Information and Knowledge

Suhail Malik

IN HIS now venerable 'report on knowledge', Jean-François Lyotard states that technoscientific 'transformations' in cybernetics, communication theory, data storage and transmission, and so on, 'can be expected to have a considerable impact on knowledge'. This has of course become a truism and a reality in the 20 years since the writing of *The Postmodern Condition*, as has the specific determination of this 'impact':

> [Knowledge] can fit into the new channels, and become operational, only if learning is translated into quantities of information. . . . The 'producers' and users of knowledge must now, and will have to, possess the means of translating into these languages whatever they invent or learn. . . . Along with the hegemony of computers comes a certain logic, and therefore a certain set of prescriptions determining which statements are accepted as 'knowledge' statements. ([1979] 1984: 4)

The transformation of knowledge into information demands its codification into a 'certain logic', a certain, determinate, 'operationality'. The movement described here is from knowledge as a mental or 'cultured' human acquisition to its 'exteriorisation . . . with respect to the knower'. Knowledge becomes systemic.

Although Lyotard stresses how this movement leads to knowledge's commodification and mercantalization in capitalism, and to its increasingly central role in ordering power at every level, what it is also highlighted is how this is a movement of knowledge's instrumentalization. Knowledge will itself continue to have meaning only insofar as it will be operational, which is to say in keeping with means–ends and productive logics, categories and functions; that is, insofar as it accords with certain rules, codes and 'prescriptions'. Such a demand limits what knowledge can be; it is a reductive determination of knowledge. And, as is well established by the critical determinations of instrumental rationality in the humanities and social

■ *Theory, Culture & Society* 2005 (SAGE, London, Thousand Oaks and New Delhi), Vol. 22(1): 29–49
DOI: 10.1177/0263276405048434

sciences, this reductionism accords with the systemic requirements of efficiency and exchange that do not accord with personal, social or even human needs but are instead directed towards capitalism.

Even disregarding the fatalism of this scenario, the point stands: when it becomes information, knowledge is not free and not in the name of (human) freedom, or anthropic determination, or 'for its own sake'. The move is from knowledge, which has a meaning and value that is intrinsic to it, to information, which has an extrinsically determined meaning and value. In this externalization of what is meaningful, knowledge is determined in terms of exchange-value rather than use-value.

There is a nuance in this argument that needs to be addressed, however. It is not that information requires knowledge to be instrumentalized – as will soon be seen, there may be modes of information that cannot be determined as knowledge. Rather, the point made by Lyotard among others is that the *instrumentalization* of knowledge transforms it into information. The difference to be highlighted here is between the characterization of information as such and, on the other hand, knowledge's instrumentalization as information. What is left begging between these two determinations of how information and knowledge relate to one another is whether information is *per force* an instrumental category. If it is, then the nuance brought to light here collapses and the argument about knowledge has no special place: whatever becomes determined as information becomes instrumentalized and the fate of knowledge is only one such case. However, it seems that there is a stronger connection between knowledge and information than this: specifically, information displaces, if it does not replace, knowledge in the new channels and structures stipulated by technoscientific and contemporary capitalistic determinations. Correlatively, epistemological concerns are displaced, if not replaced, by material-systematic ones. This is, for example, a central contention of Scott Lash's *Critique of Information* (2002) in the description of the collapse of the temporal, spatial or logical conditions for reflection (allied with knowledge) as condition of critique in 'information societies'.

The transmuted identity of knowledge and information can be contested, however. A hesitation about their relation allows for the otherwise intimate knot between these terms to be loosened. With that, some leverage can be had on the question of whether knowledge is in fact, operation, or concept instrumentally displaced by information, or even how the relation and movement from one to the other – if there is such a movement – is to be understood. To be clearer about this, a more precise characterization of information is needed. This is notoriously difficult given the variety of ways the term is understood and operates: as an embodied and material cause (in some genetics), as a signal with a transmissible quotient without determinate location or material/embodied specificity (in cybertheory), as a statistical quantitative property of a system (in communication theory), as an instruction. The divergence in what information means or even is marks it out as an inconsistent category. But it is not incoherent: each of these determinations of information proposes a rationalization of the system in

question into (usually linearly organized) channels of control and transmission. In particular, the uncontroversial notion of information as an instruction – with all its implied connotations of programme, design, rule-following, coding, command, and so on – seems to lead directly to its characterization as a type of instrumental rationality, both in its theory and practically. If so, then information is at once an instrumental category and the question of its transformation of knowledge is settled.

Staying at that level of analysis, together with the common theoretical-political positioning and condemnation of instrumental rationality that attends such conclusions, however, foregoes further investigation of what is occasioned within such determinations of system 'operationalities'. That is, certain critical positions are quickly consolidated at this point without further consideration of what something like 'instrumentality' actually amounts to. The following discussion takes up various characterizations of information across a number of disciplines in order to comprehend the effects of such an instrumentalization (if it is one). By examining arguments in theoretical biology, developmental systems, and social theory, the initial stage of the argument establishes that information is a situated event, an event that takes place in a mnemically organized system which, following an argument from developmental biology, is then seen to be epigenetically constituted. This determination provides a basis for a critique of the dominant statistical-quantitative model of information in the physical and mathematically developed sciences, notably as information theory. Dispensing with this model as the primary reference for comprehending information, the argument then turns to various arguments about and in response to 'information societies'. These societies are precisely those which Lyotard addresses in the comments remarked upon above: societies in which information takes a leading role in (de)structuring their economies, knowledges and cultures. As well as Lash's concerns with the reorganization of the spatiotemporal constitution and circulation of knowledge, rationality and (in a general sense) intelligence in such societies, Virilio's argument that information societies are societies of the general accident and Stiegler's investigation of human (social) genesis through what he calls an 'instrumental maieutic' are also examined in view of this general characterization of information. These illustrations accumulate to demonstrate again that meaning is epigenetically constituted – but this time at social and anthropic levels. The last stage of the argument proposes a continuity between this register and the organic epigenesis discussed earlier. This continuity is not that of a staged evolution but the process of information's epigenetic constitution and mutations of (bio)material, symbolic, and social meanings and systems.

