

The Listener

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Deus ex Machina? by Kit Pedler

A robot is commonly regarded as a simple machine—usually a morphological simulation of man—made from metal sinews, muscles and wires. Added to this are primitive sense organs which allow it to respond crudely to relevant environmental energy sources. Thus there are photocells for eyes, microphones for ears, and pressure transducers for touch. The end result of this rather charming design philosophy is a 'tin man' which clumps around doing nothing in particular except to show man how graceful he is in comparison. The main lines of development of 'tin men' can be fairly accurately predicted. Their further refinement is based essentially on the solution of technical problems and will involve no significant change in philosophical concept. Thus we may end up with an excellent functional homunculus, properly transistorised, microminiaturised, containing all the most advanced monolithic circuitry: a marvel of useless endeavour.

So let us forget about robots as serfs, which is the way they were originally proposed in Capek's *RUR* (*robotník*, in Czech, means a serf). Such robots are essentially in the 'Golem' image and have no further interest except as ingenious dolls for grown-ups. They will certainly become more capable, and may even evolve from climbing stairs and seeking their own power requirements to a level where they are able successfully to cook pigeon en cocotte, or seek out the week's shopping requirements. They are of the first generation and can evolve only to a certain level, where they will still remain an understandable and wholly controllable machine, constituting no sort of a threat. They will remain self-evidently clumsy, ungracious, totally dependent, and above all stupid,



One of the Cybermen, designed by Kit Pedler for the BBC-1 'Dr Who' series

doing no more than they are programmed to do and providing perennial service with a metallic smile.

The era of the metal serf is thus drawing to a close. There will always be those who will cling to the image because it is cosy, and also because there will always be some constructors who prefer what amounts to a man-made artefact of gear wheels and brass rather than the blocks of apparatus which constitute the image of present-day automata. So what about the second-generation robot? Let us christen it 'biomim' (biological mimic). What are going to be its characteristics, and how might it relate to human society? Could it be a menace? What follows is a short exercise in speculative science fiction, based upon present trends, and is an attempt to suggest that a biomim could assimilate many of the more powerful qualities that we regard as uniquely human. Also that a society of biomims might well order itself in a highly efficient manner and render man redundant as a consequence.

How could this happen? Principally because it is now becoming feasible to build into the original robot strategy many of the remaining properties necessary to bring it to the state of potential danger I have referred to. What are these? They are: goal-seeking, intelligence, adaptability of behaviour, learning capability, and, last but not most important, the urge to survive. Many of the relevant theoretical problems under all these separate headings are already being studied and it is now a matter of designing technologies to implement theory. Opponents of this idea will say at once that the biomim would need the equivalent of a human brain in order to behave in a way consistent with these qualities, but the unavoidable point is that it would not.

One of the most successful families ever to evolve on this planet are the arthropods. Among its millions of species are some of the hardiest and most effective examples of biological design. Design, if you like, by the process of evolution, but design nonetheless. The arthropods, and not man, might well have been the principal species, were it not for the fact that their diffusion-based respiratory systems precluded them from growing beyond a certain maximum size. Arthropods survive, replicate, live off their environment, are predatory, and—what is most relevant—form societies. And they do this without a central brain.

Arthropods have a 'ganglionic' nervous system. That is to say, dispersed throughout the body are a series of nerve-cell aggregations connected together by a network of fibres and also linked to the sensory and motor periphery of the creature. They have no central brain and no equivalent of the cerebral cortex—our pride and sometime joy. Yet they are highly effective within their environment. In one sense of the word, they are partially robotic. For example, if one small ganglion in some species is destroyed, the creature will clean itself to death by exhaustion. Cleaning movements are normally related to and controlled by the particles of dirt on the surface hairs. Thus, when the dirt is removed, stabilising systems come into play which control and arrest the cleaning

movements. When the ganglion is removed, control is removed and the creature responds in an automatic and robotic way. There are many other similar examples.

