The Practice of Handwriting Identification

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by

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Introduction

THERE ARE TWO KINDS OF INTEREST in the practice of handwriting identification. One is that of the scholar and librarian: literary and historical research, for instance, frequently encounters manuscripts that have no obvious author, or whose authorship is disputed, and sometimes there is a need or wish to settle the matter by a comparison of handwriting characteristics. This branch of scholarship is usually considered to be part of the area of study known as palaeography. The other domain is that of forensic science: around the world there are forensic document laboratories, expensively equipped and staffed by experts, most of whose full-time job consists of analysing documents for evidence of authorship. Their discipline is called forensic document analysis.[1] Palaeographers and document analysts have curiously little in common;[2] the former usually have arts degrees, and are either academics in university humanities departments, or librarians, or archivists, or enthusiastic amateurs of various kinds. Document analysts, in contrast, almost invariably have science degrees, are not much interested in old documents, and have a heavy case-load dealing with contemporary material whose defining characteristic is that it is, in some way, disputed, and subject to actual or potential legal action. The work of palaeographers is open and publishable, and the material they work with is enigmatic only because it was written in the past and information about it is lacking; the work of document analysts is highly confidential, and their material is enigmatic because there is normally some allegation of deliberate deception. Palaeographers and forensic scientists read and write for different journals, attend different conferences, work in different environments, and do not communicate with each other.

[1] In the USA it is more commonly called Questioned Document Examination (QDE).

[2] The main business of palaeography, apparently in whatever period and language, is interpretation, i.e. decipherment and transcription. Much of the training and literature of the subject is devoted to that aim. In contrast decipherment occupies a very small part of the time of a forensic document analyst.

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This paper is an attempt to bring the two together. My own position is unusual: I am an arts academic, working in an English department, specializing *inter alia* in bibliography and textual criticism. I have also worked as a forensic document analyst since 1974, have examined thousands of cases, and given evidence in court many times. Recently I have become involved in three very different palaeographical projects: the Cuneiform Digital Palaeography Project,[3] which takes as its purview the entirety of three thousand years of cuneiform writing on clay tablets; the International Dunhuang Project at the British Library,[4] which studies tenth-century Tibetan paper manuscripts from a miraculously preserved archive on the Great Silk Road; and the Johnson Dictionary Project,[5] which is interested in the manuscripts produced by Samuel Johnson and the professional scribes who were his amanuenses in the compilation and revision of his great *Dictionary of the English Language* of 1755. In each of these projects the scholars concerned came to me with a question: how do we analyse the handwriting in our documents in order to determine authorship?[6]

These questions arose because the scholars in each of those very different disciplines were aware of interesting similarities in the handwriting that they studied. These similarities suggested to them that different documents had the same author. But nowhere in the literature of their subjects was there an agreed and established methodology for testing the hypothesis of common authorship by examining handwriting. In each of these disciplines scholars frequently notice instances of similarity suggesting identity, and frequently conjecture about authorship based on these instances, but there is no coherent published account of how to do it.[7] The researchers in each of the projects assumed that in forensic science, where expert evidence about handwriting identification is offered in courts on a daily basis, such a methodology would be available: could it, they wondered, be applied to their own research?

This is an interesting question. Any attempt to answer it reaches to the heart of the subject, because what it asks is: can one communicate expertise?

[3] See http://www.cdp.bham.ac.uk/. All of the web references in this paper can be found as live links on the index page of the website that was created to accompany it, http://doiop.com/3mhmia.

[4] See http://idp.bl.uk/. The Dunhuang Project studies both Chinese and Tibetan manuscripts; my involvement is with the Tibetan material.

[5] See http://www.english.bham.ac.uk/drc/.

[6] 'Documents' and 'handwriting' are used here in a larger sense, to include cuneiform. Cuneiform is written on clay tablets using a stylus, square in section, a corner of which is pressed into soft clay to produce a wedge-shaped indentation. The combination of wedge shapes creates a cuneiform sign. The individual indentations are to some extent uniform, which suggests printing, but the writing is produced by hand, and is, in fact, idiosyncratic. For that reason it can properly be called handwriting.

[7] After the inception of the Cuneiform Digital Palaeography Project a PhD thesis was produced that makes an excellent initial attempt at the formidably difficult job of identification of scribal hands in cuneiform: see John Lee Ellison, 'A Paleographic Study of the Alphabetic Cuneiform Texts from Ras Shamra/Ugarit' (unpublished doctoral dissertation, Harvard University, 2002). Most cuneiform signs in most of the cuneiform languages represent syllables or words rather than letters of an alphabet, which greatly increases the problem of identification.

Expertise requires both explicit knowledge, from published material, and implicit knowledge, from experience. There is now much published research on forensic handwriting analysis,[8] but one cannot read that material and derive from it a programme, an explicit algorithm that leads in an orderly fashion to an established conclusion. Experts consult their experience; it is as if each expert has a large, and private, database of material that only he or she can consult. It is assumed that the database inside each qualified individual will contain much the same material and produce the same conclusions, as indeed in document analysis seems to be the case: qualified handwriting experts normally agree in their conclusions, and arrive at the same conclusions independently of each other. This is presumably because of the way in which the experience is acquired and monitored: it is usually learned in forensic laboratories by an apprenticeship-based training system, essentially therefore by exemplification; and it is maintained by rigorous in-service vetting and monitoring procedures: each report that issues from a forensic laboratory will normally have been duplicated independently by two practitioners. And of course the contestatory judicial system will normally provide another expert to check and test the findings, which are then subject to cross-examination.

This is, however, not an entirely satisfactory state of affairs, for two reasons. Firstly, because as it stands it makes it very difficult to transfer the expertise from one area of investigation (say, modern writing with a ball-point pen) to another (say, the work of tenth-century Tibetan monastic scribes, who used a wooden pen-like implement and water-based ink). How is the Tibetologist to learn the technique, without the years of mentoring that go to create a document analyst? Secondly, an expertise that is substantially experience-based has only a weak claim to be scientific. Science depends on falsification, and that which is not explicit and publishable cannot be falsified. This is a considerable problem for forensic handwriting analysis, one that has produced recently strong pressure for, and movement towards, change.[9]

[8] The methodology of forensic handwriting identification was codified by Osborn in the United States and Harrison in the UK, and published in their classic texts: Albert Sherman Osborn, *Questioned Documents* (Rochester, NY, 1910) and Wilson R. Harrison, *Suspect Documents: Their Scientific Examination* (London, 1958). A full account of current procedures in North America is given in Roy A. Huber and A. M. Headrick, *Handwriting Identification: Facts and Fundamentals* (Boca Raton, FL, 1999). For the current practice of the discipline in the UK, see David Ellen, *The Scientific Examination of Documents: Methods and Techniques*, Taylor & Francis Forensic Science Series, 2nd edn (London, 1997). The most comprehensive bibliography is the *QDE Index* (http://qdewill.com/qdeindex.htm), compiled by Marcel B. Matley and privately published; it is updated annually. The most recent (2005) edition contains 3,835 entries.

[9] In 1993 the United States Supreme Court handed down a decision in *Daubert v. Merrell Dow Pharmaceuticals* that set a rigorous standard for admissibility of expert evidence. This led to the challenging of a number of expert testimonies as to identification of handwriting. These challenges were largely ineffective in barring the expert's testimony (see, for instance, *United States v. Thornton*, decided by the United States District Court for the District of Kansas on 24 January 2003), but led to welcome reassessment of the nature of handwriting evidence and the necessity for research in the field.