It is perhaps worth emphasizing in advance that what is developed and then deployed through these diverse registers is a *general* characterization or theory of information. Such a theory is, on the one hand, required, if the term is not to collapse into the each time specific determinations of the disciplines in which it is deployed; if, that is, the *concept* of information is not to be undone by its disciplinary manifestations. And it is precisely this

concept of information and its consequences that this article seeks to establish. On the other hand, working towards this level of conceptual generality and consistency (for the *general* sense of 'situatedness', for example) requires an abstraction from precisely the disciplinary and empirically specific characterizations of information and the constellation of terms that it carries with it. So, though the characterization of information as an event that is situated in a system with an organized memory is developed in the following pages by moving between the biological and social determinations of information, this general characterization does not, however, mean that organic memory and social memory (or personal memory for that matter) are the same thing or are unproblematically identifiable, or that what information is, in fact, is the same thing in every instance. In fact, the argument here suggests that it cannot be since what and how the mnemic organization is for each developmental system is, precisely, different and particular. The concern here is not then to specify what, for example, the mnemic organization is, and so what the specificity or actuality of information is, in every case. For all that, such specificity is observed in the later section on information societies since what is being constructed here through the examples considered is an understanding of the centrality of information, not just in the formation of certain kinds of society, but, more intrinsically, as a condition for the constitution of complex societies at all.

What appears through these arguments is that rather than being the reduction of knowledge, information involves a complexification of meaning and systems, a complexification that can now be attributed to the operation of information with some specificity. In particular, there is a reversal of the conventional critical attributions noted above: it is not that information is the latest or only a particular mode of instrumentalization (of knowledge, say) but rather that instrumentality is a particular stratum of informatic operationality, one that determines and is determined in an anthropotechnical complex (and which therefore precedes consciousness as the condition for knowledge in its anthropically derived sense). The received critique of instrumentality is thus seen to be a disavowal of this complex mnemic organization that is central to the development of all orders of living systems and societies; central, that is, to production from pre-cellular-organic to post-industrial levels.

The Situated Event

In her critique of the reductionist concept of information in biology, propounded for example by neo-Darwinianism,[1] the developmental systems theorist Susan Oyama proposes that the information in a living system is not reducible to the gene – or any other one element – as sole site or causal control of heredity. Rather, what counts as information depends upon the conditions of the system under question at any particular time:

> The 'informational' function of any influence is determined by the role it plays in the developmental system as whole. Regularity of gene function is thus a

> result of developmental regularity as well as a cause of it. . . . What is crucial is not *permanence*, but *availability at the appropriate time*. Persistence is beside the point in accounting for reliability. (Oyama, 2000: 84)

The generational regularity and variation of the system – the information conveyed in the system and by it as regards its transmission – then depend on the system as a whole at the time at which the transmission is taking place. Oyama's extended and *systemic* notion of information develops Gregory Bateson's deceptively simple definition of information as 'a difference that makes a difference' (Bateson, [1972] 2000; Oyama, 2000: 67). Despite the abstraction of this definition, it immediately proposes a relational determination of information. As Oyama puts it:

> This invites questions: a difference in what (What are you paying attention to?), about what (What matters?), for whom (Who is asking, who is affected?). Asking these questions leads us to focus on the knower, a knower who always has a particular history, social location and point of view. (2000: 147)

The point here is that Bateson's definition of information as a difference that makes a difference, and Oyama's extension of it as being correlated to the 'role it plays in the developmental system as a whole', propose a set of relations and a history as the conditions for information. To say that there is a difference is to posit a relation and a history, a memory (of whatever sort, technical or natural), with respect to which a difference can be determined. But for that difference to be information rather than just a difference, it must also *make* a difference – it *alters* extant relations and memory. As information, the difference in question presumes *and* generates a specific organization of relations and memory. By contrast, as will be seen below, the statistical-quantitative definition of information is that it is the reduction of uncertainty. This corresponds to the specification of fewer organizations of order in the range available at the moment that the information takes place. Even at this early stage of the argument, then, it can be noted that such a definition is a limitation of the wider – qualitative, ontological – definition proposed by Bateson and others following him.

By virtue of a difference recognized as such, a relation is constituted; in making a difference, information proposes a system and organization in alteration. This latter point is re-articulated by a systems theorist with different concerns: Niklas Luhmann:

> By information we mean an event that selects system states. This is only possible for structures that delimit and presort possibilities. Information presupposes structure, yet is not itself a structure, but rather an event that actualizes the use of structures. ([1984] 1995: 67)

As a relational term, information presupposes organization, requires systemization: 'Information is always information for a system' (Luhmann, [1984] 1995). The presupposition of structure for there to be information is what

leads to characterizing it as necessarily 'operational' and even instrumental. However, this very determination of information as intrinsically systemic, as 'operational', cannot be separated in principle from what is often held to be contrary to such reification in the critical parlance: its eventhood.

Information is an event for three main interconnected reasons. First, it makes a difference – it is event-like in that it alters the state of the system. Second, it cannot be repeated – the repetition of information (an event) is not further information but no information (not an event as such). It is event-like in this respect – or eventive[2] – in that each instance of information happens only once. Third, it temporalizes and historicizes the system – its alteration produces a 'before' and an 'after' for the system, either for the system itself (as an experience) or for an observer (as a history). Its evention here is that in a certain way it happens in time – if, that is, it does not generate the experience of the actuality of time. As Luhmann puts it, and as the example makes clear:

> a piece of information that is repeated is no longer information. It retains its meaning in the repetition but loses its value as information. One reads in the paper that the deutschemark has risen in value. If one reads this a second time in another paper, this activity no longer has value as information (it no longer changes the state of one's own system), although structurally it presents the same selection. The information is not lost, although it disappears as an event. It has changed the state of the system and has thereby left behind a structural effect; the system then reacts to and with these changed structures. (Luhmann, [1984] 1995)

Through its repetition, information 'retains its meaning' but 'disappears as an event'. A piece of information alters the state of the system, changes the organization in its actuality, and that alteration is retained as a (new) meaning, which is to say an altered mnemic organization of terms and their relations. Equally, the repetition of the information does not then further transform the system: since the repetition does not alter the mnemic organization of the system, it disappears as information (unless the information is 'forgotten', i.e., the system returns to an earlier state). Conversely, if the system or its internal meanings are not altered by what is ostensibly a piece of information, it is not in fact information. Its meaning/effect is already within the system and is consolidated. Indeed, its meaning – and the meaning of the system to itself – remain intact *because* it is not information.

