Being Reborn: The Humanities, Computing and Styles of Scientific Reasoning[1]

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> Of course, each scientist must master a certain palette of techniques, whether empirical or theoretical. Nonetheless, the idea of seeing how we can go beyond technique to answer fundamental questions remains crucial if the fruits of these techniques are to transcend mere data collection. (Arbib 2000, 214)

> . . . it is only by extending common sense in ways that render it fallible and susceptible to falsification that knowledge of the world can possibly advance beyond self-evident experience. What is obvious and familiar is thereby reinterpreted so as to incorporate coherently the unfamiliar and unusual. Such extensions, however, require profound empirical insight coupled with bold theoretical speculation, as common sense alone provides no intuitions to confirm or deny. (Atran 1996, 119)

Perspectives on Computing

The French term "renaissance," originally denoting "the great revival of art and letters, under the influence of classical models, which began in

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Italy in the 14th century," has come to mean "any revival, or period of marked improvement and new life, in art, literature, etc." (*OED*). Who constructed *the* Renaissance, for what purpose and to what effect are matters I leave to others who are more qualified to speak of them. It seems fair to say, however, that whatever we take that great change to have been, historically it is bound up with Gutenberg's technology, and so, by the comparison often made, we are invited to speculate about a contemporary renaissance somehow related to the computer. What grounds might there be for asserting such a rebirth, and what good would it do us to be thinking in this way?

This *is* an intellectually exciting time, and wherever one looks, computing seems to be at or near the epicentres of disturbance. We know enough now to credit assertions that as a straightforward means of access and delivery, computing has made a profound difference to scholarly habits of work and so to scholarship. At issue is not just quick delivery in bulk of what previously came in smaller quantities more slowly, but also directed or serendipitous access to many areas of learning otherwise effectively out of reach. These are only changes in scale and frequency, but they imply systemic effects. Consider, for example, what is likely to be happening to standards of argument, canons of evidence and genre-distinctions as the amount and variety of data available to a discipline mushroom. Consider also how a discipline's basic assumptions are likely to be affected by increasingly unavoidable encounters with standard terms and concepts in new and surprising contexts. Our disciplinary blinkers may be robust, but the evidence coming from beyond their ken is getting much harder to block.

The problem is, however, that by simply following up such implications of access and delivery, we silently take on the assumption that computing acts primarily to amplify and extend ways of thinking formed independently of it. In other words, we assume that the computer is a new kind of tool, like Archimedes' lever, and so proceed to ask more deeply unquestioning questions about its application, such as where the fulcrum is to be placed and how long a handle of what tensile strength is required to move a familiar obstruction. But we already know that computing is not simply a new tool or appliance—that, by the design of Alan Turing, it is an open scheme for the making of an indefinitely large number of tools. All around us is the evidence that, as Michael Mahoney says (2004, 1990), there are *many computings* and no reason to think that their number will be limited by anything other than sloth, lack of ingenuity, backsliding or major human catastrophe. The better question to ask, then, is not what we can do with a given manifestation of the scheme, but rather what it means for scholarship to have taken on this curiously protean mold in which to cast its practices, thinking and communications.

The paradox is unavoidable: on the one hand, computing is what we implement it to do; on the other, it implements only what can be described with total consistency and absolute explicitness, leaving nothing, and therefore everything, to the imagination. So two questions are possible, one from each side of the paradox. The first is the historical question of how computing, thus restricted, has refracted the whole of scholarly inquiry into what methods or kinds of questioning. When we look at digital scholarship as a whole, that is, what *kinds* of things do we see? The second is the philosophical question of how computing directly serves the central purpose of scholarship, to ask ever better questions. How is questioning inherent to or at least compatible with digital form?

Neither question would occur to us, or at least survive the pressures of life to be asked, if we did not already have a perspective from which the multiple encounters of computing with the humanities can be surveyed and compared. This extra-disciplinary perspective is what has come to be called "humanities computing."[2]

Logically as well as historically, humanities computing can be said to originate with the bi-lateral curiosity joining the technical practitioner's focus on abstract method to the humanist-scholar's focus on a particular object of knowledge. Over the last half-century, practitioners have thus been motivated to ask the standard question of computer science—"what can be automated?" (Denning 1985)[3]—powered not by the computer scientist's interest in the theory of computation, but rather by the humanist's concern

[2] For an extended argument along these lines, see McCarty (2005).

