Synchronization 4: Hermes, Angels and the Narrative of the Archive
    By Geoffrey Bowker

"I first looked for a Greek word signifying 'messenger' but the only one I knew was *angelos*. This has in English the specific meaning 'angel', a messenger of God. The word was thus pre-empted and would not give me the right context. Then I looked for an appropriate word from the field of control. The only word I could think of was the Greek word for steersman, *kybernetes"*. (Wiener)

"It may be that universal history is the history of the different intonations given a handful of metaphors". (Borges)

Introduction
The history of science is a discipline that has at many times appeared orthagonal to 'normal' history. Where normal history demonstrates the emergence of a contingent set of facts about the social world, the history of science has appeared to demonstrate on the contrary the emergence of a pre-existing set of facts about the natural world. Few professional historians of science would now hold such a position. Few scientists, however, would reject it. Most professional historians of science would accept that our memory of the past is sketchy, messy, faulted, and constructed in interesting ways. Many scientists would argue that each scientific discipline displays total recall: every important discovery is remembered in articles, textbooks and by practitioners.

In this paper, I try to go beyond the standard assertion that scientists often have a naive conception of the past of their own disciplines. I look at the work that memory of the past does in a set of cybernetic texts. My central argument is that the integration of the past history of the world, the past disciplinary history of cybernetics and the understanding of memory as a cybernetic phenomenon was an important tool of cybernetic analysis - though not necessarily recognized as such by practitioners. I will argue that this integration was one of the means for moving across disciplinary boundaries without which there can be no universal discipline - a universal discipline being a powerful set of practices and beliefs that lays claim to encapsulate in one way or another all of human knowledge.

Where a given particularistic discipline can claim at degree zero to be at once cumulative, completely falsifiable and in search of a disappearing future truth (though at degree one it will often claim universality - the universal scientific method), a universal discipline in some sense already needs to have discovered the truth. Its goal now is to unpack that truth in all its infinite complexity. Time becomes a marked category for universal disciplines - much as it has done for evolutionary theory, whose basis in retrodiction means that temporal patterns and historical theory needs to be carefully thought through by practitioners. If one wants to draw from the work of many disciplines simultaneously, as cyberneticians in the period 1943-1975 did, then one must also be able to deal with the fact that particular disciplines operate within very different timescales and philosophies of time, each appropriate to their own internal structure.

In this paper, I will look at the temporal patterning of the universal discipline of cybernetics. I will argue that much of its power comes from the complexities of its temporal patterning. In particular, I will maintain that the standard split between time as duration and time as container (MacTaggart's A and B times: see Adam, 1990) breaks down in interesting ways within the discipline of cybernetics in the period 1943-1975. I will argue that both kinds of time dissolve into a form of time with agency. This latter time takes the human-centeredness out of duration and the object centeredness out of the container, thus permitting a temporal merging much of the same kind as cyberneticians argued spatially for insides and outside (inside and outside an organism; inside and outside the human race and so forth - see Bowker, 1992).

Capitulating Recapitulation
Historians have long rightly been suspicious of the endless quest for the first x. It is always possible to push a given origin further back in time. The first member of the bourgeoisie has I believe been discovered in 12th century France: the next question is what to do with him. This origin is perforce anachronistic. A new social movement, or a new scientific discipline, creates its own origin at the same time as it writes its textbooks. Lavoisier's revolutionary textbook in chemistry removed all filiation with the affinities and alchemy of previous centuries by changing chemical nomenclature. In the beginning was the word. History started here, chemical time henceforth had an arrow - and all before was chaos. Lyell made the same move in geology: arguing that before his tract, geological theories had been catastrophist and had changed catastrophically, with his theory geology had become uniformitarian and would change uniformly. Michel Serres in a recent work expatiates brilliantly on the theme of geometrical origins using the analogy of the source of a river. Capillaries feed into the source, filling it slowly, immeasurably until the reservoir is full and a torrent is unleashed. It is only after the torrent has begun to run its course that we can speak of the arrow, the swift march of events... . What pours out of Euclid's axioms cannot be traced back before Euclid: since there was no arrow to geometrical time before the axioms were inscribed. Let us take a working definition of a 'discipline' as a field of research that has a commonly accepted origin myth, ritually incanted in the first chapter of textbooks and the opening lectures of a survey course. Where does this leave interdisciplinary work? Not without origin myths, certainly, but with perhaps a different kind of origin myth.