This paper seeks to answer the question: how does one do handwriting identification? The most developed methodology is that of forensic document analysis, which is also where my expertise resides, and that is what will be described here.[10] In handwriting identification there is (in order of communicability) a terminology, a methodological procedure, a body of knowledge and theory about the components of handwriting (the way in which the pen creates the graphic trace, for instance, and the way in which the physiology of the hand executes the writing movement), and finally a set of largely experience-based criteria that are at the centre of the process of identification. Each of these will be presented here as clearly and explicitly as possible; where the information is implicit it will be offered, not as a barrier to further enquiry ('it all depends on experience'), but in the form of suggestions for a research project that will work towards rendering the implicit explicit. This will be followed by a description of the differences between forensic work and palaeography, and a discussion of the implications of those differences; and then a series of suggestions as to how the model may be modified for the analysis of old documents, and what kinds of expert knowledge will be necessary in order to do so. In the final section I shall offer worked examples of the application of the forensic method to documents that would normally have received the attention of palaeographers.

Terminology

To begin with, a note on terminology.[11] When someone looks at handwriting, what they see on the page before them is a series of graphs: that is, in an alphabetic script, the letters as they actually — uniquely — appear on that particular page. Each graph is an individual, necessarily unique, representation of a grapheme, which in our alphabetic writing means a letter, considered abstractly, as a distinguishable member of a signifying set. A reader sees graphs, recognizes graphemes, and is thus able to read. If a given writer produces a graphic form of the grapheme /n/, which resembles his (graphic) version of the grapheme /u/, so that the two cannot be distinguished, a reader may wonder, 'Which letter is that?'. What he or she is actually asking

[10] Handwriting is studied not only by forensic scientists and palaeographers but by a number of other disciplines: graphic linguistics, education, graphology, and calligraphy. Each of these has evolved its own terminology; each has something to contribute to the theory and methodology of identification. What follows derives primarily from the published literature of document analysis and the everyday practice of forensic document examination in the UK, but it is supplemented with information from related disciplines.

[11] The summary that follows is of the terms that apply to the linguistic aspects of written signs, and is intended to serve as an introduction to that theory. There is also an extensive vocabulary of words that refer to parts of letter-forms. See the full glossary in Huber and Headrick, *Handwriting Identification*, pp. 394–412. A similar account of terminology, and of some aspects of the methodological discussion that follows it, appears in Jacob Dalton, Tom Davis, and Sam van Schaik, 'Beyond Anonymity: Palaeographic Analyses of the Dunhuang Manuscripts', to be published in the *Journal of the International Institute of Tibetan Studies*.

is, 'Which grapheme am I seeing here?'. This kind of graphic habit, if it occurs regularly in a particular hand, is idiographic: it is a (usually rather subtle) variation in graphic form (which need not be illegible) that gives evidence of individuality. It is a characteristic of that particular writer. The most valuable idiographic items for the purpose of identification of the writer are those that are not entirely under his or her conscious control; this makes them difficult to forge, and difficult to disguise. Also characteristic of individual writers is allographic variation. Some writers, for instance, use a flourished cursive form of the capital /T/, others a plain block capital form. This difference is common, and normally conscious, and so only weakly idiographic; it is a licensed and recognized variation in the representation of the grapheme, and it is called allographic.

What we have, then, is a hierarchy: graph, idiograph, allograph, grapheme. The grapheme /a/ is the letter considered independently of any particular realization of it. An allograph is an accepted version of that grapheme: 'a' and '*a*' are allographs of /a/. An idiograph is the way (or one of the ways) in which a given writer habitually writes /a/. A graph is a unique instance of /a/, as it appears on a particular page.

Methodology

Forensic handwriting examination concerns itself with questioned documents. The question will usually concern the authorship of a particular document. Was it written by a particular individual, or not? A large proportion of the cases examined include an allegation of deliberate deception: forgery, or disguise. It is rare that deliberate deception can be completely ruled out, and so the whole apparatus of forensic handwriting analysis is constructed with that possibility firmly in mind.

In order to establish the authorship of the questioned writing, sample writing is obtained: writing that indisputably was produced by alleged or possible authors of the questioned document. The sample writing will be of two kinds: writing that was produced for the purpose of the examination (request writing), and writing that can be shown to have been produced without the knowledge that it would be examined by an expert (naturally occurring writing). The function of the latter is to act as a control sample, to test the validity of the request writing. Request samples may be disguised in order to hinder identification of the questioned writing. Why then have request samples at all? Because their content can be controlled. If the questioned writing is an extended text, the analyst can ask for the request writing to contain the same content as the questioned writing. Handwriting analysis depends on letter-by-letter comparison, and if the same letters occur in the same place in each document, such comparisons are much easier.

The emphasis on the trustworthiness of the sample writing is important. The procedure is always to establish firmly what is known, and with what

degree of certainty it is known, before moving on to examine what is not known: the questioned writing. Any identification derives from comparison with the sample; if the sample is in any way unsound, then doubt, possibly fatal doubt, is cast upon the conclusion deriving from the analysis. An opinion of identity is only as good as its evidential basis, and that basis is the sample writing.

Sample writing should be representative and contemporary, exemplifying as far as possible the whole range of natural variation in the hand under examination at the time when the questioned writing was produced. The sample should be produced under the same or similar circumstances as the questioned writing: the same kind of pen should be used, and anything unusual about the writing conditions of the questioned writing should, ideally, be duplicated in the sample. If the questioned writing material was resting on an uneven surface, for instance, or the lighting conditions were poor, then this should as far as possible be duplicated in the sample. The sample writing must be of the same kind as the questioned writing. If the questioned inscriptions are in capitals, or cursive script, or print script,[12] then the sample should be the same; capitals cannot (with a few exceptions) be compared with lower-case writing. It is considered important that the document examiner should see the original documents, both request and sample; there are aspects of forgery, for instance, that can be concealed in photocopy reproduction.

Once the sample writing has been obtained, and its degree of validity established, the next step is to analyse it. At this stage the questioned writing is ignored: all attention is focussed on the sample. The usual procedure is to prepare an analytic chart. For this, blank chart forms are usually used. These consist of pre-printed tables whose cells are labelled, in alphanumerical order, with each of the graphemes that may be found in the sample: each of the lower-case letters, each of the upper-case, punctuation, numerals, and common abbreviations such as the ampersand. The examiner will take a blank set of chart forms and address the sample writing. Each letter in the entire document is examined, one after another. If the first letter is, say, a capital /A/, then a drawing of that graph is entered in the /A/ box. The examiner may add arrows to indicate line direction, and comments and sketches about, for instance, the height of the letter relative to adjacent

[12] In the UK handwriting is taught in two stages. The child is first taught a set of individual letters, known as print script; these are formed into words on the handwritten page without any connection between the letters. In the second stage, known commonly as 'joined-up writing', a second, cursive script is taught, based on one or more of the available models. In the UK, where considerable freedom in how handwriting is formed is culturally acceptable, the script that the adult finally adopts may be a combination of cursive and print script forms. But the result of this educational process means that each adult normally has at his or her disposal two different scripts, one current (in both senses of the word) and the other associated with childhood: print script. People who wish to disguise their handwriting often revert to the childhood form.

letters, letter spacing, and other potentially useful items. And then the next letter is addressed, in the same way, and the next, all the way through the document, one letter at a time. The next time a capital /A/ is found, the examiner will check the /A/ box: is the graph already described essentially the same as, or different from, the next example encountered? If the examiner decides there is a significant difference, then a new drawing is made and entered in the /A/ box; if not, not. And so on throughout the document. If there are twenty capital /A/s in the document, the /A/ box may contain descriptions of one, or up to five or six instances, not usually more; the same is true for all of the other graphemes represented in the document.