[3] By "standard question" I mean, with Denning, the central question of the standard view of what computer science is. There are other possibilities, for which see McCarty (2005 , ch. 4).

for practical application. While many scholars have emerged from such collaborative exchanges to pursue their research where it has led them, practitioners have stayed to collect, compare and codify the emergent digital methods. Thus they have discovered a loose but cohesible body of techniques, committed to no discipline but of use to them all. These techniques relate to research not according to subject matter but according to the type of data involved—discursive or tabular text, numbers, images, sound and other temporal media. They define a metaphorical space which we at King's College London call the "Methodological Commons."

So far so good—but not enough, not the whole story. The activity that began decades ago in computing centre offices, at help-desks and in collegial acts of kindness, has gradually become a way by which the technical practice of applied computing has taken on webs of significance interconnecting it with all the humanities at a basic level. Only very recently we have begun to understand that this informed, connected-up technical practice is an expression of the humanities rather than their servant or helpful side-kick—a computing that is *of* as well as *in* or *alongside* them. We can now say that the central event of this practice happens when scholarship confronts another form of itself in a comparative negotiation. In analytical work, negotiation is between relevant technical methods and the scholar's perceptions and beliefs about the artifact in question. In the synthetic phase, this step involves a similar negotiation between scholarly approaches to questioning and the craft of designing and implementing these approaches. Here I am squeezing a great deal into a few words. The key phrase is "comparative negotiation"—*comparative* because the discrepancy is essential, *negotiation* because the creative struggle for agreement, rather than the agreement itself, is the point.

In this paper my concern is not simply with the direct consequences of this scholarly *agon* but also with the broader implications of computing for how we conceptualize the humanities in a techno-scientific world. My argument comes in two parts. The first part (in the next two sections below) addresses the means and consequences of this negotiation, summarizing and extending an argument I have made elsewhere: that the central fact of computing for our purposes is its unlimited capacity to accommodate manipulable representations of knowledge. The second part (the next two sections again) appears here for the first time. In it I ask, more ambitiously than wisely perhaps, where computing stands with respect to the humanities in the history of reasoning. I offer for further thought the possibility that the renaissance on offer comes from computing's framing of scientific method within the humanities. I conclude in a final section with some thoughts on where we might turn our attention next.

An Old Problem With Books

Let me set the stage by summoning an old problem from within the heartland of the traditional humanities.

In his essay, "The Renaissance of Books," Northrop Frye recounts a childhood sight of cultural authority: "several shelves of portly theological tomes in black bindings. . . [O]n a child," he wrote, these tomes

> . . . gave an effect of immense and definitive authority, of summing up the learning and wisdom of the ages. . . And yet when I was old enough to begin to try to use these books myself, I became aware of [an] important principle connected with books: the principle of the mortality of knowledge. . . [T]here was hardly a statement in any of these volumes which had not become demonstrably false, meaningless, or obsolete. . . The black bindings were appropriate: the books were coffins of dead knowledge. Their impressiveness as physical objects was grotesquely inconsistent with the speed at which scholarship moves, and it was clear that *books ought to have a very different sort of appearance if they are to symbolize the fact that genuine knowledge is always in a state of flux.* (1978, 49f my emphasis)

Here is as clear a statement as one could wish for, of a struggle against the winding sheets of an old technology, and of what is centrally required of a new one: responsiveness adequate to the speed and metamorphic fluidity of thought. Much the same problem, formulated by the textual editor Jerome McGann in spatial terms, is the difficulty in gaining formal perspective on codex-books from within that medium. Digital genres certainly allow for a perspective from without, but we have not yet figured out how to harness the metamorphic potential of new media to create the "network with a thousand entrances" that critical theory has been imagining at least since Roland Barthes (McGann 2001, 53–74; Barthes 1998, 11–13). Stephen Fraade (1991, 1–23), who quotes Barthes, shows that such ideas are, for example, already to be found in the social nexus of earliest rabbinic commentary. Nothing new, then—except the urgent relevance of old ideas.