Information is thus a *situated event*, an event that *generates* meaning in a system or for an organization. As a generation of meaning, this characterization goes beyond Luhmann's limitation of information to a 'selection' of system states. Information events meaning. In this movement of retention and alteration, the system has an open history. This is why the systems under consideration can rightly be called 'developmental systems', for which information is then a central concern (Oyama, 2000). And it is also why, in a context to which we return later, even if capitalism is taken to operate systemically, monologically, or axiomatically it is nonetheless (internally)

eventive in its informatic extension (information being understood here beyond the narrow determination of it through information [i.e., electro-computational] technologies).

There are thus two ways in which meaning occurs in a system. One is as information, which is also the alteration of the system, the active or passive shifting of the specific conditions of organization, its transduction and evention. The second is as a meaning that is not in the temporalization of the event of information but in the established memory, structure or organization of the system. It is a meaning that is intrinsic to the system and intrinsic to itself, maintained and preserved in its significance in the system. What needs to be emphasized, however, is that without this latter dimension of meaning, there can be no information as such since it is only this more or less established memory that provides the 'situation' for the situated event that is information. This mnemic conditionality and fate of the operation of information are not just limited to social, cultural or technical registers. Such a condition also plays a key role in organic developmental structures, as Marcello Barbieri argues in his inventive challenge to the established models of both genetic determinism and also developmental theory in embryology.[3] Barbieri's principal concern is to explain how a cell increases its own complexity in its development, and how that increasing complexity converges, 'in the sense that the outcome is neither random nor unexpected' (2003: 3); that is, given equal developmental conditions, cells of a certain type develop pretty much in the same way each time. The problem confronted by Barbieri, as it is by gene determinism and embryological developmental theory, is how such a convergent increase in complexity can take place since the information required to organize the development of a cell, the phenotype, is not contained in the cell's genome, as the doctrines of molecular biology have asserted for the past century or so:

> the information of a gene is determined by the order of its nucleotides, pretty much as the information of a word is due to the order of its letters. In both cases information corresponds to the order of elementary units along a line. Genetic information is therefore a *linear* quantity, but the function of proteins is determined by the arrangement of their amino acids in space, i.e., by their *three-dimensional* information. Clearly genes are not transporting all the information that is going to appear in proteins. Where then does the missing information come from? (2003: 30)

In other words, the genomic model of development is insufficient to explain or determine cellular development. Barbieri proposes that the increasing complexity of the living system is attributable to an *epigenetic* reconstruction, a reliable development of internally meaningful and complex structures that exceeds the genetically determined information within the system since new properties develop in the system at each stage of its development:

> The information difference that exists between the linear order of polypeptides and the three-dimensional order of proteins can be illustrated with a

> simple example. The linear order of 100 punctiform amino acids is specified by 100 coordinates, while their three-dimensional organisation requires 300 coordinates (three for each amino acid). Protein folding, or self-assembly, amounts therefore to adding the 200 missing coordinates to the 100 coordinates provided by the genes. And since the complexity of a system is determined by the number of parameters that are required to describe it, it is clear that protein folding is a phenomenon that produces *an increase of complexity*.
>
> In embryonic development . . . the term *epigenesis* has been used to describe the increase of complexity that takes place in a growing embryo, but that term can be generalized to any other convergent increase in complexity, and we can therefore say that protein folding is an example of *molecular epigenesis*. (Barbieri, 2003)

In this sense, epigenesis is 'a process [of] reconstructing a structure from *incomplete information*' with a convergent increase in complexity of that structure (2003: 71). The relevance of Barbieri's work to the present argument is that such epigenesis is in fact arranged according to 'organic codes' that (following a model borrowed from linguistics) determine a meaning for the living system at the level of its biological function and development:

> A code can be defined as a set of rules that establish a correspondence between two independent worlds. The Morse code, for example, connects certain combinations of dots and dashes with the letters of the alphabet. . . . The extraordinary thing about codes is that a new *physical quantity* appears in them, since they require not only energy and information but also *meaning*. . . . The words of language may seem arbitrary if taken one by one, but together they form an integrated system and are therefore linked by community rules. Codes and meanings, in other words, are subject to collective, not individual, constraints. Codes have, in brief, three fundamental characteristics:
>
> (1) They are rules of correspondence between two independent worlds.
> (2) *They give meanings to informational structures*.
> (3) They are collective rules which do not depend on the individual features of their structures. (2003: 94; emphasis added)

Organic codes are then the internal *meaning* of the living system (which does not even have to have reached the cellular stage of development). These organic codes/memories 'situate' or, in Barbieri's terms, contextualize (2003: 111), the function of any molecule in the cell (including the genome), enabling it to inform the development and (internal or external) function of the living system. The codes give the elements of the living system an organic meaning. Barbieri's contention is that these codes belong to neither the genotype nor the phenotype of the system but are in fact their common logical and historical condition,[4] and even artifactualize them (2003: 160).