The purpose of the preparation of the analytic chart is to produce a completely inclusive description of the hand under analysis, inasmuch as it is represented in the available documents. How does the examiner know what to include and what to exclude? Any actual written occurrence of any letter (that is, any graph) will be different from any other occurrence of the same letter in some respects, and similar in others. Choosing what to include is a matter of knowing which differences are likely to be idiographic. Certain principles are followed: in practice, the differentiations chosen are distinct, but minute. Obviously gross (allographic) variation will be recorded, but such variations, because they are obvious, are easy to disguise and easy for a forger to copy. The important variations are those that are evident to close examination but so small as not to be in the conscious control of the writer, which makes them hard to disguise and hard to copy.

Chief amongst these identifying characteristics is the issue of line quality: the single most important item in any forensic handwriting examination. Producing handwriting requires skill, acquired through practice. Roughly speaking, the greater the skill, the faster the pen can move, and the smoother and more fluent the graphic trace that it will produce. Line quality is an indication of the skill of the writer. It can reveal other things too: hesitations or irregularities in the line quality may be caused by illness, drug consumption, psychological stress, and a variety of other causes. But crucially a forger's pen is likely to be moving more slowly than that of the normal and practised writer of that particular hand, and the difference between the two, as manifested in the line quality, is a vital piece of evidence.

However, this is not a complete description of the criteria for selection that the analyst uses. If the analyst is pressed beyond this, the usual answer will be: experience. Analysts know what to do because they are experienced at doing it. As I have said, this is hardly a satisfactory answer, since it closes off an essential component of the process from discussion and, crucially, falsification. This is a key issue, which requires, and will receive, separate discussion.[13]

[13] See below, p. 258 and pp. 270–76.

The creation of the analytic chart is a laborious business: it is completely different from the glance that enables most of us to recognize the handwriting of a friend. The basis of the difference is that such casual handwriting expertise is not cross-examined, and not much depends on it. No one is required to justify and explain, sometimes in exhaustive detail, the reasons for their identifications, as any forensic expert must. This is what justifies the tedious detail of the analytic chart. At some later point, perhaps a few months, perhaps even a year or more later, the forensic document expert will be required to explain his or her opinion, in whatever detail a cross-examining counsel may require. The completeness of the analytic chart is motivated by professional discipline and the importance of the task at hand (someone might go to prison on the basis of this evidence) but also by simple self-preservation: the expert, in giving evidence, must be ready for anything.

Once the sample handwriting has been analysed, the same process is applied to the questioned handwriting. This is and must be a distinct activity from the analysis of the sample writing: there is a natural tendency to compare, to skip to a conclusion, but established procedure insists that this tendency should be resisted. The questioned writing should be examined as if the sample writing had not been seen, and in the same laborious letter-by-letter fashion. Comparison comes later. An important part of the function of these charts is to ensure a rigorous approach to the business of identification. If one begins with comparison, or strays into it during the process of analysis, it is easy fall into the trap of hypothesizing a theory of authorship early in the procedure, and then (consciously or unconsciously) only looking for evidence that will confirm the hypothesis, ignoring evidence that refutes it. Disciplined application of the analysis-by-chart method ensures that every aspect of each hand is taken into account before the hands are compared, so that when the comparison actually happens inconvenient disparities are not ignored.

Once the charts are complete,[14] and only then, the hands are compared, using the original documents with extensive reference to the charts. The examiner is looking for significant matches, and significant mismatches. What constitutes significance? Some of the criteria are published;[15] some are implicit, and experience-based. As a result of the comparison of hands, an opinion is formed. This will usually be expressed according to a prescribed

[14] The completed set of charts is essentially a private document: the charts form part of a laboratory notebook, and will normally only be seen by the examiner and his colleagues in the laboratory, though on occasion defence counsel will ask to see the notebook of an expert witness called by the prosecution.

[15] A good, though incomplete, list of the aspects of handwriting that are thought to indicate identity is given in Huber and Headrick, *Handwriting Identification*, pp. 90–139. The criteria include, for instance, relative heights of letters and of elements of letters, relation of letters to the baseline, the shapes of letter-forms, the style and positioning of connectors, and so on. Much more helpful in revealing the nature of the identification criteria than a list of terms are illustrated examples of the method in use; this is provided in the final section of the present paper.

formula, the prescription differing from laboratory to laboratory.[16] At either end of the spectrum, the opinion will state identity, or difference, beyond reasonable doubt: the standard required for conviction in criminal cases. In order to express a strong opinion of identity, one would normally expect to find significant matches between all, or very nearly all, of the significant idiographs in the questioned document and the sample writing. Nearer the middle of the scale will come a judgement that expresses similarity or difference 'on balance of probability', the lower standard required in civil disputes. Midway between the two ends of the spectrum will be some version of 'I don't know', which is an opinion quite frequently offered. It is important to stress that document examiners are notoriously cautious. The police find it frustratingly difficult to obtain a definite, or even usable, answer from a document laboratory. However, when such an answer is forthcoming, they are happy to have it: forensic document examination has a good reputation in the UK, and the effectiveness in court of established experts compares favourably with that of any other forensic scientist.

The opinion will be expressed in the form of a report, which carefully lists the documents under examination and analyses their relationships (this can be a very complex matter). But the opinion as to identity will be at this stage the simple, formulaic opinion, without the evidence that supports it. This evidence will only usually be provided when the matter comes to court.

For this purpose a second chart is provided. This consists of a photographic display in which the actual idiographs, enlarged and in context, are shown, with a verbal commentary. The fact that the evidence is only produced in this way means that it is oral, not written, and therefore not published, and it is normally selective, though of course the examiner giving evidence should have the whole range of material at hand, and be able to answer on it. Quite commonly an expert will be provided by the other side to assist the cross-examining barrister in finding the right question to ask.

There is thus a two-stage process involved in the standard practice of forensic document examination: firstly the examination itself, recorded in laboratory notes in the form of an annotated chart, and leading to a simple formulaic conclusion, expressed in a report; and secondly the production in court of the evidence on which that opinion is based, which is in the form of an oral commentary illustrated by photographic reproductions (though the original documents will be available in court for inspection). This may be supplemented by further oral testimony on cross-examination and re-examination.

[16] The practice of the Metropolitan Police Forensic Science Laboratory in London, for instance, is described in D. M. Ellen, 'Expression of Conclusions in Handwriting Examinations', *Canadian Society of Forensic Science Journal*, 12 (1979), 117–20. Ellen was at the time of writing director of the document section of that laboratory.

This final process of explanation and justification is held to justify claims for the scientific nature of the process of document analysis. There is some truth in this: every significant element of the analysis must be explicable, and rendered explicit on demand. It is a severe test. The expert must be able to explain to a jury the entire basis of the opinion expressed, and convince them of its validity; this explanation must survive hostile questioning and the critical analysis of an expert employed by the other side. However, the explication, and its 'publication', is, nonetheless, ad hoc. Here is an example of the kind of statement that is made in textbooks on handwriting identification:

> Individuals differ in their writing insofar as its vertical dimension and/or its horizontal dimension. Copybooks and writing instruction give us general parameters within which the writing should be executed and prescribe certain consistencies that should be observed. Nevertheless, many writers develop their own practises, some of which are quite distinctive and unique. Perhaps a majority of writers, however, will display a degree of similarity in these dimensions.[17]

It is clear that reference is being made not to published research (though the authors are very good at citing and summarizing published research where it exists) but to personal experience. The imprecision is telling: 'many . . . some of which . . . quite distinctive . . . a majority . . . a degree', and, particularly, 'perhaps'. There is no way to access the database from which this information derives in order to test the conclusions that result from it.

Moreover, the display of information is not published in the sense of being generally available to criticism. It is oral, and therefore impermanent; the testing by cross-examination and by one other expert is often very rigorous, but a permanent contribution to knowledge is not being made, and the science acquires no new knowledge as a result.

