A Ship without a Rudder

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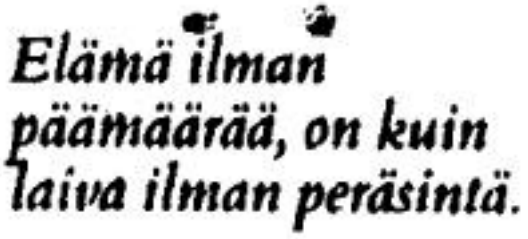
Abstract

In order to excavate something of cybernetics, I look at the notion of stability. Stability is related to the basic cybernetic concept goal. It is shown that every goal must have a goal of its own. It is also shown that the determination that the goal is a goal is observer dependent. By an inversion, it is shown that every stable system must be assumed to have an internal goal of its own. Thus, apparently random behaviour (viewed from the outside) is entirely stable (viewed from the inside). Several ways of handling these potentially difficult concepts are indicated. A codification is given in an appendix.



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Introduction

The intention in this conference is to excavate cybernetics (and systems). The position I take is that cybernetics has more-or-less thrown itself away (see the introduction to this volume). It has allowed its ideas to be borrowed piece-meal and as a result its coherence has been lost and its ideas have been both much misrepresented and so diffused that they are hard to find. In an attempt to deal with this, I believe that we should consider the basic concepts of cybernetics, to look at them afresh and stripped down and to explore their consequences. I find it hard look at a more central and more elemental cybernetic concept than stability, which is so closely identified with the steering of the name cybernetics. In this paper, therefore, I examine the notion of stability in cybernetic systems in an attempt to cast light on this basic concept, and thus contribute to a re-establishment of the significance and coherence of cybernetics itself: ie, its own stability.

Stability

Early cybernetics (understood as being cybernetics in the period immediately preceding and following the publication of Wiener's book of the name (Wiener 1948) was concerned with the notion of steering. Indeed, the name comes from the Greek for a steersman.

Behind the notion of steering, and all that goes with it—goal, purpose, course or trajectory, sensing, feedback and error (and its correction and regulation)—is the notion of stability. Steering keeps a ship, for instance, stable on its course (a form

of dynamic stability, ie a stability achieved in movement). The thermostat keeps a temperature stable (static stability, ie stable without movement, around—or at— a fixed point). Living systems are stable[1]: that is, they continue to live, and their stability consists in them remaining alive. And the business of firing guns to destroy aeroplanes (a major pre-occupation of the proto-cyberneticians, forming their thoughts in the think-tank of the Second World War) also achieves a stability: the stability of the repetitive action that continues doing something (in varying circumstances). In this manner, as unlikely as it may at first seem, this is like the thermostat.[2]

Stability occurs in an environment, and manages to absorb variations in that environment, at least to a certain degree. It is not assumed that the environment is simply predictable, nor that stability is necessarily absolutely fixed (there is the dynamic stability involved in keeping moving along a path, and there is the approximation to absolute stability in the thermostat, where the system switches on and off and the temperature is (only) more or less constant). In fact, more recent understandings would probably have it that stability existed not of the object said to be stable, nor of the attribution of the property stability to the object by an observer, but between the object and the environment (which would include the observer)—where object is not used to refer to a physical item, but to an object of attention in the sense expounded in my Doctoral Thesis (Glanville 1975).

In this paper, steering is looked at through the frame of stability.

Goal

Stability is in reference to something, called a goal. The system aims towards the goal, and can sense when it attains it (or reaches near enough for it to consider it has attained it).[3] It can also sense that it has not attained the goal, and act accordingly. This information is fed back so that the system's behaviour can be modified. Purpose is the word given to the system and describes its motivation in having its aim. The whole system may also be called teleological.

The estimation of the system's stability is in reference to its goal. The goal may be fixed, or may move. It may also invoke a behaviour that is either stationary or moving (static or dynamic). Thus, the yacht moving towards a buoy is dynamic while its goal is static; a missile chasing a plane is dynamic while its goal is also dynamic. When the yacht or the missile reach their goals, they usually stop. These

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[1] The word system will be used, here, for that which is taken as being steered: it is generally used in contrast, and as a complement, to goal.

