How to Do Things With Writing Machines

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I want here to argue that literary techniques, far from being the opposites or adversaries of calculation or mathematical procedures, are in fact typically much closer to this kind of procedure than other kinds of communication. Modern literary writing is moving ever closer to this kind of procedural operation. A technography may be defined as any writing of any technology that implicates or is attuned to the technological condition of its own writing. I will try to push through the claim that technography is not just one mode among others of literary writing; that all literary writing is in fact technographic, in the sense that it constitutes what, following George Spencer Brown, I will call an injunctive operation, the engineering in writing of the particular kind of engine of writing it aims at being. So modern writing is ever more technographic, not in the simple sense that it is concerned with other kinds of machinery, but in the sense that it is ever more taken up with the kind of machinery that it itself is. Oddly, this may mean that technography comes into its own against technology, that is the notion of a technology-in-general or technology-as-such. Technography is particular where technology is general; technography is immanent, exploratory and procedural rather than declarative. Technography is not up to phrases like 'The question concerning technology'. This allows technography to operate both beneath and beyond the threshold of technology. Technography does not know yet for sure what a machine is or could be.

I want to say that there is a particular kind of machine that literature has always aspired to be, which is a calculating machine (though all machines are in fact kinds of calculating machine). There is a fundamental distinction within philosophy of mathematics, between mathematics as discovery and mathematics as invention. Philosophers of the first persuasion believe that all mathematical relations exist already and that mathematics consists in their uncovering. Philosophers of the second persuasion believe that human beings engineer the mathematical relations they appear to unearth. Plato is the patron saint of the first kind of mathematician, Wittgenstein a principal exponent of the second.

If most people are inclined to credit the idea of mathematical discovery, there is one respect in which the mathematical experience of most people may actually incline them towards the idea that mathematics is a making, not a making manifest. For most people, mathematics is something that has to be done, rather than displayed. Sums are procedures, to be performed, often with difficulty. Mathematics is worked out, as exertion, often as ordeal itself a mathematical term implying the allocation or dealing out of a penalty.

As such mathematics requires mediating objects. Even Plato, demonstrating to the slave at the beginning of *Meno* that he already in some sense knew how to construct a square *b* of exactly twice the area of a given square *a*, required a stick and a patch of sand for the demonstration. The demonstration is a procedure, that is articulated in stages, and cannot be shown all in one go. And this procedure requires – indeed, in some important sense, actually *is* – an apparatus. It is a technography: a writing out of an operation that consists in that very writing.

What is a calculation? It is an operation performed by some means, through some intermediary machinery – fingers, or toes, or the calculi of the abacus from which calculation derives its name. ('Abacus' sounds as though it might be abecedarial, but in fact may derive from Hebrew *abaq*, sand or dust, referring to the surface in which figures would be inscribed.) Calculation machines are a kind of writing, because they have, because they largely are, memory. They allow quantities to be stored, processed and moved around - as we say, 'carried across'. One might note that there is a secondary calculation module in the mnemonic chant that may accompany these operations, subvocally or out loud.

Calculations perform work, the work of sorting. One does not need stones in particular, but one does need some machinery, something that is hard and external, precisely in order that it can allow for manipulation. No play without a plaything: no work without workings. The soft requires the hard, variation requires the invariant.

Calculation is performed with what are called figures, arranged spatially in diagrams. These diagrams make a machinery of the page-space, or exploit its machinery for what is called 'working out'. Calculations are a sort of primary technography- the writing out of a mechanism, the mechanism that functions through a particular machinery. The earliest mathematical notations – lists of quantities and equivalences, records of amounts – all seem to have in common the manipulation of visible space. Almost all numbering systems, for example, render the first two or three digits as simple tallies of straight lines, like the I-III of Roman numerals, for example.

The passage of mathematical notation from words across to numbers is not accomplished easily or straightforwardly, and calculations were much impeded in the Greek and Roman worlds by the lingering interaction and interference between words and numbers. But, as numbers and number functions become more autonomous, so it becomes easier to perform calculative operations upon them directly, as though they were the actual objects of the calculation, which could be moved about on the space of the slate or page.

