As it almost was:
historiography of recent things[1]

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Abstract.
Within the last 20 years historians of science and technology have asked how a recent history might be written, and within the last 10 interest has significantly increased, culminating in an online project at MIT. Since humanities computing owes its existence to developments in recent technology and needs to become historically self-aware to be fully *of* the humanities, work toward an historiography of recent things is deeply relevant. In this essay I draw on this work to highlight the difficulties and opportunities of such an historiography, in particular its ethnographic character and the tempting lure of prediction. I focus on the crucial question of tacit object-knowledge, concluding that it is gained by concernful action. I recommend that we awaken from a progress-and-democratization chronicle to a genuine history of scholarly technology.

> Mozart writes a sonata on a cold day in a spiteful mood; Pomare, high chief of Tahiti, at the same moment distractedly 'eats' the eye of a human sacrifice. Yet we have a common-sense confidence that the 'real' past, like the 'real' present, is much more connected and ordered. We have a confidence that the past is ordered in itself in such a way that we can make a narrative of it. It is text-able…. This mythic confidence in a text-able past is the ambience in which histories are made.
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> Greg Dening, "A Poetic for Histories" (1996): 41f.

1. Introduction

The aim of this essay is to connect the nascent field of humanities computing to a body of work in the history of recent science and technology. In it I argue that the difficult problems faced in the latter are shared by the former and that

both benefit by mutual awareness and a combined effort. Humanities computing is a product of developments in science and technology, so understanding what has happened there is clearly desirable. But the stronger benefit is by virtue of the fact that history is central to the self-understanding of both, in each case because the field is in and of the humanities. (I refer here to R. G. Collingwood's argument in *The Idea of History* that historical thought is foundational for the humanities as a whole.) For humanities computing, the history of recent science and technology has not only this broadening scope to recommend it and common attention to foundational ideas but also the attention of a vigorous, well-developed research community that assimilates techno-scientific practice into the older cultural mainstream. Finding ourselves, as we so often do, in the position of arguing that humanities computing belongs to that mainstream, this assimilation is an immediately practical matter to learn from.

My method proceeds largely by a stitching together of patchwork from elsewhere. I strive to keep the stitching obvious by numerous references, not to avoid a charge of plagarism or hide uncertainty in a bibliographic flourish but to point emphatically and self-consciously to the strengthening work of important allies. Each citation imports an utterance or supports one of my own, but its constant other purpose is to draw attention to the outside source. We are (perhaps all have always been) in an age of warm noises, whose current vocabulary prominently includes the words "interdisciplinary" and "collaboration". If the former is to mean anything at all, much more of this stitching needs to be done. If we are actually to understand what the latter might do for and to us, then we need to look at its practice critically, not just assert its benefits. The model of collaboration so often held up to the humanities is from the sciences. The best study of collaboration I know is from the history of recent science (Galison 1997).

My epigraph is similarly intended to point to a powerful body of ethnographic theory and to ethnography as a contributory discipline, for reasons I will give later. It is also there to help make a simple but essential point: that the past is much more than its text-able component. For an historiography of the recent, the non-textable part is of major importance. The non-textable as a source for technological history makes for interesting trouble: it brings the very ideas of "history", "science and technology" and indeed the significance of "recent" all into question. The basic questions it stirs up, I take it, are – "what does it mean to write history?" – "what are science and technology when we see them historically 'up close and personal'?" – and "what is important about the present moment that it should endow the recent past with such evidently special qualities?" These are, of course, not new questions, but they are certainly quickened by the attempt to write the history of recent things. They are questions that humanities computing cannot avoid.

2. Recent Science and Technology

According to an online source from an academic centre that is now history, the expression "'history of recent science" can be dated to a conversation in Berkeley, California, "on graduation day in the spring of 1981" (Judson 1999: 1). Well before that time eminent authorities in the history and philosophy of science, most notably Thomas S. Kuhn, had argued in principle that writing such a history is impossible, as history, properly speaking.[2] Since then a number of those who counter or ignore such arguments have made strong claims for the new and unique challenges that the attempt perforce encounters:[3] volume, variety and complexity of the evidence, and difficulty of access to it; biases and partisanship of living informants; unreliability of memory; distortions from the historian's personal engagement with his or her informants – the "Heisenberg effect", as it is popularly known;[4] the 'presentism' of science and its perceived need for legitimation through an official, triumphalist account; strenuous demands of acquiring and maintaining technical knowledge; and so on. But, as Jeff Hughes and Frederic Holmes have argued in their contributions to *The Historiography of Contemporary Science and Technology* (Söderqvist 1997), very few of these challenges are entirely new. Most of them are also characteristic of earlier periods and different subjects or are already familiar beyond the confines of documentary history. "If there are problems unique to the history of contemporary science," Hughes declares, "they lie in the contests which increasingly surround the history of science and in the increasingly bitter politics of scientific legitimation" (1997: 31).

In this essay I will focus on two historiographical challenges in particular: object-orientated epistemology and temporality. Preliminary to considering them, I will also look briefly at the approach of The History of Recent Science and Technology project initiated by the Dibner Institute at MIT. HRST represents, I think, an important first step in the communalization of experimental practice. Several projects in the humanities would appear to be going in a similar direction.