Now why are these myths of any interest? Could it not be argued that they serve much the same function as the reference to the proof of God's divine handicraft at the beginning of many nineteenth century scientific texts - a ritual obeisance orthogonal to if not at odds with the actual work done in the pages which followed? A central theme of this paper will be what I will call *recapitulation*, by which I will mean the encapsulated retelling of a history in another medium: for example ontogeny's tendency to recapitulate phylogeny. I will argue, through recapitulation, that much of what cyberneticians in the period 1943-1970 said about their own discipline and its origin was recapitulated in the scientific work that they did: so that there was a resonance between the 'inside' and the 'outside' of the discipline. In a sense this is not surprising since cybernetics can be characterized as that method of working which does not recognize the distinction between insides and outside.

My immediate argument is, then, that the history of all science (culminating in the development of cybernetics), of all humanity and often of the universe is recapitulated within the development of the science of cybernetics over the previous ten to fifteen years - so that first there was a complete reworking of all of science in a different medium (a new language); and that second truths about the history of science and humanity were also, within cybernetics, truths about the world - there was a formal analogy between these two.

The first step toward this recapitulation can be found in many cybernetic texts, taking the form of the assertion (by no means peculiar to the cybernetics itself) that the kind of processes and change that prior civilizations went through over centuries in order to get where they are today are now being repeated within a single lifetime or fraction thereof. Thus Gioscia writes: "Rearviewing the decade of the sixties, we can now estimate that technology has wrought more rapid social change in the last ten year than in the past ten millennia. This makes it imperative, yet more difficult, to forecast the seventies" (Gioscia, 1974: 52). Note the phrase 'rearviewing'; doubtless a reference to the superb Fiore image of a rearview mirror looking at a stagecoach at the center of <u>The Medium is the Massage</u> accompanied by McLuhan's haunting phrase 'we march backwards into the future'. This recapitulative developmental process was itself inexorably speeding up: "Once, Whitehead could write that there had been more change in the first 50 years of the twentieth century than there had been in the prior 50 centuries. Now, reviewing the decade of the sixties, we can say that there has been more social change in the last decade than there was in the previous five ... . All this *before* computers". (Gioscia, 1974: 42). This recapitulation was made possible by the fact that time was now going faster than it once did; and typically cybernetically Gioscia slipped its results from the outside (history of world civilization in this case) to the inside (ordering one's thoughts): "Just as the second (automated) industrial revolution generalized the first by dealing with the informational *exponents* of energy-processing rather than simply with energy constellations (mechanical objects) one at a time, so the second (psychedelic) chemical revolution generalized the first (narcotic) one by dealing with the temporal exponents of getting high rather than simply getting drunk time after time". (Gioscia, 1974: 47). The assertion of a contemporary temporality new to this era and exemplified by cybernetics is not peculiarly psychedelic.

Accelerated time, permitting recapitulation, was a very common trope - from Alvin Toffler's <u>Future Shock</u> through the cybernetic literature. John Pfeiffer for example wrote that: "In eighteenth-century Europe science, like polo and yachting today, was still largely an activity of gentlemen with ample personal funds and leisure. Since then, science and technology have become the full-time occupations of millions of persons. Furthermore, every investigator probably gathers more data in a week than his predecessors of a century or two ago gathered in months or years" (Pfeiffer, 1962: 5). Pfeiffer matched his odd vision of science for the millions (is not big science the most capital intensive endeavor?) with a curious temporal inversion not uncommon in recapitulative logic: "The development of all sorts of computers comes at a crucial time.

Indeed, it is difficult to imagine how we could cope with our problems if such computers did not exist" (Pfeiffer, 1962: 4).