Wittgenstein's mathematical constructivism involves the view that mathematical operations do not refer to anything in the world in such a way that they may be said to be true or false. Mathematical operations are wholly syntactic, having reference only to the game they may be said to be playing. The fact that numbers do not refer to the world means that they are wholly present in a way that signs are not: '[n]umbers are not represented by proxies; numbers *are there*' (Waismann 1979, 34n.1). Because the signs of numbers are the numbers themselves, mathematical operations are not signified by the arithmetical notations: '[a]rithmetic doesn't talk about numbers, it works with numbers' (Wittgenstein 1975, §109). This means that 'mathematics is always a machine, a calculus' and '[a] calculus is an abacus, a calculator, a calculating machine; it works by means of strokes, numerals, etc.' (Waismann 1979, 106) . 'In mathematics, *everything* is algorithm and *nothing* is meaning: even when it doesn't look like that because we seem to be using words to talk about mathematical things' (Wittgenstein 1974, 468). 'Let's remember that in mathematics, the signs themselves *do* mathematics, they don't describe it. The mathematical signs *are* like the beads of an abacus. And the beads are in space, and an investigation of the abacus is an investigation of space' (1975, § 157). Similarly, 'What we find in books of mathematics is not a description of something but the thing itself. We *make* mathematics. Just as one speaks of "writing history" and "making history", mathematics can in a certain sense only be made' (Waissman 1979, 34).

Wittgenstein will also declare that 'Language is a calculus. Thinking is playing the game, using the calculus. … Thought is the actual use of the linguistic calculus'. The meaning of such a statement changes over the course of Wittgenstein's writing. Having begun by believing that language could be reduced to the kind of logical calculus provided by Russell, Wittgenstein came to believe that there were many games or calculative operations at work in language.

Calculations become possible in the graphematic space of mathematics – and only there, for they do not take place so much in a space, as with space, because of the self-referentiality of the symbolic machine of mathematics. Calculating procedures are themselves kinds of spatial machinery. Sums and accounts have in common with abacuses the manipulation of space. Since space and place have numerical significance, the movement of numerals across and between spaces performs operations. The simple arrangement of numbers in particular configurations is enough to effect mathematical operations, not just to display relations. The zero is the most important mediator between sign and function. The zero signifies not just a void or gap, but an active holding open of a space, the effect of which is to change the values of the numbers adjacent to it. In effect, inserting a zero has the effect of multiplying the number to its left by ten and dividing the number to its right by ten (or whatever numerical base is being employed). The zero is both the indication of this relation and the injunction to make this shift to left or right, just as one would in an abacus. The zero materialises the space that previously would have been just that, a space left between two numbers.

But I want to claim that the writing we progressively come to think of as literary mimics and in recent times increasing approaches this condition. I propose to call mathematical expressions which perform the actions they signify *operatives*. This is in the model of John Austin's performatives – utterances that do not represent a state of affairs but carry out a function or procedure.

A good example of the operative function of mathematical figuring is the Sieve of Eratosthenes, a procedure designed to find prime numbers. The numbers are arranged in rows from 1-10, 11-20, 21-30 and so on. First of all multiples of 2, which are in alternate columns from 4 onwards, are struck out. Then the same is done for multiples of the next three numbers, 3, 5 and 7 (4 and 6 having already been struck out). Once all the multiples of these numbers have been removed, the remaining numbers will be all the primes below 121. The sieve is one of the earliest forms of the number square, which has been used for many purposes.

I am able to run as well as to show the sieve in an animation (http://www.hbmeyer.de/eratclass.htm), because its operations have been coded. We can say that code is the mediator between text and action, *dynamos* and *energeia*, in that a code is a set of instructions for performing an action. A sieve is, of course, literally a kind of riddle, something used to sift and sort, a suggestive coincidence given that riddles of speech can also be seen as mechanisms for sorting the right answer from mistaken ones. In fact, the two kinds of riddle have different roots, the one deriving from *reden*, to give counsel, yielding the word *read*, the other from a root cognate with Greek *krinein*, to separate; we might say, then, that *riddle* is first-cousin to *crisis* and *criticism*.