Their timeliness is curious. An important part of the reason they are so timely is, I think, that like other inventions, computing creates its own visible trail of precedents from the general fund of historical exemplars by highlighting just those problems it is able to deal with and the prior approaches to them that it can implement. (In other words, methods and tools are cognate.) The precedents thus identified yield in turn the encouragement and wise instruction we need to look past the formidably stubborn technical, psychological, conceptual and scholarly problems of implementation to the potential of the basic equipment we now have. We write the histories we need, get the tools we can use.

Computing is, as I noted, special among inventions. Its incorrigible plurality makes talk of its *advent* and *impact* seriously misleading. We may be forgiven for worrying about our reputations, but it is wrong to construe computing as if it were a singular, irresistible force, like a bowling ball, and its scholarly audience the wooden pins awaiting impact. Similarly misleading are the implications of the standard term "end-user": we are not mere recipients of whatever comes off the production line—unless we configure ourselves that way. Rather, in light of Turing's scheme, we are potentially "end-makers" of new scholarly constructs that we are free to imagine, build, try out and discard, or keep, at will. I suggest that the question facing us is not so much what we are to make (although that *is* a hard question), but rather the form of life out of which the futures we may choose to make with computing are to come. The question is, who do we think we are, and being thus, what do we want?

Digital Scholarship

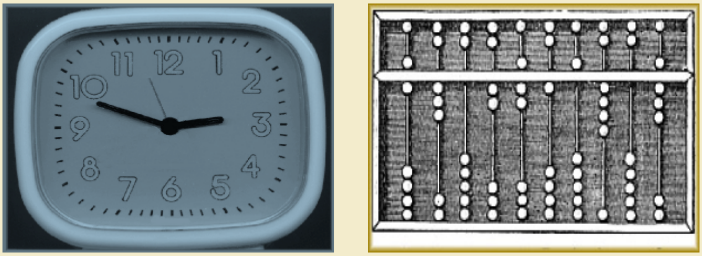
I will answer that question. We are, let us say, inquirers into transcendent artifacts and events—things and situations which cannot in principle be completely specified and so exhausted by our descriptions of them. Our fundamental method of inquiry is in consequence an endless cycle of assertion and denial, or what Michael Sells has identified as kataphasis ("saying" or "speaking-with") followed by *apophasis* ("un-saying" or "speaking away"):

> Any saying (even a negative saying) demands a correcting proposition, an unsaying. But that correcting proposition which unsays the previous proposition is in itself a "saying" that must be "unsaid" in turn. It is in the tension between the two propositions that the discourse becomes meaningful. That tension is momentary. It must be continually re-earned by ever new... acts of unsaying. (1994, 3)

The apophatic method thus reaffirms the ultimate inexhaustibility of the object but does not turn its back on the quest for better knowledge of it. Progress is not ruled out.

As vehicle for the apophatic method, then, computing is valuable precisely because it is, in Vannevar Bush's words, "a stone adze in the hands of a cabinet-maker" (1967, 92)—not just now, as we all know perfectly well, but forever. It can never be completely and entirely adequate to our scholarly purposes because *in principle* there will always be a difference between the object of study and the data taken to represent it, and *in principle* we will always want to know that difference. This is a stronger claim than saying that a representation is not identical to its corresponding object; it is to specify a particular kind of difference. This difference is at the heart of what is now being called "digital scholarship."

"Digital" begins as a metaphor of the digits or fingers of the human hand, which are distinct from each other, much alike and literally manipulative. It is often contrasted with the continuously variable or "analogue" quality attributed to objects viewed holistically. Consider the following two examples in Figure 1. The old-style clock-face (a) is ambivalent, both representing continuous movement and denoting discrete states; hence it may be read either digitally ("two forty-eight" or "two forty-seven and fifty-seven seconds") or as analogue ("getting on for three" or "almost two



(a) (b)

Figure 1

forty-eight").[4] Physically the abacus (b) allows infinite, analogue variation of position for each bead but, by a convention invariant across all cultures where the device is found, it is used and read only digitally, here (from left to right) "6302715408." To speak somewhat anachronistically, my point is the layer of processing between the object and how it is perceived, read or used. Consider now the limiting case in Figure 2: a physical device in which this processing has been implemented, in Boolean logic circuitry, such that only the digital interpretation ~~of the analogue reality~~ is visible.

