

ASTRONAUTICS

Man in a Space Ship

Man's future success in space flight will depend on his ability to solve the problems of creating an environment similar to that of earth within the space craft itself.

By HELEN BUECHL

➤ JUST A YESTERDAY ago, Buck Rogers and his space crew were considered interesting, although fantastic, science fiction phenomena.

Space flight at that time consisted only of the problem of reproducing the imagination on sketch paper. Today, space flight is no longer fiction. A short tomorrow away will bring the reality of flight to the moon and other planets.

But unlike fiction, today's problems must be solved realistically if man is to attain tomorrow's goal.

One of these problems that still remains unsolved is the condition known as weightlessness. In simple terms, this means that a man in a space craft will lose the sensation of having weight. This phenomenon occurs when the space craft reaches zero gravity, or escapes the gravitational pull of the earth.

Weightlessness

Psychologically, it is the most fascinating problem of space flight because it has no parallel in human experience on the ground or in most conventional flying, Dr. Siegfried J. Gerathewohl, staff member in the department of space medicine, School of Aviation Medicine, U. S. Air Force, pointed out.

The force of gravity keeps man on the ground, preventing him from bouncing. But this force of gravity decreases in inverse proportion to the square of the distance from the earth's center. This means that at a height of 4,000 miles above the surface, or twice the earth's radius above the earth's center, it is only one-fourth of what it is on the ground. At 8,000 miles it is one-ninth, and so on. At a distance of 36,000 miles it is reduced to a mere one one-hundredth.

At supersonic speeds, centrifugal forces begin to counteract the earth's gravitational force to an increasingly noticeable degree as the inertial force in the line of flight resists the centripetal or inward pull of the earth. In other instances the inertial force may reinforce the gravitational pull. When the forces are in balance, the condition of zero gravity or weightlessness will be experienced by the crew of the aircraft.

Recently, Dr. Gerathewohl conducted experiments with a cat during parabolic, or egg-shaped, flight trajectories in a T-33 aircraft. The parabolic flight trajectories simulate a weightless state for brief periods. The objective of the experiment was to determine whether or not the cat would

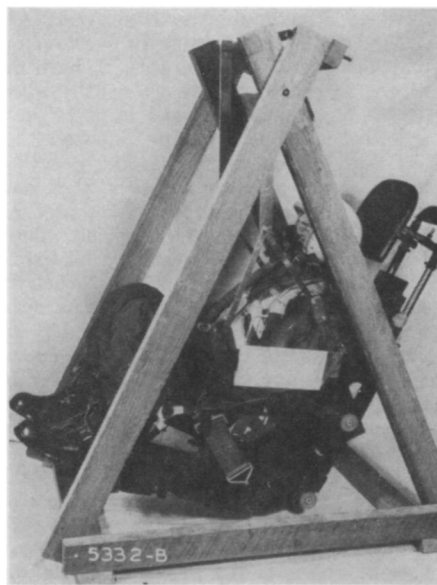
be capable of "righting" itself when held upside down while experiencing weightlessness. How this condition would affect the reflex behavior of the animal was also studied.

Under ordinary conditions if a cat is held upside down and suddenly released, it turns in a flash into normal position so that it always lands on its feet. This reflex ability functions under both normal and blind-folded conditions.

Motion pictures of the experimental cat under weightless conditions revealed that when released upside down, this animal, normally able to "land on all fours," turned slowly in mid-air and tumbled in the cockpit. Evidently its reflex was delayed or failed completely.

Then the cat showed signs of confusion and panic. Furthermore, it "righted" itself in the wrong direction.

The zero gravity conditions completely disoriented the animal. In addition, the cat was still bewildered after the weird experience was over. An account of the experiment appears in the Air University Quarterly Review (Summer, 1958).



PINPOINTING GRAVITY—*This center of gravity device automatically pinpoints the center of gravity of a man seated in a rigid chair. Later, "dummies" are used for space-flight experimentation. They duplicate man in size, weight, mobility and locations of centers of gravity. The dummies were designed at the Wright Air Development Center.*

To date, almost 100 men have participated in experiments on weightlessness conducted at the Aero Medical Field Laboratory, Holloman Air Force Base, and at the School of Aviation Medicine, Randolph Air Force Base.

