Bio-Medical

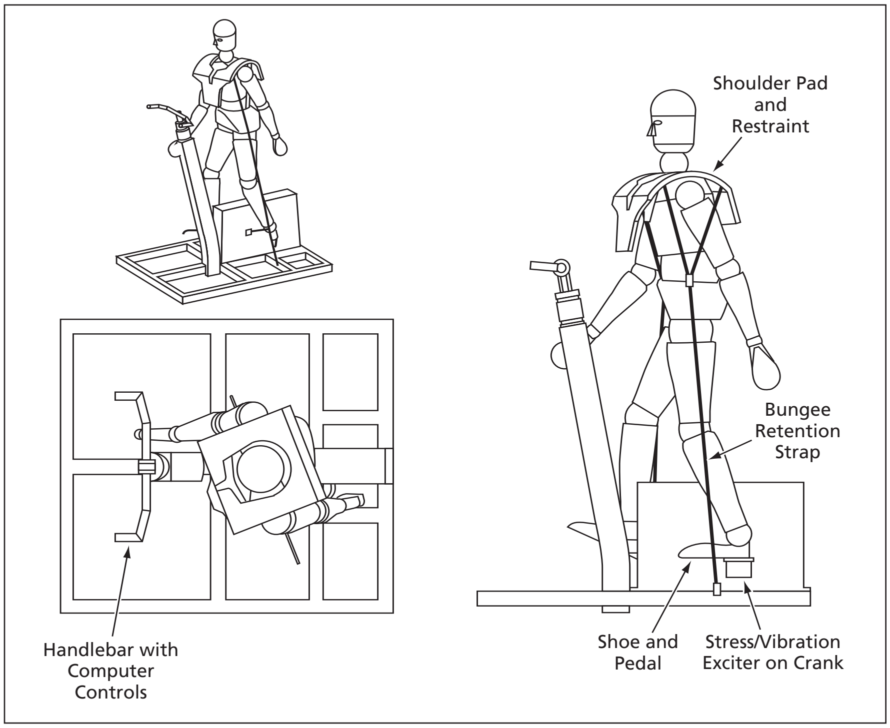
Stationary Apparatus Would Apply Forces of Walking to Feet

The forces would be tailored to prevent loss of bone density.

Goddard Space Flight Center, Greenbelt, Maryland

A proposed apparatus would apply controlled cyclic forces to both feet for the purpose of preventing the loss of bone density in a human subject whose bones are not subjected daily to the mechanical loads of normal activity in normal Earth gravitation. The apparatus was conceived for use by astronauts on long missions in outer space; it could also be used by bedridden patients on Earth, including patients too weak to generate the necessary forces by their own efforts.

The apparatus (see figure) would be a modified version of a bicyclelike exercise machine, called the cycle ergometer with vibration isolation system (CEVIS), now aboard the International Space Station. Attached to each CEVIS pedal would be a computer-controlled stress/vibration exciter connected to the heel portion of a special-purpose pedal. The user would wear custom shoes that would amount to standard bicycle shoes equipped with cleats for secure attachment of the balls of the feet to the special-purpose pedals.



An **Exercise Machine** would include computer-controlled stress-vibration exciters that would apply forces substituting for normal exercise forces to stimulate bones.

If possible, prior to use of the apparatus, the human subject would wear a portable network of recording accelerometers, while walking, jogging, and running. The information thus gathered would be fed to the computer, wherein it would be used to make the exciters apply forces and vibrations closely approximating the forces and vibrations experienced by that individual during normal exercise. It is anticipated that like the forces applied to bones during natural exercise, these artificial forces would stimulate the production of osteoblasts (bone-forming cells), as needed to prevent or retard loss of bone mass.

In addition to helping to prevent deterioration of bones, the apparatus could be used in treating a person already suffering from osteoporosis. For this purpose, the magnitude of the applied forces could be reduced, if necessary, to a level at which weak hip and leg bones would still be stimulated to produce osteoblasts without exposing them to the full stresses of walking and thereby risking fracture.

This work was done by Jessica Hauss, John Wood, Jason Budinoff, and Michael Correia of **Goddard Space Flight Center** *and Rudolf Albrecht of ESA. Further information is contained in a TSP (see page 1).*
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Instrument Would Detect and Collect Biological Aerosols

Samples would be quickly collected on substrates that would be analyzed automatically.

Marshall Space Flight Center, Alabama

A proposed compact, portable instrument would sample micron-sized airborne particles, would discriminate between biological ones (e.g., bacteria) and nonbiological ones (e.g., dust particles), and would collect the detected biological particles for further analysis. The instrument is intended to satisfy a growing need for means of rapid, inexpensive collection of bioaerosols in a variety of indoor and outdoor settings. Purposes that could be served by such collection include detecting airborne pathogens inside buildings and their ventilation systems, measuring concentrations of airborne biological contaminants around municipal waste-processing facilities, monitoring airborne effluents from suspected biowarfare facilities, and warning of the presence of airborne biowarfare agents.

The instrument would be based partly on a conventional aerosol-particle counter and partly on a fluorescence subsystem for identifying biological particles. Aerosol particles would be drawn through a series of aerodynamic lenses (nozzles sized and shaped to focus variously sized particles into a narrow stream). The lenses would be designed so that only respirable particles would end up in a narrow outlet stream flowing across the optical path of a pulsed ultraviolet laser in the fluorescence-based subsystem. Before reaching the optical path of the pulsed ultraviolet laser, the aerosol particles would cross the beam of a continuous-wave semiconductor diode laser that would be used to size the particles. If the size of an individual particle was found to be within a certain range, the ultraviolet laser would be triggered to fire as the particle crossed its path, thereby dramatically reducing power requirements for autonomous operation.

The pulse of ultraviolet light would excite fluorescence in the particle. The fluorescent light would be collected and split into three separate spectral bands by use of lenses, dichroic filters, and band-pass filters. The outputs of photodetectors for the three spectral bands would be processed to determine whether the particle could be of biological origin. The indication of a possible biological particle would cause an aerosol-sampling module to be turned on to collect particles on a solid substrate. The substrate would be placed under an automated microscope equipped with a video camera, the output of which would be digitized and processed by image-analysis software to identify the collected particles.

This work was done by Steve Savoy and Mike Mayo of Nanohmics, Inc. for **Marshall Space Flight Center**. *Further information is contained in a TSP (see page 1).*
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