In Figure 3, an analogue waveform (of a musical note) is shown with a digital interpretation of it superimposed. As this figure suggests, in representing something analogically, we try by means of continuous correspondence for a faithful mimicry: the object changes in some way, and the representation mimics that change, move for move. In representing digitally, we use a standard, all-or-nothing unit-measure. We extract, as Warren S. McCulloch and Walter H. Pitts said in 1943, "a logical calculus of ideas immanent in the represented object."[5] We reduce likeness to a logical formalism operating on data, from which the represented object may be reconstituted. There are all sorts of advantages to this procedure,

[4] The example is Nelson Goodman's (1976, 157ff), from a considerably more subtle and detailed philosophical analysis of an exceedingly complex and difficult subject. My use of the metaphor of human digits is not intended to contradict his point that "a digital system has nothing special to do with digits" (Goodman 1976, 160).

[5] I refer to the paper they wrote, "A Logical Calculus of the Ideas Imminent in Nervous Systems" (McCulloch 1988, 19–39), which John von Neumann took up most famously in his "First Draft of a Report on the EDVAC" in 1945.

Figure 2

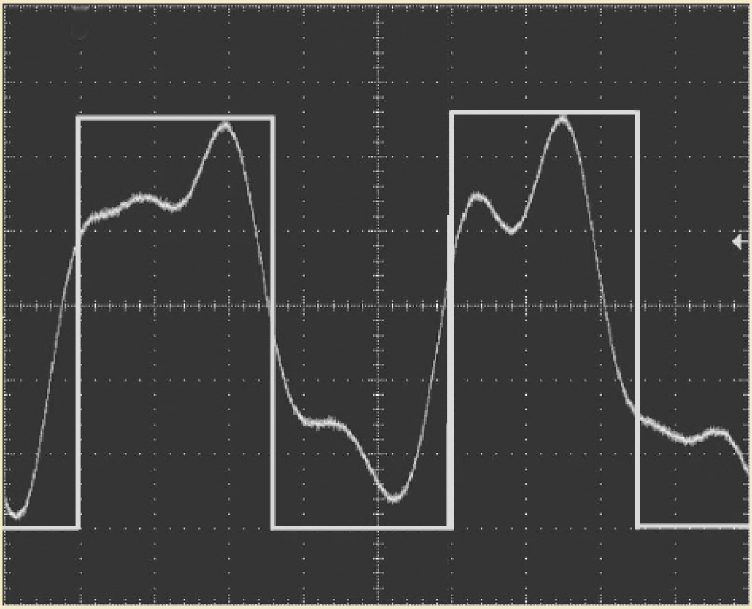


Figure 3

as we know. If your interest is in the engineering of likeness, such as in the case of a music-CD,[6] then the crudity of the representation is concealed by operating at a granularity finer than human ability to discriminate. If, however, your interest is in the transcendent reality of the original, then the digital method of representation is valuable for the purchase it gives you on the discrepancies of correspondence. The enhanced digital

[6] Manovich (2001, 49–51) makes the point for film and animation. See his discussion of "The Myth of the Digital" (52–5).

ability to manipulate the approximation-to-likeness becomes a means of isolating, and so privileging, difference.[7]

Reasoning by constructing representations, then seeing how well they do in comparison to their originals, is intrinsic to how we think, I suspect. Traditional scholarship typically approaches the transcendence of artifacts by classification and categorization, then by studying how the individual work inflects or even violates the categories to which it has been assigned. The deliberate *implementation* of this style of reasoning began in the sciences centuries ago, where such representations are called models. Computing has made a radical difference to model-building in the sciences by reducing the time required to construct and reconstruct them, typically by an order of magnitude or more. (Watson's and Crick's work on DNA in the Cavendish Laboratory at Cambridge, using metal rods and wire for their modelling, provides a good example of how slow and cumbersome it once was.)[8] But the difference is not just a matter of efficiency. Since we are creatures in time, and time-scale shapes how we conceptualize and act in the world, this radical speeding up means a shift in thinking, from a focus on and investment in the thing to a focus on and commitment to the activity of changing it—from, that is, *models* to *modelling*.[9] Common tools for modelling have arisen in consequence of the homogenizing reduction of formerly disparate materials to data and of methods of transforming them to algorithms. The end-maker of do-it-yourself assemblages has in consequence become the norm.