Riddles, puzzles and poems are closely cognate; sometimes, as in *Oedipus Rex*, a riddle is seen as central to the operations of a literary text. One of the earliest and most influential collections of Greek poems, the *Greek Anthology*, mixes poems (some of them early examples of ‘pattern-poetry’ or poetry set out in shapes that correspond to their subjects, like eggs, swords and wings) with epigrams, enigmas and mathematical puzzles. Whatever poems were, it seems clear that they were regarded as things to do things with, to be worked with or operated upon, more hopscotch than well-wrought urn. Fibonacci’s *Liber Abaci*, or *Book of Calculation* (1202) mixes description of the Hindu-Arabic numerals and the methods of calculation (without the use of an abacus) that they allowed, with practical puzzles and conundrums. Many calculative or diagrammatic procedures pass across to literary writing from magical or religious usages, such as the acrostic verses to be found in the Hebrew Old Testament, such as Psalm 19, the so-called Abecedarian Psalm, in which each verse begins with a successive letter of the Hebrew alphabet.

The most literary form of calculative puzzle is the crossword, which came into being remarkably late, but is perhaps the modernist technographic form par excellence. The first crossword (or ‘Word Cross’ as it was intended it should be called) was by Arthur Wynne and appeared in the ‘Fun’ section of the New York World on 21st December 1913 (Danesi 2002, 62-3). The techniques of the ‘cryptic’ crossword clue were developed during the 1920s, again in the US, though it has become a speciality of British crossword puzzles. The classic cryptic clue couples a definition with a set of instructions for constructing the solution word. It therefore requires a kind of double vision; the apparent reference suggested by reading the whole clue must be ignored in favour of what might be called the principle of modular construction, in which the elements of the required word are decomposed and then recomposed in turn, following a series of coded terms. Among the most common of these codes is that any word suggesting revision, disordering, or scrambling is likely to be an injunction to reorder the letters of one or more words, that is, to construct an anagram. There is always a kind of magic implied in the anagram. Perhaps the most amazing of all crossword anagrams was that effected by the *Guardian*'s Araucaria, the pseudonym of the Rev. John Graham: 'O hark the herald angels sing the boy's descent which lifted up the world (5, 9, 7, 5, 6, 2, 5, 3, 6, 2 3, 6)' has as its solution 'While shepherds watched their flocks by night, all seated on the ground'. Literary writing has rejoined these kinds of game-like procedure in the work of Queneau, Perec and the Oulipo group, which in its turn anticipates the developments in electronic text of recent years.

Sorting

Reading and reasoning are both conceived as a kind of sorting, which has always had an unusual status. Sorting has links with divination, through the practice of the *sors*, in which a text, usually a sacred or prestigious text such as the Bible or Virgil would be used as the source for divinatory wisdom. This gave the action of sorting considerable prestige – sorting was not only divinatory, it was also literally regarded as the action of a divinity, as in the seventeenth-century expression, evidenced in *The Merchant of Venice*, 'God sort all'. J.C. Maxwell puzzled mightily over the apparent paradox that a hypothetical demon guarding a trapdoor between two chambers containing a gas of a given temperature might be able to open the trapdoor selectively to let through more energetic molecules, and thereby create a thermal differential between the two chambers, which would then be capable of performing work. But this would have created the possibility of work (that is, reduced the entropy of the system), from nothing, or from the simple action of sorting, which would contradict the second law of thermodynamics, and indeed make it possible for there to be perpetual motion. The pseudo-problem (as it has always seemed to me) is generated by the assumption that the act of sorting does not itself do any work, or thereby introduce any energy, into the system. But of course the demon has to do some kind of work in opening the valve, unless we are to assume that the mental act of distinguishing the molecules is enough to cause their physical separation. There will have to be some kind of work because there is some kind of sorting. Maxwell introduced this entity in a letter to P.G. Tait of 1867, as 'a very observant and neat-fingered being', and the fingers, or their equivalent, seem as important as the observant eyes. In fact, we seem to have a strong prejudice against seeing the simple act of arranging as any kind of work, or operation in itself. Of course, I may have to perform some physical work in going through my filing cabinet and deciding which files to shred, walking over to the shredder and feeding them in, and so forth. But our tendency is to feel that the sorting is here being put to work, rather than constituting work in itself. Against this, we should probably set Michel Serres's principle that, not only is all sorting a kind of work, but in fact all work amounts to a kind of sorting.