This theory of the development of living systems as being conditioned in the first instance by organic *meaning* – whence Barbieri's 'semantic

biology' – surpasses the limitations inherent in both molecular biology and embryology in accounting for the development of living systems, whether they have genomic components or not. The key aspects of concern here are the following: first, information constitutes an *epigenetic* (or, in Oyama's terms, non-persistent) memory for the system. The organic codes of the cell are therefore dual:

> A memory is a deposit of information, and we can give the name organic memory to any set of organic structures that is capable of storing information in a permanent (or at least in a long-lasting) way. The genome, for example, is not only a hereditary system but also an organic memory, because its instructions are not only transmitted to its offspring, but are also used by the organism itself throughout its life. We can rightly say, therefore, that the genome is the *genetic memory* of a cell.
>
> The state of determination [for the 'histological fate' of a cell, its differentiation] has also the characteristics of an organic memory, because it has the permanent effects on cell behaviour, but it has an *epigenetic* memory, i.e. a memory which is built in stages during embryonic development by epigenetic processes. We conclude therefore that embryonic cells have two distinct organic memories: the genetic memory of the genome and the epigenetic cell memory of the determination. (2003: 114)

That is, there are (at least) two mnemic registers that determine the developmental order and regularity of a cell, not just the one stipulated by the genoinformatic determinism of neo-Darwinian molecular biology. Second, then, the dual organic memory of the cell gives the linear information contained in the genome its meaning in the developmental process. And the more general inference is that the organic memory of the cell gives whatever information is contained in the cell – either in its linear coding or in its spatiotemporal ordering – functional effectivity:

> Without [an epigenetic] memory it would not be possible to obtain a convergent increase in complexity, and the real logic of embryonic development is precisely that kind of increase. . . . Cell memory is a key structure of embryonic development because it is essential to the convergent increase in complexity that is typical of development. (2003: 120)

Without such a memory, whatever information there is in the developmental system would be insufficient to determine the very development it is meant to explain, for example, in the doctrine of modern genetics.

In this mnemically organized production of information and the informational production of memory, the cell – the primary model of a living system – is therefore a mnemic *and* temporalized system. Though Barbieri makes a distinction between 'informatic processes, where only energy and information are involved' (2003: 95–6) – which are the systems considered by the physical sciences – and 'semantic processes, where rules appear which add meaning to information' (2003: 95), it is the case

that the information in a system events nothing, has no effects, without the latter.

Barbieri's argument from – and to – biology demonstrates the principal argument here at the level of nature and its sciences: information requires meaning and memory (here, the organic codes) in order for it to be information *and*, given that requirement, information generates further meaning. What is proposed is a more comprehensive account of the conditions for both models that recognizes the condition of an organization of (here, organic) memory – and therefore (organic) meaning – for there to actually be information at all. Information is meaningful in the system. Or, meaning is dual: it is mnemic and informatic.

Critique of the Statistical-Quantitative Determination of Information

Having established the two dimensions of how meaning occurs in a system or organization, we can come back to the question of the relation between knowledge and information. It can now be seen that the instrumentalization of knowledge as information, Lyotard's concern in *The Postmodern Condition*, is the putting into time and alteration, the 'eventing', of the memory, organization and meaning of a system (even to itself: information can come from within a system as well as from without). The challenge of this evention to the received account of meaning is that in the proto-Platonic account the principal (anthropic) securing and ordering of meaning is *knowledge*. Comprehended as the established (if not, as Plato writes in the *Meno*, sempiternal) memory and organization of a system, knowledge is the conservation of (the meaning in) a system (including its own meaning for itself) and information is the alteration of that system and, correlatively, in however limited or extensive a way, its meanings.

The distinction between the principal terms in question here is then clear: knowledge is mnemically and organizationally confirmed meaning while information is the temporalization of meaning, the generation and emergence of meaning and system, of organization. And it is this proto-Platonic stabilization of meaning as primarily knowledge (with its consequent stabilization of information in reference to meaning) that lies at the heart of the communication theory account of information in the physical and mathematically derived sciences, as well as in the discourses that claim their authority. This is unintentionally demonstrated in Fred Dretske's *Knowledge and the Flow of Information*. Dretske identifies the alteration of a situation by information – its evention – as 'learning' (1981: 45 and passim), and gives information the following 'nuclear' sense: 'a state of affairs contains information about X to just that extent to which a suitably placed observer could learn something about X by consulting it' (1981: 45). Suffice to say that Dretske's 'state of affairs' and 'suitably placed observer' all testify to the 'situatedness' of information that is being emphasized here. Learning, then, would be another name for the temporalization of meaning that is evented by information. However, Dretske stabilizes the condition of

meaning, and consolidates the communication theory account of information with it, by arguing that this 'ordinary, semantically relevant, sense of information . . . is something to be distinguished from the concept of *meaning*' (1981: 46), suggesting instead that the relevant criterion for information is 'whether it can provide an illuminating account of that commodity capable of yielding *knowledge*' (1981: 46; emphasis added). Dretske's argument is that knowledge is an absolute category since it is not a matter of degree (in our terms, it is consolidated):

> factual knowledge . . . does not admit of . . . comparisons. If we both know that the ball is red, it makes no sense to say that you now this better than I. . . . If a person already knows that the ball is red, there is nothing he can acquire that will make him know it better. . . . In this respect factual knowledge is *absolute*. (1981: 107–8)

For Dretske, the absolute character of knowledge stems from the absolutism of information 'on which [knowledge] depends', on information's eventual redundancy. Information can be redundant because it contributes nothing to knowledge:

> Information itself is not an absolute concept . . . since we can get more or less information *about* a source. Information *about s* comes in degrees. But the information *that s* is [the knowledge] *F* does not come in degrees. . . . Once the information that *s* is *F* has been received, there is *no more* information to be had about whether or not *s* is *F*. Everything else is either redundant or irrelevant. (1981: 108–9)

Dretske is in his own way articulating the point we saw Luhmann make earlier: the repetition of the same piece of information is not information. The difference from Luhmann's characterization, however, is that for Dretske this redundancy arises not because information can happen only once (in its evention) but because knowledge as knowledge is immutable and because further information can add nothing to knowledge. The Platonic assumption here is clear. Meaning for Dretske is to be filled and completed rather than mutated. What follows (in a perfectly Hegelian way) is that information is determined by and directed towards such a stabilized or fulfillable knowledge – as Dretske puts it, 'no more' information can modify knowledge once there is knowledge. Hence their common absolute character.