From the common strategy of reasoning, it's tempting to infer that we have been modelling all along, and so to conclude that computing offers nothing essentially new here. The mistake is in overlooking the crucial difference: the quasi- or even semi-physical manipulation—as Lorenzo Magnani (2002, 309) says, "thinking *through* doing and not only, in a pragmatic sense, about doing." It is what Ian Hacking (2002, 180f) makes room for when he rejects "thinking" as "too much in the head," prefers

7 For quite a different view, see Smith (2005).

8 The story is well told by Watson (2001, 83–91).

9 The case for modelling is argued in McCarty (2005, ch. 1); a somewhat abbreviated version is given in the chapter by McCarty in Schreibman, Siemens and Unsworth (2004).

"reasoning" because it is also done "by talking and arguing and showing," then finds fault with it for not sufficiently invoking "the manipulative hand and the attentive eye." Note, then: at the same time as digitization reduces our artifacts to really rather crude representations, modelling expands our powers of reasoning about them. The trade-off, I suggest, is a sign that we are witnessing a genuine change rather than entertaining an empty claim (the no-free-lunch principle).

Thanks to the computer, modelling is taking root in the humanities. While we wait for the consequences to emerge, it would be well to consider what it means for the investments we are making, for our technical practice. An early computer scientist, Alan Perlis, asked in one of his delightful epigrams, "Is it possible that software is not like anything else, that it is meant to be discarded: that the whole point is to always see it as a soap bubble?" (1982, 11). Let me rephrase: is computing all about blowing software soap bubbles and learning from their evanescent behaviour? I think the answer is a qualified "yes," and I think that this answer is steadily requiring fewer qualifications as, increasingly, our tools turn for us into tool-maker's tools. When genuine histories of computing (rather than the chronicles of firsts we now have) become possible, one story I think they are likely to tell is of the computer becoming more and more a ludic, experimental device, for the humanities as well as for the sciences.

Stylistics of Reasoning

But what are the consequences for scholarship? What do these developments presage?

I have mentioned modelling and experimenting. These are important clues to an answer, because both play a prominent role in intellectual history. So, by a tried-and-true method of the humanities, we can look to our own history, thus backwards into the future—or at least to a trajectory for which we have the initial coordinates.

The trajectory I propose emerges from the intellectual history meticulously documented in a three-volume work by A. C. Crombie, entitled

Styles of Scientific Thinking in the European Tradition (1994). Crombie confesses that he was moved to write his "comparative historical anthropology" by the experience of years of teaching in Japan and crossing oceans to visit his native Australia. The practitioner of humanities computing will immediately recognize an ex-patriot's mode of thinking. Simon Tanner uses a religious metaphor to describe much the same thing: he calls it being "lapsed" from one's discipline of origin (Deegan and Tanner 2002, xii). The state of mind is a powerfully effective cross of alienation and engagement—and, I think, precisely what anthropologists mean by "participant observation."

I was led to Crombie's work by Hacking, whose commentary on it provides a philosophical bridge from the past to "the history of the present. That is Michel Foucault's phrase," Hacking explains, "implying that we recognize and distinguish historical objects in order to illumine our own predicaments" (2002, 182).[10] As a historian, Crombie is not concerned with the fact that the styles he documents are all thriving and available to us now. Hacking is.

Crombie documents six of these styles, each with its particular objects and modes of operation:[11]

> The simple method of postulation exemplified by the Greek mathematical sciences;
>
> The deployment of experiment both to control postulation and to explore by observation and measurement;
>
> Hypothetical construction of analogical models;
>
> Ordering of variety by comparison and taxonomy;
>
> Statistical analysis of regularities of populations, and the calculus of probabilities;

[10] For his commentary on styles of reasoning, see also Hacking (1985).