The methodological ground that humanities computing shares with the history of recent science and technology centres on the qualities of imagination that writing history requires. The obvious place to begin is with the works of classical historiography, e.g. by Collingwood (1946/1994) and Finley (1985). The core problem they explicate is how to enter through surviving evidence into the mental world of the long dead, or what Collingwood called "re-enactment". Writing the history of recent technology of course encounters the opposite problem – how to gain detachment from the mental world we share with our subjects while remaining engaged with their work. But these are not *fundamentally* different acts of the imagination: both

seek to achieve a state of historical knowing in which one is both oneself and another, both detached and engaged. This is not to advocate a scholarly mysticism but rather to describe the common ground of history and anthropology, i.e. the fields that study those who are separated from us by time and those others who are separated from us by space.

Anthropology (the practice of which ethnography is the written method) shares with archaeology an interest in physical objects. Science and technology are largely object-orientated. The common historiographical ground we require therefore extends to ethnography for an additional reason, so that we may admit non-verbal sources as well as the concerns of the living to the pool of primary evidence. I mention archaeology to indicate in passing a direction for further research but say no more about it here.

3. Reconfiguring the Constraints

The History of Recent Science and Technology project has gone a significant part of the way toward implementing such a history as I am suggesting. It has built "a web-based collaborative system and digital library for the history of five contemporary technical fields"[5], implementing documentary sources in several media. (I will return to the question of objects later.) The Web is employed because "[t]he extraordinary scale and the technical and social complexity of modern science and technology pose significant challenges for historians."

> The skills necessary to comprehend contemporary developments, as well as the vast array of objects that must be examined – ranging from documents through e-mail to video and computer simulations – make it essential to enlist the direct participation of those who were actively engaged in producing them.
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> We have accordingly used the power of the web to provide digital libraries and collaborative software that will enable clusters of scientists and engineers to work with historians in developing the history of their disciplines.

Here I wish to consider how well the Web suits such an enterprize.

In *Understanding Computers and Cognition*, Terry Winograd and Fernando Flores argue that the computer is "ultimately a structured dynamic communications medium" defined by the act of communication itself: "not a process of transferring information or symbols, but one of commitment and interpretation" (Winograd and Flores 1986: 176). What interests me most about this medium, including the use of it in the HRST project for a new kind of writing of a new kind of history, is the commitment to refurbish our intellectual forms, such as the lexicon, commentary, essay or seminar. Acting on this commitment profoundly engages our historical interpretation of these forms. The outcome depends vitally on what we understand such interpretation to entail.

This commitment also engages our interpretation of what these forms *include*. In his important essay, "Farewell to the Information Age", the

Stanford linguist Geoffrey Nunberg argues that "the importance of the Net and the Web… lies in the forms of discourse that are emerging in all those Web sites and discussion groups that the electronic referral services are helping us to avoid wasting our time on…. Perhaps not surprisingly", he notes, these "tend to mirror those of the preinformation age" (Nunberg 1996: 130f). He is thinking, for example, of the Royal Society journal *Philosophical Transactions* as it was in the 17th Century, when it "might mix the serious contributions of a Boyle or Leeuwenhoeck with a report from a gentleman in Suffolk about a curious sand flood or the birth of a monstrous calf." The liberties of the online medium, Nunberg argues, reverse "the effects of nineteenth-century immurement and professionalization of the disciplines", with the result that all manner of things now "come bubbling back up into public view from the orality where they have been repressed for the past two hundred years." Use of the new medium appears thus to express the *etymologizing* tendency e.g. for 'publishing' to return to its roots, as 'making public', 'authority' to refer directly to the individual 'author', whose virtual street-cred is sometimes all we have to go on. Informational publications have colonized the Web, but they are not native. The interesting problems, Nunberg notes, are caused by the autochthonous forms of electronic communication.

I am not so naïve as to think that everything thus liberated bespeaks our liberation or is even remotely interesting. One's own e-mail provides abundant negative evidence of that. But, as the oral historian Jan Vansina remarks in quite a different context, it is first necessary to understand the character of a tradition before we begin worrying about the truth value of what it transmits (1985: 82-3, 153). What matters here is rather the opportunity to reconfigure the constraints of scholarly communication. The HRST project illustrates the considerable promise of this reconfiguration, as does Paul Ginsparg's document server and our own electronic seminar *Humanist*.[6] HRST also goes part of the way to broadening the audience and educative function of its own academic work, as does *Humanist*. The potential here is great, though realizing it well is no simple matter.

In the sciences efforts have been made for many years to broaden the appeal of research – and not simply to guarantee generous public support. Such books as J. Robert Oppenheimer's *Science and the Common Understanding* (1954), Jacob Bronowski's *The Origins of Knowledge and Imagination* (1978) and John Ziman's *Reliable Knowledge* (1991) attest to a long and distinguished tradition in the "public understanding of science", as it is often called.[7] The science journalist Terence Monmaney has suggested, however, that perhaps it is time to retire the old notion, turning from reliance on such books to open, active engagement, as befits the increasingly problematic nature of some scientific research (2000: 15). He points to the work of Sheldon Krimsky and his idea of "public hypotheses"[8]. Furthermore, sociologist Steve Fuller, in the

concluding essay to *The Historiography of Recent Science and Technology* (Söderqvist 1997), argues that because books in the old tradition have declined in quality, they have "lost their traditional ability to legitimate science in the eyes of non-scientists" (1997: 248). Nor is the problem literally with books as such, rather with one-way bookish communication. Thus Michele S. Garfinkel and Steven C. Weiss (1999) unfavourably compare U.S. Congressman Vernon Ehler's recent *Unlocking our Future: Toward a New National Science Policy* (1998), published bookishly online, to Vannevar Bush's hughly influential *Science: the Endless Frontier* (1945), originally of course printed.