[2] Another example of stability in repetition may be walking. In walking, we are "walking and falling at the same time" (Laurie Anderson 1982): we lose our balance, catching ourselves before we fall to the ground and thus attaining forward movement. Walking consists of repeating this action. The motion, without the catching, would be unstable: with the catching it becomes stable, and with repetition, it becomes walking, itself a stable action, and itself possibly leading to our following a trajectory to arrive somewhere, at a goal, (and then to set off again).

[3] Henceforth, it will not be mentioned that "hitting the target" may only mean being near enough.

are (two types of) dynamic stability.

In contrast, the thermostat is normally sustaining a more-or-less static temperature around an unmoving goal. This is static stability.

In the case of the yacht, it may go on to a further goal at another location. In doing this, it creates stability in a different way: the stability of repetition. (In the limit, of course, the thermostat is also an example of stability through repetition: it is all a matter of scale.)

Of course, the difference between dynamic and static stability is a matter of the frame of reference. How do we decide the goal should be taken to be dynamic? In reference to what is it moving? The system? But, if the system has to move toward the goal, how does it know that the goal is fixed. This question is easily answered at a superficial level: the background (ie, the environment) tells us the goal is moving. But this only shifts the question.

There is a problem here. It has to do with the absolutism of the goal, or with the notion that it is somehow fixed, immutable. This is, in fact, a problem of reference. And it is at its most powerful and problematic not in the "small" question of whether it is moving or not (a relativistic question of point of view and relative motion), but in how it can be the point of reference.

For, stability is to be estimated against a goal. Therefore, I am to measure the stability of my system against the goal, which is the point of reference. But now I have only passed the problem of stability along to the goal. I must assume that my goal is somehow stable. How do I do that? By assuming it has some goal of its own. In a structure that passes the attaining of a quality (in this case, stability) to something else (the goal), we cannot assume that stability is attained unless we can be sure that the goal, itself, is stable. But, in a structure that passes the attainment of a quality (eg stability) onwards, we can only "pass the quality" on to another goal.

This is a familiar problem and needs no elaboration. The only thing that is remarkable about it is that it should occur in terms of stability (there is a delicious irony in stability depending on something that forever shifts), and that this should not have been recognised. It is, of course, the old problem of recursion and of where the buck stops.

There are a number of solutions to this difficulty, which have been developed and propagated in "recent" cybernetics (of the last 25 years). They all revolve around circularity: that the reference point (the goal) becomes its own reference point (goal); or that the "yacht" and the "buoy" become the reference point of eachother, in a larger circularity (as I have shown to happen , generally, in control systems (Glanville 1987). Indeed, in one way, the establishment of these notions can be seen as the major concern and achievement of the cybernetics of cybernetics.

We can capture this state of affairs thus:

EVERY GOAL MUST HAVE A GOAL OF ITS OWN.

This goal of the goal may be made in one of three ways: either there is an infinite

regress (an endless concatenation of goals), or there is a circularity (the goal is its own goal) or there is a circularity between the goal and the system so that the gaol's goal is the system. Note that all three "go on forever", but, whereas the first goes along an endless "line" (in my preferred metaphor, the track left by the wheel), the second and third are wheels that just rotate—they are processes that generate the trace that is the line. The first can also be reformed so that it is also a process, the asking of the question "Where is the goal of…?" . (There is seemingly another case: when the regression of goals within stops: but this stopping is taken to indicate a circularity: at this point, the goal becomes its own goal or is made up of two "goals-to-eachother".)

When one of these conditions is satisfied, the goal may be taken to be stable. Then the system at least has the potential to be stable in reference to the goal. Stability requires a goal, and the goal needs to be stable. If the goal is of this form, the goal may be stable. And, reciprocally, if this is the form of the goal, the system may attain stability.

Inversion

We have found that

for a system to be stable it must have a goal in reference to which its stability is estimated.

goals must be stable.

every goal must have a goal of its own.

