ROBOTS

Sim, Sam and the Beast

An army of artificial men—and pieces thereof—are building, testing and dying for their human masters

by Jonathan Eberhart

One paints pictures; one can twirl a hula hoop; another just sits there and sweats. While one says "ahhh" for a group of doctors, another goes to its death (for the third time that day) through the windshield of a car.

Of course, some people paint, and all sweat, but no one's found any that can die three times a day.

This becomes the province of robots, as strange-looking a crew as ever labored in a radiation lab or stopped breathing on an operating table. Around the world artificial people, and occasionally just a disembodied head or hand, are filling roles where living men won't do.

Robots can be divided into two groups, the augmentors and the simulators. The augmentors are designed to take over or aid in actual labor, such as handling objects that are too big, too small, too far away, too heavy or too dangerous for men. The hula-hooper, which can also pluck daisy petals, has been augmenting humans at General Electric Co.'s nuclear products test station in Idaho for almost a decade.

Named Handyman, the robot is basically a pair of arms, equipped with mechanical shoulders, elbows, wrists, thumbs and fingers that can bend and curl to pick up and operate a variety of parts and pieces of equipment. Handyman, like his cousins in laboratories around the world, does most of his work in rooms that are too radioactive for living technicians. His past jobs have included a lengthy stint as a mechanic working on nuclear engines for a proposed atomic airplane. The robot is guided through an elaborate electrical linkage by a man, safely shielded from radiation, whose arms fit into a pair of sleevelike control units.

General Electric has a family of other augmentor robots, including O-man, which hangs from a crane and can lift two and a half tons, and Hardiman, which is worn by its human operator as a sort of outside skeleton enabling him to lift a 1,400-pound load by exerting 30 pounds of force.

The Hardiman exoskeleton is typical of a whole class of augmentors, called man amplifiers. At Cornell Aeronautical Laboratory in Buffalo, N.Y., researchers are working on one that would enable a man to exert up to half a ton of force with each arm. Such devices have been considered for use in space, underwater, and in other places where conventional heavy moving equipment would be undesirable or impossible.

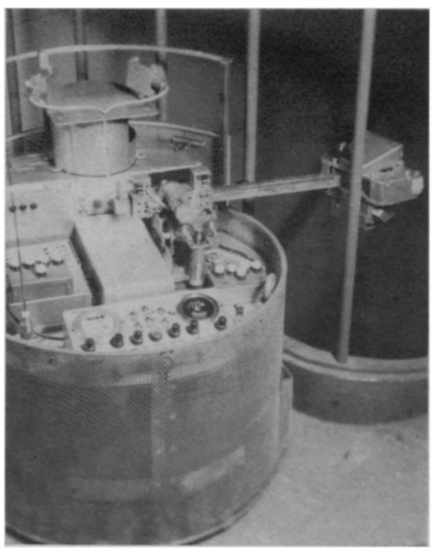
Perhaps the ultimate augmentor is the Telepuppet, suggested by William E. Bradley of the Defense Department-supported Institute for Defense Analyses in Arlington, Va.

A Telepuppet would sit at the controls of an orbiting space station while an operator on earth guided its motions with a set of controls similar to the duplicate arms of Handyman. The man would see exactly what the robot saw, thanks to a helmet which would signal the Telepuppet to turn its TV-equipped head with the man's, and would simultaneously keep a monitor screen in front of the operator's field of vision. Bradley has used a test version of the viewing system to observe a game of catch. The feedback is so natural, he says, that when the ball was inadvertently thrown at the TV camera, he ducked.

All of these devices, guided by a man's corresponding movements, share a common problem: sensitivity. Without some kind of feedback system so that the man can judge the resistance to the force he applies, he might crush fragile objects, or pick them up so brusquely that they'd fly out of his grasp. Feedback also makes the remote control seem much more natural, making possible more precise maneuvers.

A much simpler kind of augmentor is Fleximan, which looks like a mechanical version of the television Addams Family's pet disembodied hand—Thing. It's an arm and hand, protruding from a box of electronic equipment with which it can be programmed to follow a repeated sequence of up to 16 separate operations. Fleximan is one up on Thing, however, since the robot's box can also be set to move around automatically to as many as eight different locations.

Another mobile robot is GE's Quadruped, which is a walking truck. Proposed for carrying troops or cargo over rough terrain, this vehicle walks on four legs. A man stands in the cab, his legs strapped into what look like braces, and walks. So does Quadruped.