The interactive, dialogical Web, as suggested by HRST, would seem fit for the task not only of revivifying dialogue between researchers and public but also refurbishing its nature. Fuller, though he does not mention the electronic medium, argues like Nunberg for the potential of reversing professionalization, so that we might undo the basic agreement over the plot-structure of the history of science – which if not triumphalist tends to ignore the problems – and return it to its "polemical roots" (1997: 247). Whether this should be done is not so much my concern as the fact that (to paraphrase Hayden White) 'the content of the electronic form' makes it easy to do (1990). It thus offers a basis for what Fuller calls a "constructivist historiography", which by showing "that things could have been other than they are, had events been other than they were" emphasizes the contingency of the present on multiple undetermined possibilities of the past (1997: 247). This is a commonplace among historians, but we need reminding to ward off triumphalism of our own. This triumphalism is clearly visible in many so-called histories of computing, which are little more than chronicles of "firsts" with the heroes who achieved them (Mahoney 1996).

4. Historical Imagination

Thinking clearly about the older intellectual forms now subject to refurbishment and the library in which they are found is already an urgent historiographical problem. Again, as I have argued elsewhere – *contra* techno-liberation theology, according to which "information wants to be free" (Clark 2000) and will be as soon as all references are replaced by hyperlinks – one has to work quite hard to imagine the realities of the footnote, say, before hypertext changed how we tend to think about referring (McCarty 2002). Appreciating the subtle range of its craft, the *disciplined freedom* that it affords the skilled user (Reynolds 1978), now requires an act of the recent-historical imagination. Attempting to construct an adequate electronic successor to a printed original without understanding that original as an historical object, expressing a particular "style of knowing"[9] the world, seems utterly foolish. Digitization, I would suggest, is thus like translation in Umberto Eco's sense,

an interpretation of a text in two different languages, involving the culture of each (Eco 2001). If we are to build on what we know, neither slavish imitation nor discarding of the old will do. Rather we need to know how to write the recent history of our sciences and technologies – imagining back into the present moment what we once knew or might have known, much of it without saying, for which there could then have been no certainty.

Technologically engaged scholars across the humanities are, as we know, deeply in the midst of digitizing legacy artifacts and designing new resources based on perceived limitations of the print medium as we have it.[10] In the fields of literary criticism and textual studies, for example, Roland Barthes' call "to make the reader no longer a consumer, but a producer of the text" he or she reads – a "plural text" conceived as an "entrance into a network with a thousand entrances" rather than a canonical *Urtext* – has changed how many of us think about language (Barthes 1990: 11-13). Hence as the Cambridge classicist Simon Goldhill has said, inherited ideas about the edition and commentary are now deeply problematic (1999). The textual critic and theorist Jerome McGann has pointed out, however, that what we have done to date with our new medium, despite all the talk of de-centred texts and all the massively hyperlinked documents, more or less reproduces the problem (McGann 2002: 74). The way forward, I am suggesting, at least begins with the way back – imaginatively, into the inherited forms, to look at them historically for what they were attempting to do, for what they in fact did in their own terms, preferably while we still have living informants. Asking how we might do as well would not be a bad way to begin – a much needed antidote to the progress-talk that the historian of technology Skúli Sigurdsson calls "progressive forgetting" (1997).

Let us, for the purposes of argument, assume that digitization of legacy artifacts proves a transitional effort, and that it reaches triumphant completion in a world-wide digital library. (I am not being naïve, I am having visions, aware that they are exceedingly unlikely ever to be realized.) The historiographical problem would still be with us, however, because it is inherent in the evolution of tools. So, our problem is a perpetual and universal problem. There will always be a recent past, and we will always be gazing back into it.

5. The Nature of Things and the Ideas in Them

Two points about the nature of things: their historicity and their objectivity.

Richard Rorty and Ian Hacking both remind us that historians cause the same sort of trouble when they insist on historicizing philosophy as when they historicize science: pointing out that our forebears were not in fact interested in the topics that preoccupy us, or not in the same way as we are, problematizes engagement with them (Rorty 1984; Hacking 1984). Indeed, as

a colleague recently remarked, reversing the polarity, "There is always an allegation from historians that everyone else is triumphalist".[11] But the historicization of science, technology and perhaps also mathematics is, Hacking argues, a special matter: the basis for his realism, in the permanence of the phenomena we create and the devices we invent, despite revolutions in concepts and categorizations, suggests that the things of science and technology, though they come into existence in a particular time and place, are in an important sense not historically constituted.

In an important essay Clifford Geertz notes that "the relativist bent anthropology so often induces in those who have much traffic with its materials, is… in some sense implicit in the field as such" (2000: 44). The stark, undeniable difference of an alien culture's things tend to have, in the Blakean sense, a deeply corrosive effect. So also, it would seem, the ontological status of artifacts as objects.