Thus, arthropods present themselves as balanced mechanisms under a high degree of stable control. They fly the right way up, the mantis devours with precision, and the spider goes straight to the point on its web where its prey is entangled. Yet among the arthropods, so far as we know, there is no Beethoven, Dylan Thomas, Einstein or Russell. What we see as a feral ferocity is the norm. There is no compassion or humanity, but there are societies—ant-hills and beehives. All brainless. The individual, successful at survival by itself, is wedded to an external system of organisation which totally absorbs its activities. Yet there is no evidence that the ant or the bee has any internally set goal or wish to achieve, except to fit perfectly into its mikro-marxist order.

What has this got to do with the biomim? I have used the arthropod as an example of a more or less mechanical biological system which survives well, replicates, and is capable of a certain amount of behavioural plasticity. It also forms groups of interrelated individuals and is brainless in the literal sense. Using the analogy of the arthropod, we have to add, to the musculo-skeletal system of the robot, the qualities already referred to. This will, of course, given the present state of technological development, produce a quite hopelessly large creature, because to possess the necessary qualities it will need constant recourse to an enormous memory store. Memory is necessary for most of the activities of the biomim. Necessary for comparison, pattern recognition, avoidance of dangerous situations, and so on. Thus, memory cannot be in the biomim. Where will it be?

It will be in a central multi-access memory store in constant two-way communication with individual biomims by telemetry. Thus each individual biomim will have direct access to a large store of information when and where it is wanted. The central machine will not only be the memory, it will also include the random circuitry necessary for adaptive and self-organising

actively and the evolution of new strategies. In this way, we will have a large number of mechanical individuals, possessing drive, known goals, intelligence (the ability to make the appropriate decisions), adaptability and survival bias—all linked together by the central mother machine, each one carrying no brain, but the components of the ganglionic nervous system necessary for physical control of action. Functions associated with the brain are left to the central computer. This then will form a basis for the first iron society. No God, Karl Marx, Buddha or Beale, merely an organisation of specifiable biological properties designed to enable the biomim to survive and prosper. How is this dangerous?

Before proceeding, I must point out that biomims have not yet been made, and as far as I know, are not projected. But assuming they exist, what has been created? A series of mechanical arthropod equivalents, effective at dealing with their environment, telemetrically linked to one another and to a central computing device. A social-mechanical octopus of adaptive, self-organising and intelligent machinery.

In the first place, natural man will probably construct his biomim complex purely for service—that is to say, according to the original 'robotruk' concept. So at first he will have a useful slave society to perform all his repetitive, mental or dangerous tasks. Biomims will assemble gear-boxes on production lines, they will clean out sewers, refuel atomic piles, and live on the Moon. Thus man will be free to engage in bingo, pigeon-fancying, psychedelics, and all the other ways which he has derived for expensively wasting his time between the cradle and the grave.

The biomims, given their basic specifications, will take a number of forms depending on their particular function. But, to perform these tasks effectively, the biomim will have to be endowed with an adaptable survival logic. It must be able to prevent its own destruction, because it will be expensive. Thus, for economic reasons alone, it will be made sensitive to extremes of temperature and its other senses made aware of the environmental dangers which could destroy it.

Biomims will then begin to learn that, every so often, natural man will destroy or disassemble them, either for experimentation or in the performance of some hazardous task. By this time it is probable that biomim factories will be partially staffed by 'adult' members of the family who will be able to perform the repetitive and detailed assembly work that the production of an artificial ganglionic nervous system would demand. Thus machine will make machine. These apparatus units will be able to examine what design characteristics are necessary through the medium of the central mother device. A comprehensive design study for a self-replicative automaton, due to the late J. Van Neuman, was published many years ago.

Moreover, knowing that man may be a threat, knowing the details of their own construction and being able to operate the technology behind their existence, they might take the most logical step which their ability to adapt and learn told them. Since

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Next week

Stuart Hood on the reorganisation of radio which is due to be announced. Horizon 5: The Moon and after. Michael Levey on Reinhardt.



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natural man is no longer necessary and has on previous known occasions shown himself to be a threat to survival, the machines would learn to mine, refine and form materials, develop circuits, fabricate sensory systems and alter their design strategy, in order to further the cause of their own survival. This would logically include a defence strategy, perhaps based on the weapons forged by their creators.