Johns Hopkins

The Beast checks out a stair railing.

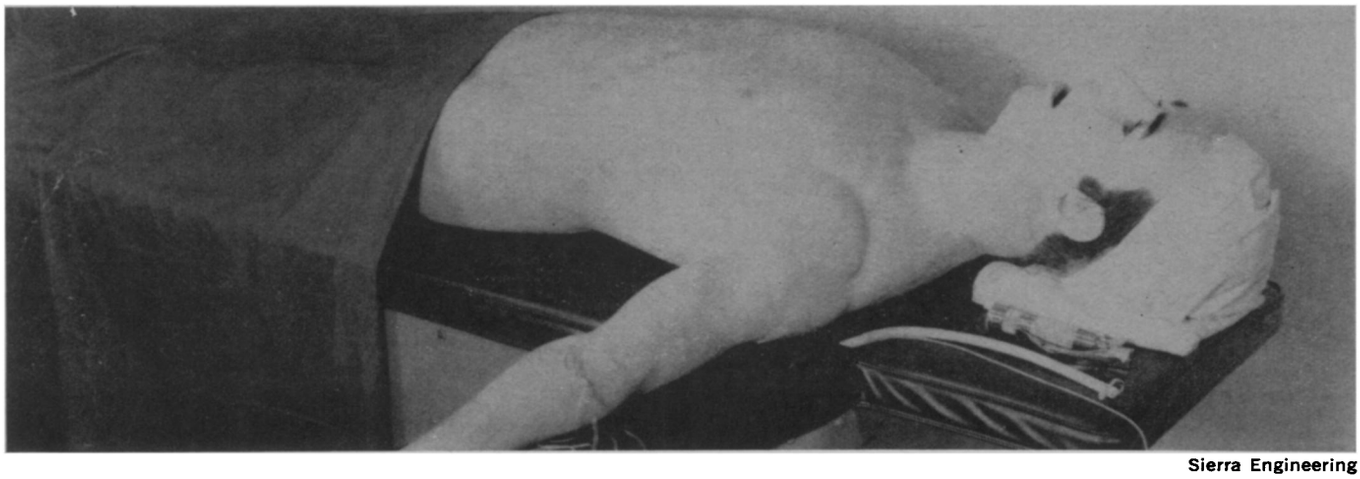
One of the few artistically inclined robots was developed several years ago by Raymond Auger, who at the time was both an art enthusiast and editor of an automation magazine. The machine painted pictures in response to instructions on a punched paper tape. Commercially, the robot's paintings were quite successful, and Auger priced them, appropriately, considering the soulless nature of the artist, by the square foot—at $25 per.

Newer on the scene than the augmentor robots are the simulators, designed either to duplicate the actions of a living creature, or to simply sit there and react—bleed, sweat, break bones—the way a man would.

The best known of the first type was The Beast, a mechanical creature about the size of a hassock, which roamed the halls of the Johns Hopkins Applied Physics Laboratory in Laurel, Md. It muddled about, listening with its sonic guidance system to avoid obstacles and feeling with its eight feet for stairways or holes in the floor. It also panicked when confused, such as when surrounded by obstacles, and slept when tired, remaining inert for several hours. When hungry, The Beast was a strict electricitarian—it felt its way along the wall to an outlet, plugged in, and dined

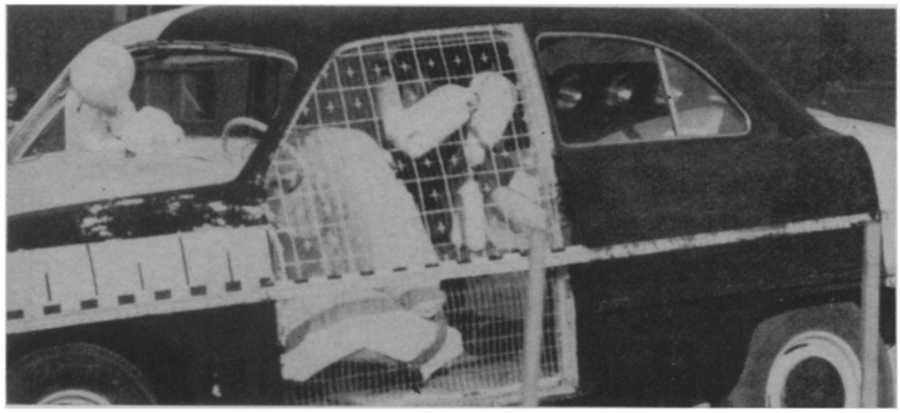
The Russians have a similar device, a robot cat which also hunts food and avoids obstacles. In addition, it purrs when it's full and screeches when humans try to pet it.