We can think of this another way round. We can say that when we judge a system to be stable, then we must assume a goal, and that that goal has a goal (according the descriptions of regressions given above). We can insist on this even when the goal is not visible to us. In effect, it is simply an extension of the definition. When we determine a system is stable, we determine it has a goal.[4] It does not matter that the system "actually" does or does not have a goal within. Indeed, the notion of actuality is inappropriate and inapplicable, because we cannot access the inside while remaining outside: the notion of goal, in these circumstances, is necessarily a construction: we cannot search to verify it; we work through explanatory necessity.

Let us consider the case of an object that continues to be: amongst other things it might be alive (using Maturana, Varela and Uribe's trick (Varela, Maturana and Uribe 1974), we redefine live as a verb: life is ability and action of continuing to live); it might be a yacht sailing a course; it might be a (Paskian) concept; it might be what I call an Object (ie, an object of attention), all of which are ways of forming the world so that it can be stable in our understanding of it. Indeed, it

[4] We are using, here, the devices of common sense and recognition: we are saying we know what is stable, we recognise it, we define it by instantiation. Doing this, we form the results of the analysis we carried out into what is involved in stability, and determine that the instances recognised as being stable have these qualities. The alternative, which is often very helpful—that we use the necessary qualities of the recognised instances to determine how we understand the qualities—is not helpful, here, because it leaves us with no discoveries. (An example of the other tactic is the recognition and therefore acceptance that self-reference is necessary to our account of the world, no matter what logic may say.)

might be anything, for this is a way of looking. The question is, where is the goal?

If it is invisible—and we have determined that it is—then the goal, the essential goal, must be within the system. That is to say, within the shell/boundary that defines the system (the Spencer Brown distinction), we must assume that the system has its own (invisible, because within) goal. This goal, being invisible, may be seen when the system is re-formed into fragments (as in vivo systems are systemically killed and fragmented in order to be analytically examined in vitrio; leading to the paradoxical and absurd attempt to analyse just precisely what has been removed from the system—life extinguished by death).

And, in order for us to talk about a system, it must appear stable (at least for the instant of talking): that is, it must be recognisable, meaning it must have a continuity of existence in our observing, as with the conserver objects of Piaget (Piaget 1972), and therefore it must be assumed to have a goal. That is, for us to talk, in this way of seeing things, we must have a concept of it (Pask) and it must support a concept with this structure (it must be an Object). And we must consider it to be continuing to be, for the moment (again it must be an Object).[5]

Behaviour

How would such a system behave?

In one sense it is absurd to ask—and to attempt to answer—this question. We cannot know. We cannot be inside this system without destroying its integrity: we would see it differently, and it would be different. Our treatment of the system is from outside. We cannot, de facto, predict its behaviour.[6] The system is a Black Box (Ashby 1956). In considering that a system is purposive, we are treating it as not being a Black Box (Glanville 1979 and 1982): we know where it is going and why: it is heading towards this buoy, it is aiming to keep the temperature around so many degrees. But our stable system, with (assumed) internal but without external goal, may go anywhere, while still being stable. It is not that it is static or dynamic (although it may be either): rather, it is that we will assert, using our understanding of what it is to be stable, that it is governed by something we cannot see. Stability is not necessarily concerned with any externally observed regularity in behaviour other than that of continuing to be. Therefore its behaviour is outside our realm, and may well appear best described, generally, by the term “random”. (Random meaning, in the mathematical sense (Chatkin 1975) of non-reducible, or without pattern.) In this sense, the system is literally “A Ship without a Rudder”.

This holds not only for systems, but for goals themselves. The goal must be stable. Therefore, the goal must have its own goals. These goals are, at some point, invisible. The goal, now considered as a system, exhibits behaviour that is random

[5] There is no need for eternity, but there is for continuity, for the moment.

[6] I mean something different from Wittgenstein’s point that history contains no necessity. I simply mean that prediction is not an action we have contol over or that is contingent on our relationship with the system, even though we may try, and may have fortuitous, serendipitous success.

(Chaitin 1975).

(The case when a stable system appears to behave non-randomly—not to wobble—is either a product of its purposive behaviour, ie, an external goal or the observer is moving in parallel with it, along a similar track, or it is a product of luck, good fortune, the place where we stand and how we look: serendip.)

Thus, if stability is a quality attributed to some system, that system needs a goal. And, for that system to continue to be (ie to be observable, to be talked about), the goal must be within the system, invisible. That is to say, the need for a goal remains a product of our definition.

