Muscles in space forfeit more than fibers

Scientists and ex-football players know that muscles atrophy from disuse. But in space, where there is little gravity and muscles carry almost no load, the atrophy is compounded by other factors. After two weeks in space, rat muscles not only shrink but also lose blood vessels, nerve connections and even their own cells, according to a new study.

At the annual meeting last week of the American Society for Gravitational and Space Biology in Washington, D.C., Danny A. Riley of the Medical College of Wisconsin in Milwaukee reported findings from his research using five rats flown in the Soviet Cosmos Biosatellite 1887 last October. Soviet researchers dissected the rats and sent the chemically fixed and frozen tissues for study by Riley and his collaborators from San Jose (Calif.) State University and the University of Sydney, Australia.

In an environment with one-thousandth the gravity of Earth, muscles exert only a small amount of force to move the body. Because many muscle fibers are not used, muscles lose contractile proteins and shrink—by 40 percent in the case of the rats flown for 12½ days in the Cosmos. Their decrease in muscle mass was 10 percent greater than that of rats flown for a week in the 1985 Challenger's Spacelab 3—indicating that muscle atrophy in space is progressive, according to Riley.

Muscle atrophy during inactivity is "part of the normal turnover of muscle proteins," Riley says. But when his team examined inner thigh and calf muscles in the Cosmos rats, they found not just atrophy but serious damage in 4 to 7 percent of the muscle fibers. The damage was "much worse" than that found in Spacelab 3 rats, according to Riley.

The affected fibers were swollen and had been invaded by white blood cells that "clean up" infected or inflamed areas. Blood vessels had broken and red blood cells had entered the muscle. Half the muscles had damaged nerve endings.

"You see this kind of pathology in human nerve-muscle diseases," Riley says. He suggests that in space, such changes may result from several things, including cosmic radiation, stress and reduced circulation as well as muscle disuse.

Riley says his findings may explain why astronauts lose muscle strength and coordination despite vigorous exercise programs. In the 1973 Skylab missions, U.S. astronauts who exercised still lost 10 to 15 percent of their strength over three months in space. "Either it wasn't the right type of exercise," Riley says, "or there is pathology that is causing the muscle shrinkage and weakness."

Although astronauts' muscles — like those of rats — seem to regenerate after return to Earth, "that doesn't mean there's no pathology," Riley says. He warns muscle recovery may be compensatory and not actually regenerative.

It is not known whether the normal muscle-repair processes that work on Earth will work in space. If they do not, astronauts' muscles are likely to weaken progressively, and possibly irreversibly, on very long missions. "If someone goes to Mars, the regeneration process may be slow," Riley says. A potentially more serious problem is that damaged blood supply to some muscles may affect supply to bone, he says.

Exercise can help prevent muscle atrophy by generating new muscle protein. But it won't stimulate muscle fibers disconnected from nerves, and it can't help those that remain unused in space. And fibers with damaged blood supply can contract for only a short time before they become exhausted.

"It appears that muscles have their own hormone that stimulates cell division and repair," Riley says. "It may be possible to identify that. And that [hormone] might benefit someone with damage from space flight."

Muscle regeneration might theoretically be promoted by hormones that stimulate protein production, such as growth hormone, or by anabolic steroids, which promote both protein synthesis and muscle repair. "I think the answer will be exercise plus anabolic steroids," Riley suggests.

He cautions that no one knows for sure whether the pathologies seen in rats occur in astronauts. Rats, for one thing, do not eat as well as humans in space. Nonetheless, says Riley, "the animal literature is saying we should biopsy humans." *— I. Wickelgren*

Fish learn their facts of life from elders

A biologist says he has shown experimentally for the first time that younger members of an animal species learn where to mate from older ones, not necessarily from environmental cues. Robert R. Warner of the University of California, Santa Barbara, believes the results of his work with bluehead wrasses, fish inhabiting coral reefs north of Panama, should generally caution scientists against explaining mating habits solely on the basis of the distribution of food and other resources.

Warner's experiments, described in the Oct. 20 NATURE, involved introducing younger wrasses to 22 Caribbean patch reefs previously occupied by older members of the species to determine if the newcomers would use established mating sites.

Before transporting younger fish to new reefs, Warner removed all previous occupants from some sites, but only some from others. At the reefs where older wrasses remained, the newly introduced fish continued using the mating sites frequented by their elders.

At the reefs no longer housing older wrasses, the newcomers showed no preference for the established sites. "Old sites and previously unused sites were equally likely to be used" by the new inhabitants, Warner told SCIENCE NEWS. For experimental controls, Warner reintroduced some fish to their home reefs after the reefs had been cleared of all wrasses, finding the native fish returned to their established mating sites.

Had the control groups mated at different sites, Warner could not have concluded that the younger wrasses choose where to mate by observing their elders. The behavior of the fish reintroduced to their home reefs also suggests that transporting them in nets did not affect mating-site choices, he says. *— C. Knox*

Magellan and Hubble

Preliminary analysis indicates the Magellan spacecraft suffered only minor damage in an Oct. 17 electrical fire that occurred during tests at the Kennedy Space Center in Florida. Damage to the craft, scheduled to take off for Venus next April on the first U.S. interplanetary mission since the Pioneer Venus mission went there in 1978, necessitated changes to a wiring harness and some insulation material. NASA has appointed an investigating board to study the incident.

A battery burned in the fire was only a test unit, not the one planned for the flight itself. "We don't think it will affect anything on the mission," says NASA spokesman Charles Redmond. "We think we've got the problem itself understood."

On the other hand, a source close to the project told SCIENCE NEWS: "My main concern is not damage to the mission. It's the concern that the spacecraft is not being handled with the proper amount of care that's scary." He notes there is now only about three weeks' leeway to handle any additional postponements. Beyond that, Magellan could miss its launch window and face a delay of nearly two years.

On the positive side of NASA's space science plans, the agency this week advanced the launch of the Hubble Space Telescope to December 1989. Originally scheduled to fly in August 1986, it was delayed by the Challenger explosion until February 1990 (SN: 9/10/88, p.164). The new date, according to NASA, resulted from an exchange of shuttle payloads between already scheduled NASA and Defense Department flights. □

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