hu"    |                      |      |                           |              |                                      |      |                           |      |        |      |
| Style of "H" and "W" |                      |      |                           |              |                                      |      |                           |      |        |      |
| H <sup>1</sup>       | 109                  |      | 10                        |              | 9                                    |      | 6                         |      | 134    |      |
| H <sup>2</sup>       | 15                   |      | 4                         |              | 8                                    |      | 4                         |      | 31     |      |
| H <sup>3</sup>       | 2                    |      | 1                         |              | 5                                    |      | 6                         |      | 14     |      |
| H <sup>4</sup>       | 0                    |      | 0                         |              | 0                                    |      | 0                         |      | 0      |      |
| Totals               | 438                  |      | 75                        |              | 132                                  |      | 97                        |      | 742    |      |
|                      |                      |      |                           |              |                                      |      |                           |      |        |      |
|                      | Style of "b"         |      |                           | Style of "r" |                                      |      | Style of "t"              |      |        |      |
| Style 1              | 623                  | 84%  |                           | 674          | 90.8%                                |      | 593                       | 80%  |        |      |
| Style 2              | 119                  | 16%  |                           | 68           | 9.2%                                 |      | 149                       | 20%  |        |      |

**Table 4.** Statistics Respecting Selected Elements and Their Relationships to One Another

all of the discriminating elements or, if you wish, physical attributes of writing and lettering, to be enlisted to properly complete the examination. Some writers, although not many (28 in this study) displayed such variation in one or two of the aspects of writing being classified that they appeared in two or more categories. In some cases, the memory of the investigator brought specimens together. There may still be isolated instances in which all the products of one writer have not been properly associated with each other.

Only 96 cursive writers employed the Palmer "r" but only a dozen of these employed it in a medial position, which suggested that its use was system related. For the most part, if used at all, it was a style adopted when "r" occurred as the terminal letter in "Huber" or in "Dr."

Of the 119 writers employing the clockwise "b" form, in only 31 instances was its use combined with the Palmer terminal "r" and in only 2 cases of medial use did its use seem system related.

An obstacle that lies in studies of this nature

occurred in the terminology to be used for writing practices. A glossary of terms must be developed to adequately describe and identify the patterns that one wishes to classify.

The differentiation between allographs (letter styles) by a numerical superscription proved to be a convenient method for tabulating the assortment of the discriminating elements that the sorting system employed. Admittedly, there were a few gray areas where discrimination between allographs presented problems, but practical solutions evolved from thoughtful contemplation and sample study.

In this collection of some 968 writers and letterers, and based on the nature and quantity of material that the envelopes provide, no instance has been encountered in which two individuals are so deceptively similar in their written products that they could not be distinguished from one another. Indeed, it is obvious that the consideration of other additional writing attributes, e.g., size, lateral expansion, numerals, serve to

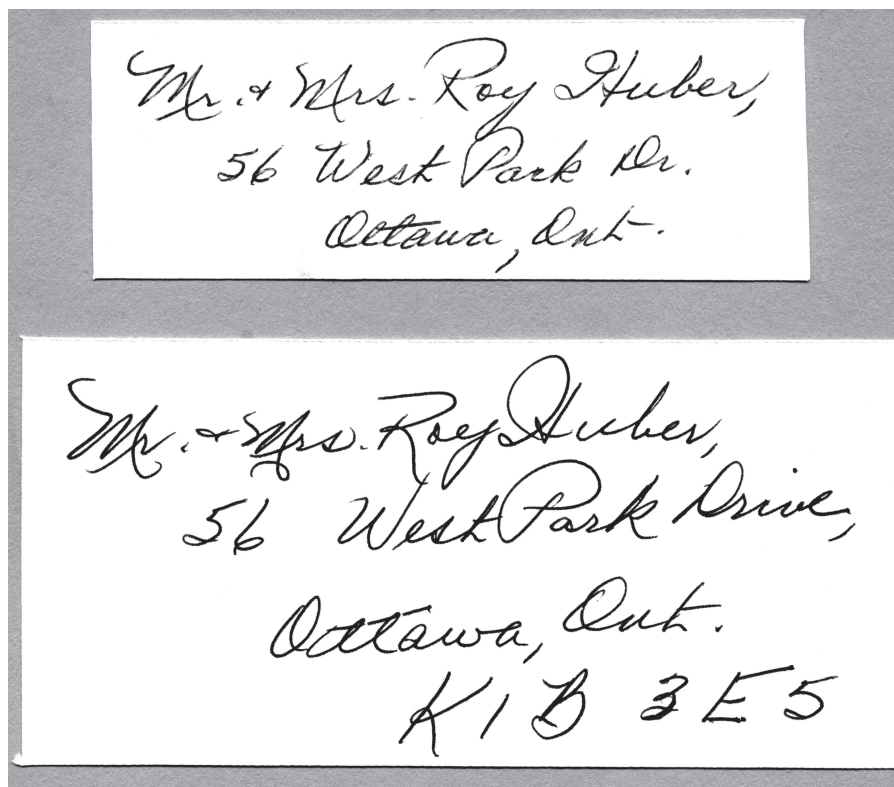


Figure 2.

differentiate between writers even more profoundly. Only samples from two practiced, professional penmen, both taught the same (Mills) system, made the task of discrimination, on the strength of small samples, particularly difficult.

It is obvious, too, that the risk of not properly associating two writings or letterings as having a common author is far greater. This is of particular import insofar as conclusions that might be indicated in matters of writer elimination.

### Conclusions

Based on the writings and letterings of nearly 1000 persons, this study has provided some frequency data respecting a limited number of the discriminating elements of handwriting and lettering. The populations of writers to which other examiners are exposed may provide different statistics but, because of the breadth of the source from which our samples are drawn, we would expect that the differences would not be great.

Furthermore, in addition to the evidence provided respecting heterogeneity, other evidence is exhibited regarding the habituation of cursive writing. Notwithstanding the variation of a few writers in a few particular respects, there is no doubt as to the stability of normal writing, over periods of time, insofar as the distinguishing elements of handwriting that were considered. These are necessities in the course of demonstrating the process of handwriting identification as a scientific pursuit propounded by Huber (1999).

The study of lettering, sometimes called handprinting, needs to be expanded and pursued with a much larger sample than was available in this study. Lettering, as practiced by some people, exhibits much greater variation in gross features and dimensional aspects of the allographs. On the whole, however, lettering tends to correspond, to a greater degree than cursive writing, to the copybook designs.

Furthermore, this study has demonstrated quite profoundly that the risk of error respecting the elimination of writers and letterers requires further thought, at least insofar as the criterion of writing evidence required to support positive conclusions, and in the language in which such conclusions may be expressed.

### References

- Huber, Roy A. (1999). *Handwriting Identification: Facts and Fundamentals*. CRC Press, Boca Raton, 1999, p. 391.