Theory

This, then, is the practice of forensic handwriting identification. What of the theory and the body of knowledge on which it is based?[18] When handwriting takes place a number of factors come together. The writer has an internalized model hand, acquired by practice, imitation, and, to a small extent, creativity. The text to be written will be realized as a result of a compromise between this internalized model and the exigencies of the pen used, the writing material on which the text is to be written, the writing medium (ink, for instance), the writing surface (a desk, perhaps), on occasion the writing

[17] Huber and Headrick, *Handwriting Identification*, p. 102.

[18] This (summary) theoretical account of the factors of identity in handwriting is based on the literature of document analysis, and also on a number of related fields: the psychology of skilled behaviour, principally. A good introduction to the latter is still David Legge and Paul J. Barber, *Information and Skill* (London, 1976).

environment (which can, for instance, be stressful, or vibrate, as in a train), the architecture of the hand, and the neurophysiological characteristics of the writer. The latter can be affected by a wide variety of external factors: cold hands, for instance, or alcohol, or illness, or old age, or stress — the list is long. And, finally, the writing can be affected by conscious effort on the part of the writer: there may be an intention to disguise, or write beautifully, or practise a different hand, or create a forgery. These diverse components will have a variety of different effects on the graphic trace, but the basis of forensic document analysis resides in the belief that nonetheless a given writer will tend to produce writing that is idiographic: that a given piece of writing can have characteristics that are ascertainable by expert analysis, constant between different writings by the same individual, and unique to that individual.

This is not of course true of every piece of writing. Forgery, or illness, or disability of various kinds will hinder the process of identification, and perhaps make it impossible. There must be enough text to analyse, and there must be appropriate sample writing with which to compare it. But the fundamental belief is that the process of identification is possible. This is a hypothesis; it is widely accepted, and has been tested and found to be true many times. There is scope for more rigorous experimental testing of the hypothesis, and some of this work is in progress;[19] at the moment it is a viable and successful theory, and is likely to remain so.

What kinds of knowledge make it possible for the examiner to identify handwriting? I shall deal with some instances of explicit knowledge first, and then address the issue of implicit knowledge: experience. Each of the components of the act of writing will be described in terms of its implications for identification. Firstly, I shall describe the mechanism of the hand in the act of writing, and how this affects the written trace. The hand will of course be holding a pen when it does this, and the kind of pen will affect how the hand moves, and the appearance of the written line. In forensic work of the last thirty years the large majority of writings examined have been done by a ballpoint pen, so I shall use this in the model described. The physiology of the hand presumably remains constant in any pen-based writing activity, whether in tenth-century Dunhuang or eighteenth-century London, so this part of the description will be of general utility; the particularities of the ball-point pen will, of course, be of no direct interest to palaeographers, but will serve, I suggest, as an instance and model of the kind of knowledge that any examiner of idiosyncrasy in handwriting should ideally have.

Pen-based handwriting is produced by a combination of vertical and lateral (usually, left to right) movements. In skilled cursive writing this

[19] See, for instance, Sargur Srihari and others, 'Individuality of Handwriting', *Journal of Forensic Science*, 47 (2002), 856–72.

combination will produce a wave-like formation. Graphologists will commonly ask their clients to produce a number of instances of the letter /m/, connected, and written fast.[20] The result will usually degenerate into either a series of sharp peaks and rounded troughs, like a set of linked /u/-forms, or a zigzag effect, like a set of /v/-forms, or a debased series of /m/-forms, like archways. These are called, respectively, garlands, saw-tooths, and arcades. Complex computer studies have shown that a skilled writer, instead of producing a series of letters, one after another, is operating a mental model whereby one of these three basic wave forms is being produced, with modifications.[21] The kind of fundamental wave form that a given writer uses is a basic element of identification.

The vertical movements in this wave form are produced by the flexion and extension of the fingers.[22] The lateral movements are produced by flexion of the hand, pivoting at the wrist; commonly, the heel of the palm rests on the writing surface, and horizontal left-to-right movement is done by turning the hand around this stable fulcrum. When the flexion of the wrist that this causes becomes too great, the hand shifts to the right relative to the writing material, providing another fulcrum, and the same process is repeated. At the same time pressure on the point of the pen is maintained: this is caused largely by pronation of the hand, acting in delicate concert with the other muscular movements to produce the complex, skilful dance of the hand that leaves the written trace.

It is a peculiarity of the handwriting movement that the writing hand prefers to pull rather than push. The fingers are stronger when they flex, weaker when they extend, and the left-to-right movement of the hand also feels stronger (to the right-handed majority) than a corresponding right-to-left movement. As a result the pen is essentially pulled across the page. It is likewise a peculiarity of all pens, even the most tolerant, that they are easier to pull than to push. The combination of these peculiarities has consequences for handwriting identification, as I shall show.

As the hand moves, it has to be monitored. We tend to think that this monitoring is done by visual feedback, but for the most part this is not the case: visual feedback informs us about how near the pen is to the edge of the paper, and whether the line of writing is reasonably straight, but the detail

[20] Graphology attempts to determine the character of the writer from an examination of handwriting. Forensic document analysis, as classically defined by Osborn and by Harrison (n. 8 above), does not accept the validity of this procedure.

[21] See, for instance, Hans-Leo H. M. Teulings and Arnold J. W. M. Thomassen, 'Computer-Aided Analysis of Handwriting Movements', *Visible Language*, 13 (1979), 218–31, and A. M. Wing and I. Nimmo-Smith, 'Variability of Cursive Handwriting Measure Defined along a Continuum: Letter Specificity', *Journal of the Forensic Science Society*, 27 (1987), 297–306.

[22] What is described here is a standard pen-hold and the most common handwriting movement in the production of cursive English handwriting. There are, of course, a variety of non-standard pen-holds and movements.

of the written trace is produced too quickly for the eye to monitor it effectively. It is surprisingly easy to write with the eyes shut, for this reason. What is doing the feedback is a form of proprioception, the extremely fast and efficient information system that tells the brain where any part of the body is in space at any time. It is this internal awareness, for instance, that tells the writer when to stop an upstroke and retrace for a downstroke in order to execute, say, the first part of a cursive /u/.

This model of normal skilled handwriting is important because it enables an understanding of how deviance in handwriting occurs, and what it looks like. Deviance is of two kinds: intentional, and inadvertent. One of the main reasons for inadvertent deviancy is that although the proprioceptive feedback system is robust (it keeps us alive, after all), for delicate movement a variety of factors can slow it down enough to make a visible difference in the writing trace. The handwriting of someone who is drunk, for instance, may increase in size, because the feedback is not operating at the usual speed; or, sometimes, it will decrease, because of over-compensation.[23] Another example: both forgery and old age cause deterioration in line quality. Both these deteriorations are caused by slowing down of the writing movement, but for different reasons. Forgery characteristically exhibits hesitations in odd places, for instance in the connecting lines between letters, where the writer (who is, in fact, not writing but drawing) needs to look at the copied model to see what to do next. Moreover because the forger is drawing, rather than following an internalized model, he or she will use slow visual feedback rather than fast proprioceptive feedback in order to monitor the written line, resulting in poor, unskilled, line quality. If the forger attempts to learn the graphic shapes so that they can be done quickly, with a view to improving the line quality, then there will be a tendency for accuracy in copying the target letter formation to decrease, and even for the learned model of the forger's own natural handwriting to manifest itself, particularly in the minute details on which the analyst will focus. In the handwriting of the elderly, in contrast, one finds in the line quality involuntary but regular tremor and decrease of pen pressure, each of which is quite different from the over-controlled line quality of the forger; and the learned patterns of letter formation will for the most part be preserved, though there may be an increase in size of the letters because of slowing down of proprioceptive monitoring. This distinction, between the kinds of deviation found in forgery and in the handwriting of the elderly, is important, because signatures on wills are often made by old people, and are often forged.[24]

[23] See, for instance, M. D. Stinson, 'A Validation Study of the Influence of Alcohol on Handwriting', *Journal of Forensic Sciences*, 42 (1997), 411–16.