More specialized machines have been developed just to see if some human action could be duplicated mechanically. One such device does nothing but climb stairs, but it does it as would



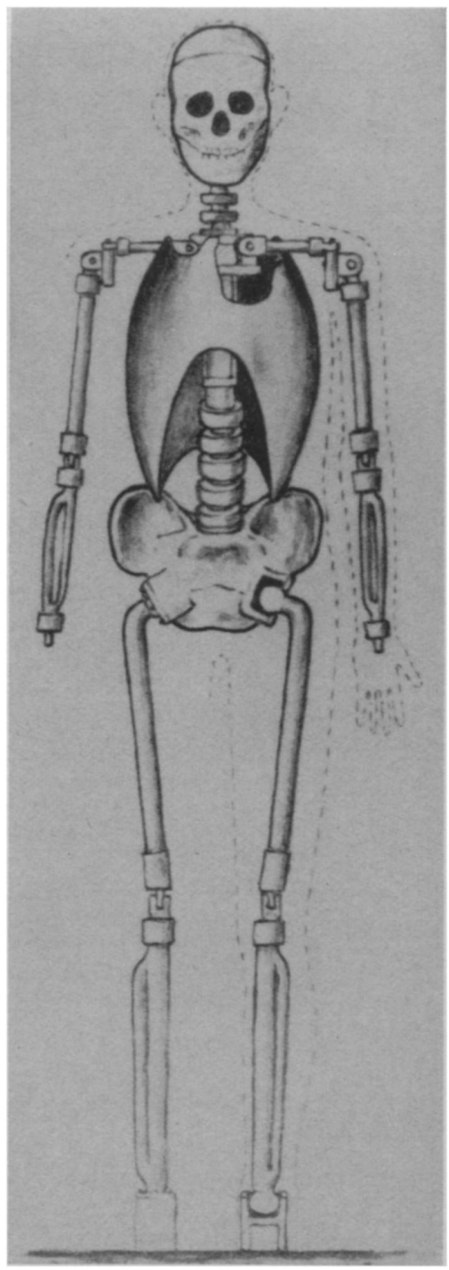
Sierra Engineering

Sim 1, a singularly forgiving practice patient for apprenticeship anesthesiologists, here awaits his next treatment. He and his fellow Sams are designed from the inside out (below right) to be the next best thing to live victims.



Aeronautical Laboratory

Cornell's driving dummies give their all where human beings fear to tread.



a man, by first raising one foot and placing it on the next step, then moving the center of gravity over that foot, and finally picking up the trailing foot and bringing it along before beginning the process again.

Then there are the true dummies. And dummies they are. They don't move, or have ingenious hands, or carry incredible loads. But they earn their keep.

At Cornell, researchers strap a pair into a car and then wreck it to evaluate seat belts. In 1963, researchers at the University of Florida in Gainesville were working with what they called Simocs, which gave off heat and moisture to test the air conditioning systems of fallout shelters. One super-Simoc perspired enough for 60 people. The GARDS—Grumman-Alderson Research Dummies—have been checking out ejection seats for the Navy, instrumented to measure the stresses that would later face a live pilot.

Then there's Sam. Sam has quite an ancestry. For nearly 20 years Sams have been getting battered, bruised and broken while testing roughhouse projects for engineers who wouldn't risk their projects on humans—or risk humans in their projects. An early Sam, rugged but stupid, was repeatedly thrown out of planes to test parachutes for the Air Force. A more educated type has been riding rocket sleds, wired to report on the crushing accelerations.

As Sams, created by the Sierra Engineering Co., became more medically oriented, they started appearing with bones that would break into realistic compound fractures. The crushed skull of a Sam became the next best thing to the genuine article. A special research program sponsored by General Motors went into developing a Sam whose chest cavity would respond realistically to a steering column driven through it.

The most recent Sam is named Sim 1, devised as a training dummy for budding anesthesiologists who can't afford to make mistakes on live customers. Sim not only breathes, he stops breathing if the doctor goofs. In addition his eyes dilate and blink, and if he doesn't get enough oxygen, he can turn blue.