Are objects objective? In his foundational work, *Oral Tradition as History* (1985), Jan Vansina argues that "[a]ll traces from the past fall in two major categories according to a basic characteristic: whether they are messages or not…. Messages are information that has been interpreted in the mind of one or more persons… and has to be interpreted again through the mind of the person who receives them…. Messages are therefore characterized by a double subjectivity" (1985: 193f). An object, however, is singular with respect to interpretation; "it bears direct testimony to the age in which it was made and used". Vansina argues that paradoxically messages are more objective than objects *because the original subjectivity of the message constrains the second subjectivity of the historian*. He or she has no such help with the object. Utterly fantastic interpretations of them are not uncommon.

These two characteristics, historicity and objectivity, indicate that objects, even cultural artifacts, require a very different style of historical reasoning. Here, I think, we have a key to something quite important.

Steve Fuller notes that an "obstacle to assimilating the study of the natural sciences to the humanities has been science's reliance on manually operated technology, especially laboratory apparatus, for its inquiries" (1997: 249). Unlike humanists, scientists "have depended on book-learning almost entirely for educational, but not research, purposes" and have "held no special respect for the literary forms of knowledge found in the archives, except as vehicles for the 'virtual witnessing' of natural or experimental phenomena". This is because, as Michael Mahoney has pointed out, "Technology is not a literate enterprise; not because inventors and engineers are illiterate, but because they think in things rather than in words."[12] He quotes Henry Ford – "Machines are to a mechanic what books are to a writer."

In contrast the primary objects in mainstream humanistic scholarship – in history, for example, certainly since Leopold von Ranke – have been

written documents, literary, linguistic, historical, philological (Grafton 1997: 34-61). But for a complex set of reasons, even with physical objects in their hands, many humanist scholars have tended deliberately or unconsciously to ignore their physicality, reducing them to their textual "content" or to textual transcriptions. Putting aside some aspects of an artifact in order to concentrate on others is hardly sinister or wrong, but it does have consequences. Again for complex reasons, in the case of textual documents it has aided and abetted what Geoffrey Nunberg calls "the impression of information", i.e. the implicit notion that content exists independently of form, that it is a noble substance, like the Pythagorean soul, whose physical embodiment is a secondary, transitory, almost accidental matter (Nunberg 1996: 116f). Among the many consequences of this culturally pervasive attitude is the difficulty we humanists tend to have in dealing with any intellectual culture whose cognitive activity is expressed in things rather than in words. My target here is the culture of science and technology, including those aspects of humanities computing, but as palaeographers, bibliographers, art historians and historians of the book frequently remind us, many of the humanities themselves suffer from object-blindness.

Computing might seem to exacerbate such latter-day Pythagoreanism and so be quite unhelpful in staging the history of science and technology, except in trivial ways. But, Nunberg argues, this "impression of information" is historically a product of printed genres, such as dictionaries, telephone books, voters' lists, newspapers and the like. It is weakened rather than strengthened by the electronic media, which, as I have already quoted him as arguing, "don't preserve the social and material boundaries that the informational mode of reading requires" (1996: 124). Textual data may move in a seemingly Pythagorean, device-independent way from system to system, but what we see and design for are the embodiments, the materially articulated ideas.

6. Visual Knowing

In delineating an historiography adequate to technological artifacts, Mahoney directs our attention for example to Eugene Ferguson's study of the link between engineering, the arts and printing from the Renaissance well into the 19th Century. Ferguson notes that during this period engineers, who were routinely trained as artists, retained the artist's habits of nonverbal thought and so communicated ideas by means of printed diagrams as well as in the constructed objects themselves (1994). Without this training we have great difficulty thinking as they thought, and so are apt to find their intellectual culture opaque. Fuller argues that the same problem has thwarted verbally-orientated historians studying the object-orientated sciences. He cites the influential work of Ludwik Fleck, whose idea of *Denkstil* ("thought-style") in

Genesis and Development of a Scientific Fact (1935/1979) – a book astonishingly ahead of its time, and very timely now – suggests a close relationship between the laboratory sciences and art history.[13] Nor is it surprising to find supporting argument from art history for the intellectual nature of constructed objects, perhaps most notably in Rudolf Arnheim's pioneering work *Visual Thinking* (1969).

Emphasis on the visual representation of objects, and so on their materiality, is helped by computing, with the development of ever faster, higher-resolution graphical display, and by new attention to the communicative function of graphics, for example by Edward Tufte.[14] The reading out and transcription of knowledge in visualized objects are similarly enhanced by image-mapping and to some degree by automatic analysis. Object-orientated fields of study, such as archaeology, palaeography and art history, are greatly favoured, as for example Richard Beacham's virtual-reality reconstructions of ancient theatres have shown.[15] Data-visualization techniques hold promise for mild to radical change in others. One day, I keep telling my students – again I am having visions, but this time am inclined to think they may come to pass – *Excel* charts of word-distributions across literary works will appear in mainstream journal articles. Seriously, why not?

7. Performative Knowing

Richard Rorty has speculated about an "end to the epistemic wars" between C. P. Snow's "two cultures" (2000). Perhaps the eagerness with which graphical capabilities of computing have been welcomed in the humanities is a sign of this. If so, it is not the only one, nor the most important.

