Introduction

It is hard to remember what cybernetics was, when it was first born. There are no pioneers left to tell us, and many working in the field have travelled a long way since our first encounters.

The work of distinguished academics seems also to fade in the mists. I have observed a sort of cycle: a scholar's reputation increases on death, then decreases—often to a point of invisibility— before finding a natural level. Gordon Pask's work currently seems nearly invisible. I believe it is time to reconsider this work—to promote it to its natural level. I have already explored the constancy and sources of themes in Pask's work [Glanville 2007]. In this paper, I shall show aspects of his thinking to be central to cybernetics.

But, in order to consider the significance of this work as I shall discuss it, it is necessary to try to imagine ourselves back 40, 50 and 60 years.

Cybernetics and the Machine

Cybernetics began as an essentially mechanistic subject. It was concerned with form, rather than content: with (changes in) behaviour, and the structure of systems that might generate or permit such (changes in) behaviour—rather than what these behaviours might mean or how they might be experienced. Early cybernetic texts are abstract, formal, mathematical, and concerned with behaviour. While scholars from the humanities and less precise sciences had an equal part in the forming of cybernetics, they tended to write what may be thought of as texts with cybernetic content, rather than cybernetic texts. Cybernetic texts, of which perhaps the best example of all is Ashby's "Introduction to Cybernetics" [Ashby 1956], were concerned with mechanism: the links and channels, the states and suchlike that compose a cybernetic system, through which messages flow and regulation occurs (under the supervision of concepts such as variety), which are taken to account for observed changes in behaviour. Wiener's characterisation, "Cybernetics, or control and communication in the animal and the machine" [Wiener 1948], emphasises this approach, especially in the way Wiener first applied it. Cybernetics is not concerned with the quality of the experience in a cybernetic system, but with the system that allows this experience. Compare it with (the contemporaneous) Information Theory [Shannon and Weaver 1949]—much influenced by Wiener—which has no interest in meaning, merely in the capacity of a system to transmit encoded messages.

I have suggested early cybernetics, using the concepts of animal and machine from Wiener's original subtitle, is dominated by the metaphor of the mechanical (often describing the animal), distinguishing it from the later, second order incarnation in which the dominant metaphor is the animate (often describing the machine).

Behaviour: the Cybernetic Machine and Freedom of Action

It is sometimes thought that studying systems in a machine-like manner limits human freedom, but I have always seen this approach as a way of sustaining freedom: it is the existence of the structure that allows us to play as we do, to make our own content, to understand the meanings we make as we make them. Wiener understood the danger of the machine metaphor being taken literally when he wrote the deeply technical "Cybernetics" and tried to compensate soon after by writing the much more philosophical "The Human Use of Human Beings" [Wiener 1950] .

Behaviour and the Black Box

Behaviour was also the main theme of a type of psychology that flourished contemporaneously with cybernetics: behaviourism, particularly the radical behaviourism of BF Skinner [Skinner 1972], which grew out of the operant conditioning experiments of Pavlov's school. Skinner tried to describe behaviour in objective

terms, regardless of experience, and as absolutely mechanical: stimulus A directly causes response B through the operation of some known mechanism (that is, cause).

However, there are many things we cannot open (using the phrase in a most intuitive manner) and examine in order to observe and determine their mechanism. One such is the working human brain (the one we use, when alive). To overcome this limitation, Skinner often made use of the notion of the Black Box. The Black Box, originally invented by James Clerk Maxwell, was assumed to be a device containing a mechanism. By studying the change from input (behaviour) to output (behaviour), a causal mechanism connecting input to output is deduced, which is taken to be what's inside the Black Box, causing the changes. In this process, the Black Box is said to become White. The viability of the deduced mechanism can be tested through repetition and prediction, making the way we use the Black Box arguably strictly analogical to the way we determine the viability of scientific knowledge when we carry out scientific testing, according to Popper's ideal.

In a behaviourist view, a particular input to some organism gives rise to a predictable outcome because we assert there is a mechanism at work (even though we cannot see it) which we claim is hidden in a Black Box. Although the mechanism is actually deduced by the observing scientist, there is no doubt in the Skinnerian mind that the mechanism exists and is correctly deduced.

Cybernetics and the Black Box

Cybernetics, too, made use of the notion of the Black Box. Early texts, particularly those of Ashby, contain passages exploring its working. Cybernetics is, like Skinnerian psychology, interested in systems and their behaviour, and may be thought of as essentially behaviourist, at least at first. In early cybernetics, the Black Box is treated in much the way Skinner treated it: as if it were actually present (not a thought experiment) and as observed objectively by a remote and uninvolved observer who reports on what is observed, deducing, from this, what is.

But, early on, Ashby began to contemplate just what we assume when we propose the Black Box model; and what it can tell us, under what conditions.