[11] The following list is from Hacking (2002, 182), compiled from several different versions given by Crombie. Note Hacking's argument throughout on the importance and qualified authority of this list.

> The historical derivation of genetic development.

Modelling, for example, directs us to think in terms of "common explanatory principles" that the model shares with the modelled object. These principles, however, also underlie

> a general cultural style, classically directing expectation and assent in the analysis into their elements not only of the necessities and probabilities of the order of nature, but likewise those of human, animal and mechanical communication, of human behaviour, and of visual art, music, poetry and drama. . . . (Crombie 1994, 1241)

A whole way of thinking, being and acting unfolds, and envelops us.

What interests me here is not modelling as such; rather, it is the idea that *reasoning has style*. Hacking explains that a style of reasoning has nothing directly to do with whether something is true or false. Rather it is what creates a range of possibilities for being true-or-false. It is "a way to be reasonable" (Hacking 2002, 188). To cite a choreographic analogy: within a given dance style (as opposed to a particular dance within that style), an indefinitely large number of moves will be true to it, others not; but in neither case are these moves true or false absolutely. A clever choreographer could invent a jerky style within which moves that would otherwise get a dancer sacked would be just right. Hacking cites Foucault's idea of discourse, in each kind of which there are likewise categories of possibility and a specific range of either-true-or-false. This range defines what Foucault called a "field of positivity," populated by candidates for positive knowledge. The result is not subjectivism—Hamlet's "nothing's either good or bad but thinking makes it so"—rather, the result is relativism, which yields a plurality of styles.

Historically new styles are marked by the introduction of many novelties, as well as new candidates for true-or-false, new kinds of objects, evidence, laws or modalities, possibilities, and sometimes new kinds of classification and explanation (Hacking 2002, 189). Having surfaced, styles then develop and attain maturity, each "in its own time, in its own way" (Hacking 1985, 145, 155). Crombie documents the process meticulously, across almost 2,500 pages of text.

Computing is a historical event. There is much talk of innovation. Are we witnessing the birth of a new style?

The Sciences in the Humanities

A slight detour before I deal with that question. I have been proceeding as if we could simply ignore the adjective "scientific" in Crombie's and Hacking's work so that I could get on with exploiting the history and philosophy of science, where the idea of a stylistics of reasoning has arisen. But before going further I must justify the mingling of sciences and humanities. It was, after all, also in Cambridge that Charles Percy Snow—novelist, physicist, civil servant and peer—delivered his Rede Lecture, "The Two Cultures," 46 years ago (see Snow 1998).

Along with the historian of science Lorraine Daston, I am concerned that so little is known about "the epistemology and practices of humanists," i.e. *how* we know what we know. I am concerned because computing raises precisely this question. Daston (2004, 363) notes that the historical and philosophical literature, "especially in English, is overwhelmingly slanted towards the natural sciences." There are perfectly good reasons why this should be the case. Hans-Georg Gadamer (2000, 3–9) and Carlo Ginzburg (1989), for example, explain the imbalance of attention by contrasting the opposed tendencies of nomological, Galilean science and the particularizing humanities: the one, in seeking out the law-like behaviour of things, formulates detachable means of knowing them; the other focuses on the uniqueness of the artifact and so is disinclined to abstract means from ends. Computing alters this comparative picture by requiring such a detachable means irrespective of the knowledge domain.

Earlier I spoke of the detachable methods with which the Methodological Commons is populated. But here as great a qualification must be made of these methods as I made for digital representation—because these methods *are* digital representations. It should now be clear that in realizing these methods computationally, we are *constructively inferring* them from the general obscurity of how we have been working—and that, however we have been working, it certainly has not been exactly in the manner we are able to model on the computer. The gift of computing to the humanities is as much or more creative as it is instrumental. By inducing us to model our heretofore largely tacit methods, it invites us to look backwards to what we have done and forwards to what we can imagine with it. It simultaneously raises the question of how we know what we know and gives us the external means of probing for an answer (or, rather, a better question) by means of a digital approximation.

