

REITH LECTURES 1967: A Runaway World

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Lecture 2: Men and Machines

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The marvels of modern technology fill us with amazement but also with dread. All the time we are haunted with nagging anxiety. Isn't the gadgetry getting too clever? Moon rocketry is all very well, but Dr Strangelove was too lifelike to be funny. If the computers take over, where do the human beings come in at all?

But the anxiety goes deeper than that: where do I come in at all? It was all right when the surgeons just fitted us up with artificial arms and legs, but now that there are people going around with plastic guts, battery-controlled hearts, dead men's eyes and twin-brother's kidneys, there begins to be a serious problem of self-identification. What is there left of me as a human being if all the different parts of my body can be treated like spare parts to be bought over the counter of a bicycle shop? Am I just a machine and nothing more?

But surely there is a muddle here. We love our machines. Machines are what we desire most in the world. A car, a telly, a fridge, a washing-machine, the very latest thing in cookers—what would we do without them? Technical wizardry is just what makes life worth living, it is the badge of civilisation, the marker which separates off the educated man from the poor benighted savage who lives in a grass hut and cooks his food over an open fire. So what is there to be afraid of? Where's the worry?

I think the worry is that all of us are haunted by three very big ideas which somehow ought to fit together but won't. The first is the idea of nature: the world as it is 'out there' before human beings start messing about and turning forests into cities and broad valleys into airstrips. But nature includes the whole animal kingdom, and we are animals. It was on that account that some 18th-century philosophers maintained that the original primeval man must have been 'a noble savage', an ignorant creature of nature inspired by sensual poetry long before he became a rational human being. It is this uncontaminated nature which modern science is now exploring with such great success.

The second big idea is the opposite to the first: civilisation as opposed to nature—what the anthropologists refer to as culture—everything about our environment or about our behaviour that is due to human intervention or to learning as distinct from instinct, our roads, our houses, our tidy fields, our manners and customs, our laws, our language and above all our machines, the gadgets on which modern civilised life depends. The third big idea, which ought to bridge the other two, but somehow doesn't. Is much the most difficult: it is the idea of the conscious self, the I. Am I a part of nature or a part of culture? Well, both, but how?

The trouble here is that each of us feels capable of 'acting intentionally': that is to say, we think we have free will; we think we can make choices. But where does choice fit

into the total pattern, the grand combination of nature, culture and the human self? We met this same puzzle last week when I was talking about scientific detachment. The scientific observer can't ever admit the possibility that the stuff he is looking at might be changing in an intentional way. For change of this sort would produce events which could not be predicted, either as the outcome of mechanical rules or as the outcome of probability, and all scientific investigation would become futile. Nature must be orderly, and we have the same feeling about the man-made part of our environment. The machines are all right as long as they behave in a predictable way; what terrifies us is the idea that somewhere along the line they might start making choices on their own: they might start to think, they might begin to act like us. And that would mean that we are no different from machines.

But why do you feel humiliated by the idea that you might be a machine? Why are you so sure that our human consciousness makes us something different, separating us off both from nature and from our own creations? This is really very important. If only we could come to feel that consciousness is not something which makes human beings different and sets them apart but something which connects us all together—with each other and with everything else.

Part of the trouble is that we still take our cues from the first chapter of the Book of Genesis. We still think of man as a special separate creation in a world of separate things. If we were more evolutionist in our attitudes we might feel more connected up. Evolution is a theory of change; a theory about how things have come to be as they are. But remember what I was saying just now about intention, The interesting thing about evolutionary change is that it is unpredictable; evolution is not a simple mechanical process, nor is it a simple randomised chance process; can we then say it is an intentional process?

The first thing we need to understand is that in nature change of any sort is rather rare. The most important process in biology is the almost incredibly exact copying of what was there already. The natural world of living things is quite certainly very heavily committed to orderliness and stability. It is only because of this accuracy that different species of living things can perpetuate themselves at all, so you might argue that, from a biological point of view, change of any sort is dangerous error. On the other hand, without such errors, all variation would be impossible. In general, species of living things become differentiated by becoming adapted to use particular resources of particular environments. By a sequence of slight changes extending over many generations the form of the organism gradually develops into a uniquely efficient apparatus for the exploitation of selected elements in its geographical surroundings.