The Skinnerian use of the Black Box notion fails to keep in mind two elements:

•) that the Black Box is introduced by an observer. It's an invention, a gedenken experiment,

•) what is seen as the behaviour emanating from the Black Box is the result of the actions not of the Black Box in isolation, but of the Black Box and the observer working together.

Consider the following quote:

> *"…what we are considering can be viewed as …composed of Box and Investigator. He acts on the Box when he stimulates it, and the Box acts on him when it gives him a(n) …observation. Thus each acts on the other."* [Ashby 1958]

Here, Ashby points out that whatever behaviour we find in a Black Box is not due only to the Black Box, but to the Black Box in conjunction with the investigator (or observer). We have another cybernetic, circular form: a circle of acting together that moves thus: from observer to Black Box and back to observer. Skinner, however, had treated this essential circularity as linear, and the behaviour observed as generated only in the Black Box, giving rise to a consequent linear causality.

Furthermore, the Black Box is, itself, a fantasy—for the Black Box is an invention that allows us to treat a change as made visible through changes in behaviour, by the insertion of this fantasy. The act of insertion differentiates behaviour into input and output, and also houses the supposed mechanism which is taken to generate the change that the Black Box is brought in to account for. In this respect, Ashby follows Maxwell rather better than Skinner did.

These two factors mark an enormous difference between the behaviourist and the cybernetic understandings of the Black Box. Since the Black Box is invented and inserted by the observer [Glanville 1982], the explanation we construct is no more than that: an invention that we use as an explanation, or what Gregory Bateson refers to as an "Explanatory Principle". It can never be a truth, or concern a fact, in the objectivist usage. As Gordon Pask says in his early book, "An Approach to Cybernetics" [Pask 1961]:

> *"…the ultimate restriction is imposed by our own capabilities … the object of the study appears to be enclosed in a container, the so called 'Black Box', to which we, as observers, have incomplete access."*

Finally, Ashby considered the Black Box might be nearly universal:

> *"…the … Problem of the Black Box … arises in electrical engineering, but its range is really far greater—perhaps as great as the range of science itself."* [Ashby 1958]

What's the difference?

According to cybernetic understanding, this circularity between the Black Box and its observer makes any system involving a Black Box a cybernetic system; and the invented nature of the Black Box means there is no certainty in what we deduce from our action together with it ("we live in a profound ignorance" as I like to say [Glanville 2005], reflecting Feyerabend [Feyerabend 1975]) and links us to a radical constructivist worldview. It insists we are involved in making our explanations: the Black Box is not, in fact, the ultimately mechanistic device that Skinnerians believe, but opens up the freedom (the necessity) to construct and, with it, our responsibility for our actions in constructing. Foerster [Foerster 1993] makes what may be interpreted as a similar distinction between what he terms the "trivial machine" (entirely predictable, like the completely revealed behaviourist psychologist's Black Box) and the non-trivial machine (which cannot be assumed to be predictable—as in the cybernetic Black Box—since it is both a fantasy and remains black).

So that, whenever we have a system with a Black Box, the considered cybernetic interpretation treats the system as circular, i.e., organisationally closed. Put simply, A leads (links) to B, while B leads (links) to A—and that's it!

In turn, this implies autonomy. The organisational closure of the system maintains its circularity and its distinction, keeping it autonomous, even if it is open to acting with other autonomous systems (it is informtionally open).

Thus, each autonomous, circular system has identity and stands, in its identity, separate from its envronment/context by dint of organisational closure: its mechanism of distinction. We can think of this as a source of the identity of a cybernetic system involving a Black Box (and, by generalisation, all cybernetic systems). The identity arises in the conjunction of the Black Box and the observer, a product of their working together.

The system's closure, the drawing of a distinction around it forming a boundary, means that there are different views: the view within the system and the view from without [Glanville 1994]. Consider, for instance, the matter of goals. Cybernetic systems are generally considered to be goal orientated systems. But the autonomous, closed system can only be within it, if it is to be autonomous. This goal is, then, not knowable to the outside observer, who provides an external goal for the system and an account of the system's behaviour based on that externality: whereas the internal observer within the system may very well have a goal, but that goal is not knowable to the observer outside the system. Systems may appear to wander while still continuing to be. It is even possible that such a circular system may appear, when viewed from the outside, to be quite unchanging (static), or dynamically moving although maintaining identity (a person going through life) or even random and chaotic. Thus, Pask asserts:

> *"The behaviour of a statue is a special case [of the observed], for the statue is immobile, or to use an equivalent*

formalism, it changes at each instant of time into itself." [Pask 1961]

This quote clearly anticipates the best known of recent cybernetic systems, the autopoietic system, as can be seen by considering the intention behind this early definition:

"An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which:
(i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and
(ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network." [Varela, Maturana and Uribe 1974]

Two questions

Two questions result from this position:

The first concerns the nature of the making of (new) wholes

The second, how such wholes can communicate, while maintaining their autonomy.