In Pfeiffer's case, this first step towards recapitulation took the form of the working through of data. It could also take the form of the reworking of philosophy: the pattern is more important for our purposes than the details. In a very similar passage, Beer refers back to another leisurely past, those halcyon days when: "the study of conic sections in geometry was an intellectual pastime for Greek gentlemen" (Beer: 1959: 64). Now, however: "a case can certainly be made for saying that cybernetics is the embryo science which draws for its pure theory on at least 2,000 years of 'useless' philosophizing." (ibid). Thus past philosophical progress can be recapitulated in accelerated form by the new discipline, and for the first time it would be realized - made real. All of past history of philosophy will be instantly reworked now. We have seen three kinds of accelerated recapitulation - accelerated social change (whole civilizations in a decade), accelerated data processing (whole centuries of scientific progress in a year) and accelerated philosophizing (whole millennia of useless philosophy taken up and reworked in a trice). This is not yet recapilation in the sense of a literal replay of past events at a faster rate. Rather, what is happening in each case is that the unit of historical time is changing such that processes once tied to civilizations and 'longue durée' are now attached to individuals/societies and much shorter duration.

Cyberneticians posited a formal connection between the history of cybernetic ideas and the history of humanity. Pierre de Latil's Artificial Thought: introduction to cybernetics (1953) bristles with examples of this connection. The first sign is the position so common to cyberneticians that cybernetics was 'in the air' (25). Unlike traditional sciences which argued their separation from the flow of political and social events (see Latour's We have never been modern), de Latil revelled in it: "However the cybernetic revolution would no doubt not have spread with such explosive force if it could not be found 'in the air'. This banal image - 'in the air' - is in fact profound: the idea was everywhere invisibly present, such that the spark of a book [Wiener's] set off the conflagration" (25). A new kind of temporality has been introduced into science. In the past, "a whole series of new disciplines saw the light of day. But they were merely specializations and sub-divisions of specializations; here, on the contrary, the doctrines are united and fertilize each other. Thus after a long work period that we could call its age of analysis, science is, under our eyes, achieving its age of synthesis. And, for future centuries, the dawn of this era will be marked by the birth of cybernetics" (26).

Cyberneticians, through their work with machines, were taking up and working through all of human history - and even the history of the universe - at an accelerated rate. Through cybernetics, machines are evolving in a history of the conquest of liberty recapitulating the human history of the conquest of liberty, with the freedom to determine their own actions as the penultimate stage - the same stage that humanity had achieved (319). The final stage was the integration of the history of machines and the history of humanity. The former two are unproblematic for de Latil: "More exactly, here is how we need to understand things. We have seen that with respect to simply determined machines that they are in fact always used by humans retroactively - their operated

observing what they do and correcting one of their organs so as to keep the effect at a certain value; the human-machine complex must then be seen as being master of these factors. At this highest degree of automatism, humans and the organs they dote themselves with form a single complex, of the seventh degree this time. Through scientific progress, the human species is currently in the full flow of 'evolution', giving itself sense-organs and possibilities for action that set back these limits. This is why our technology is of the highest philosophical importance" (316). The logical sequencing of the degrees of freedom of machines matched the historical sequencing of machine development which recapitulated - and finally integrated with - human development. Human history and the history of machines could be rationally reconstructed into a single underlying history inscribed in different media. Going back in time through the history of feedback mechanisms revealed precisely the same story as going back in time through the history of humanity.

This kind of argument was not peculiar to cybernetics. We all learnt variations of it in school; and it has a pedigree going back into the nineteenth century and beyond. Thus the great historian Jules Michelet produced a nested three-world theory of human history. On the largest scale was the whole world, with France in its center. Nested inside this was the world of Europe, with France at its center. Nested inside this was the world of France, with Paris at its center. Each of these worlds had synchronic and diachronic extensions. At each level, as you went out in space from the center, so you went back in time, and so you had a smaller scale recapitulation of world history. The further you went out the closer you were to nature - India at the first level was maximally subject to the environmental effects of race and climate. At the second level, Germany was Europe's India - and so on (Michelet, 1831: 229-238). Clearly the recapitulative trope is one that in its many incarnations is suited to systems thinking - one thinks also of Serres' brilliant analysis of cycles in Comte's historiography of science, the world and humanity. Here I am just marking the existence of these past occurrences: I will not in this paper try to give a complete account of its genesis; such a project would be ill-suited to a work denying the existence of origins... .