Virtually all of the men reported sensations of floating or slowly drifting during weightless states. About half of them felt very comfortable and reported no unusual sensations of motion other than a slight elation associated with the feeling of exhilaration and pleasantness. Several vividly described sensations of falling, tumbling, rolling over, or being suspended in mid-air upside-down. About one-third of the men reported that they experienced discomfort, nausea and severe attacks of motion sickness.

Eating, drinking, elimination and normal digestion pose yet another problem. For the crew members will take with them into space the many daily needs of the human body. Nature has spent millions of years adjusting the human body to the environment of the space ship that man now inhabits, the earth.

The state of weightlessness has created the need for special food and drink containers. Eating in the manner familiar to those who are earthbound is virtually impossible in a space craft at zero gravity.

Floating Dinner

Food floats in the space cabin, making it difficult to "corral" into the mouth. Water, or any liquid, forms little droplets and proceeds to glide through the air like beads suspended from an invisible wire.

Therefore, it has been proposed that special containers be manufactured to seal in ready-to-eat foods. Several of these containers have already been tested. In essence, they are of the squeeze tube variety.

The perfect food container would perhaps be one that could be made of some nutritious and digestible material. Otherwise, metal or other type containers would eventually create a disposal problem. And it is not easy to throw things away in the middle of space. Anything tossed out of the space craft would not be jettisoned cargo because it would simply follow closely behind the craft. The crew would then literally be space-highway litterbugs.

Another medical problem is how to provide sleep and relaxation for the crew. Since under normal conditions, the posture of rest is associated with a shift in weight distribution within our body, it may be easier to catch 40 winks or a sound satellite snooze.

On the other hand, weightlessness may affect the nervous system in a different manner. The lack of body contact with a chair or bed during sleep may give rise to a feeling of insecurity and precipitate wild

dreams. It has been proposed that a large-area body harness of foam rubber or similar elastic fabric be used to provide natural rest by creating the sensation of slight pressure on the body.

Another problem still unsolved is that of g-pull before the state of weightlessness is reached. As the space ship starts its long journey, it must withstand increased gravitational forces before it attains zero gravity. This creates a stress on the human body that is normally accustomed to the one g force at sea level.

Members of the Anthropology Section at the Air Research and Development Command's Wright Air Development Center have developed a "dummy" that is life-like in every respect except for life itself. It duplicates man in size, weight, mobility, and locations of centers of gravity in both the body as a whole and in each segment. It is even covered with plastic "flesh" of about the same resiliency as human flesh. One requirement of these dummies is the ability to withstand a force of 100 g or 100 times its own weight.

Just how much and in what manner the strain of g force will affect the circulatory and respiratory processes of man is still unknown. Perhaps these space dummies will provide the answer.

Problems to Solve

There are many other problems that must be solved if man hopes someday to visit the planets. The unknown quality and quantity of cosmic radiation, for instance, is still only speculated. The effects of space-cabin isolation on a crew over a long period of time is still to be determined. A training program and criteria for choosing crew members is only in the proposing stages. For that matter, a successful and dependable technique of penetrating space with an unmanned craft has yet to be accomplished, let alone a manned ship.

Manned spacecraft travel is still in the grounded stages. Even if man never does pierce the unknown universe, he will have learned much about himself and gained additional information about his environment and the interrelationships that determine his way of life.

Science News Letter, January 10, 1959

Questions

ASTRONAUTICS—What was the peak count for electrically charged electrons or protons in the two Van Allen radiation belts? p. 21.

GENERAL SCIENCE—How does the number of American women in science and engineering compare with the number of Russian women in these fields? p. 22.

PHYSICS—What is the physical basis for the proposed gravity wave detector? p. 19.

Photographs: Cover, Lockheed Missile Systems Division; p. 19, Dr. James Van Allen; p. 23, Indiana University; p. 26, Wright Air Development Center; p. 32, Arthur S. LaPine and Company.



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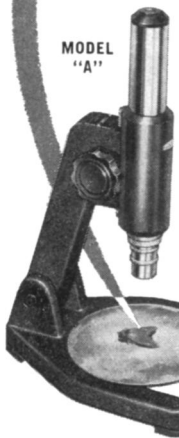
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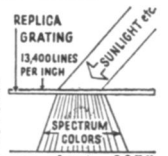
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