Here's where the stylistics of scientific reasoning enters the picture I have sketched out. I asked earlier if computing represented the emergence of a new style of reasoning in the humanities. This, again, is a historical question, so for an answer we can look to the history of humanities computing so far. There we find that possibly all the scientific styles of reasoning he lists are exemplified in current work: *modelling*, as I have argued here and elsewhere; *experiment*, in the wide-spread empirical exploration of source materials on an unprecedented scale, for example in corpus linguistics; *taxonomy*, in the rampant ontologizing of knowledge engineers and the design of textual encoding and metadata schemes; *probability*, in literary stylistics and applications of computational linguistics in the language industries; and *historical derivation*, in studies of manuscript stemmata, for example. The one Crombian style I have omitted, *postulation*, requires more thought. In humanities computing (and in the strongly device-orientated fields of textual editing and lexicography) it corresponds, I think, to the crafting of what we may call, generically, "editions," viewed as metatheoretical statements, postulating the edited work as having the scholarly qualities attributed to it.

The populating of these styles by work in humanities computing would appear, then, to suggest that computing is not a new style at all, but rather a bounded scheme within which existing (and perhaps new) styles of scientific reasoning can be represented and applied. In effect computing raises modelling to the status of a meta-style, within which all the reasoning styles are included. It thus frames them conjecturally. It says to us, "Let's construct mechanical simulacra of our cultural artifacts and treat

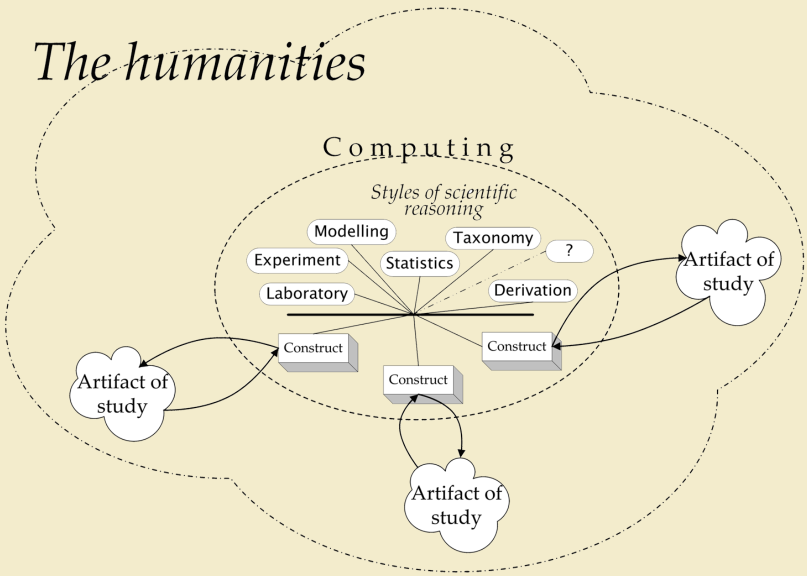


Figure 4

them as if they were natural objects. Here is what our scientific tradition has taught us that we can do with them."

Thanks, then, to Crombie's historical research and to Hacking's philosophical extension of it into a history of the present, we can see our situation with computing in a new light. What we can see, I suggest, is adequately diagrammed in Figure 4, where you will note the bounded scientific realm computing defines, the reasoning styles, the simulacra on which they operate and the negotiation between these simulacra thus analyzed and the artifacts considered in the usual way.

Annoying as C. P. Snow's lecture can be, as dated as some of the ideas are, we have him to thank for keeping the issue of a two-cultured world alive. It has pushed us to think about an unproductive if not destructive cultural barrier and how we might remove it. But now, after 46 years, I think not only that a proper reply is conceivable but that it would demonstrate a prominent role for those two crucial, bridging fields, the history and philosophy of science, in making better sense of computing for the humanities.