Resonances
The reference back to Michelet is doubly useful, however. It also displays a feature found in cybernetic recapitulations: boundaries between nature and society get redrawn (for Michelet over time in one country, over space throughout the range of countries). Loewenberg (1958: 10) asserts for systems theorists Darwin's role in opening up the possibility - even the necessity - of discovering such patterns: "Darwin gave biological science an historical dimension. He likewise gave history a biological dimension. If Darwin succeeded, as Whitehead asserts, in putting man back into nature, he also succeeded in putting nature back into history. Man is part of nature and nature is part of man. Such separations as are properly drawn are drawn, not by nature, but by man himself. The theory of evolution is a history of life. The history of civilization, whether product or by-product, is continuous with that history" (10). This opens up the possibility that stories that we tell about human history (the development of morality, mind etc) or about natural history (aggressive instincts) can also be told about any other kind of

history - of cabbages and kings. A common universal history could be told over many timescales and was in fact inscribed in many media: "Evolutionary insights and the logic of analysis applied not only to rocks but to animals, not only to animals but to man. Evolutionary insights and the logic of analysis applied to mind, to morals and to society "(13). Gregory Bateson put this ability to cross media at the heart of cybernetic explanation, arguing that since cybernetics excluded all things and all real dimensions from its explanatory system, what was left was a propositional and informational universe peopled by processes in which the map often *was* the territory - for cyberneticians: "the bread *is* the Body, and the Wine *is* the Blood" (Bateson, 1967: 30-32).

A central argument that Ross Ashby runs in his classic <u>Design for a Brain</u> is that adaptation in animals, and civilization in humanity, can be understood in terms of 'homeostasis': keeping critical variables (temperature, thirst, hunger etc) within acceptable limits. This can be read as the double destruction of time: cyclical time (the seasons) and linear time (getting hungry) are rendered null by the black box of the homeostat. Further, it sets the destruction of time (homeostasis) as the motor of history (adaptation). There is a temporal complexity here analogous to Marx's taking time out of future history: the cybernetician took out time and humanity. Central to our purposes here is his observation that it is very difficult to do the temporal accounting which would allow for random changes in organisms and a fortiori in the brain over time, since on a naive systems view so many of the possible adaptations would be destructive of homeostasis: using a standard trial and error systems, he reckoned that the brain would take 10^{22} years to have reached its current state. Linear time could not do the job required! The only way that really complex systems, like the brain or English civilization, can be kept within reasonable limits is that they are 'ultrastable': lay waste to a county in England and the paper-making industry would still survive; similarly one can gouge out a portion of the brain and still have a working organ (182-3). Ultrastable systems can deal with adaptations at a fast enough rate, since death does not necessarily ensue from failure. The brain's greatest trick is that it can help us react flexibly to a wide range of different possible environments, and still maintain our key variables within reasonable limits: it is a general-purpose machine.

By the same token - and it is *exactly* the same token - the cybernetic method must be a general purpose method:

> The actual form developed may appear to the practical worker to be clumsy and inferior to methods already in use; it probably is. But it is not intended to compete with the many specialized methods already in use. Such methods are usually adapted to a particular class of dynamic systems: one method is specially suited to electronic circuits, another to rats in mazes, another to solution of reacting chemicals, another to automatic pilots, another to heart-lung preparations. The method proposed here must have the peculiarity that it is applicable to all; it must, so to speak, specialize in generality. (12)

Thus just as the brain is the result of a long adaptive process forcing it to be general in purpose and either machine or organic in medium; so is the universal discipline of cybernetics the result of a long adaptive process forcing it to be general in purpose and

not tied to any one specific discipline. The resonance between method and object works because the same kind of temporal patterning can enframe each: they are the outcome of a time which effectively has agency.