This is a long way from our original notion of goal. In that case, the goal was external to the system, and visible: it was something the system could aim towards or for. What is the difference?

Observers

Where does the difference lie, in these differing situations?

The difference lies in the observer, or rather, in where the observer is and what he does in relation to the system. In fact, the difference is indicative of the distinction between what are still called first and second order cybernetics. This distinction may help clarify the difference. In first order cybernetics, the observer is outside the system, observing without affecting. In second order cybernetics, the observer is in the system—forming it—and therefore affecting it. (He may affect it in other ways, too, of course.) In terms of the second order, the first behaves as if it believed that there could be observation without there being an observer.[7]

It is the observer that determines the goal—including that it is a goal.

And it is the observer that determines that a system is stable.

Thus, the observer determines that there should be an (assumed and invisible) goal in the stable system.

And that that condition should apply also to the goal.

Since the observer is outside the system, this is determined from the outside. It is the consequence of the decision that the system is stable that there should be a goal within. But it is also a consequence of the decision that the system is stable, that this is observed from outside. What sense does it make to talk of stability as a quality within the system (with its own assumed and invisible goal)? What could that mean? (We can have no idea what it might mean within that system from which we are completely excluded. But we can know that it cannot mean what we mean when we speak from the outside.) It is these systems, stable and with internal

[7] I should like to see the difference between first and second order done away with: it served (and occasionally still serves) a significant purpose, but I like to think that second order is now accepted and seen as being the more general, and therefore more powerful, case (the wheel that gives rise to the track). I believe this account shows the intertwinedness of the two almost as complementary facets of the same.

goals, that are like “A Ship without a Rudder”.

Yet there are systems, the systems both we and cybernetics started from, where the goal is seemingly outside the system. In the case of the yacht reaching for the buoy, for instance, the buoy (the goal) is quite distinct from the yacht (the system): at least while the yacht is heading towards it, reducing the distance.

What is not taken into account is the role of the observer in forming these accounts and in determining the goals, and that they are goals. In the account that has been developed here, the observer makes both the goal and the system (and places purpose on the system). Not in the manner in which systems (and goals) that are stable are taken to have goals. But in the manner of establishing the roles and relationship involved, ie defining the yacht as the system and the buoy as the goal, and giving purpose to the yacht such that its observed behaviour is seen as being purposive. These are observer attributes. And they form a whole. A goal without a system would be pointless! The goal needs a system as the system, looked at in this way, needs a goal. They form a unity. But the difference is that the observer is within this whole, this unity. Thus, we have a supersystem, a whole that contains a goal and a system, just as does the whole called an concept, or that called an Object (in my sense, see Glanville 1975, for instance). Of course, the supersystem is, anyhow and regardless, a system.

Thus, the goal can be seen as always within the system. What changes is where the observer is in reference to that system—or sees himself as being. Is the observer also within the system, or outside it. When the observer is outside the system, he/she can see the system as being stable but must presume the existence of the goal within the system. Then he is within that supersystem. And when inside the system—thus a supersystem—the observer can see the goal, but must nevertheless determine that the system and goal are both stable, and therefore must be presumed to have internal goals of their own.

But what about the case of the thermostat? There is no significant difference between the thermostat and the yacht in this respect. Both are concerned with reduction of the “distance” between the system’s performance and the goal. One is repetitive/circular and the other one off or serial, but that makes no significant difference. And, anyhow, the yacht can be seen as repetitive/circular in how the yacht sticks to the course that will get it to its goal. As far as the need for goals and the role and location of the observer are concerned, they are the same in both cases. The observer is within the system determining both the system and the goal in the thermostat, and having to attribute goals to both, just as in the case of the yacht.

The Steersman

Cybernetics is initially concerned with steering and the steersman. The cybernetician is, himself, a steersman. But the steersman under consideration is not always the cybernetician. He may well be the yachtsman at the helm.

In the case of the yacht reaching for the buoy, we consider the helmsman (or some automaton equivalent) as steering the yacht towards the buoy. This helmsman is, of course, an observer. If he did not observe, he could not move purposefully towards

the goal. He is, of course, inside the system, visible only when the system is split and otherwise necessarily assumed to be present while remaining invisible. Thus, he is hidden much as the (internal and assumed) goal is.