Again to quote Winograd and Flores, in its use the computer is clearly a "*dynamic* communications medium". As game-players know perhaps better than scholars, it has not merely given public channels to long-suppressed discourse, it has also dramatically emphasized the temporality of communicating. In the humanities the most obvious manifestation is conversational exchange via e-mail, which began professionally less than 20 years ago;[16] online publishing, via document-servers and independently, has had much less of an effect, but that seems bound to increase. Hence the monumental, elephantine pace of humanistic scholarship is now accompanied by the antics of conversational runners and – this is a prediction – won't ever be the same again. It is becoming far more obviously performative. And, as I will argue in a moment, it is becoming experimental.

But the emphasis on communicative temporality, and so on interactive thinking rather than declarative thought, is not all there is to the computational push toward the dynamic. Objects in an electronic document can of course be algorithmic. Diagrams, whether controlled by the user or simply animated, can show as well as imply motion, hence explicitly engage

kinaesthetic response (Craig, Nersessian and Catrambone 2002). Research in cognitive science and allied fields suggests quite strongly that we think and remember not only in terms of objects as well as words, but also in terms of movement. Thus oldfashioned chalkboard diagramming in the sciences, with arrows of force and curves of acceleration, made its point at least partially in the performance (Shin and Lemon 2002), which included not simply the initial drawing but also alternative versions. The technology of animation and visual modelling, allowing for repeated, exploratory re-production, highlights this historical fact as well as recovers the benefits of performance in the digital textbook and lecture. Within and beyond the humanities, this technology raises the question of where performative diagramming has always played an important but unremarked role – and where, in the form of tools such as *PowerPoint,* automated diagramming has had what sort of effect.[17] Animating dramatic literature by providing access to recorded performances is a recent example of response to a problem noted desparingly by professors of drama for a very long time. As with many effects of computing, how this or other implementations will affect communication is unknown, but it does force us to consider the history of what we do.

8. Tacit Knowing

In *The Structure of Scientific Revolutions*, Thomas Kuhn argues that a group of scientists "can… agree in their *identification* of a paradigm without agreeing on, or even attempting to produce, a full *interpretation* or *rationalization* of it…. Indeed, the existence of a paradigm need not imply that any full set of rules exists" (1970: 44). For support he cites Michael Polanyi's eponymous theory of "tacit knowledge", which begins with the fact that that we know and act on more than we can say. Its central assertion is that in an act of tacit knowing we *attend from* this 'silent' knowledge in order to *attend to* other things that we know explicitly.[18]

Knowledge can be tacit for many reasons and in different ways. Something may 'go without saying' because everyone knows it.[19] That which is explicitly known may be forgotten, lost or concealed, surviving implicitly, tacitly in the circumstantial evidence. Historians are, of course, centrally concerned with recovering such knowledge, in making it once again explicit. In the history of physics a prominent example is Jed Buchwald's work on Heinrich Hertz (1994).

The genius of Polanyi's theory turns more specifically on how we interpret the nature of such knowledge. Two of three possibilities I can see would seem to make the theory uncontroversial and unpromising: that tacit knowing is only temporary, while the attention it enables is focused elsewhere, or that as part of our unconscious mental processes it is permanently inaccessible. Kuhn argued for the third possibility in the

"Postscript – 1969" to the 2nd edition of *Revolutions*: a kind of knowledge, learned from and communicated by exemplars, no "less systematic or less analyzable than knowledge embedded in rules…" but "misconstrued if reconstructed in terms of rules that are first abstracted from exemplars and thereafter function in their stead" (1970:191-8).

I hazard the suggestion that tacit knowing of this kind speaks directly to Henry Ford's point in words quoted by Mahoney: "There is a great deal to be learned simply by tinkering with things" (Mahoney 1996). Allow me further to suggest that such tinkering has two modes: a 'tinkering by means of', when one uses a device to probe something else; and a 'tinkering on', when the device itself becomes the object of attention.[20] And finally, allow me to go all the way to the end of the limb I am sitting on, to suggest that the Heideggerian argument which Winograd and Flores make in *Understanding Computers and Cognition* is just right for this circumstance: that we 'tinker by means of' our computers until a breakdown of some kind forces us to 'tinker on' them improvingly, so that we can then resume 'attending from' them in our acts of tacit knowing (McCarty 2004).

9. Persistence of tacit knowing in the networked world

If such disciplined tinkering is as central to what we do as I am suggesting, then it provides a central crux in the historiography of our recent things. One curious illustration of this is provided (again outside the humanities) by Timothy Lenoir, who speculates on th e outcome of combining a specialized form of computational tinkering, simulation, with the Internet, in "Science and the Academy of the 21st Century" (2002).

Citing a pronounced trend in the biological sciences toward simulation, Lenoir predicts that "the fusion of the communication and experimentation functions – the merging of the journal and the lab – in the post-modern academy" will result in "the relocation of the lab to the industrial park and the dustbin of history" (2002: 115, 129).[21] The problem with this vision (and potentially with all visions of epsitemic interaction at a distance, including the explicitly educational) is that it omits the human factor of tacit physical and social interaction, face-to-face in the laboratory and in other collaborative settings.

