GRAVITY: LEARNING ABOUT LIFE ON EARTH BY GOING INTO SPACE – AN INTERVIEW WITH JOAN VERNIKOS

Joan Vernikos, PhD, Thirdage LLC, Director, NASA Life Sciences (ret.)

We at the Aviation in Focus are honoured to interview Dr. Joan Vernikos, former Director of Life Sciences at NASA (1993- 2000). During her time at NASA, Dr. Vernikos pioneered research on how living in a microgravity environment adversely affected the health of astronauts. Significantly, she was able to work with scientists from the Soviet space program in the 1970s – despite the animosities of the Cold War – subsequently heading the development of a "bed-rest" facility able to mimic the effects of microgravity on test subjects. Much of the research undertaken by Dr. Vernikos led her to perceive that there are many similarities between the effects of microgravity on the physiology of astronauts who spent time in Space and the aging process here on Earth. She concluded that managing stress and effectively using gravity in daily life are key in achieving health and wellbeing. In an effort to bring such matters to the public eye, Dr. Vernikos has published a series of books that present simple, effective plans for maintaining good health throughout life. Her latest book, “Sitting Kills, Moving Heals”, published in 2011, was one of the finalists in the Indie Excellence Book Awards. Other publications by this author include “The G Connection - Harness Gravity and Reverse Aging" and “Stress Fitness for Seniors".

AVIATION IN FOCUS: What sort of environment does man find in Space?

Joan Vernikos: Space conjures up some place way out there beyond the atmosphere. Sir Frederick Hoyle said that if you drove your car straight up you should be in space in about an hour. Even at this altitude an orbiting spacecraft is not stable because of atmospheric drag. You have to be above 130 km (80 miles) to maintain orbit.

Humans cannot survive unprotected in space. There is radiation and vacuum, temperatures of -118° to 135°C and no oxygen to breathe. Mini-ecosystems must be provided to sustain life. It takes 90 minutes to orbit the Earth so astronauts go through 16 day-night cycles every 24 hours. Even inside the orbiting spacecraft they experience the effects of reduced gravitational pull. On Earth the direction of gravity (G) is perpendicular to the surface, and it is called 1G. The gravitational force on the Moon is 0.17G and Mars is 0.3G. Even 200 miles away from Earth and at a speed of 27 thousand km/h, Earth’s gravity is counterbalanced, resulting in continuous free-fall around the planet with a resultant G of about 10^{-6} or 1 microG. This is not zero G, but microgravity.

AVIATION IN FOCUS: Mankind only reached Space in 1961 – why did it take so long?

Joan Vernikos: From the beginning of time, the human instinct has been dominated by the need to challenge gravity, then to reach beyond the atmosphere, to travel and land on other planets. The technology has been the limiting factor. At first from Daedalus and Icarus, kites and balloons, airplanes, rockets with satellites and spacecraft where human and other Earth life could be sustained, technology has been the limiting factor.

AVIATION IN FOCUS: Longer duration Space missions are now possible, but they are not without consequences. What is one of the main concerns associated with that?

Joan Vernikos: Microgravity is not a threat to life. Astronauts endure physical and emotional stresses for short periods of time and survive to complete a mission. Living in space for a record 18 months, they find it increasingly difficult to recover and re-adapt to Earth. After 4½ months on Mir, David Wolf lost 23 lb, 40% of muscle mass, 12% bone and it took a full year to get his bone mass back. On Earth people lose about 1% per year. Astronauts now spending six months on the International Space Station (ISS) have lost the equivalent of 20-30% of bone a year and recovery even after two years is incomplete. More significantly, even though bone strength and mass may recover, the architecture of the bone does not and is more like that of an old man.

AVIATION IN FOCUS: What are some of the problems experienced by astronauts upon their return to Earth?

Joan Vernikos: On return to Earth, long and thoughtful rehabilitation is needed. Ligaments and cartilage in the joints have wasted and with weakened muscle and bone it is hard for the body to support its own weight. It is at first hard to sit up without fainting, because in microgravity blood volume is reduced, the heart grows smaller and lazy, blood pressure sensors lose their sensitivity, blood vessels lose their lining, and are now no longer able to fight G's pull towards the feet by pumping blood up to the head. Standing and walking is like that of a young baby with feet apart for balance. Leg movement coordination and proper balance are disturbed because the vestibular system in the inner ear that senses G and acceleration has received no such input in space.

AVIATION IN FOCUS: Can anything be done to reduce the aftereffects of Space flight on the human body?

Joan Vernikos: Exercise alone does not prevent adaptation to microgravity nor help maintain Earth health status to reduce this long rehabilitation. Providing 'artificial gravity' using onboard short G exposures must be tested. Tests on Earth using healthy volunteers in bed (Gx) mimic the effects of spaceflight and are used on Earth to evaluate the best treatments. On Earth, we associate these spaceflight symptoms with growing old. In astronauts they appear to be fully reversible after they return.

AVIATION IN FOCUS: You have compared the physiological effects of microgravity on astronauts to those of aging on Earth – could you elaborate on that?

Joan Vernikos: Their age has not changed nor has their lifespan back on Earth. However, these same symptoms are believed to be inevitable with aging. Because we also see them after continuous bed rest, and even in our modern society where younger people are increasingly sedentary, it is clear that healthy people can also develop these aging symptoms much earlier than they would had they used Earth's G more effectively. By becoming aware of how gravity deprivation affects health and mobility, we may become more diligent about using the G that surrounds us through simple everyday movement.

By studying the normal physiology of astronauts living in the hostile environment of Space, the overwhelming significance of gravity to human life and health on Earth has become apparent. So what is growing old? On Earth we use it to describe debilitating changes as age increases, eventually leading to death. Clearly this does not apply to what happens in space. Perhaps growing old on Earth should be redefined. We have learned a great deal from space about growing old on Earth. The degenerative changes we see in astronauts and, as we age, are telling us how important it is to use G to its fullest here on Earth if not for longer, at least to lead healthier lives.

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