Unreasonable Effectiveness

What does this inclusion do for (and to) us? I am not arguing that at last we can demonstrate the superiority of the humanities, and so put to rest Snow's imputation that they are culturally exhausted. Rather I am suggesting a new way of construing their relation to the sciences. Clearly the old image of disciplines polarized from hard to soft—the sciences at one end, the humanities at the other, the social sciences in between—will not do. Its emphasis on linear transition from one discrete unit to the next limits us to relation by contiguity, which is to say, no direct relation at all for most of the disciplines. Computing, I have argued, gives us relation by inclusion—not of the sciences themselves but of their reasoning styles, modelled on the computer.

The old distinction of hard *versus* soft turns out, once we deal with the implicit sexism, to cause no problem at all. Quite the contrary. With a playful imagination one can reconceive the hard programmatic core of included scientific method enveloped within its soft, interpretative integument as something like the genetically programmed seed within its fruit, ready to germinate and grow into a fruit-bearing tree.

In any case, framing scientific styles *is* fruitful. It re-acquaints us with an old and powerful tradition, gives us people to talk to and much to learn. It allows us to borrow from scientific practice in a critically self-aware way. It allows us to ask the methodological question of our own practice without danger of impoverishing ourselves. It educates and disciplines our probing. It enriches and strengthens our curriculum. It raises the stakes and helps to make the intellectual case for what we do. Many benefits, as we will realize in time. But greater than these is the field of intellectual conflict where the digital analytic mind-aspect and the synthetic analog body-aspect of computing come to grips. Around that field the humanities are, as Greg Dening (1998, 183) has said about disciplines generally, situated "on the edge of things in a great ring of viewers"—with humanities computing centre-stage.

At the end of his essay, "The Question Concerning Technology," Martin Heidegger (1977, 35) declares that "questioning is the piety of thought," *die Frömmigkeit des Denkens*. Questioning is, to paraphrase him, the scholar's critical devotion to the life of the mind, following it from change to change. What here is to be questioned is, I think, precisely the comparative negotiation between software construct and material artifact. This question maps straight onto the enigma posed by software itself—what, exactly, it is, or in more practical terms, what happens and could happen when we formulate its relationship to the world it models.[12] There must be, we are told, a precise way of doing this—a mathematics of software—though no one currently knows what it might look like (Mahoney 2002, 38–42). One reason for trying very hard to find it, or cheering on those who know how to look, is to open up the greater enigma Eugene Wigner and Richard Hamming have called "the unreasonable effectiveness of mathematics"—"the astonishing power to establish truths about the world independently of experience" (Hacking 2002, 183). As scholars we take comfort and even pride in what rigorous schemes cannot net, but we really need to be moving on, to ask why they net anything at all?

Consider, for example, the intelligible patterns emerging from statistical analyses of literary texts, in the work of John Burrows and others.[13] Let us call what his methods do not catch the element of chance—that which happens for reasons or from causes we cannot adequately specify. Is it possible that here we see the humanities converging on the mysterious interplay of order and chance, and so inversely matching, with a humanist's own uncovering of determinism, what Hacking (1990, 1) has described from the other side as "[t]he most decisive conceptual event of twentieth century physics. . . the discovery that the world is not deterministic"? Is it possible that humanists, with their computers, are converging from the opposite end on the goal of the cybernetic programme in the life sciences—to gain, as Warren McCulloch declared in 1965, "a satisfactory explanation of how we know what we know, stated in terms of the physics

[12] For the enigma of software, see Colburn (2000); Mahoney (2002); Smith (2002); Smith (1995), 462.

[13] See the articles by Craig and Burrows in Schreibman, Siemens and Unsworth (2004).

and chemistry, the anatomy and physiology, of the biological system?"[14] In his introduction to McCulloch's collected papers, *Embodiments of Mind*, Jerome Lettvin gives me my next-to-last words: "Critics carp," he writes,

> that the current golems do not resemble our friends Tom, Dick, or Harry. But the brute point is that a working golem is not only preferable to total ignorance, it also shows how processes can be designed analogous to those we are frustrated in explaining. . . It suggests what to look for. (McCulloch 1988, v–vi)[15]

It suggests, I suggest, that a particular kind of *looking for* is what computing has given us, and that what we do now is to see what we can find out, not only about our world but also about looking.

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[15] See also Arbib (2000).

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