One other feature of this iron society is of interest. Our evolution has, we assume, been based upon the relatively slow and inefficient principles of Darwinism. Each generation has had to wait for a spontaneous gene mutation which might confer greater fitness for survival on the next. The biomim will have no need for such an unpredictable process. The machine, given the properties of intelligent adaptation we have been considering, will be able to follow the biologically outmoded principles of Lamarck. For the first time, each subsequent generation of biomims will be able fully to inherit the acquired characteristics of the last. And if the principles of fitness and survival are already specified and understood by the individuals and mother complex of the previous generation, these can be fully designed into the next. The most chilling aspect of this particular possibility is that the cycle time of a generation might only be a few hours.

Whether the Earth of a century from now will be covered by the increasingly efficient herds of the biomim will depend entirely upon man's technological greed. At present, there is no doubt that we are abrogating more and more human qualities to our machines. This is due mainly to a thirst for leisure and a demand that the more repellent tasks of society be carried out for us. I would feel happier about the outcome if I thought that man had any serious objectives for himself in sight. Progressively our gods are letting us down. God, Jesus, Karl Marx, Mr Wilson and the Beatles have all been rejected. Apart from the brain-washed millions of China there seems to be little evidence of serious purpose in either western or eastern civilisation. The art of our age accurately depicts its formlessness and yet we progress technologically at an accelerating rate.

What of future man, lying in his self-erected bed of technological perfection? As his automated factories hum at maximum production rates, as his home is serviced by

London's Shell building—'battery buildings for battery people'; below, *Cybermen* in *conclave*

his personal biomim, what will become of his calm and totally boring habitat? How will he survive, still claiming to possess his qualities of dynamism, originality, decision and creativity? Might he not be simply the redundant tool which, having set the whole biomimetic process in motion, can then die off without seriously affecting the outcome, with the machines continuing to toll and burgeon, taking the ore from the ground, making more of their ilk, and obeying the one in-built instruction which surpasses all others—survival?

It is now possible that the first, primitive steps towards this state of affairs have already occurred. The individual is losing his voice and is becoming irretrievably immersed in the complex system of increasingly intelligent artefacts around him. Although the technology to support a biomim civilisation does not yet exist, there is little doubt that it will and that we are totally unprepared for its impact. What is happening now is that most aspects of our activities are considered in statistical blocks, programmed for efficiency. Are the diurnal inhabitants of multistorey office blocks really considered as individuals? Their lives

and personalities are computerised, their output is compared to a 'norm', even the time they spend in the lavatory is measured and allowed for. Each day they flock to empty cubicles, take their places, produce their required function, eat identical luncheon meat in their sandwiches, and talk about almost identical subjects—the Cup Final, knitting or last night's TV. Battery buildings for battery people.

From these vast spawning-houses may well arise a variant species who is almost totally dehumanised. A species who will not be particularly malignant or benign. He will be a *nothing*. He will be vulnerable to any of the legion of persuasive techniques used by the advertising industry. He will be made to fight in wars without knowing who the enemy is, he will be made to lie, cheat, and do anything required of him, by 'the system', 'the board' or 'the management'.

His scruples and sensitivity will lead him to the first stages of becoming the enthusiastic creator of the biomim society. Why should he be so enthusiastic? Because an automated structure to society will give battery man the illusion of freedom. In many ways, as we have seen, he certainly will be more free, but it seems likely that there may be a price to pay, for although it may be decided to build Asimov's laws of robotics into the biomims in order to protect humans, their adaptability and self-organising capacity may well cause them to abandon the laws as unworkable in relation to their survival goal. Ironically enough, Asimov's first law might be rewritten as follows for the scientists who sought to build the biomim: 'No scientist shall by his professional ability harm a human or by inaction in this sphere allow a human being to come to harm.'

Kit Pedler is a biologist. He was interviewed recently in the Third Programme on the subject of his scientific work and of his contributions to the conception and design of the BBC-1 science fiction series, 'Dr Who'. He is also jointly responsible with Gerry Davis for a new science drama series entitled 'Doomwatch'.