We can find answers to both in the early work of Gordon Pask. These answers (although sometimes well hidden, initially) place Pask at the Centre of cybernetic discourse and the development of a cybernetic view through which to build an understanding of what we call the world.

Making (new) Wholes

The wholes that form the circular cybernetic systems that are constituted of a purported Black Box and its observer (who invents and installs it[1]), are made of two elements creating a unity in and through their circular form. Each provides, in its output, the input to the other. The formal circularity is what ensures organisational closure and autonomy, that is, wholeness.

What gives this sense of wholeness, the ability to satisfy the adage "the whole is greater than the sum of its parts"?[2]

I will consider this question through an early Pask machine.

In the early 1950s Pask created 2 extraordinary machines: Musicolour [Pask 1971] and the first machine of a series that came to be known under the generalised name, SAKI [Pask 1982]. These machines were, and remain, quite unlike the machines of others. What distinguishes them is that their performance with humans is genuinely interactive—in the manner in which humans interact. The sense in which I use the term interactive is not the diminished sense of the computer industry, where it rarely means anything more than responsive, but to indicate an involvement of all engaged participants leading to a new outcome, something that surprises; neither programmed nor predictable from the behaviour of the individual participants alone.

In the case of Musicolour, a light projecting machine computed a model of a musical performance in real time as a result of which a light show is projected. If it did not have to change this model, Musicolour became bored and started behaving in a manner not determined by the model, unsettling the performer(s). The musical performer(s) came to consider Musicolour a further performer, one of a band contributing to a shared group dynamic. Thus, the performance became an outcome of the interaction between musical performer(s) and machine—unpredictable and extending the range of all concerned: interaction, in my sense.

Consider, now, the way in which the Black Box and its observer form a new whole: is this not essentially similar? The interactive machines Pask built in the 1950s, and Muscolour in particular, constructed, in

[1] It is important to remember that in writing this account, I am doing so as an (external) observer. I have no idea how this may seem to a Black Box, which might consider it has invented me.

[2] But, as I have argued, a part is a whole (which an observer places) in the role of a part. All parts are wholes (gestalts), no matter how apparently incomplete, otherwise they would be imperceptible. [Glanville 2001]

performing with their musical colleague(s), new wholes: the redefined band (consisting of musical performer(s) and Musicolour machine in interaction), together created something that neither element could have imagined on its own.

Pask's early concern with interaction, gives an insight into the creation of (new) wholes from parts (the whole arises in the interaction of the parts with each other), which maps the form of the arrangement between the Black Box and the observer, generating the situation Ashby describes (above). Thus, in the early 1950s, Pask is already tackling interaction, and, in so doing, he provides at least one "solution" to the question of how parts generate wholes that are greater than their sum.

I believe it is possible to extend this Paskian thinking into his later work in how learnable topics must be arranged in locally circular and productive relationships; and the circular structure of the more global Entailment Meshes of his knowable subject matters. Perhaps this extension will be obvious to the reader. Unfortunately there is no room here to do more than hint—to lay a claim.

Communication between Wholes

If it is now clear that Paskian interaction leads to the making of a new whole such that this "whole is greater than the sum of its parts", it may be less immediately obvious why we should be concerned about communication between wholes constructed in this manner.

The model of communication based in Shannon and Weaver [Shannon and Weaver 1949], so extensively used in early cybernetics, depends on coding. Coding presumes the transmission of meaning: ie, that sent is that received. The assumption is that there is a one-to-one correspondence between the transmitter and the receiver, and that the meaning each (transmitter and receiver) has is thus transmitted and the same at each end.

But if we are each autonomous and distinct, then each will interpret that message as only we will interpret it; that is, uniquely. There is no general, universal decoding, and so there is no meaning transmited and none received: each constructs its own meaning when faced with what is assumed to be the same.[3] The meanings and understandings we each build are essentially inaccessible to any other, and so cannot be compared or tested for similarity; any attempt to do so is fraudulent.

The question of communication then becomes a question of how we can establish "Communication without Coding" [Glanville 1996].

What was to become Gordon Pask's solution appeared early on in his work. From his earliest days in cybernetics, Pask talked about conversation as a means of communication. For instance, the performance of Musicolour and its musician(s) is conversational, and the performance of the later Colloquy of Mobiles[4] is even more so: a conversation between the different mobiles, and between the mobiles and the viewers. Indeed, Pask's work on learning, culminating in his Magnum Opus, is called "Conversation Theory" [Pask 1975], Thus (and merely as a sample):

> *"…it is possible for an observer to make sense of what goes on … providing he "converses" like the student in a teaching system. But, as a result of this close coupled interaction, he fashions the system in his own image."* [Pask 1961]

(Note the co-incidence of conversation and interaction lends substance to my claim that conversation may be thought of as the epitome of interaction, and the individualisation of meaning ('he fashions the system in his own image').)