Meaning *qua* information can thus be exhausted in knowledge – and therefore quantified: the certainty in knowledge offers a 0 (no knowledge) and a 1 (knowledge) by which the relevance and transmission of information can be calibrated. Dretske establishes the mathematization of information by communications theory on this basis. What is measured between the 0 and 1 is not the information itself or the knowledge it generates but the material and practical context in which that knowledge and information take place:

> To know, or to have received information, is to have eliminated *all relevant alternative possibilities*. These concepts are absolute. What is not absolute is the way we apply them to concrete situations – the way we determine what will qualify as a relevant alternative. . . . Knowledge exhibits [a] pragmatic character *because* a communication system, *any* communication system, presupposes a distinction between a source *about which* information is received and a channel over which this information is received. The source is the generator of (new) information. The channel is that set of existing conditions that generate no (new) information. . . . It is in the determination of what constitutes a relevant alternative, a determination that is essential to the analysis of *any* information-processing system (whether it results in knowledge or not) that we find the source of that otherwise puzzling 'flexibility' in our absolute cognitive concepts. (1981: 133–4)

Having evacuated meaning from information by premising both on the absolutism of knowledge, what is being measured and operationalized in communications theory are the 'relevant alternatives', the possibilities, as is well attested, that are proximate to a piece of information or knowledge (here, a signal) in a 'concrete situation'. In other words, what communications theory is concerned with for Dretske is not information as such, nor knowledge as such, but the pragmatic conditions for the transmission and 'relevance' of information. The communications theory of information is then a pragmatics.

But this solution runs directly into the problem which it is supposed to solve: the 'relevant alternatives' in a 'concrete situation' speak *in fact* to the situation of the information that is being transmitted. To that extent, it is to speak about the range of actual meanings of information rather than what Dretske would call a knowledge of it. What other gauge can there be for the '*relevant* alternatives'? What is therefore being accounted for in such determinations of information is the paradoxical formulation of a range of meanings whose meaning has been evacuated. Though this abstraction is the condition for the mathematization of information (and in fact all it is concerned with), it is also the reason why what is addressed through such formulations is not in fact information but an absolute knowledge of situations.

It is no great surprise to see that the mathematical abstraction of information is also its (proto-Platonic) epistemological securing in its being premised on a consolidation in and of knowledge taken to be absolute rather than informatically transmuted. As is firmly established from the Shannon–Weaver model of information and its subsequent development, into cybernetics and A-Life, for example, it is a probability analysis indicating that a more or less situated transition can take place in the alteration from one state to another of a system. But this rendition belies the very conditions of information in that it negates the situatedness, the mnemic organization, in which information has its always unique operation and temporalizing evention.

In every sense, then, actively and by default, the mathematical

epistemology of information refutes the meaning of information. This does not present any difficulty to that model of information because it has decreed from the off and has striven to establish that information has no meaning *per se*. The only question that remains is what then it is dealing with if not the very absoluity or sedimentation of knowledge that information in fact alters. Likewise, organic memory as Barbieri speaks of it – as the primary condition of meaningful information – is abstracted away by the doctrine of genetic determinism, predicated as the latter is on the notion of asemantic information as the sole condition and control for development. What is left for consideration in both cases are the statistical and quantitative properties of signal transmission rather than the semantics of the signal. And what is evacuated from such considerations is that information is a situated occurrence – situated in and by a mnemic organization. This limitation means that the consideration of living systems by the physical sciences or on their model – such as in terms of purely 'informatic processes' – is in fact incapable of comprehending them at all.

Information – Society

If, by contrast, information dominates knowledge as the primary condition of meaning, then epistemological securing is displaced, if it is not replaced, by (an ontology of) systemic evention. Three analyses of this displacement have recently been put forward, each of which addresses the characteristics and impact of the 'information age', meaning primarily the era of the proliferation of electro-computational networks. Their brief sketch-review will be instructive in bringing the characteristics of the informatic dimension and operation of meaning more clearly into view.

First, Lash's 'critique of information' highlights the duality of meaning in focus here. Lash argues that there are two types of information in the information society. The first is the production of discursive or analytic knowledge which replaces labour production (2002: 141–4). The second type of information 'has to do with the unintended consequences of the first type of information' (2002: 144), namely information overload and disinformation, 'the out of control anarchy of information diffusion' (2002: 146) that makes reflection impossible and leads to an irrationalization. This 'risk society' thesis leads to another central contention of Lash's book – that 'the critique of information is information itself' (2002: 220 and passim). Lash's twofold account of information society is consistent with the duality of meaning as knowledge and information that is being highlighted here. There is nonetheless an important difference in terminology that needs elaboration since it is also a difference in orientation. What Lash calls *dis*information is, in our terms, information in its eventing, information *as such*. And what he calls information we would say is knowledge, as is partly acknowledged in Lash's description of knowledge-production. Though Lash is explicit in insisting that the 'essence of the information' is 'the contradictory pair, the undecidable of *information-and-disinformation*', such that 'disinformation converts just as readily back into information as the reverse'

(2002: 154) and there can be no separation between information and disinformation, it is nonetheless important to emphasize that with the analysis proposed here the 'risk' effects of the information society are not 'consequences' of information but are the operation of information itself. Risk, the meaning of risk, is occasioned with information because information involves the transmutation of existing conditions. The alteration to knowledge that follows is just the informatic dimension of *meaning*, even if it is not meaning*ful* and even countermands meaningfulness (as knowledge). In this way, the 'anarchy' of information is institutionalized – mnemically organized – to some degree or other. It is then not so much that 'the critique of information is information itself' but that information is the critique of *meaning*, the vector of meaning's transmutations. The move from founding and orienting social order and meaning on the basis of secure knowledge, whatever local modality that securing may take, to 'information societies' (the move of capitalism, arguably) is a move that promotes a society turned towards evention and the alteration of meanings. But it does not spell the collapse of meaning – only that meaning is not established or, pushed to its limit, establishable. It is contingent – on new information.