Historiographically recent history is special because it has no outcome to work with and so must confront multiple unresolved, unfiltered possibilities. The strong temptation, which Lenoir's example is but one of many to illustrate, is to let prediction supply the untold story, here of what exactly the Web and simulation will mean for the collaborative use of knowledge-making equipment. But the prediction is far from useless – as long as we do not take it at face-value. If we allow it to function as a thought-experiment, then the *reductio ad absurdum* points the message that we have

been getting from the sociology of scientific knowledge all along: to look beyond results to the "epistemic culture" that produces them, and even more to focus on the "community of practice" that instantiates this culture in real people and their actions.[22]

This is not to deny the possibility of distributed laboratory work, rather to suggest that such work seems likely to augment rather than usurp face-to-face interaction. In the humanities it is not at all uncommon to find in research projects a varying mixture of long-distance and face-to-face, with the latter remaining at the centre, playing much the same role as a general editor of a large collection plays with his or her contributors. One of the clearest examples of networked collaboration is the *Suda On Line: Byzantine Lexicography*, an open-source project to publish a translation of and commentary on this "10th century Byzantine historical encyclopedia in five volumes, derived from the scholia to critical editions of canonical works and from compilations by earlier authors" – as contributions become available.[23] While it is true that much of the work is not done face-to-face, the long-distance collaborators share a common intellectual and social culture acquired and maintained face-to-face, and the whole is controlled from a central location. The Canadian *Text-Analysis Portal* (TAPoR), currently under construction, aims to "build a… human and computing infrastructure for text analysis across the country by establishing six regional centers to form one national text analysis research portal" to be accessed online.[24] Here is a (very Canadian) regional emphasis in a loose national frame with in fact frequent face-to-face encounters among people who know each other well. Typically, as in TAPoR, what is networked is simple use of a resource rather than the work on it; note also the several self-declared 'hypermedia archives' or resources such as the *Perseus Digital Library*. On a smaller scale, as yet not widely distributed but more experimental, is Jerome McGann's *Ivanhoe Game* (2002: 209-48), which has been played by people who also know each other quite well.

My point is, as Thomas Kuhn suggested many years ago, that tacit knowledge is not only central to epistemic practice but is normally communicated by shared practice, in the laboratory, face-to-face. This we see by studying the historical past and examining the social present. Predictive powers are not required.

10. Consequences of augmentation

Let us, however, entertain Lenoir's fusion of laboratory and journal so that we might imagine the consequences. (An equivalent in the humanities would be, for example, a complex online database with the ability to save queries and make notes.) For the sake of simplicity, let us assume the best of circumstances: controlled access for which only the well-behaved qualify;

clear explanation of device and data; and so forth. Among the various questions that arise here, let us focus on just one: what happens to the truly tacit knowledge, i.e. the unspeakable beyond the unspoken?

The argument I want to advance, borrowed from recent work on experimental practice, is in essence that a kind of knowledge inheres in knowledge-making equipment as in other cultural artifacts and so travels with it. Thus Elke Kurz-Milcke and Laura Martignon, in "Modeling Practices and 'Tradition'" (Franck 2002: 127-46) point out that when devices are detached from their cultures of origin they migrate, *partially* disencumbered of original meaning, across what Peter Galison has called disciplinary "trading zones", effecting change where they land. Ian Hacking likewise argues that they have an independence from their theoretical, ideational origins: "once created, there is no reason except human backsliding why they should not continue to persist" (1984: 118f) – and, thus seed-like, to communicate the knowledge they tacitly carry to their users. Hence, as Hacking has subsequently argued, the robustness and self-vindicating nature of the laboratory sciences (1992).

In my example from the humanities, this argument does not apply in any interesting way to the computer hardware alone, since hardware does not constitute a useful device without software. But it does apply with increasing force the closer we get to the layer-cake combination of things that manifests a particular database design, with all the tacit knowledge encoded in that design. The upshot, then, is that computing systems, like laboratory instruments and physical inventions, become media of thought and so media that communicate knowledge we may be able to paraphrase but cannot completely extract.

Of course the partial disencumberment of original meaning can easily lead to profound *mis*interpretation from the perspective of the originating culture. Objects, as we saw, are far less constrained in this way than words, and so paradoxically less "objective". But in the scholarly environment now emerging, on the Web'd periphery of what may be called the digital library, they are being let loose to wander wherever. Much digital library research concerns in one way or another how, as we move into the digital media, we negotiate the balance between new freedoms of expression, which motivate the work, and the constraints of convention, which are required to communicate at all.

In this negotiation (or, rather, re-negotiation) how is the tacit knowledge communicated? Some of it, by the Galison-Hacking argument, comes with the equipment itself. But if we actually care about the message put into its proverbial bottle, then as Mahoney has said, we need to be able to read it. The question then becomes one of historiography: how do we read old things – or in the present context, how do we read things from the recent past?

11. Poetics for Histories

Two criteria for an historiography adequate to the situation have emerged from what I have been saying: (1) object-knowledge; and (2) knowing in the present moment. Collingwood's historiography is powerfully appealing in its emphasis on re-enactment, enabled as he says "by the power of present thought to think of the past, [and] by the power of past thought to reawaken itself in the present" (1994: 294). But it needs that object-knowledge beyond the orbit (as Hacking would say) of the "idealist gambit" which has dominated our philosophy. It needs an ethnographic component. It requires participation.