The mechanism of communication at the centre of Conversation Theory allows the existence of non-

[3] How we can assume this, when each of us is taken to understand differently, is at the crux of my PhD [Glanville 1975]: it is certainly convenient, even essential, that we can. Note that we are talking at the level of the individual, not of society. There is a quite different discussion to be had about apparently shared meaning in socially agreed/inhabited language.

[4] Shown at the Cybernetic Serendipity Exhibition at the Instititute of Contemporary Arts, London, summer 1968.

comparable meanings within the different conversational participants by permitting communication without coding through construction of meaning by each individual, and testing against others via error correction feedback.

Thus, meaning in a conversation is not transmitted. In the simplest case of a conversation between two participants we will call A and B (which may be in one person), A makes an utterance that re-presents the meaning they have in mind, and B constructs, from that utterance, its own meaning which is re-re-presented (in a different utterance) to A, who, from B's utterance, constructs a meaning. A now compares the two meanings it started and ended with: if they are similar enough, A concludes B has understood. If not, error regulation comes into operation and a new utterance, intended to help B construct a meaning which B can re-present in an utterance A will understand as more adequately close to its original meaning (a process of negociation).

Note that, in the case of a conversation, not only is there no transmission of meaning (and no coding), but also each participant assumes the meaning the other constructs is inaccessible, private to each. Thus, each treats the other as a Black Box, containing meanings and meaning generators. We return to that central cybernetic concept!

Note, also, that we cannot ever assume to know what the other participant(s) mean(s). We remain in our profound ignorance. While we can observe behaviours, we have no idea (other than any explanatory principles we may construct) giving us access into the Black Box that is the other. Whereas communication in the Shannon/Weaver model occurs between Foerster's trivial machines, conversation does not. In conversation there is always room for surprise—one source or creativity, and the machines (Black Boxes) are definitely non-trivial.

Note, finally, that this process is stable while the conversation continues. There may be agreement (a belief that my understanding, which I take to be of the meaning of the other, allows me to map it onto my original meaning in a (relatively) error free manner—and the mutualistic, complementary belief that the same holds for the other)—or there may not, in which case we might wish to agree to disagree. But, as long as the conversation continues, the unity of the participants is maintained. We can think of this in terms of international negociation where the overriding aim is to keep the participants talking. And we observe that this sort of stability may, when viewed by an outsider, appear either unmoving, or to follow a path, or even to lurch. It makes no difference to the whole's internal stability which, for these are judgements of the behaviour made from the outside, whereas the stability comes from inside.

It is often argued that, in order to establish a conversation we need, in the first place, a code. I claim the opposite. We cannot agree on a code without agreeing that it is a code, and how the code works, which requires nogociation. Otherwise we are presuming the outcome of the argument as its postulate.

Thus, Pask's early understanding, developed in its full glory as Conversation Theory, supplies a means of communication that does not require we assume the transmission of (common) meaning and that we may treat the other we communicate with as a Black Box, thus maintaining the autonomy of each whole. In so doing, the conversational interaction takes, for the time it persists, the form of another, new (and stable), organisationally-closed whole.

An Observation and a Conclusion

There is an as yet unmentioned common feature in this discussion of Pask's thinking concerning the question of wholes, and communication between them: recursion. The form in which the observer and Black Box engage so that a description of the Black Box's behaviour in the presence of the observer can be accounted for and is situated between both, is not only the form of a conversation: as we discuss it from our position in this paper, it too is a Black Box and we its observer. That is to say, the cyclic relation between a Black Box and its observer,

when considered by another observer accounting for it, is also as a Black Box (containing the original Black Box and its observer). Each Black Box consists of another Black Box and its observer, and hence we have recursion and a source of the generality of the Black Box. Thus, this understanding of the Black Box is at the heart of the Cybernetics of Cybernetics, for it satisfies Mead's requirement that the way we treat the system and our relation to it should mirror the relations we treat the system as being made of [Mead 1968]. One feature that is particularly human, is our ability to transcend these Black Boxes (to hop across levels) to be the observer on many levels, thus breaking the potential infinity of regression. A conversation is an example of these processes in operation: the creation of the regress that comes about through observing, as a Black Box, the outcome of an interaction of a Black Box and its observer, but also arriving at an agreement and maintaining stability through the process of conversation, giving wholeness and a sense of novel identity. This treatment of regress and of re-entry, is one matter that is at the heart of so-called second order cybernetics, and it is implicit in the concepts that Pask developed from the earliest days of his involvement in cybernetics. This is how, in cybernetics (and in spite of his current relative obscurity) we find Gordon Pask at the Centre.

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