Indeed, the history of one of the key terms in thermodynamics, energy, seems to enact this interchange between the informational and the physical. The word *energy* in fact enters English through Philip Sidney's usage in his *Apology for Poetry*, as a term signifying force or vigour in language, so is rhetorical rather than mechanical. Sidney is comparing the mere assertion of love with the kind of writing which is likely actually to have some desired effect:

> But truly, many of such writings as come under the banner of unresistible love; if I were a mistress, would never persuade me they were in love; so coldly they apply fiery speeches, as men that had rather read lovers' writings (and so caught up certain swelling phrases which hang together like a man which once told me the wind was at north-west and by south, because he would be sure to name winds enough) than that in truth they feel those passions, which easily (as I think) may be betrayed by that same forcibleness, or *energia* (as the Greeks call it) of the writer. (Sidney 2002, 113)

Sidney is here referring to the discussion in Aristotle's *Rhetoric* III.xi of the means whereby metaphors make us see things, which, for Aristotle, depends on using expressions that represent things in a state of activity. The word *energeia* that Aristotle coins for this, and which he tends to use interchangeably with his other coinage *entelechy*, has been translated by Joe Sachs in Heideggerian fashion as 'being at work': 'the thinghood (*ousia*) of a thing is what it keeps on being in order to be at all (*to ti ēn einai*) and must be a being-at-work (*energeia*) so that it may achieve and sustain its being-at-work-staying-itself (*entelecheia*)' (Sachs 2005, 14-15)

The dynamism of such verbal operations often depends upon the conjunction of words, letters and numerals. Ciphering (derived from the Arabic word for 'zero') often involves the numerisation of the alphabet, such that one series of letters is translated into another by some regularly-applied principle – at its simplest, something like transposing each letter into another letter a given number of letters along in the alphabet. More complex forms of transpositions may involve the use of a key, to move each letter according to a different number, corresponding to the letters in the keyword. This was elaborated in the German World War II Enigma machine by a series of gearings, which shifted letters along. The Enigma machine was indeed an actual physical device, and work on breaking its code was materially advanced by the capture of particular examples. But breaking the code depended on the puzzling through of the interaction between different kinds of components or machinic processes, some of them having to do with the structure of language. The weakest part of any code lies in the fact that it must produce an output that can be translated back reliably into language – and language is full of redundancies or machinic elements, iterable modules about which it is not necessary to think, which may then provide ways in to understanding the code. The codebreakers at Bletchley Park were able to make considerable headway with the recognition that there must be something like a zero-degree formula that was frequently exchanged, since in any human communication there is a great deal of this kind of thing: the formula 'Keine besonderen Ereignisse', or 'nothing special to report' proved to be an important point of entry into the code.

The essential principle here is *alphametical*, to adopt the usual name of a kind of puzzle invented by Henry Dudeney, in which the idea is that the reader has to reverse engineer the code that allows for an operation such as the following:

  S E N D
+ M O R E =
M O N E Y

The operativity of this puzzle depends upon the fact that the alphabet is in fact a numerical series – an ordered sequence of reorderable because equivalent elements. Claude Shannon demonstrated the stochastic nature of word formation by applying a series of sieving operations to a randomly generated series of letters, first of all applying the probability of letters like T and H clustering together, then the probability of three letter combinations, then the probability of these letters clustering in words of typical letter-length. After only 6 such filters an output such as:

> XFOML RXKHRJFFJUJ ZLPWCFWKCYJ FFJEYVKCQSGHYD QPAAMKBZAACIBZLHJQD.

turns into an output like

> THE HEAD AND IN FRONTAL ATTACK ON AN ENGLISH WRITER THAT THE CHARACTER OF THIS POINT IS THEREFORE ANOTHER METHOD FOR THE LETTERS THAT THE TIME OF WHO EVER TOLD THE PROBLEM FOR AN UNEXPECTED (Shannon 1948, 7).