Second, Paul Virilio's 'accident thesis' also articulates the risk of information at the sociotechnical-global level. Virilio adopts Aristotle's categorical distinction between substance, which is 'absolute and necessary', and accident, which is 'relative and contingent', to inscribe a logic of global history: 'we can now equate "substance" with the beginning of knowledge, and the "accident" with *the end* of that philosophical intuition initiated by Aristotle and a few others' (2003: 25). That is, the accident spells the end of knowledge. And, for Virilio, this is a global concern because the sociotechnical developments of modernity have industrialized and eventually globalized the production of the accident such that it is, in another version of the risk society thesis, the habitus of the contemporary world:

> if *speed* is responsible for the exponential development of the *man-made accidents* of the twentieth century, it is equally responsible for the greater incidence of *ecological accidents* (in the various cases of environmental pollution), as it is for the *eschatological tragedies* that loom with the recent discoveries relating to the computing of the *genome* and biotechnology.
>
> Whereas, in the past, the *local accident* was still situated (*in situ*) – the North Atlantic for the *Titanic*, for example – the *global accident* no longer is, and its fall-out extends to entire continents. Waiting in the wings is the integral accident, which may, some day soon, become our only habitat. (2003: 24–5)

The accident, as Virilio describes it, is of the order of the event, and it undermines the securing of a social or personal order on the basis of knowledge. It can be equated with the evention of information as it is being elaborated here. What is at stake for Virilio in this re-orientation of meaning at all levels is, however, the 'catastrophic' abolition of knowledge, including the mode of knowing that is consciousness. Virilio issues the dire warning:

> the loss of consciousness of the accident, and of the major disaster, would amount not just to thoughtlessness, but to madness – the madness of voluntary blindness to the fatal consequences of our actions and inventions (I am thinking in particular of genetic engineering and the biotechnologies). . . . We would see the fatal emergence of the *accident of knowledge*, of which information technology may well be the sign by the very nature of its undoubted advances, but also by the incommensurable damage it has done. (2003: 7)

The promotion of the accident by information technologies is reiterated by Virilio's observation that 'it is the intensive use of powerful computers that has facilitated the decoding of the map of the human genome, thus fostering the fateful emergence of the genetic accident' (2003: 27, n.2).

The 'accident of knowledge' Virilio is so concerned with is the de-substantialization of knowledge. But this is only the effect and operation of what is here being called the evention of information, the vector of meaning's mutation. Comprehending Virilio's accident thesis on this basis, what is apparent is that Virilio's catastrophic-eschatological conclusions and apprehensions are derived from an anxiety about the de-securing of knowledge as the condition of meaning by information. That is, Virilio implicitly desires knowledge as a secure basis of meaning and thus relies upon a certain Platonic sensibility for the logic of his argument and anxiety. Without such a premise, the increasing prominence of information as the continued production of meaning, the 'emergence of the accident of knowledge' as Virilio puts it, is nothing absolutely new, nor does is necessarily result in the 'fatal' habitus of the global accident. On the contrary, what can be affirmed is that insofar as meaning is informed, it is produced by accident, so to speak. The accident of information annihilates the world of meaning if and when its evention overwhelms the mnemic organization or (natural, social or technical) developmental system in which it occurs. If, however, the accident cannot be registered in any mnemic organization or system, it cannot be comprehended as information. In this case, the accident has no meaning. It is an event without evention.[5] Such an event-accident cannot be ruled out, mainly because it is precisely that which is beyond any power or rule. However, the identification of such an accident with information depends upon the prior repudiation of information as constitutive of meaning – which is to say that, in a kind of contemporary Platonism, it presumes knowledge as the sole condition for meaning. What would then have to be explained but could not be is the history and development of meaning without its accidents, without its epigenesis.

Third, in *Technics and Time* Bernard Stiegler ([1994] 1998) proposes an account of the epigenetic emergence of the anthropo-technical complex: the coming into historical and temporal being and meaning of the human – which is to say a relation to the past and the future – *through* its technical 'accident'. Stiegler's manifold and complex argument cannot be reproduced here in all its dimensions. Only one aspect of its argument from (a very

specific) palaeo-anthropology will be summarized here. Stiegler takes up the work of Leroi-Gourhan on the early emergence of the human from its animal ancestors, a transition that Leroi-Gourhan argues is one of a change in skeletal frame to the upright posture. This enables the enlargement of the skull and the flattening of the face which in turn allows for the increase of brain size. All this is relatively uncontroversial. However, Leroi-Gourhan's importance for Stiegler (and Derrida before him) is his thesis that this process of hominization or brain-enlargement and reorganization is *conditioned* by the technical instrument, notably the accompanying evolution of the flintstone:

> From the Zinjanthropian to Neanderthal man, a cortical differentiation as well as a lithic differentiation is effected, extending from the flaked pebble and the laurel leaves of the Neanderthalians to the [flint] biface [of the early axe]. We submit that . . . cortex and equipment are differentiated *together, in one and the same movement*. The issue is that of a singular process of structural coupling in *exteriorization* that we are calling an instrumental maieutics, a 'mirror proto-stage' in the course of which the differentiation of the cortex is determined by the tool as much as that of the tool by the cortex; a mirror effect whereby one, looking at itself in the other, is both deformed and formed in the same process. (Stiegler, [1994] 1998: 157–8)

The importance of this argument is that it undoes the traditional mono-determination of the technics as invented by the human, in terms of either the technical instrument emanating from the human (mind or body) or of serving human ends, that is, technics designed by and for the human. Rather, the evolutionary and social development of the human is co-conditioned by technics. With the human, then, the process of the development of life is 'exteriorized' from its biological determinants and evolution into technical artefacts that at once continue the development of the human and, importantly, because it is taking place technically and thereby effectuates a mnemic trace that is external to any one individual, that development is *socialized*. The continued development of the human (a form of life) is then not (just or predominantly) biological; it is primarily social and technical. Technics – and the society it inaugurates – are the specificity of the human ([1994] 1998: 157). At the same time, it is 'the pursuit of the living by other means than life' ([1994] 1998: 135 and passim).