As long as the environmental conditions are completely stable, this physical specialisation will ensure that even very similar- looking plants and animals living side by side in the same terrain will avoid cutthroat competition. Indeed, the more specialised the diet, the more certain is the food supply. But a high degree of specialisation of this kind could lead to total disaster if the environment itself were to change. Although all creatures, including man, are adapted to live in special environments, some are a good deal more versatile than others. They are less fussy about diet and can accommodate themselves to a relatively wide range of situations.

When the environment changes, the more versatile species are at a great advantage. What happens can easily be seen by looking at your own garden. Most of the plants which you admire developed originally in rather specialised environments in other countries, and if you don't go to a lot of trouble to provide just what they need they will die out. But the weeds are adaptable—no matter what you do you can't get rid of them. In the wild, weeds and rare plants are found living side by side, but as soon as change is introduced the weeds begin to flourish and the rare plants to disappear. Now in relation to all other species, we human beings are the weeds. We are all the time generating changes in the environment but, like rats, we can accommodate to all sorts of different situations, so the changes are always advantageous to us and disadvantageous to nearly everything else. In the long run we and the rats may be the only survivors.

But the puzzle I want you to think about is this...Any weed-like or rat-like kind of versatility calls for at least a rudimentary capacity for making decisions. In a situation of random choice, some choices are encouraged by the environment and some are not and, in the outcome, the species 'learns from experience'. But isn't that pretty much what we mean by 'conscious intention'? In that case is free will really a human peculiarity? Are we unique at all? Well, we are if you insist that 'intention' has something mystical about it, but not if 'intention' is just a kind of mechanical response.

This is tricky country. The margin between 'mechanical response' and 'intentional behaviour' can be very narrow. I don't want to push this argument too far. I am not claiming that a sprouting potato in a dark room searching for the light should be described as 'acting intentionally', nor am I trying to deny that man is an altogether exceptional kind of animal. In the matter of language, for example, man is 'in a class by himself'. Human speech is a message-bearing and information-storing device of quite a different kind from that possessed by any other animal. All the same, we are much less unique than most of you think.

It is only quite recently that scientists have begun to observe the normal behaviours of wild animals with real care, and the results have been surprising. It has become apparent that the classical distinction between animal behaviour which is governed by inborn instinct and human behaviour which is governed by reason and learning must be abandoned. Animals, too, can learn and in some cases they can pass on what they learn. Indeed in the long run learned behaviour can even have consequences for physical evolution. For example, our own flattened faces and tool-using hands could only have become advantageous to the species after our ape-like ancestors had learned to defend themselves with weapons. Animals then—or at any rate some animals and in some degrees—can possess 'culture'. They can possess a body of hereditary knowledge which is not transmitted genetically. Many kinds of animal behaviour are the result of habit rather than of instinct and animal habits, like human customs, can be modified quite rapidly. We must accept the fact that animals can make choices. In that case the usual distinction between evolution and history largely disappears.

You and I were brought up to believe that man is unique because he alone belongs to history. At school we learnt about history and evolution as quite different 'subjects'. Evolution was some thing that happens to particular animal species; it is extremely slow and it is studied by scientists. History was something which goes on all the time in human societies and is studied by historians. The argument was that evolution is

opposed to history, as nature' is opposed to culture, as science is opposed to art, as order is opposed to chaos, as instinct is opposed to free will, as body is opposed to mind, as animal is opposed to human being.

But by making this radical distinction between what is animal and what is human we get ourselves badly tangled up. We, too, are animals. The totality of any animal is not the biochemical thing but also its behaviour, the way it connects up with its environment and the way it modifies that environment. A bird is not just a two-legged animal covered with feathers: it is a creature which flies, a creature which builds nests in a very specific way, a creature which communicates with others of its kind by means of sound signals of a special sort. Likewise man is not just a naked ape, with a special shape of skull: he is a creature with a uniquely versatile technical facility for modifying his environment and communicating with other members of his species. But, you say, man is different because he can exercise free will and intention. The difference is only one of degree. In any kind of species, genetic endowment does not determine behaviour: it sets limits. It specifies what an individual can't do—in our case we can't use our arms to fly and we can't see out of the back of our heads—but within these limits the individual animal—human or non-human— can adapt to the environment in any way it chooses. Well, maybe and maybe not: and that choice is a matter of social organisation as well as social behaviour. At this level the pattern of relations is not predetermined by evolutionary adaptation. Of course man is different, but he is not totally different. What we need to understand is not what man is like 'by himself' but what he is like in relation to all the rest. Where do we fit in?

