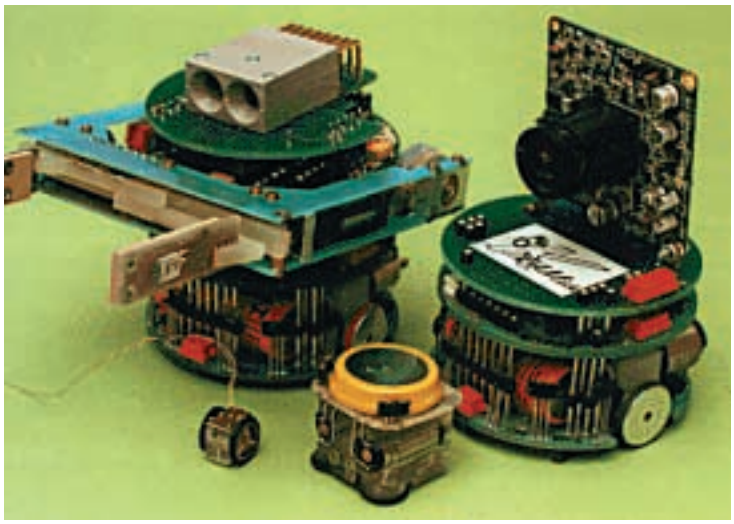
THE DAY IS COMING WHEN ROBOTS WILL BUILD, DESIGN AND REPRODUCE THEMSELVES.

Mating robots

IT ALWAYS USED TO BE THAT robots were the fruit of human imagination. Now researchers are promising a new generation of robots that can design themselves, build themselves and program themselves. Not to mention reproduce.

Richard Watson and Sevan Ficici of Brandeis University in Massachusetts are working on what they call 'Embodied Evolution' (http://demo.cs.brandeis.edu/pr/ee/). Their idea is to set up a population of robots in some environment and – wait for it – let them mate with each other.

For their experiments they've been using little home-made robots they call 'tupperbots'. Each robot is about the size of an ashtray, and inside the plastic casing are two light sensors, a simple microprocessor, a motor, and an infra-red comms link. The robots draw power directly from a floor ruled with stainless steel power strips, engaging with contacts in the base of the robot between the wheels. Each robot's task is to move towards a light at the centre of the environment, finding its way around all the other robots who are trying to do the same thing.



Snap happy: some of Khepera's robots with cameras

Each robot starts off pre-programmed with a simple behaviour algorithm – its 'genetic code' – and when two robots come within flirting distance, they transmit their genes to each other, via their infra-red links. A random mutation is introduced into the sets of transmitted genes, and each robot incorporates the genes it receives into its own genome. The effect after several generations of evolution is that the robots gradually get better at finding the light and, surprisingly, their performance even beats that of a behaviour program hand-crafted by the researchers. You can try a Java simulation of the tupperbot experiments at www.demo.cs.brandeis.edu/~miguel/cgi-bin/Bots/.

Hod Lipson, also at Brandeis University, is taking the idea of robot evolution one stage further, and wants to build robots that change their shape on the fly, according to their given task (www.demo.cs.brandeis.edu/golem/). Currently Lipson and his colleagues are running evolutionary algorithms on a computer connected to a '3D printer', which deposits layers of thermoplastic to build up a 3D structure – and out pops a simple robot. In the future, miniaturised 3D printers could be incorporated directly in a robot's body, so it could sprout extra limbs on demand, and even give birth to new robots.

At the other end of the evolutionary scale, Mark Tildon of Solarbotics (www.solarbotics.com) builds bug-like robots he calls 'junkbots', that are cobbled together from whatever spare parts he has lying around. His prototype junkbots are made from old Walkman mechanisms, bits of printers, and solar cells that once powered calculators. One of Tildon's creations is a junkbot built from disk-eject motors that wriggles like the primitive, fish-like lamprey. Strangely, a team based at the University of Genoa, led by Vittorio Sanguineti, is also interested in lampreys and robots, but in a quite different, not to say chilling, way.

They've dissected out the brainstem and spinal cord from a living lamprey (presumably living no longer) and wired it to a standard Khepera lab robot – rather like a jam jar on wheels (http://diwww.epfl.ch/Khepera/). In the lamprey's brain are some large neurons whose function is to process signals from its sensory organs and relay them to its motor cells. Sanguineti and his colleagues have attached the Khepera's light sensors to the lamprey's neurons, and connected their outputs to the servo motors used to steer the robot. As grotesque as it may sound, it works – the fish's brain steers the robot to the light.

As Isaac Asimov once said: the robots are coming – but some of them are likely to be beyond even his imagination.

TOBY HOWARD