The key point for Stiegler throughout is that the technical instrument is a memory of accumulated knowledge that is *external* to the biologically determined aspects of human development. Two corollary points are relevant here: first, human development – understood from now in the sense of the anthropotechnical complex – happens through the development of these external memory supports, of technics and its societies. It can therefore take place through those external supports at rates faster than those allowed for by biological development. Second, such a development is in every case an accumulation of knowledge, memory and learning from an earlier generation rather than an immutable code. For any generation the

tools of its predecessors are 'already there' as a technical maieutic. In other words, anthropotechnical development is an epigenetic process. Moreover, since this process speaks to the specificity of the human in its distinctness to other forms of life, it is in fact an epiphylogenetic process:

> The point here is to focus on the originality of the epigenetic process that is put in place from the moment of the appearance of tools, insofar as they are conserved in their form beyond the individuals producing or using them.
>
> . . . Epiphylogenesis, a recapitulating, dynamic, and morphogenetic (*phylogenetic*) accumulation of individual experience (*epi*), designates the appearance of a new relation between the organism and its environment, which is also a new state of matter. If the individual is organic organized matter, then its relation to the environment (to matter in general, organic or inorganic), when it a question of the *who*, is mediated by the organized but inorganic matter of the *organon*, the tool with its instructive role (its role *qua* instrument), the *what*. It is in this sense that the *what* invents the *who* just as much as it is invented by it. (Stiegler, [1994] 1998: 176–7)

The pertinence of Stiegler's argument to the present discussion is in this notion of epiphylogenesis, of the who-what – or anthropotechnical – complex of invention. In this complex, the mnemic organization of meaning is technical as well as organic. The human in its biology – in particular, through the plasticity of its brain as regards species determination of behaviour (Stiegler, [1994] 1998) – is a mnemic organization by which technics takes on its meanings in the instrumental maieutic. Equally, technics is also a mnemic organization by which human action takes on meaning (gestures, language). As Stiegler puts it in speaking about modalities of memory: ' what takes place here . . . is the passage from . . . the genetic to the nongenetic' ([1994] 1998: 138). Which is also to say a passage in mnemic conventions, or *a passage in meaning*. In other words, what Stiegler presents in the hominization of life, which is its technicization, is the emergence of a mutation in meaning from the one determined by biology: the system of meaning that constitutes life is altered by the instrumental maieutic of technics through the human. Hominization, the development of the human, is in this sense a process of information. The human, more exactly, the human brain and its society, is the site for information. Information is not then external to the interests of the human (as Virilio's doom-laden scenario pictures it, for example). It is rather another name for its continued development, and the development of (its) meaning, as a complexly constituted phylum.

But here it is not just information in the limited sense of the alteration of a certain modality of mnemic organization. What Stiegler proposes is rather the constitution of a mode of mnemic organization altogether other than the biological one, hence its 'rupture'. This goes beyond the description of information as the alteration or eventing of a mnemic organization. Stiegler's key term 'invention' thus seems a more appropriate term than evention to capture the break-passage – the schiz – in modalities of memory

that Stiegler affirms in the process of hominization. But we can note that the distinction Stiegler draws between human development through the sociotechnical exteriorization of memory and the rest of organic life – the specificity of the human – is somewhat weakened by the 'organic codes' Barbieri speaks about. Because what Barbieri proposes is that even at the level of biological formation of the cell, a process of epigenetic development is underway that includes the genetic code as but one of its determinants. Hence, any distinction between genetic determination and epigenetic formation is undermined at the base biological level of the cell if not below it. The distinction between the human and the rest of life made by Stiegler on the basis of the former's epigenetic development and the latter's more completely genetic formation cannot then be sustained. The continuity rather than rupture between anthropotechnical life and life in general is further confirmed by Barbieri's argument that even at pre-cellular stage of the production of ribonuclear proteins, the presence of coded polymers requires the production of polymer units *external* to the organic codes that generate them. That is, there is a production of molecules 'from without' (2003: 160) – an artificial production. The organic codes act in this sense as a technical memory at the level of pre-cellular organic production.

Instrumentality Reviewed

Stiegler's 'instrumental maieutic' as an epigenesis vectored through an external mnemic organization is not then restricted to the emergence of the human as anthropotechnical complex. Rather, 'it structures all levels of the living' as he puts it in a commentary on Derrida's notion of the *grammé* ([1994] 1998: 137). If, then, epigenesis can be identified with the process of information's evention of meaning, it can be said that information – the alteration of meaning – is at the heart of the development of life from organic to inorganic organized matter, from base levels of the biotic to the technical, for which the human is then one site *among others*. What is in transition, what is in continuity, through this rupture is meaning, from organic meaning to socio-technical – i.e., symbolic, cultural and operational – meaning.

Some caution, however, needs to be observed about the continuity of the epigenetic constitution of meaning from pre-cellular-organic to social informatic processes. As stated in the introductory comments above, the interest here has been in developing a *concept* of information, and this entails a certain necessary degree of abstraction and therefore of generality. The situatedness of information, however, means that *what* information is, and what meaning/mnemic organization is at any level (or even sub-level), in any situation, is distinct and demands differentiation from what it is at any other. That is, although it is argued that the process of informatic-epigenetic constitution described here runs from pre-cellular-organic to post-industrial-social conditions, this ought not to be confounded with a developmental continuity between them. It is an argument for a conceptual consistency in how 'development' (which is to say, changes in meaning and

systems) happens: informatically. This conceptual continuity is, to repeat, instanced in each and every case differently because of information's (and therefore meaning's contingent) situatedness.

The 'instrumental' relation in the limited sense that is Lyotard's concern (among many others) is this instrumental maieutic understood from an anthropocentric viewpoint. The received critique of instrumentality – instanced above by Virilio in particular – repudiates the general operation of information as constitutive and, at once, (de)structuring of human meaning if not, differently, life and, differently again, social order. Understood otherwise, however, 'instrumentality' in the limited sense is but the hominoid – which is to say, the *inextricably* anthropotechnical – stage of the development of life in its meaning, what Stiegler calls its 'maieutic' and what is here being called its evention. It is information that alters, and continues to alter, the mnemic organization of living and social – henceforth unstable – systems. That is, instrumentality is *intrinsic* to the constitution of organic life, anthroponoetic operation, and social (dis)structuring. It informs life in general.

At any level, then, information as the eventing of meaning cannot be separated from the operationality and instrumentalization Lyotard speaks of. In fact, it is the one process: information is operational in a way knowledge is not to the extent that it alters the system and selects states that are open and mutable in its structure. This is not to say that the informatization of knowledge in the mode of computerization does not mean the stipulation of 'a certain logic' and a 'certain set of prescriptions', as Lyotard put it. Only that this mode of information is but *one* technical determination of information and not the only one. And that, perhaps even in this case, such an informatization is no less a way in which the mental and social mnemic and organizational systems of the human in modernity are reconstituted not on the basis of its maintenance, its memory and sustained organization, that is, on the basis of what is *known* of it – which is what a logic and prescriptions more traditionally codify – but in terms of generalized evention.