[24] See Tom Davis and others, 'The Handwriting of Old People' (1985), a research project funded and privately published by the Home Office.

Handwriting movements are made in order to effect an inked trace with a pen. The point of contact of pen to paper in a ballpoint pen is, naturally, a ball, which is mounted in a socket that enables it to rotate freely in any direction. As it rotates, it picks up ink that is stored behind it in a plastic tube, and transfers the ink to the writing surface, creating an inked line. The ink is viscous and quick-drying; it is prevented from drying out in the storage tube because the ball creates an airtight seal.

This mechanism has many advantages: the pen is versatile, convenient, carries its own long-lasting ink supply, and writes smoothly under most conditions. However, it has two very minor limitations that have important forensic implications. The first is this. A dip pen, using water-based ink and a cut steel nib, very much prefers to write in one direction, that is, downwards towards the writing hand, rather than upwards, away from the writer: in the latter case, the pen will dig into the paper. This has significant effects on the way the pen is used to form letters. Even more restricted is an implement similar to a nail, when used to scratch letters on an ancient Greek potsherd, or a modern car. It is almost impossible to push the implement: it has to be pulled, making upward strokes very hard to achieve.

The ballpoint has no such problem, since the ball will rotate easily in any direction. But unlike with a nib pen, a definite amount of pressure is required in using a ballpoint in order to affect the transfer of ink. In addition to this, the pen is almost invariably held at an angle to the paper, with the result that even with this tolerant writing implement it is slightly more difficult to push than to pull the pen across the paper. This serves to reinforce the physiological preference for pulling rather than pushing already mentioned. An important consequence of this for identification of hands is that whereas right-handed writers normally produce horizontal lines (for instance, t-crossings, or the horizontal line in a Roman capital /A/) by pulling the pen from left to right, left-handers are very likely to produce the same line by pulling the pen from right to left. Left handers, for the same reason, are more likely to produce clockwise /o/ formations, whereas right handers tend strongly to produce anti-clockwise /o/s.[25]

In order to perceive this evidence of handedness in the graphic trace, however, one must first determine pen direction, and for this another small drawback of the ballpoint pen is used. The socket in which the pen rotates is rarely perfectly machined; there will usually be raised burrs in the circular housing. These scrape off a line of ink from the ball as it passes them, creating a white mark on the ball which is passed on to the pen line. These burr striation marks, as they are called, behave differently depending on which direction the pen is travelling, as long as the pen is making a curved

[25] J. E. Franks, T. R. Davis, and others, 'Variability of Stroke Direction between Left- and Right-Handed Writers', *Journal of the Forensic Science Society*, 25 (1985), 353–70.

line. They run diagonally from bottom left to top right of a line if the pen is moving from left to right, and from bottom right to top left if it is moving in the opposite direction.[26] Since most pens show this defect, and since most horizontal lines (for instance, t-crossings) are not straight but slightly curved, it becomes possible to identify pen direction, and therefore handedness, which can have considerable forensic significance.

Burr striations are, of course, of very little interest to the Tibetologist or the cuneiformist. But this is the kind of knowledge that lies behind and motivates the first question that someone trained in document analysis will ask a scholar in either of those disciplines: what kind of writing implement was used to produce this inscription? How did it work? What do we know about it? And, indispensably, where can I get my hands on one? What this shows is the kind of detail and specificity of information about the writing implement that is considered essential for the process of forensic handwriting analysis, and, in addition, the way in which the components of the handwriting mechanism are highly interdependent, and may have unexpected implications for identification.

All of this information belongs to what I have called explicit knowledge: it resides in, and can be learned from, published sources. I now come to the heart of the matter: the implicit, experience-based knowledge of the expert.

When a writer writes, what he or she does is reproduce learned patterns of behaviour. When analysts look at handwriting, what they are looking for is the abnormal, the idiosyncratic; the elements of the hand that successfully reproduce the model handwriting that the writer, along with many others, learned to copy, will be largely ignored. To distinguish between the two requires a knowledge of what that learned pattern may be, so that a sense of what is rare and what is commonplace is necessary in order to proceed with the business of identification. This is information that the analyst will have internalized, from examining a great deal of handwriting on a daily basis, but also from his or her own education in and lifetime practice of handwriting. In addition, the analyst will know a great deal about other aspects of handwriting: what forgery is like, what disguise is like, what kinds of aspects of a given hand are likely to be of use for identification purposes, and so on. This constitutes the internalized knowledge, the 'experience' of the document analyst.

The information consists, presumably, of an extensive set of recollected graphic shapes. It is impossible for words adequately to describe the detail of handwriting that experts find significant; it is therefore hard to preserve and communicate this information in written form. This is why the information is presented to juries in pictorial form with a commentary. And this is

[26] K.W. Snape, 'Determination of the Direction of Ball-Point Pen Motion from the Orientation of Burr Striations in Curved Pen Strokes', *Journal of Forensic Sciences*, 25 (1980), 386–89.

why paper publication has been inadequate both for forensic document analysis and for palaeography. Chemical photography is expensive, and the results are extremely expensive to print and circulate. Moreover, to some extent the knowledge that a forensic scientist has is secret knowledge. What is of use to other document examiners may also be of use to forgers. And the object of examination is normally, as I have said, confidential: experience is based on cases, and publication of casework material is very difficult, or impossible.

It is now recognized that there is a need for publication of the information on which handwriting examination depends, and a number of interesting research papers are appearing, as I have mentioned above. This is important, and goes some way to render explicit, and testable, the bases for the common assumptions of handwriting identification. However, these papers are printed, and though they are frequently illustrated the illustrations are never sufficient for a complete survey of the issue at hand.

Relatively recently, of course, this difficulty has disappeared. The World Wide Web is perfectly adapted for the creation and publication of graphic databases: precisely the kind of database that we envisage in our model of the mental process of the experienced examiner. What he or she knows is based on having seen a great deal of handwriting: it is now possible to model that experience and make it available for all to see, simply by photographing and publishing images of a great deal of handwriting, as they are used for analysis of the evidence for identity, with accompanying commentary. The revolution in publication, particularly graphic publication, represented by the Web is still in process, and issues of copyright and validation of knowledge are still being formulated. But this is clearly the way forward, in this as in many other areas of inquiry.[27]

Here, strangely, document analysis is at a disadvantage compared with palaeography. There are no databases of information about forensic aspects of handwriting available on the internet, as yet; and the habit of confidentiality makes such projects very difficult to envisage. The documents analysed by forensic scientists are confidential, and so is the analysis. Research projects in document analysis are commonly funded by the Home Office and circulated privately between document laboratories. Those who undertake such projects are required to sign the Official Secrets Act. Research results are published in forensic science journals, but these are not particularly easy

[27] The uses of the computer that I shall describe in this paper are relatively modest. Ambitious proposals for using computer power to identify scribal hands of the medieval period are in progress. See Arianna Ciula, 'Digital Palaeography: Using the Digital Representation of Medieval Script to Support Palaeographic Analysis', *Digital Medievalist*, 1.1 (Spring 2005) (http://www.digitalmedievalist.org), and the work of Linne Mooney (http://www.medievalscribes.com/). Whether the methods proposed will produce results that can be used by palaeographers is still unknown. These methods are unlikely to replace, though they may supplement, the work of the document analyst, because, however powerful computers will (surely) become, it will probably not be possible to cross-examine them.

to access, and subject to the limitations of print. The Web is open and available to all: for publication of results in forensic science this is a serious problem, because it makes it easy for forgers, as well as document analysts, to learn their trade.