A complex reading of the link between evolutionary theory and cybernetics - but a link nonetheless supported by a careful reading of Ross Ashby - is that just as evolutionary theory sought for the 'missing link' between homo sapiens and ape, so did cybernetics seek the missing link between person and machine. We are in the process, he argued, of creating right now machines that will prove to have been the missing link:

> Thus, *selection for complex equilibria, within which the observer can trace the phenomenon of adaptation, must not be regarded as an exceptional and remarkable event*: **it is the rule**. The chief reason why we have failed to see this fact in the past is that our terrestrial world is grossly bi-modal in its forms: either the forms in it are extremely simple, like the run-down clock, so that we dismiss them contemptuously, or they are extremely complex, so that we think of them as being quite different, and say they have Life.
>
> Today we can see that the two forms are simply at the extremes of a single scale. The Homeostat made a start at the provision of intermediate forms, and modern machinery, especially the digital computers, will doubtless enable further forms to be interpolated, until we can see the essential unity of the whole range. (231-232)

Ashby is not the first to see a link between homeostasis and adaptation: Wittezaele and Garcia (1992: 60) cite Bateson's pleasure in finding that Wallace had had a psychedelic experience following a malaria attack and had written back to Darwin his insight that the principle of natural selection was like the operation of steam engine with a governor (this latter being a central image for all cyberneticians).   The cybernetic equivalent of the synchronic great chain of being (Lovejoy, 1936) is the diachronic great sequence of history. The development of life on earth was, for Ross Ashby, completely inevitable (233). He argued that: "nothing short of a miracle could keep the system away from those states in which the variables are aggregated into intensely self-preserving forms. ... We can thus trace, from a perfectly natural origin, the gene-patterns that today inhabit the earth". In this counterfactual, we get the Christian's miraculous origin of life inverted into the imaginary miraculous failure of life to evolve. This is passage marks a twist in the Moebius strip that leads us from inside cybernetics (reasoning that all practitioners would regard as integral to the interdiscipline) to its outside (the recapitulative history of humanity in which the existence of cybernetics as a discipline became inevitable). We shall see in a minute that for cybernetics memory was destroyed through its transformation into a spatial configuration of organism plus environment. Here the miraculous moment of origin is destroyed through its transformation into an inevitable systems configuration; and through this destruction all histories can become one. Thus the complete history of the world makes sense now, at this moment in time, because cybernetics with its attendant machines has interpolated the missing link in the single great narrative that can now resonate at all levels.

Cybernetics is quintessentially the universal discipline of the meso-level: it stand between organic and inorganic, between inside and outside, between the art of reduction to the very small (physics) and relegation to the transcendent (Christianity). This meso-level is one that has frequently appealed most to systems thinkers: the great systematiser Comte was also happiest there for example.

The Destruction of Memory
For an illustration of a resonance between the history of civilization and the insides of cybernetics, we will now look at the cybernetic theme of the destruction of memory.

When Auguste Comte wrote his 'Course of Positive Philosophy' in the 1830's, he produced a complete classification of the sciences - from the purest mathematics to the messiest sociology. Each science would, reflecting the model science of physics, be divided into a statics and a dynamics. Not all sciences had yet achieved their place in this classification system: sociology was still too inchoate, chemical dynamics were not yet clearly worked out. However, at that future time when all sciences did occupy their fated slots, there would no longer be any need for or possibility of a history of science. No need for because everything would flow forwards from the first principles whose existence was guaranteed by the existence of the classification scheme. No possibility of because the stories to be told would have become so long and messy that students would get lost in the byways before they ever learnt the first principles. Thus for a science-in-the-making we need a history, a true science just needs to be part of a classification system. Comte still had a role for the great figures from the history of science: he developed a positivist calendar which replaced the old pagan names of the months and Christian saints days with the names of great scientists. When geology no longer had a history, it would have a day and a month... . So classification can often involve destruction of memory.

