MICROBES IN SPACE

GRAVITY DOESN'T SLOW GROWTH

Astronauts might not face increased dangers of infection. And radiation hazards might be less than was thought.

LONDON—Bacteria proliferating in the microgravity environment of space grow at the same rate, and with the same energy efficiency, as those on earth, according to experiments designed by Philippe Bouloc and Richard d'Ari of the Jacques Monod Institute at the University of Paris in France. Their observation on cultures of *Escherichia coli* carried on the Soviet satelite *Bicosmos 2044*, orbitting the earth, repudiates earlier suggestions that earth-bound microorganisms have to expend significant amounts of energy in fighting against the effects of gravity and can therefore grow more efficiently or rapidly in space.

Though disappointing for exobiotechnologists who hoped to achieve increased bioefficiency in orbitting bioreactors, the finding has a more welcome implication. If it is applicable to pathogenic bacteria too, the discovery militates against anxieties that astronauts face increased dangers of infection. Furthermore, Bouloc and d'Ari report that the cosmic radiation which penetrated into the satellite did not cause significant levels of damage to the *E. coli* DNA. Radiation hazards for both bacterial and human inhabitants of space may be less than was thought.

The University of Paris researchers designed two series of experiments to evaluate the effects of two characteristics of the space cabin environment—the near absence of gravity and the presence of cosmic radiation (which includes high energy protons, alpha particles, and heavier particles). They measured the mean cell mass of their cultures (from which they calculated growth rate), the bacterium's growth yield per gram of carbon, and the SOS response, in which an array of genes is turned on to repair the DNA and thus ensure survival.

Both the flight samples and control cultures, maintained under otherwise identical conditions on the ground, were carried in a "Cytos" automatic incubator. This consisted of 96 polypropylene bags, each containing growth medium and ampules of *E. coli* which could be broken to release the organisms into the medium and thus initiate the experiment. A computer program triggered the experiment after the satellite was launched from a site at Plessetsk and then terminated growth 24 hours later by lowering the temperature inside the incubator to 4°C. The satellite subsequently landed in Kazakhstan, where the cultures were analysed.

As detailed in the current issue of the *Journal of General Microbiology* (**137**:2839, 1991), there were no differences between the flight samples and ground-based controls in either the growth rate of the organism, its growth rate per gram of carbon, or the level of the SOS response. "The constancy of the growth yield in space, in both cell mass and cell number, strongly suggests that there is no major economy of energy during growth in microgravity," Bouloc and d'Ari conclude. They also argue that while genotoxicity cannot be ruled out over a prolonged period such as the two to three years required for the first manned trip to Mars and back, their SOS tests were sufficiently sensitive to establish that the radiation flux in a satellite is insufficient to cause major DNA damage under normal conditions.

—Bernard Dixon