In palaeography, by contrast, nothing is secret, and there is considerable pressure to publish. Moreover the new medium is extremely cheap. It is no longer necessary to envisage a large equipment budget, or a large publication budget: powerful digital cameras, powerful microcomputers, and fast broadband internet connections are now common consumer items, and are more than capable of handling remarkable image databases. And the motivation for palaeographers in the production of such material is strong. Forensic scientists already know, in an internalized database, the material they need to do their work, and are very used to accessing this database for explaining and objectifying their analyses, on a daily basis. Palaeographers do not have the benefit of this daily practice (identification is quite a rare activity for a palaeographer), and would benefit greatly, I would suggest, from the objectifications that building a graphic database designed to assist in identification of hands would instil. I shall make some suggestions for the kinds of database that this might be in the final section of this paper.[28]

The Difference between Palaeographic and Forensic Handwriting Identification

The first difference is this. In most palaeographic work the possibility of forgery can be discounted. Forgery of old documents of course takes place, and requires identification, but most of the writings that scholars read have good provenance and (usually) limited commercial value; forgery is simply not an issue. This requires a rather radical adjustment of the forensic mindset. In palaeographic work examiners are really only looking for idiographic evidence at the level that distinguishes two different naturally occurring handwriting samples. They will therefore include in their evidence allographic features: obvious alternative ways of writing individual letters, ways that are under the conscious control of the writer and are deliberately produced for aesthetic or other display reasons. Were there a possibility of forgery or disguise, then the analysis would concentrate much more on those

[28] This is not to imply that the palaeography of English documents has not already begun to be published on the Web. In the early modern and particularly in the medieval areas of study a great deal of work has been done, and much more is on the way. But (at least in the post-medieval period, which is as far back as my knowledge extends) most of this is designed towards display of documents, making accessible to all what was previously secluded in manuscript libraries, and towards training in their interpretation (see, for instance, the excellent Ceres project (http://www.english.cam.ac.uk/ceres/ehoc/lessons.html), which provides a comprehensive online course in transcription). There is not much to be found on the identification of hands, which is the theme of this paper. One exception is the Warwick-based LIMA website (http://www2.warwick.ac.uk/fac/arts/ren/publications/lima/intro/), which has a substantial introduction to handwriting identification, referring to and largely based upon my own published material.

features that are not consciously produced: subtle aspects of letter formation or line quality. This is a considerable advantage to palaeography, because it means that some of the concentration on the fine detail of handwriting characteristic of forensic work, which makes essential the examination of original documents, is less necessary.

Secondly, in palaeographic work there is normally no questioned document: no dispute. In both disciplines the problem of identification is caused by the fact that we know too little about the past, but in palaeographic identification this is because not enough information is available; in forensic work a great deal of information is available, but some of it will consist of deliberate untruths. Palaeographers seek, tentatively, carefully, to add to a structure of conjectural knowledge about the past, sometimes the distant past, about which, very often, too little is known to be very definite about anything at all. Forensic experts seek to find out, definitely, and in criminal cases beyond reasonable doubt, whose version of the (very recent) past is true.

The fundamental basis of the examination is different. Science and the law both absolutely insist on clarity and simplicity. What police officers and solicitors do, with remarkable skill, is to take a complex issue expressed in a number of witness statements, which often conflict, and reduce it to a simple and unambiguous question: typically, a question with a yes/no answer. Were the questioned and sample writing produced by the same person, or not? The questioned writing is unknown, the sample writing is known. The latter is the basis for examining the former. If this simplicity is not available, neither science nor the law will countenance it. Forensic scientists do not speculate, guess, or offer conjectures.

In non-forensic work the difference is striking. The writers, though truthful, are usually dead, and can have been dead for up to five thousand years. They are thus not available for questioning and clarification. This means that it is very common in palaeographic work for the essential basis of comparison, the known sample writing, to be of doubtful status. The Sneyd-Gimbel manuscript of Samuel Johnson's *Dictionary* could contain up to eight different handwritings, for only three of which are there good samples to use for comparison. One of those samples is only a signature; it is usual for signature writing to differ significantly from text writing. Shakespeare's handwriting may or may not appear in the manuscript of *Sir Thomas More*, but all we have to compare it with is half a dozen Shakespeare signatures (and, perhaps, the words 'by me') on legal documents.[29] In cuneiform there are some (very few) tablets that appear to have been 'signed' by scribes, but

[29] There is a rare example of the application of forensic handwriting analysis to palaeographic problems in the debate about Shakespeare's handwriting: see R. A. Huber, 'On Looking over Shakespeare's "Secretarie"', in *Stratford Papers on Shakespeare: Delivered at the 1960 Shakespeare Seminar*, ed. by B. A. W. Jackson (Toronto, 1961), pp. 52–70. Huber is a Canadian document analyst.

that may only mean that the scribe who produced the tablet was a member of the school or scriptorium of the scribe whose name is on the tablet. Ashurbanipal, the Emperor of Assyria (685–627 BCE), was famously literate, but do the tablets that bear his name also bear his writing, or have they simply received his *imprimatur*? We can only conjecture.

This kind of uncertainty feels very vertiginous to a forensic specialist. But to any student of the past it is normal. Scholarship about the past is not scientific: one cannot rerun the past in laboratory conditions in order to test predictions about it. History has few certainties: it is a structure of probabilities and possibilities and conjectures that would not meet the exacting standards required by a court of law or a forensic science laboratory, but does not have to. The standard of proof for palaeography must of course be as high as one can make it, but one must also accept that it very often cannot be anywhere near as high as one would like.

Another striking difference between palaeography and forensic handwriting examination is that although the latter activity is highly confidential, access to original documents is made easy for the consulted expert. In palaeography the opposite is true: the material under examination is usually freely available for public, or at very least scholarly, examination, but access is another matter. One of the manuscripts relating to the making of Dr Johnson's *Dictionary* is in the British Library in London, and another is in Yale University Library. Further relevant material is now in the Bodleian Library, Oxford. To assemble those three sets of documents in one room for close comparison, which would be a minimum and insisted-upon requirement for forensic document examination, is virtually impossible.

Here the solution resides in the difference mentioned at the beginning of this section: in palaeography deliberate forgery or disguise is normally not an issue. It is extremely unlikely that any of the scribes of Johnson's *Dictionary* forged the hand of any of the others. This being so, the need to examine original documents is very considerably reduced. Good photography is now easy and cheap; even photocopies show enough detail of the hand under examination to allow inspection of what needs to be seen. Again, this is not ideal, but it is certainly possible.

The next difference is financial. There is a great deal more money available in forensic examination than there is in palaeography. The state pays for extremely expensive forensic laboratories and the time of highly qualified experts; the crushing urgency of a criminal trial, or the massive sums of money that can depend on a signature in civil disputes, mean that high-quality expert evidence will be required, and paid for. In the study of the past there is simply much less money: research grants are hard to come by, and costs have to be counted with care and parsimony.

It may be that in particular cases the laborious and intensive letter-by-letter work of the forensic document analyst is simply not appropriate; the

time spent cannot be justified by the degree of importance of the task at hand. It may be, and quite likely will be, that the degree of uncertainty in the documentary evidence may be such that this level of detail in analysis is not appropriate, and a probabilistic statement will (or must) suffice. One cannot prescribe a general answer to this problem; it is for the individual researcher or research team to weigh, measure, and decide.