Literary writing is commonly thought of as being at the other extreme from how-to books, instruction manuals, and other uses of writing to assist mechanical or other procedures, whether recipe books, almanacs, change-ringing manuals, musical scores, prayer-books and liturgies, horticultural guides, almanacs, or all-purpose guides such as Joseph Moxon's *Mechanick Exercises: Or, The Doctrine of Handy-works. Applied to the Arts of Smithing, Joinery, Carpentry, Turning, Bricklayery* (London: D. Midwinter and T. Leigh, 1703), the second volume of which is devoted to the arts of printing, that is to say, is an operation upon itself: as Moxon remarked: 'by a typographer I mean such a one who, by his own judgement, from solid reasoning with himself, can either perform or direct others to perform, from the beginning to the end all the hand-works and physical operations relating to typographie. Such a scientific man was doubtless he who was the first inventor of typographie'. As the name suggests, manuals are intended to be held in the hand while other kinds of procedure (other kinds of procedure than reading, that is), are conducted. But this physical involvement in the designated action , along with the implied breaking-up of the reading process required by the action of putting the recommended actions into practice in the way recommended, blends or interleaves text and action. As with the working out of a calculation, or the keeping of a ledger of transactions, the book does not merely describe or record some state of affairs: it enters into its operation. It is not an operation described or implied by the book: it is something that one does, as we say, *by the book*. Nothing could seem further away from a literary text than a recipe-book; and yet there are respects in which literary texts can be regarded as programming the action of their reading, in something of the same way that a recipe book programmes the making of a pie. A recipe says 'make a pie like this'; the kind of text that we think of as literary seems to say 'try reading me like this'.

There is a long history of overlap between number and the kinds of performative we call 'spells'. These 'mathemagical' procedures are strong indications of the ways in which treating words as numbers makes them operatives, or treating words as operatives helps to make them seem number-like. One of the most obvious examples of the magical confluence of number and word is the counting-out rhyme, used for centuries worldwide as a way of drawing lots or casting fortunes. Often, the counting-rhyme is a determinate procedure for producing indeterminacy. The counting rhyme exploits the fact that most human beings lose count very easily. In this respect counting rhymes are really a form of divination procedure. They have in common the fact that they are determinate operations designed to produce indeterminate outputs. They are literally the machinery of the divine, the *machina dei*. But divination is also akin to a kind of calculation, a procedure for revealing a solution or set of relations that is latent in a set of numbers or a statement of relations but not apparent in it. The sifting of a quadratic equation is an operation that is cognitively equivalent to the riddling of grain.

Divination procedures are designed to be magical. Perhaps all machines tend towards the magical, in that, because they are designed to work by themselves, that is, they work without needing to be worked. This means that we can know that they work without knowing or needing to know precisely how. This makes mechanisms useful in the devising of magical procedures. We may characterise the magical through Freud's formula of 'omnipotence of thoughts', where the act of thought is supposed to be all-powerful but occult in its workings. Indeed, thinking may perhaps be regarded as the ultimate magical machinery, since all thinking is unconscious thinking, given that I do not know how I do it. I don't mean that nobody has any idea what is going on, for example neurologically, when I perform the action I call thinking, because we are much more aware than we used to be of the complex physiological correlates of thinking and are likely to become ever more so. What is magical in thinking is its particular ratio of knowledge to ignorance. I know how to think; I know just how to set myself to the work of reflecting, reverie, calculation of consequences. What I don't know is how I know how to do this. I do it by just willing it, but I do not know how that act of willing makes it happen. This is especially the case because willing does not in fact always in fact do the trick – I have to will harder to overcome distraction, for example, but I don't know exactly what I do when I will harder. Magical thinking is thinking that ascribes powers to mental operations – powers for example to make things happen in the world – while keeping hidden the actual operation of those powers. Magical machines often provide the mediation between the known and the known-unknown. There always seems to be some kind of black box by means of which thought makes thinking thinkable.