After that digression about evolution let's get back to the relation between men and machines. There are two rather different points I want to make here. The first is that the way a human being functions, just as the way any other living creature functions, is mechanical through and through. We haven't got a special little private manikin sitting inside our heads pulling the strings. The other is that we should think of man-made machines as related to ourselves in much the same way as a bird's nest is related to the bird.

Every species of bird has become adapted by evolution to live in a particular way in a particular habitat; the nest which it builds expresses this relation. The bird uses particular elements from the environment to make the nest. If you substitute a different environment in which those particular elements are missing, the bird may, or may not, be able to make a suitable substitution. If it does manage to cope, then the innovation expresses a new relation with the new environment. So also with us. Human beings with their gadgets are all the time establishing new relations with their changing habitat, but in the human case, it is the human beings themselves who cause the habitat to change. But I am going too fast. I have dragged in the difficult idea of 'relation' without explaining what I mean.

Let me go back to something I said last week. When we first go to school we learn about the world by classifying things— kinds of plants, kinds of birds, kinds of insects. We are taught to separate one object from another and to label each item with its proper name. But later, when we go to secondary school or to university, we gradually come to be far more interested in how things are related than in what they are called. This is because the comparison of relations is more thought-provoking than the comparison of things. For example, there is not much point in comparing a whale

as an object with an airliner as an object; but you can easily see that the shape of a whale—that is, the set of relations which determines its outward appearance—and the shape of the fuselage of a large aircraft are very similar, and, as most of you will know, the reason for this is that the relation between a whale and the water through which it swims is very similar to the relation between an aircraft and the air through which it flies. There is nothing new in this: the whole point of mathematics even in its most elementary form—such as the formula $2 \div 2 = 4$ —is that relations have a sort of reality which is distinct from and more general than that of the objects which are related. Let's take another example. Supposing you wanted to answer the question 'What is a motor-car?', you could, if you liked, simply list several thousand individual parts by name. This would be description of a sort, but it wouldn't be much use. What most people would want to know is how the thing works as a whole, and to explain that you would need to show just what connects up with what. You would almost certainly use mechanical models and diagrams and chemical equations without reference to any actual motor-car at all. In other words, the model has much greater explanatory power than the thing in itself.

Almost the whole of modern science is like that. It is concerned with how things work rather than with what things are; it is concerned with relations not with objects. But the habits of childhood persist. Although experience teaches us that relations are real and that things are to some extent a by-product of the way we use our language, nearly everyone finds it easier to think the other way round. Even professional scientists who operate in the mysterious world of particle physics, where all the experimental evidence is concerned with relations and all the entities are entirely hypothetical, seem to feel that the existence of relations must imply the real existence of things which are related: so they feel obliged to invent names for things they can never see and even for entities like neutrinos, which, by definition, have no material existence!

You see, the real point is this. We are all specialists of one kind or another—carpenters, bricklayers, cooks, electricians, farmers, doctors, philosophers, or what have you—and we all have our private languages. As the compartments of knowledge become more and more numerous and more and more complex, it becomes more and more difficult for the specialists to talk to one another, to swap ideas across the artificial frontiers of language which they themselves have set up. But when they do communicate, when a zoologist manages to say something to an aircraft designer, it is because we are able to make comparisons between 'relational structures' as distinct from 'material things'. And this isn't just a game for the boffins. It's what we all do, all the time.