Cyberneticians have frequently announced the dawning of a new age and with it new classificatory principles. Thus Pierre Auger declaimed: "Now, after the age of materials and stuff, after the age of energy, we have begun to live the age of form. The old age, he argued, was one of diachrony and materialism: it gave us the historicist visions of Darwin and Marx (see Tort, 1989 for diachronic classification in the nineteenth century). This age, he argued, is that of synchrony and form. When such an epistemic break is operated, the knowledge of the previous age becomes irrelevant; when the break is constituted by the move from diachrony to synchrony, the past is doubly deleted.

In Ross Ashby's work amongst others, this new age them resonates with a need internal to cybernetic analysis to destroy memory. Consider the following extract from an article on general systems science as a new discipline, in which the need to do without memory is expressed purely as an internal concern:

> I have just said that when the Box is not completely observable, the Investigator may restore predictability by taking account of what happened earlier. Now this process of appealing to earlier events is also well known under another name. Suppose, for instance, that I am at a friend's house and, as a car goes past outside,

his dog runs to a corner of the room and cringes. It me the behavior is causeless and inexplicable. Then my friend says "He was run over by a car a month ago". The behavior is now accounted for <u>by my taking account of what happened earlier</u>.

The psychologist would say I was appealing to the concept of 'memory,' as shown by the dog. What we can now see is that the concept of 'memory' arises most naturally in the Investigator's mind when not all of the system is accessible to observation, so that he must use information of what happened earlier to take the place of what he cannot observe now. 'Memory', from this point of view, is not an objective and intrinsic property of a system but a reflection of the Investigator's limited powers of observation. Recognition of this fact may help us to remove some of the paradoxes that have tended to collect around the subject.

In his <u>Introduction to Cybernetics</u>, Ashby railed against memory more technically but with an equally strongly weighted vocabulary, arguing that it was an epiphenomenal process that only our incomplete knowledge of the appropriate Markov chain for the given closed system (black box plus investigator) being considered. Memory is a metaphor needed by a 'handicapped' observer who cannot see a complete system, and "the appeal to memory is a substitute for his inability to observe ..." (Ashby, 1956: 115).

This theme of the destruction of memory is a complex one. It is not that past knowledge is not needed; indeed it most certainly is in order to make sense of current actions. However, a <u>conscious</u> holding of the past in mind was not needed: the actant under consideration - a dog, a person, a computer - had been made sufficiently different that firstly past knowledge was by definition retained and sorted and secondly that only useful past knowledge survived. Thus von Foerster's quantum theory of memory featured centrally an algorithm for forgetting (Beer, 1959: 35-39). This position clearly resonates with Loewenberg's analysis of evolution we have looked at: you don't need a memory if evolution is doing your thinking for you... . and of course the way that evolution is doing this thinking is by forgetting: by deleting organisms that do not work. The creatures of evolution are hypotheses (Fogel, Owens and Walsh).

One thing that becomes impossible when you deny the conscious holding of memory is any principle of duration: this ties back into the synchronic nature of cybernetic insights, the ability to shift between levels (one second can be a thousand years and so forth) and the denial of a difference between human and non-human actants. Past duration held within human memory is replaced by present emergence (Bergson's creative evolution) held in the configuration of objects and people in the now. Thus Bateson argued that: "we are left regarding each step in a communicational sequence as a *transform* of the previous step. .... We deal with event sequences which do not necessarily imply a passing on of the same energy" (Bateson, 1967: 32).

Retention of the past in consciousness would militate directly against the principle of feedback being applicable across the great divide between organic and inorganic. Thus Ross Ashby, echoing Wiener, Bigelow and Rosenblueth argued that once it was appreciated that feedback could be used to correct any deviation: "it is easy to understand that there is no limit to the complexity of goal-seeking behaviour which may occur in

machines quite devoid of any 'vital' factor. ... It will be seen, therefore, that a system with feedback may be both wholly automatic and yet actively and complexly goal-seeking" (55). The future and teleology can be made respectively determinate and automatic, yet at the price of legislating away the past and history by denying memory.