This is apparent in the huge and systematic confluence between technology and magical thinking. Dirk Bruere's self-published book *Technomage*, to take only one contemporary example, has a chapter entitled 'Machines'. Bruere explains that, despite drawing on quantum mechanics for his theories of magical influence, 'we do not need radio telescopes or the paraphernalia of real science, because we are essentially performing a series of symbolic actions' (Bruere 2009, 92). This unwittingly goes to the heart of the question of what a writing machine is. Is a symbolic machine really a machine, or just the symbol of one? What if the machine in question is designed to process symbols? Can we securely distinguish between a real symbol-processing machine and a symbolic one (is the mechanical processing of symbols itself symbolic?)

Sit

What is a machine? A machine is a material device that allows the iterable and automatic performance of a specific task in the stead of some performer, usually with some gain in efficiency. A machine performs operations without needing or being able to know how or perhaps even that it performs them. The four defining elements of a machine are iterability, automaticity, specificity and surrogacy. Machines do specific jobs for us repeatedly. That they have a material form is usual, but not necessary for them. Most especially, machines usually involve what Ian Bogost, extrapolating from the design of video-games to game-like structures in general, calls 'unit operations' (Bogost 2008). That is, machines are assemblages of autonomous components that can be linked together in variable ways. Machines, we may say, are defined by the fact that they do not know everything about themselves – that they contain encapsulated sub-routines or black boxes. A.N. Whitehead points to the importance of what a later generation would begin to call 'object-orientation' in his 1911 introduction to mathematical thinking:

> It is a profoundly erroneous truism, repeated by all copy-books and by eminent people when they are making speeches, that we should cultivate the habit of thinking of what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them. Operations of thought are like cavalry charges in a battle – they are strictly limited in number, they require fresh horses, and must only be made at decisive moments. (Whitehead 1911, 61)

If there is something machinic about codes and ciphers it is not just because they are constructed mechanically, but because they are also, as we say, 'machine-readable'. HTML code is probably the most familiar of the forms of machine-readable code. Like most codes, it involves a combination of natural language and machine-language, as signified by the pointed brackets which must enclose all the tags. The human reader who is able to distinguish and discount the HTML tags will have the whole of the text available for them, albeit unadorned by any format. The browsers for which HTML is written 'understand' only the tags which tell them how to format the otherwise unreadable text. So, like the crossword clue, the code embodies a difference between reading and processing. When the term 'word-processing' appears in around 1967, it was in fact applied to the IBM's 'Selectric' typewriter, which had been launched in 1961. The innovation was mechanical, in the replacement of the cradle of type bars with a golf ball, which in itself increased the speed and accuracy of typing immeasurably, through avoiding the clashing of type bars which inevitably occurred at high typing speeds. The electric typewriter made the transition to word-processing in 1964, when a magnetic tape system was added, to enable the storing of characters. A word-processor was blind to the meanings of words, which it was able to treat as mere blocks of matter, but it could only do this effectively once the words were no longer in fact hard, but soft, that is, once they were encoded, as instructions to display a particular shape in a matrix of dots. This movement from the electric to the electronic (a machine mechanically powered by electricity to a machine using electricity to encode and decode) meant that the Selectric typewriter became the favoured interface for engineers and computer scientists to input data to computers.