For obvious reasons, as the focus of research approaches the present moment we turn from the kind of "scientific" historiography characteristic of the 19th Century, with (as the Australian ethnographer Greg Dening says) its "mythic confidence in a text-able past" and documentary obsession with a singular, correct account (1996: 42). We turn, in part at least, to the social sciences. As distance in time is replaced by distance in space, recognizing with Clifford Geertz that "Foreignness does not start at the water's edge but at the skin's" (2000: 76), historiography becomes ethnography, and that means (again as Dening says) actually crossing the beach. Ethnography, of course, knows about orality, conversation, memory and physical relics. But I am not concerned with detachable research techniques, which in desperation we might be tempted to lunge for. Putting on one's disciplinary pith helmet and treating a bunch of scientists or humanists as "natives" is just silly.[25] Rather allow me to recommend with some urgency that you go immediately from this essay to Dening's "A Poetic for Histories" (1996: 35-63). Here in fact is one of the *very* few occasions on which I would wish for a hyperlink.

The core of Dening's poetic is an ethnographer-historian's dilation beyond the textable past and beyond the "scientific" reduction of evidence in a correct and singular account.[26] Even Leopold von Ranke's quest read non-trivially as an asymptotic goal, for a history that "will bloß zeigen, was eigentlich gewesen ist", "*wants* only to show what actually was" – but of course never quite gets there, and so is ennobling – is too narrow. Just as to us now there is no one text but a plurality of them, so there are a plurality of histories. In terms of humanities computing, for example, we discriminate not one way of doing research but as many as there are in the ever-changing combination of researchers, projects, theoretical approaches, types of material and so on. Yet there *are* ways, some more effective than others. Programs can be written to implement their exact specifications; these programs can be judged as more or less good.

The dangers are nevertheless not inconsiderable. Apart from Dening the best guide I know is Geertz, whose wonderful essay, "Anti- Anti-Relativism"

(2000: 42-67), argues that although both relativists and anti-relativists go badly wrong, the relativist's worry about provincialism is the more serious. The real danger, he says, is "that our perceptions will be dulled, our intellects constricted, and our sympathies narrowed by the overlearned and overvalued acceptances of our own society" (46). The histories of recent science and technology, whether taken to serve the purposes of humanities computing or those of historians of science, offer a wake-up call.

12. Conclusion

But wake up from what and to what, exactly? What am I recommending?

With respect to the subject at hand, the "acceptances of our own society" depict an historical path leading rapidly upward from lesser to more powerful machinery and broadening from the narrow purview of the few to the broad commons of the many. This path is marked by milestones denoting the firsts achieved by the well-known greats, whom we celebrate: Turing, Bush, Englebart and the rest. It is often walked in memory when the story of computing is told. But although (let us say) not a single metaphorical paving stone be false, like the great processional ways of urban history this *arrangement* of undoubted facts not only tells a particular story but induces a very particular mythical way of thinking. It is this myth from which we need to make certain we are fully awakened so that we can write a proper history in which solid technological progress appears in the context of all the humanities.

I am certainly not arguing that we awaken from shadows on the wall to direct sight of what really is – *that* is an altogether different story. Rather I am arguing that the simple-minded story we have, overlearned and overvalued, is dangerously misleading, especially now, when among other things we are having to re-imagine both our scholarly forms and the library with which they interrelate. This means not merely, perhaps not even primarily understanding the new tools at hand but interrogating the old ones in their own terms while we still can.

The first step toward writing the recent history we need is thus to awaken from object-blindness by what Hacking nonchalantly calls "taking a look."[27] Mahoney agrees:

> The point to emphasize here is that one must look. As [Henry] Ford said, books do not suffice to tell us how things are made and work. Mechanics must learn to read machines. So too must historians of technology, and indeed historians of science. The technical and cultural meaning of the Model T lie in the automobile as an artefact. That is where Ford expressed his ideas, addressing himself to an audience he clearly understood well. To understand his audience and the meaning they attached to the car, historians must see what they saw and feel what they felt, for their experience of the car was visual and tactile, not verbal or literary. Reading a machine means determining

> what the artifact says about the people who designed it, the process of its design, the assumptions made about its purposes, the expectations held of its putative users, and the ways it could actually be used. Most interesting and revealing are the points at which these overlapping questions do not have coinciding answers. For it is there, rather than at the level of theory, that the dialectic of technology is carried out. (2003)

Obviously I am suggesting that we need *to read* the book. Indeed, by first taking a look at the codex as "a machine to think with" (Richards 1926: 1), then reading it exactly as Mahoney recommends for any other machine. This is already happening piecemeal in research on the history and material culture of the book, on textual editing and occasionally in computer science.[28] But what is not done often and often not done well is the looking at our inherited forms in their own terms by those who are also able, as Don Fowler said in his fine example, to bring to bear "the heightened self-awareness that [technological] change has generated" (1999: 427). For a particular scholarly form, such as the commentary, the crux is where past and present means and ends collide in an "interference pattern" of reinforcements and cancellations. This is the paradoxical vision in which one is both oneself and another, both detached and engaged. What did our forebears do well that we want to do? In what respects or in which instances are the older means still best? Answering those questions begins in a history both rich and recent.