Look here: I am communicating with you right now. I don't quite know what I am communicating, but I am communicating something. This is because the sound waves which are reaching your ears are organised in patterns which correspond to something that is going on in my head, and you are able to recognise the patterns: the patterns are 'relational structures'. They happen to be impinging on your ears in the form of air vibrations, but they are passing most of the way from this studio to your room in the form of electromagnetic waves, and in my head, and in yours, the patterns probably take on some kind of electro-chemical form. But the patterning, the structure, is the same all the time. It must be so, otherwise there would be no communication. But consider the communication path—my head, my voice, the

microphone, the radio transmitter, your receiver, your loudspeaker, your ears, your brain. There is no break in the sequence. There is a transformation in the form of the pattern at each stage but not a change in structure.

I think we can now begin to answer the question I posed right at the beginning: Why are you so upset by the idea that you might be a machine and nothing more? The trouble is in the way we use language. For most people the word 'machine' evokes the idea of a material object, made of metal, and full of revolving wheels and electrical circuits. If then I tell you that 'man is a machine' you immediately assume that I am saying that man is just one of Karel Capek's robots. But in my language the word 'machine' means something much more general; it is shorthand for a 'structural system which works'. From this relational viewpoint any two machines which work in the same way or do the same kind of job are the same kind of machine even if they are made of quite different substances and operate in quite different environments. And we can usefully compare one machine with the other just as we can usefully compare the shape of an aircraft with the shape of a whale.

It is quite undeniable that some very useful analogies can be drawn between the relational systems of computer mechanisms and the relational systems of brain mechanisms. This comparison does not depend upon any close resemblance between the actual mechanical links which occur in brains and in computers—it depends on what these machines do. Brains and computers are both machines for processing information which is fed in from outside in accordance with a predetermined programme; furthermore, brains and computers can both be organised so as to solve problems and to communicate with other similar mechanisms, and the mode of communication is very similar in both cases, so much so that computers can now be designed to generate artificial human speech and even, by accident, to produce sequences of words which human beings recognise as poetry. The implication of this is not that the machines are becoming so like human beings that they will shortly drive us out of business, but simply that there is no sharp break of continuity between what is human and what is mechanical. The machines are a part of ourselves just as our brains and arms are parts of ourselves, and the bird's nest is part of the bird.

Considered simply as a material object a space vehicle, which can land on the moon and then carry out complicated instructions issued to it from the earth and report back its observations in visual form, has an existence which is quite separate from that of its human makers, and it is pretty terrifying, but considered as a machine its status is wholly dependent: it is, in effect, an extension of the human beings who control it. It is as if man had suddenly been able to grow telescopic arms and eyes 240,000 miles long.

Up to a point this is comforting. If all man-made machines are simply an extension of man they cannot constitute a threat. But there is another angle to this. Those who object to the analogy between brains and computers are always telling us that 'computers can only do what they are designed to do.' Fair enough. But likewise human brains can only do what they are designed to do. This means that all communication between man and his environment or between one man and another man is subject to mechanical limitations.

The world 'out there' seems to be how it is because our human senses of sight and touch are part of a machine adapted to record just that sort of picture and no other. It is a fragmented world full of separate things ordered into sets on the basis of visual resemblance or similarity of texture. If we had different senses— more sensitive noses and ears, for example, or a capacity to respond to variations in the magnetic field— our environment would not only seem different, it would be different, even though the 'things' in it were just the same as they are now. Sorry, that sounds rather mad. What I am saying is that what the 'world out there' is like depends on how we react to it. It is relations which constitute my existence, just as it is relations which constitute your existence, and correspondingly what I can recognise about the world out there is sets of relations, not sets of real objects.

Let's put it the other way round. You and I both feel that we exist as individuals. If we reflect on the matter this must be because of a mechanical, somewhat computer-like process, which goes on in our heads. The brains in our heads are machines —products of evolution, adapted to record certain kinds of information in the human environment which are useful to man as an animal species; our brains can't do anything else. The structures which the brain records must correspond to structures which are 'out there', outside our bodies. But that is the only thing we can possibly know about what is out there: that it is patterned in the same way as the responses in our brains. Therefore, patterns of relations are the only 'reality' with which we can have any real connection.

Things as objects are separate from us, relations occur in chains which connect up with us. Self-consciousness is awareness of relations; free will is a matter of making adaptive choices between one possible, pattern of relations and another. I am not a thing apart looking on; I am just the connectedness of one small piece of apparatus tied in with all the rest. A much more humble role — but less lonely.