What is his role as an observer?

Clearly, he has to decide that the goal is a goal. He has to move towards it. Is he part of the system? From where we stand, he is. From where he stands, he is separate. Yet he is also part of a (super)system that includes the goal and the system as well as himself, the helmsman-observer. In this he is just like us: he defines the system, the goal and his relationship just as we do. To us he is in the system, to him we are unnecessary or irrelevant. Observation, as an activity, slips across and through boundaries and distinctions. It is omnipresent, it defines the roles and the boundaries it then transcends.

Thus, observing and steering unite. In the context of cybernetic stability, observation is steering, steering is observing. Without the qualities of the one, the other would not work. Not that they are identical, but they each contain areas that throw light on the other.

And, when the observer is outside the system and can only suppose the concatenation or self-referential loop of goals and observers, he can also see the system as stable, yet always as "A Ship without a Rudder". For when he sees the ship as steering a course, he has placed himself within the system.

Appendix

The characteristics of the observer and his relationship with the system are as follows.

The observer is outside, looking inwards:

The observer can attribute stability to the system (or the goal, see below). In doing so, he must attribute an internal goal. In defining the goal he becomes part of a larger (super)system. The attribution of stability to a system does not mean it behaves with pattern: pattern is an intentional result of fortunate observation. Its behaviour is best described as random.

The observer is outside, looking outwards:

The observer can determine the goal and attribute purpose (relationship) between the system and the goal. But in doing so he becomes part of a larger system: that is, a new system is created, with the observer inside it (all is made within). Both system and goal are considered stable, and there is a firm (purposive) behaviour of the system vis-a-vis the goal.

The observer is inside, looking outwards:

The observer is a steersman. He can choose a goal and must also separate himself from the system he is taken to be embedded in by the observer who is outside the system looking inwards. In assuming the goal and the system are stable, he must attribute to them goals. He gives purpose to the behaviour (movement) of the

system towards the goal: in this, in having separated himself, he is fulfilling the same role as the observer outside, looking inwards. Thus observation transcends boundaries.

The observer is inside, looking inwards:

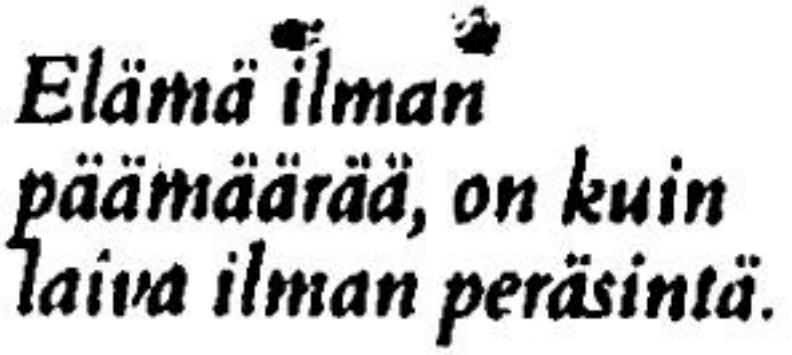
?[8]

The need for a concatenation of internal goals can be formed in several ways. Three (related ways) have been indicated:

An infinite regress of goals within goals

A circle in which the goal is its own goal, or the goal has a gaol which has the first goal as its own goal.

A circularity in which the observer (or some other such partner) becomes the goal to the goal.



Found on a Finnish sugar lump wrapper while writing this paper: "Life without a Foundation is like a Ship without a Rudder"

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[8] We cannot, as outsiders, speak of this. We can deduce the need for self-reference, and forms such as autopoiesis (Maturana, Varela and Uribe), the Paskian concept (Pask 1975) and my own Object (also von Foerster's token objects (von Foerster 1981, which have the interesting quality of appearing to recursively attain towards a state of stability, apparently through repetitive internal dynamics—although the reference point by which this stability can be estimated is nevertheless external)). It is more dramatic, and more in keeping with the intention of this paper, to leave this blank, here. I have dealt with self-reference on many occasions over the last 25 years.

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