The final difference, the most important one for the purpose of this paper, is a paradox. Forensic scientists must be able to explain the basis for any identification that they make. Everything must be based on producible evidence, and every opinion must be subject to scrutiny, explanation, and testing. This is fundamental: the law will not allow it to be any other way. However, because their material is confidential, as I have said, they cannot publish it; it is only presented in court. Palaeographers in general are under no such compulsion to explain and show the bases for their identifications. Peter Beal, for instance, in his marvellous *In Praise of Scribes*,[30] makes numerous ascriptions of documents to scribes on the basis of the hand, but never explains why: 'Without indulging in a blow-by-blow comparison of the various letter-forms shared by this script and Feathery's 'mature' script [Feathery is a scribe] — though there *is* an accumulation of similarities, including Feathery's peculiar punctuation habits — I shall summarize by saying that this script represents a more constrained, more tightly regulated, and relatively subdued version of his hand' (pp. 66–67). I shall return to this in the next section.

The Practice of Palaeographic Identification

Forensic document analysts, as I have said, publish their conclusions in court. They there explain in detail how they have arrived at these conclusions, using enlarged photographs of the letter-forms they refer to. Every assertion is illustrated: at every point, the analyst says, effectively, 'Look at this'. Palaeographers publish their findings in journals, which because of the limitations of print allow no such detailed illustration. This results in a startling difference between the two disciplines, as I shall now show.

I shall begin with an examination of what I take to be an example of normal practice: Jeanne Shami's careful and scholarly presentation of a newly discovered manuscript copy of Donne's 1622 sermon on the Gunpowder Plot, which, she believes, contains some additions in the handwriting of Donne himself.[31] The paper cites and defers to three authorities: P. J. Croft's *Autograph Poetry in the English Language* (London, 1973), Anthony Petti's

[30] Peter Beal, *In Praise of Scribes: Manuscripts and their Makers in Seventeenth-Century England* (Oxford, 1998).

[31] Jeanne Shami, 'Donne's 1622 Sermon on the Gunpowder Plot: His Original Presentation Manuscript Discovered', *English Manuscript Studies 1100–1700*, 5 (1995), 63–86. The manuscript is British Library, MS Royal 17.B.xx.

English Literary Hands from Chaucer to Dryden (London, 1977), and Nicolas Barker's '"Goodfriday 1613": By Whose Hand?', which was published as a lead article in the *Times Literary Supplement* of 20 November 1974 (pp. 996–97). Croft and Petti are standard texts: they offer collections of photographs of documents believed to be in the handwriting of English authors (including Donne), with a detailed commentary on each. Barker's essay is an extensive, magisterial, and very detailed analysis of a manuscript version of the Donne poem, in order to demonstrate that it is not, as had previously been claimed, a holograph. Shami defers, very appropriately, to these three authors as 'experts' (p. 70), and it is clear that she derives her methodology of identification from them.

In a forensic handwriting report the first item will always be a list of documents: first the sample writing, then the questioned writing. On the clear identification of these all else depends. The report will address the question: is the questioned writing significantly the same as the sample writing, or significantly different? In Shami's paper the questioned writing (the sermon manuscript) is carefully described, but there is *no list of sample writing*. Instead, during her two-page discussion of identification, what is referred to is 'Donne's characteristic scribal habits', 'Donne's style', and 'Donne's hand' (p. 68). In a forensic context this would be unacceptable. Forensic identification is based on assertions of significant similarity between actual documents that are produced for inspection. If sufficient of these details can be found, then a statement of authorship can be attempted. Shami's normal procedure in this paper is to take a verbal description of an aspect of handwriting, which derives from one of the authorities, and find an instance of a letter-form in the manuscript under examination that is felt to meet the description. 'Both Petti and Croft note Donne's use of the long shaft on *p* and there are several examples in the manuscript. [...] Croft notes that Donne's capitals are often like enlarged minuscules, *see* for instance, M, N. An example of this can be noted on fol. 19, line 2' (p. 70). A forensic examination would say, rather, that a *particular* long-stemmed /p/ or enlarged minuscule /N/ in the sample writing is matched by *particular* instances of letters in the questioned writing. And the similarity would not only be in the long stem or the enlarged minuscule form, but in the precise shape and detail of the graph.

In forensic work generalizations about the characteristics of a hand are avoided. Reference is always made to what is available, what can be seen, what can be demonstrated. Generalization is dangerous, because it can be easy to refute, which, in the heightened drama of cross-examination, can be fatal to a witness's testimony, if that witness claims to be scientific. Barker generalizes too: he does not specify sample writing, but instead cites and adds to Croft's 'acute analysis of Donne's hand' (p. 996), giving seven listed items that derive from Croft (p. 26), and adding a further eleven of his own.

Croft is principally here referring to the manuscript he reproduces, and so can be said to have an available sample document, though the seven details of the hand that he gives are said to be 'characteristic', presumably of the hand of Donne in general. Barker simply generalizes, without reference to any specific document:[32] 'The stem of the *h* ends above the line, and the bowl is formed with a clockwise stroke, sometimes linked to the next letter with another small clockwise loop' (p. 996). No forensic scientist would risk a statement like that. Handwriting is too variable. It would be surprising if, somewhere in the extant Donne manuscripts, there were not an /h/ that failed to follow that description, which could be used in cross-examination to refute the generalization. Indeed Petti in his sample, a prose letter,[33] finds just such exceptions: 'The most characteristic Donne letter forms have been well tabulated by Croft and Barker [. . .] who itemise eighteen main points, though not all of them hold perfectly true here: e.g. *N* is not regularly a large minuscule (l. 7) [. . .] nor is *R* here [. . .] really as Barker describes it' (p. 97).

This may seem like a relatively trivial point, but it demonstrates a deep difference between the two approaches to identification. Forensic document examiners do not use words very much. They are too unreliable. A laboratory notebook record of an examination will consist almost entirely of sketches, with arrows to indicate significant elements of the letter-form sketched, numbers to indicate where the original letter-form is to be found in the document, and occasionally a word or two to clarify. Symbols will be used to indicate matches or mismatches. The laboratory notebook account is not a substitute for examination of the letter-forms as they appear in the document, but a set of pointers to demonstrate the results of that examination, referenced to actual occurrences on paper; and all of the documents are available for examination, collected together in the laboratory. When the analysis is published in court, verbal descriptions are not primary, but again only pointers referring to what is there in the photographs, and, if necessary, in the documents themselves, for all to see.

In Shami's and (particularly) Barker's analyses, in contrast, the words seem to be primary. Barker provides remarkably elegant and eloquent descriptions of letter-forms, without saying which actual graphs provide the basis for his description. For instance: '*f* has a looped top, the stem beginning where the firm cross-stroke follows, the lower end decisively curved up. The stem itself is sometimes wrenched back so that it is vertical or even leaning backwards. Sometimes, when writing rapidly, the letter is made with a single

[32] A photograph of the first page of a poem believed to be in Donne's hand is included in Barker's article (the verse letter to Lady Carey, Bodleian Library, MS Eng. poet. d.197, which is the Donne sample reproduced in Croft, *Autograph Poetry*), but this is not cited in the article as the source of the letter-form descriptions.

[33] A letter to Sir Robert Cotton, 1602: British Library, MS Cotton Cleopatra F.vii, fol. 293, lower portion. Reproduced in Croft on p. 96.

stroke, the lower end continuing with a double curve to form the cross stroke' (p. 996). The contrast with the flat subjectless discourse of forensic science is refreshing; but, however eloquent, a verbal description cannot possibly provide the degree of detail necessary for forensic identification. Without looking at the letter-form it refers to, it is simply impossible to imagine what that /f/ actually looks like from the description. And since Barker does not cite examples, one has to hunt through a reduced size newsprint reproduction of a Donne holograph looking for instances of /f/ to see what he means.