For Ross Ashby, there was a clear methodological need to destroy one's memory of the past when applying cybernetic tools:

> Ordinarily, when an experimenter examines a machine he makes full use of knowledge 'borrowed' from past experience. If he sees two cogs enmeshed he knows that their two rotations will not be independent, even though he does not see them actually rotate. This knowledge comes from previous experiences in which the mutual relations of similar pairs have been tested and observed directly. Such borrowed knowledge is, of course, extremely useful, and every skilled experimenter brings a great store of it to every experiment. Nevertheless it must be excluded from any fundamental method, if only because it is not wholly reliable: the unexpected sometimes happens; and the only way to be certain of the relation between parts in a new machine is to test the relation directly. (19)

There is a triple destruction of memory implicit in this text. First of all past disciplines are destroyed: they need to be created anew from first principles. Secondly, an individual experimenter must destroy his or her knowledge of previous experiments. Thirdly, one result of this double destruction will be the discovery by cybernetics that memory itself is epiphenomenal. The three levels thus resonate, holding the same temporal pattern in different media. Note that this destruction of memory does not equate with the destruction of time and the observer in classical physics. In cybernetics memory is destroyed so that history can be unified; in classical physics non-reversible time is destroyed so that history can be ignored.

Conclusion
It is not obvious that a social history of a universal discipline like cybernetics requires a reading of temporal patterns used in some of its texts - a fortiori in that I have not operated any kind of supervenient intellectual hierarchy to distinguish between good and bad cybernetics. I have argued that complex temporal patterning plays a central role in the elaboration of cybernetic texts in the period 1943-1975 - and that in particular the destruction of memory is the temporal extension of the central notion of feedback. In order to sample this patterning, it was necessary to be able to range freely throughout the universe of cybernetic texts. The implicit social history comes out in the argument that the dissolution of boundaries between inside and outside that marked the formal operation of general systems analysis as developed by cyberneticians is complemented by a principle of resonance that makes all histories the same history. Thus, cybernetics operated in our period like a Moebius strip - if you follow round any narrative from the 'inside' (say the working of the brain) you will get round to the 'outside' (say the history of humanity) - and of course vice versa. Like many universal disciplines through the ages, cybernetics offered a way of reading the macrocosm and the microcosm as reflections one of the other. Though the logic is the same, there was a difference in tendency from early forms which as a rule read humanity and human needs writ large in

the external world: cybernetic tended rather to read the external world writ small in humanity.

Elizabeth Eisenstein points out that the printing press gave us a certain kind of packing algorithm for knowledge - the linear time of the narrative in co-ordinate space (left to right, top to bottom, forwards in time as you read). In other words one damn thing after another. In cybernetics, as in other universal disciplines, this kind of algorithm does not work: you need a principle for enfolding knowledge into itself. This enfolding is itself a very powerful tool - for a discussion of some of the roots of this power see Lucien Dallenbach's (1989) analysis of the mirror in the text. One cannot understand cybernetics as a universal discipline without looking at the religious fervor and hypernatural excitement that it generates. One way of understanding these latter is in terms of the resonances that are set up. There is no such thing as a single cybernetic statement, true for only the level that it applies to and eschewing the three m's - metaphor, metonymy and metaphysics. On the contrary, each statement in the universal discipline resonates at each possible level of analysis: the experiment, the experimenter, the history of the cybernetics, the history of the world. In this way a cybernetic text can be read as a verbal yantra: the complex enfolding of many registers of knowledge into a single textual space. In order for cybernetic interdisciplinarity to be achieved, all knowledge had to be in principle folded into the universal discipline. By looking at the temporal patterning of some cybernetic texts we have seen how such enfolding is both possible and powerful.

Life, it has been said, is a message that the universe sends to itself. This statement encapsulates the kinds of messages that cyberneticians in the period 1943-1975 dealt in: messages that were exchanged and had meaning without for all that having conscious recipients processing them. Wiener was right to reject 'angels'. He could - as Serres has done in a series of books - have chosen Hermes: a messenger who paradoxically is cloaked in secrecy and whose messages are about the way things are as much as they are about the state of mind of the gods. He did well to choose 'cybernetics', since the reference to feedback control implied messages with a distributed sender and without a past; with myriad recipients and marching sideways into the future.