If machine-readable code is to be regarded as a kind of language, in what mood or mode does that language operate? We may say that the language of operation is subjunctive, as in the Latin third-person present subjunctive of *fiat*, let it be made or *sit*, let it be, in expressions such as 'sit Deus in nobis et nos maneamus in ipso' – may God be in us and may we remain in him. The process of running computer code or putting it into operation moves it from the optative (God rest ye merry gentlemen) to the cohortative (let us pray, or let x be y, or simply, Leibniz's hearty 'calculemus'). This is the mode in which most mathematical reasoning occurs: that of the 'let it be that'. It also governs the logic laid out in George Spencer Brown's influential *Laws of Form* (1969), which aims to provide a set of algorithmic notation-procedures, in which the notation is the procedure and the procedure is effected through the notation, for the making out of complex propositions. Indeed Brown declares that:

> the primary form of mathematical communication is not description, but injunction. In this respect it is comparable with practical art forms like cookery, in which the taste of a cake, although literally indescribable, can be conveyed to a reader in the form of a set of injunctions called a recipe. Music is a similar art form, the composer does not even attempt to describe the set of sounds he has in mind, much less the set of feelings occasioned through them, but writes down a set of commands which, if they are obeyed by the performer, can result in a reproduction, to the listener, of the composer's original experience. (Brown 1969, 77)

Like Wittgenstein, Brown sees the injunctive nature of mathematical writing as electively tied to the act of writing. That is, the writing of mathematics is an invitation to its reader to actualise the mathematical propositions in a further act of writing. Mathematics thus becomes the injunction notation of an inscription, which will itself be a notation rather than a simple image or representation:

> When we attempt to realize a piece of music composed by another person, we do so by *illustrating*, to ourselves, with a musical instrument of some kind, the composer's commands. Similarly, if we are to realize a piece of mathematics, we must find a way of illustrating, to ourselves, the commands of the mathematician. The normal way to do this is with some kind of scorer and a flat scorable surface, for example a finger and a tide-flattened stretch of sand, or a pencil and a piece of paper. (Brown 1969, 78)

The principal logical operator in Brown's scheme is what he calls the Crossing, which is a primary act of self-division whereby one entity is marked out from another. 'The theme of this book is that a universe comes into being when a space is severed or taken apart', he declares at the outset of his book (Brown 1969, v), and in the process of course he effects the very action he is evoking. Brown's mark makes a primary distinction between the inside and the outside of something, and may be thought of as an abbreviated bracketing. 'We take as given the idea of a distinction and the idea of an indication, and that it is not possible to make an indication without drawing a distinction. We take therefore the form of distinction for the form'. The making of a mark which distinguishes establishes a form in a kind of self-relation., which accounts for the success of Brown's calculus with biologists like Franciso Varela, who made it the basis for his study of organic autopoeisis in living systems, in *Principles of Biological Autonomy* (1979). The mark is not only at the heart of all form, it represents a fundamental property of the universe, which conjoins knowing and being. This property is reflexivity:

> we cannot escape the fact that the world we know is constructed in order (and thus in such a way as to be able) to see itself.
>
> This is indeed amazing. (Brown 1969, 105)

Reflexivity allows for systems not just to recognise, but also to perform work on and with themselves, the fundamental feature, not just of a calculation, or the difference engine that materialises it, but also of language. Brown insists that this relation of self-seeing is also an act, and an agonistic one: 'We may take it that the world undoubtedly is itself (i.e. is indistinct from itself), but, in any attempt to see itself as an object, it must, equally undoubtedly, act so as to make itself distinct from, and therefore false to, itself' – and in a cryptic footnote to the word 'act' Brown reminds his readers of the Greek *agonistes*, actor, antagonist, and invites them to 'note the identity of action with agony' (Brown 1969, 105). One of the striking features of Brown's *Laws of Form* is how easily it slips between abstract logical relations and actual engineering applications, as in his casual remark that the logical calculus he has set out exists in the form of circuits 'presently in use by British Railways' (Brown 1969, 99), for whom Brown had acted as a consulting engineer.

