Biosat: Laboratory in Orbit

by Jonathan Eberhart

The Biosatellite scheduled for launch this week is the first in a long-awaited series, but follows in a long tradition of biological experiments in space.

Animals, in fact, are considerably older hands at space flight than humans. The second satellite ever flown carried a Russian dog named Laika, who was followed by four more canine cosmonauts before the first man (Yuri Gagarin) ever reached orbit.

And remember Enos? He was the pugnacious chimpanzee who rode a Mercury capsule twice around the world three months before John Glenn tried it. Two days after Glenn landed, a French white rat named Hector soared 95 miles above the Sahara Desert, aboard a Veronique rocket.

Since that time, animals have continued to play important roles in space research, though not always as passengers. Snakes have been spun in centrifuges to see how their eyeballs tilt; lobsters have been filled with iron filings and led drunkenly around by a scientist with a magnet; a pound of insects including flies, bees, caterpillars, moths and even yellow fever mosquitoes was once sent on a 25-mile balloon ride—straight up—to provide some of the first primitive data on the effects of high altitude radiation.

Now the critters are getting back into the cockpit, or at least the luggage compartment. The Biosatellite series, almost two years late, is finally getting underway with Biosatellite-A and the most variegated gaggle of flora and fauna this side of the jungle. Here's what it carries, and what for:

BIOSATELLITE-A PASSENGER LIST

Effects of Weightlessness

Giant amoebae—feeding and growth
Frog eggs—development
Wheat seedlings, roots and shoots—orientation
Pepper plants—leaf angle and biochemical effects

Effects of Radiation

Bacteria carrying latent viruses—virus activation
Orange bread mold—genetic effects
Spiderwort (flower)—genetic effects
Parasite wasps—genetic effects
Fruit flies, adult and pupae—genetic effects
Fruit fly larvae—development
Flour beetles—development

This collection represents 13 experiments by 21 scientists, who will be happiest if they find exactly what their biospace predecessors found: nothing. Frog eggs, for example, went on several Gemini flights to see if they would develop normally after exposure to weightlessness, which they did.

The Biosatellites, however, will have even more weightlessness (or less gravity) than the Geminis did. An astronaut moving around, as well as attitude control rockets making small corrections, both cause very slight artificial gravitational forces, even though they may be less than a thousandth of that on earth and are scarcely measurable. For at least 95 percent of its three days aloft, Biosatellite-A will have less than 0.000005 times earth-normal gravity.

A growing plant turned upside-down on earth will presently re-orient itself and grow upward again. In space, however, this may not be the case. The various plants on the first flight may simply grow in random directions, even when turned to different positions by an on-board device.

The U.S. Air Force should have a particular interest in the second flight, since it will beat them at their own game, which is to get a living creature in orbit for a month. The Air Force will send a human crew aloft aboard the Manned Orbiting Laboratory, but the National Aeronautics and Space Administration's Biosatellite-B will have a jump of possibly more than a year, carrying a macaque monkey strapped to a couch and staring into a movie camera. The previous record in orbit for anything living is held by Gemini 7 crewmen Frank Borman and James Lovell, who spent just hours short of two weeks in space.

The monkey will be instrumented as no space-going monkey ever was before. Wired up like a Christmas tree, he will have devices listening to and measuring his heart and circulation; monitoring his brain and central nervous system; analyzing his urine and solid wastes; and even keeping track of the condition of his bones. Changes in bone calcium caused some concern when they were observed in some of the Gemini astronauts.

Another Gemini finding that may crop up in the Biosatellites resulted from some batches of blood cells sent up on Gemini 3. Those exposed to a radiation source as well as zero-gravity showed almost twice the chromosomal breakage of the non-irradiated group. No human blood cells are scheduled for Biosatellites, but fruit flies have some chromosomes even bigger than human ones, and thus bear watching.

Biosatellite-C will represent everybody: plants, with a leafy herb called mouse-ear cress; lower animals, with a rat monitored for changes in his "gross body composition"; and humans, with a batch of liver cells instrumented for zero-gravity and radiation studies.

Biological satellites cause special headaches that do not exist with radiation monitors, weather watchers and the like. The biggest one is simply due to the fact that living things grow. All the experiments have to be loaded on board between 8 and 13 hours before launch, which means that there are a lot of scientists and technicians staying up all night. This is in contrast to weeks of checkout time that are available with non-living payloads.

If there is a hold of even a few hours during the countdown, the pepper plant, for example, which has gone right on growing, may well have to be replaced with another, less-developed one.

Because of this down-to-the-wire timing, the scientists responsible for the experiments live with their spacecraft all the way up to the time it is launched. A special laboratory was erected last February in Hangar S at Cape Kennedy so that the experimenters could live and work right on the scene as conveniently as possible.

Though only three Biosatellites are set, there could be six, if NASA elects to fly the three duplicate backup vehicles. Congressional approval, says NASA, is "likely."

Russia has also resumed biosatellite testing in recent months with a new crop of dog-carrying "Muttniks," probably because of biomedical problems experienced by their human cosmonauts.

The most critical of these problems, loss of balance and orientation, may have set Soviet manned space flight back almost two years.