[7386 words of main text;
9185 words total]

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Notes

[1] This essay was first delivered as a talk for "The New Web of History: Crafting History of Science and Technology Online", a special conference of the History of Recent Science and Technology Project held at the Dibner Institute for the History of Science and Technology, Massachusetts Institute of Technology, 28-9 March 2003 (http://hrst.mit.edu/hrs/public/conference/, 15/12/03). I am very grateful to Jed Z. Buchwald for the invitation to deliver the talk and especially to Michael S. Mahoney and an anonymous reviewer for extensive and insightful comments on the first written version. Any errors or misunderstandings in my response to them are, of course, my own.

[2] Kuhn 1977: 3-20, esp 16. Kuhn makes the classic argument: historians work only on matters in which they cannot possibly have a stake in what has happened because the issues of greatest importance to the historical actors no longer have the same relevance. The argument is a central one: to write recent history requires a very different conception of historiography.

[3] See Geshwind 1999; Söderqvist 1997: 1-17.

[4] A Google search is sufficient to establish the popularity of this term, e.g. in film studies, where John Stuart Katz has used it "to describe the effect the presence of a documentary camera crew has upon the people (subjects) being filmed" http://www.upenn.edu/resliv/prp/katz.html (23/3/03).

[5] These fields are the Apollo Guidance Computer, Bioinformatics, Materials Science and Engineering, Perspectives on Molecular Evolution and the Physics of Scales; see http://hrst.mit.edu/hrs/public/SiteInfo.adp (4/4/03).

[6] For the latter two see, respectively, http://arxiv.org/ and http://www.kcl.ac.uk/humanities/cch/humanist/ (23/3/03).

[7] See, for example, *psci-com: A Gateway to Public Engagement with Science*, http://psci-com.org.uk/; "Public Understanding of Science, Communicating Science, and Science Education", *NASA HQ Library*, http://www.hq.nasa.gov/office/hqlibrary/pathfinders/edusci.htm (4/4/03)

[8] Krimsky 2000; see also the publications list at http://www.tufts.edu/~skrimsky/ (23/3/03).

[9] The phrase is Simon Goldhill's; see Goldhill 1999.

[10] See esp. McGann 2002 for an analysis of the problem.

[11] Patricia Galloway, *Humanist* 16).573 http://lists.village.virginia.edu/lists_archive/Humanist/v16/0565).html (22/3/03).

[12] Mahoney 1996: x; see his other articles on this history of computing at http://www.princeton.edu/~mike/computing.html (23/3/03).

[13] Fuller asserts that Fleck "assimilates the understanding of the laboratory sciences to models derived from art history" (Fuller 1997: 250); see also Smith 1992.

[14] Tufte's major publications comprise a series of 3 books; see esp. Tufte 1990).

[15] For Beacham's work with computing, see http://www.warwick.ac.uk/fac/arts/Theatre_S/staff/rcb.html (23/3/03).

[16] *Humanist* began in 1987; it was preceded by Ansaxnet, for Anglo-Saxon studies, in 1985 (e-mail communication from Patrick Conner, pconner@wvu.edu, 23/3/03). E-mail was used before then to distribute "clearinghouse" news and the like, but interchange via e-mail in the humanities first started with Ansaxnet. See McCarty 1992.

[17] For *PowerPoint* see Tufte 2003; Vienne 2003; Parker 2001. In many if not most of the humanities any sort of diagramming has been uncommon, so we also need to ask whether static diagramming tools, such as those in MS *Word*, have had any effect.

[18] Kuhn cited Polanyi 1958; Polanyi 1966 provides a much clearer statement. See also Delaney 2000, Barbiero.

[19] Mahoney 1998; cf. Fleck's argument for the locus of such knowledge in the thought-collective (1990: 76).
[20] My sketch of these modes follows Geertz's distinction between "models of" and "models for" (1973: 93); see also Goodman 1976: 172-3, who distinguishes "denotative" from "exemplary" models, respectively; cf. H. J. Groenewold's "more or less poor substitute" and "more or less exemplary ideal" (1960: 98). Similar distinctions are actually quite common in the literature.
[21] The echo of Trotsky to the Mensheviks, at the Second All-Russian Congress of the Soviets, 25 October 1917, may be offhand but is suggestive of the revolutionary fervour of many such predictions.
[22] For the phrase "epistemic culture" see Knorr Cetina 1999; for "community of practice" Brown and Duguid 2000.
[23] See http://www.stoa.org/sol/ and the description at http://www.stoa.org/projects.shtml (4/4/03).
[24] See http://www.tapor.ca/ (4/4/03).
[25] The best expression of this silliness I know is the Far Side cartoon "Anthropologists! Anthropologists!" in Larson 1989: 278).
[26] See his examples, e.g. elsewhere in *Performances* and in *Mr Bligh's Bad Language* (1992).
[27] Hacking 2002: 65. He says "nonchalantly" but means it very seriously. See, for example, Hacking 1983: 186-209, from an article published two years earlier. In the essay he refers briefly to the training in microscopy he underwent.
[28] For history and material culture of the book see e.g. Johns 1998 and Duguid 1996; for textual editing McGann 2002, Robinson 2000, Bornstein and Tinkle 1998 and McGann 1993; for computer science Raymond and Tompa 1988 and the articles by Catherine Marshall listed in McCarty 2001.