This active self-relation is, many have thought, a distinguishing feature of the kind of language we call 'literary'. We may say that all executable code, like all arithmetical or algebraic functions, requires something like this primary bracketing or pocketing, in which one set of conditions is first of all set out in a self-contained or bracketted phrase or clause, and then some operation is performed upon it. The rucked or pocketted structure of code is signalled by the function of what has come to be known as the Enter key, which means 'put what has been proposed into operation'; 'so be it'; 'amen'. The sign for the Enter key is an abbreviation of the carriage return on a typewriter, which would signify the completion of a line. The Enter key performs the function of the 'equals' sign on a calculator keyboard, and was sometimes called the 'Send' or 'Execute' key on early computers. The 'entering' of the Enter function derives from the IBM 3270 made in 1971, in which the key was used to input a block of buffered code into a computer, again making the potential actual.

The hangover of all this is the 'Are you sure' dialogue that is an engrained and familiar routine for all computer users. Being given the opportunity to say 'yes' also allows one to say 'no', and to be able to undo commands. There must be bracketting, the interior delimiting of operations as bounded in extent, for an undo command to be possible – otherwise the whole linked structure would be countermanded. Programming must move by a series of encapsulated hiccups, from the proposed to the disposed, the prepared to the performed, a series of epochs in which a system is put to work to execute itself. The 'Enter' is a version of the 'yes'-function analysed in Joyce's *Ulysses* by Derrida, which Derrida sees as part of the 'gramophone effect' of an 'anamnesic machine' of utterance in *Ulysses* (Derrida 1988, 44).

This primary and renewed self-relation may be regarded as a feature not just of all coded language, but also a feature of all language as such. The principle that a sentence requires a main verb to complete it is the principle of the enter or let-it-be-so. Language proceeds by the semantic rhythm of these suspensions and activations.

However, literary language is machine-like and code-like in that it depends on a greater number of processes that may be said to be 'machine-readable' than other kinds of language use, which require and are largely exhausted by the act of communication between a sender and receiver. All language depends upon this kind of implicitness, but literary language is technographic in that the work done by these pocketings of the implicit is greater and more extensive. Another way to say this would be like this. Any piece of writing can be made available for self-scrutiny and therefore made able to act on itself by being digitised, that is, being rendered in a form that makes it machine-readable – that can, for example, count the numbers of characters, or occurrences of a particular word, or even clause-structure. The simple sorting of the information contained in the text performs a work on it that allows it to be seen not as an event but as a structure of relations, increasing its visible redundancy. Literary texts are texts that open themselves up more and more to this possibility of machine-reading in advance of the existence of any actual apparatus for performing such operations. Indeed, we may say that such texts are literary to the degree that they constitute promissory machines (a promised machine and a machine for promising) for self-sorting that would anticipate the operations we call digitisation.

My suggestion is that literary writing has in fact always had a secret kinship with such technographic forms; for, in both cases, the writing is a kind of notation, which joins in the performance of what it signifies. Technography is not just a modern matter, a feature of texts that happen to arise in a world full of machinery, and pay attention to that machinery in various ways. The mediation of other machines assists literature to imagine and start to become the ideal machine it aspires to be. Literature is not any kind of rage against the machine: it is the name for this machinic desire, the desire of this ideal machinery. And, if I am even half-way right, writing has been a machinery of calculation from the very beginning. The particular kind of machinery that has become universal in the modern world is the computer. This machine has become universal because that is what it is, in that it is not a machine for performing one kind of operation (digging, washing up or adding up, say) but a machine capable of operating any other kind of machine, precisely because of its powers of reflecting on itself, or taking itself as an object. We may say that the ways in which literary writing has been put to work, as a general form of programming, is a kind of computation. All literature is technographic, not in the sense that it is about some kind of machinery, but that we tend to call writing literary as it intensifies its attempt to write out, or in George Spencer Brown's terms, to 're-enter into the form' (Brown 1969, 69) of the kind of machinery it itself is. Its noncoincidence with itself is the law of its form and the motive principle of its action.

I have had four things to say here:

1. Literature is not less but more mechanical than other forms of writing.

2. In reflecting on machinery, a text we see as literary evolves its dream of itself as a universal, ideal machine.

3. The machinery on which literary texts electively model themselves is a calculative machinery.

4. The central principle of tis machinery is that it is operative. Like code, it not only is what it is, it does what it says.

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