Shami occasionally cites Petti, who (mercifully) gives line numbers, so that one can, once the books have been assembled, attempt to make comparisons to see what it is that Shami is talking about. But here one runs into another problem, or rather a very disabling result of the same root problem: the limitations of print for expressing detailed analysis of graphic forms. The illustrations in Shami's article consist of only two pages from the sermon manuscript, one of which has just seven words in the questioned handwriting, the other 'with various corrections and insertions in Donne's hand, notably thirteen words inserted in the first two lines' (p. 71). The reproductions are not line-numbered, making the search for the letter-forms difficult (though Shami does give line references); but in any case most of the letter-forms she cites are on pages not reproduced here, making such a search impossible without a visit to the British Library. And, finally, the pages are reproduced at about seventy-five per cent of their actual size, in order to fit the whole page on to the printed page: the letters are tiny. Document examiners usually work at a magnification of 2x or 3x, and the illustrations presented to juries are usually enlarged.

I have no doubt that careful work lies behind these analyses, and certainly do not wish to dispute the findings presented in them, though I (or a jury) would require much more evidence of the kind I have described before the findings could be fully accepted. What I wish to point out is that the limitations of print, and a habit of mind — the reliance on verbal descriptions rather than pointing at the graphic trace itself — that arises from those limitations, are limiting factors in palaeographic practice. The Web has no such limitations; and, since the analysis of old documents is not restricted by the forensic limitation, that of confidentiality, it is possible to present examples of the actual practice of forensic handwriting identification applied to palaeographic material, as I shall now attempt to do.

Examples of the Forensic Method Applied to Palaeographic Problems

The first example consists of two samples of nineteenth-century handwriting that were recently sent to me for comparison. The questioned writing (Q) is the infamous 'Letter from hell' manuscript, apparently written by the individual who became known as Jack the Ripper. The sample writing

(S) consists of two short inscriptions that were found written in chalk on a wall in the apartment of William Bury.[34] My instructions were to compare the two and determine whether the same writer wrote both. In order to analyse these documents and display the results, standard presentation software was used. This has several advantages that make it ideal for the purpose. The user creates a series of display screens, known as slides. Images can be copied and pasted on to each slide, and moved about and organized at will; text can be added equally simply. If a series of slides is created, one for each letter of the alphabet (upper and lower case) found in the shorter of the two documents, and each slide is given this letter as a heading, then the software creates an index running down the left-hand side of the screen that makes it easy to navigate round what is in effect a flat-file database of images and text. The sample writing was already an electronic image, since it had been sent to me by e-mail; it was opened in an image editor, and each word in it was copied individually and pasted into the display according to the letters it contained, so that, for instance, the word 'back' appears on four different slides, once for each of the four letters in the word. After this was done for the sample document, Q received the same treatment. As a result of this process all of the significant versions of each letter-form in the two documents are juxtaposed, letter by letter, and can be analysed. A short commentary can be added to each slide, with red numerals placed against instances of the letters in order to direct the attention of the reader to them. All of the significant forms of all of the letters are easily visible to test the assertions in the commentary, and the commentary is not a substitute for examining the letters themselves but an indication of what to look for when one does. Once the analysis has been done for each letter, a conclusion can be expressed, and displayed on a separate slide. The whole set can then be shown to whoever is interested, either as a presentation in a talk, or, with a simple transformation, as a set of Web pages. They can be found on the website that supplements this paper.[35]

This particular analysis is a difficult one. The evidence is extremely limited, and some of it is ambiguous. The conclusion is as follows:

> The questioned and sample documents (Q and S) differ markedly. In part this is due to the circumstances of composition and the writing materials used; Q seems to have been written with a pointed dip pen on paper, while S was apparently written in chalk on a vertical surface. In addition, S is poorly reproduced and heavily pixellated. The angularity of the formations in Q that are circular in S may in part be due to this disparity of circumstance of writing. Moreover, there is very little of the sample writing to use for comparison, so any conclusion must be very tentative.

[34] The inscriptions were published in the *Dundee Advertiser*, 12 February 1889.
[35] http://doiop.com/3mhmia, index page item 1: the 'Letter from hell': analysis.

In addition, the evidence of the handwriting that we have is to some extent ambiguous: there are matches as well as mismatches. However, the mismatches, weak and strong, considerably outweigh the matches. I would therefore conclude that as far as the very limited available evidence is concerned, the two documents were, on balance of probability, not produced by the same hand. None of the matches between the two seem to me to be of the kind that would compel further investigation.

The caution, the neutral guarded language, and the presentation (on the website) of all of the evidence, including the items that complicate the conclusion, are normal forensic practice.

The second example is much more complex. The Sneyd-Gimbel manuscript of Samuel Johnson's *Dictionary* consists of an incomplete copy of the first edition, into which have been pasted 1,842 slips of paper, each containing an illustrative quotation. The slips are in several different hands. The task is to determine which hand wrote which slip.

This is an enormous problem: by far the largest analysis that I have attempted in more than thirty years of practice as a document analyst. In order to cope with it a more powerful tool was needed. This consists of a web page with three columns and three rows.[36] In the box at the top of each column is an identical list of documents: these are sigla for a selection of the slips, and for some comparison writing. The slips have been arbitrarily numbered for identification. Each of the items in this list is a hypertext link: if the user clicks on, say, the siglum for document 0001, then a set of letters of the alphabet appears (/a–z/ and /A–Z/) in the box beneath it. Some of these letters are hyperlinks: the letters that are to be found in 0001. If the user clicks on (say) the letter /s/, then in the third box, beneath it in that column, images of all of the instances of /s/ that are found in 0001 appear. In the second column one can then click on the siglum for another slip, say 0002, and click on the /s/ link in the box below it in the second column, to have all of the instances of /s/ in 0002 appear in the third box of the second column, next to the instances of /s/ in 0001, so that they can be compared. This allows the comparison of any letter in any document listed in the top boxes to be compared with instances of the same letter in any other two documents.

To illustrate the use of the program two slips, 0001 and 0002, were compared.[37] The results are expressed in a simple table,[38] created in a word processor. This analysis resulted in a conclusion of identity: the evidence

[36] http://doiop.com/3mhmia, index page item 2: the handwriting associated with Johnson's *Dictionary*.
[37] 'Program' is something of a misnomer: it is a frameset, constructed entirely in HTML using a standard web-page creation tool. The advantage of framesets is that they enable this kind of interaction with the data without the use of programming. Framesets are frowned on by web designers, with good reason, but they work well for this rather specialized purpose.
[38] http://doiop.com/3mhmia, index page item 3: commentary on a comparison of two slips from the *Dictionary*.

shows that the two slips were written by the same person. Similarity is easier to demonstrate than difference: difference requires proof that none of the occurrences of a particular letter in Q match *any* of the occurrences of the same letter in S. For identity, it only needs to be shown that one form of a particular letter has a good match with an instance of the same letter in the other document. Less illustration is needed. All of the evidence is nonetheless available, in the frameset, for anyone to see. The images show much better than any words can the kind and delicacy of detail that document examiners use to demonstrate that two people wrote the same document. The results of this minute letter-by-letter comparison are, as they sometimes can be, persuasive, and the conclusion is (unusually) strong: 'There is a great deal of evidence to support the view that the two slips 0001 and 0002 were written by the same hand. The evidence against this view is, in my opinion, negligible.'

The frameset method of analysis is very powerful, and, moreover, translatable quite easily for use with very different kinds of writing. On the website can be found an example of its application to the Dunhuang Tibetan documents, with a commentary; and to cuneiform writing, again with a commentary.[39]

The comparison of handwriting for identification is not a mystery, nor an art form; it can be learned, from the observation of the practice in others. Until this century it has not been possible to make details of the forensic practice publicly available. It is now easy to do so: to expose all of the evidence, and all of the opinions based on that evidence, so that anyone interested can observe, criticize, disagree, improve, and learn. I would suggest, and hope, that an accumulation of such websites can provide both practice and precedent that will allow the exploration, learning, and development of a procedure for the identification of old handwriting from whatever language and period.

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[39] http://doiop.com/3mhmia, index page items 4–7.