Notes

1. The reader unfamiliar with biological terminology may require the following in order to make their way through this section. Standard theories of heredity in modern biology split the organism into two distinctive aspects: the phenotype and the genotype. The *phenotype* is the form of the organism; loosely speaking, its 'body' and physical characteristics. The organism's *genotype* is its hereditary material, which is localized in most contemporary biology and medicine to the gene, which is in turn found in the cell's chromosomes. This distinction between genotype and phenotype was made initially in 1909 by Wilhelm Johannsen (who also coined the term 'gene') in the attempt to account for the Mendelian model of inheritance in distinction to the Darwinian generality of natural selection (which includes the phenotype in its account of species development). After much initial dispute, this distinction was consolidated in biology in the 1940s (see Barbieri, 2003: Chapter 8; Depew and Weber, 1995: Chapter 9).

The most important point to be made about this distinction for the purposes

of the present discussion is that the dominant doctrines of modern biology, neo-Darwinism and its experimental practice, molecular biology, locate all (or nearly all) of the developmental information of the organism in the genome, i.e., in the gene which is therefore a kind of 'map' of the organism as a whole. It is there proposed that control and modification of the gene will *on its own and all other things being constant* result in a specifically modified organism (the phenotype). The genotype is supposed to 'suppl[y] the fundamental pattern of the organism' (Oyama, 2000: 16); it is the 'biological software' of the organism (Barbieri, 2003: 25), 'a deposit of instructions and therefore . . . potentially capable of carrying the project of embryonic development' (Barbieri, 2003). What is important in this determination of organic development as a background to the present argument is that the phenotype is degraded if not ignored as a factor in development, never mind the environment in which the organism exists. That is, the 'situation' of the genome is ignored and the information controlling development (as this doctrine would have it) is attributed exclusively to a material and substantial location – as a design – in the gene – whence the 'reductionism' noted in the main text. (This is the kind of preformationist fantasy behind the narratives and anxieties around genetics in popular culture, from *Jurassic Park* to *Gattaca* to more complicated concerns about GMOs.) The main text here and the argument it makes (following Oyama, Barbieri and others) for a located and situated account and operation of information are in part to be understood against this substantialist notion of information, i.e., as directed towards undermining the assumptions of the determinism of neo-Darwinism and molecular biology.

2. The term 'eventive' is constructed here to parallel 'inventive', whence 'evention', 'eventing', and so on. The neologism is useful as a shorthand way of indicating the dynamic operation of information in and to a system. This serves to indicate, first, how the each-time-event of information is transitive, verb-like and adjectival rather than substantive and noun-like, and, second, a certain proximity and distance to invention. This last point is taken up towards the end of this article.

3. Technical terms that may be required from here (though they are not significant to the present argument and so will not be presented in any detail) include *amino acids* – the base molecules out of which longer chains of certain biologically functioning molecules are made, specifically the following classes of biomolecule: *nucleotides* – chains of amino or nucleic acids (the latter are so called because they are found in cell nuclei), the only relevant ones of which here are DNA and RNA, the former being a famously helixical intertwining of two nucleotides and the basic though complex molecule of the gene; and *polypeptides* – single linear chains of amino acids such as proteins which are to be found throughout the cell and take on a wide variety of functions.

In the neo-Darwinian doctrines of modern (molecular) biology all other molecular activity is subordinated to and *organized by* the supposedly principal nucleotide that is the gene, whence the *genocentrism* that Barbieri critiques through the argument presented in the next few lines of the main text here.

4. Since both genotypes and phenotype and the 'first organic systems' (2003: 145) are constituted by the earlier production of ribonucleo-proteins, Barbieri proposes a *ribotype* theory for the origin of life. Ribotypes are the 'seat of genetic coding' in Barbieri's theory (2003: 156) – which is to say that organic codes and thus organic meaning are the condition for the development of life even at its origin.

5. This statement also characterizes the logic of Derrida's ethics, in particular the

logic of the 'to come' and the quasi-eschatological messiahanism of the promise that have gained increasing prominence in Derrida's work. See, for example, *Specters of Marx* ([1993] 1994: 91). Important differences remain, however: though the following argument in the main text on knowledge is entirely relevant to Virilio, it is only pertinent to Derrida in a severely limited way.

References

Barbieri, Marcello (2003) *The Organic Codes: An Introduction to Semantic Biology*. Cambridge: Cambridge University Press.

Bateson, Gregory ([1972] 2000) *Steps towards an Ecology of the Mind*. Chicago, IL: University of Chicago Press.

Depew, David and Bruce Weber (1995) *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection*. Cambridge, MA: MIT Press.

Derrida, Jacques ([1993] 1994) *Specters of Marx: The State of Debt, the Work of Mourning, and the New International*. New York: Routledge.

Dretske, Fred (1981) *Knowledge and the Flow of Information*. Oxford: Blackwell.

Lash, Scott (2002) *Critique of Information*. London: Sage.

Luhmann, Niklas ([1984] 1995) *Social Systems*, trans. J. Bednarz, Jr. and D. Baecker. Stanford, CA: Stanford University Press.

Lyotard, Jean-François ([1979] 1984) *The Postmodern Condition: A Report on Knowledge*, trans. G. Bennington and B. Massumi. Minneapolis: University of Minnesota Press.

Oyama, Susan (2000) *Evolution's Eye: A Systems View of the Biology–Culture Divide*. Durham, NC: Duke University Press.

Stiegler, Bernard ([1994] 1998) *Technics and Time 1: The Fault of Epimetheus*, trans. R. Beardsworth and G. Collins. Stanford, CA: Stanford University Press.

Virilio, Paul (2003) *Unknown Quantity*, trans. Chris Turner and Jian-Xiang Too. London: Thames and Hudson.

Suhail Malik teaches Postgraduate Fine Art at Goldsmiths College, University of London, and has written several articles on the conceptualization of technoscientific processes and on issues relating to contemporary art practices.