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SCHOOL OF AVIATION MEDICINE, U. S. AIR FORCE

Second of Three-part Series on the
USAF School of Aviation Medicine

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San Antonio, Texas,--Every flyer in the U.S. Air Force today owes his life, in part, to the research and instruction carried on continuously for the past 40 years by the School of Aviation Medicine.

Tomorrow's astronauts will be equally indebted to the institution at Randolph Air Force Base, Texas. The School's research specialists are hard at work right now on problems involving every aspect of space flight, from the selection and training of spacemen to the environments they can expect to find on other planets.

One of the most basic questions of all is now under study at the School. It is this: what type of man is best suited for the rigors of cosmic navigation?

From the second his rocket ship blasts upward from Earth, the astronaut will be under heavy stresses. When he reaches outer space, they will be primarily of a mental nature. He must adapt himself to weightlessness, which is characteristic of space flight; must be able to live and work efficiently in a cabin atmosphere equivalent to the pressure-thin height of 18,000 feet on Earth.

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But it is as he is slammed down hard into his reclining chair aboard the rocket ship scorching toward the heavens, that he meets his most immediate danger. G-forces equal to several times the weight of his own body suddenly will squeeze him down. His breathing will become difficult, then all but impossible as the invisible weight bears down on him. For a minute-perhaps longer-he may be unable to breathe at all.

That single breathless minute could be fatal, according to Dr. Lawrence E. Lamb, Chief of Internal Medicine and Director of Cardiology at the School of Aviation Medicine.

"Most men will be able to withstand the acceleration itself, but only a carefully selected man will survive longer than five minutes after acceleration," he says. "In our laboratory, we have found that holding the breath for less than a minute brings a drastic reduction in heart action after breathing resumes. In many cases, during this recovery period, the heartbeat stops completely if we do not change the volunteer subject's position or inject Artropine (a drug which prevents the heart from slowing down)."

Significantly, Dr. Lamb has found this tendency toward heartbeat interruption, after holding of breath and other stresses, in 21 out of 50 preflight students tested in the laboratory at Randolph.

"Here we can make the heart get back to work," the Doctor explains. "But an astronaut will be on his own. The first five minutes after acceleration stops will be extremely critical. If his heart continues to beat after the breathless period--and if weightlessness doesn't pose any new problems which we haven't foreseen--he'll be all right."

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How to insure the spaceman's safety? "Selection," says Doctor Lamb. "We have to choose for space-crew training only those men whose hearts and circulatory reflex mechanisms will enable them to stay alive during the post-acceleration recovery phase."

Another problem now under study at the School of aviation Medicine is the so-called "water barrier." Discovered by Dr. Hans G. Clamann, German-born Professor of Biophysics with the School, this curious phenomenon is created by the fact that the body gives off as much as ten per cent more water than it takes in, by converting a certain amount of its food intake to water.

In the completely sealed-in world of a space cabin, everything--oxygen, water, waste products--must be kept in constant balance by a recycling system that provides fresh food, water, and oxygen from the waste. If any one element in this cycle becomes to plentiful, something else becomes less abundant. Thus, the balance is upset and the entire recycling process is useless.

In the case of water, a certain amount is necessary. But as more is created from food intake, it cannot be introduced into the recycling system to produce more food. It is excess, yet at the same time it is vital.

"You can't just throw it out of the space ship," explains Dr. Clamann. "We cannot discard any substance which might be used for something, as food, drinking water, as a coolant, or possibly even as a propellant. On short trips of a month or less, the water imbalance will not be a problem. The space crew may use the excess to wash, or cook. "But on a long trip--a year, say--the increase becomes serious. We calculate that a five-man space crew will give off nearly 100 gallons of extra water in a year. This is 100 gallons more

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than the recycling system needs, and which cannot be returned to the system. Thus, it is apparent that the five men are producing water which they cannot use. In time, they will have all water and no food."

The answer to this unique problem might seem to be found in green algae, simple plants of the seaweed family that live in water and use it for their own metabolic processes. Under a light source, algae produce carbohydrates from carbon dioxide and water by photosynthesis, releaseing fresh oxygen.

But algae, unfortunately, are part of the recycling system, as the crew members are too. Algae can only use some of the water the body gives off. The rest remains surplus, gradually collecting while the food supply is depleted.

There are other problems with algae, says Dr. Clamann. They need almost exactly as much carbon dioxide as the oxygen they release. But the human body also produces an excess of carbon dioxide in breathing. If the algae are regulated to give off exactly the amount of oxygen the body needs, they don't get enough carbon dioxide. If they are regulated to absorb all the waste CO_2, they give off too much oxygen. Again, there is a surplus which the system cannot handle.

"True balance between man and algae is extremely hard to obtain," Dr. Clamann notes in a paper published by the Journal of the British Interplanetary Society. Rather than experimenting with algae to obtain the most efficient production of oxygen with the smallest possible amount of the plant, as in the past, Dr. Clamann suggests that "our future studies should be directed more toward such a balance."

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With all these problems solved, however, there remains one which prospective astronauts will forever dread--the chance of collision with a meteor.

Hits from tiny meteors--by far the most common in outer space, according to Dr. Hubertus Strughold--can be cushioned by a thin outer shell of metal, similar to the double bottom of a warship.

But against larger meteors, roughly the size of a small marble, even such a protective shell is no defense.

"If the damage is limited to a rupture in the inner wall of the craft, the crew will try to repair it, wearing emergency pressure suits," states Dr. Strughold. "If the craft explodes, or is completely demolished, there is no problem. The crew will be destroyed with it.

Between these two extremes are varying degrees of damage that may incapacitate the craft, yet leave the crew a possibility of survival. They may ride the damaged hulk down into the atmosphere and try to excape from it at a safe altitude, or they can abandon it in space, wearing pressure suits, and hope for rescue.

But a pressure suit can last just so long. Rescue craft must get to the man who has just abandoned ship before his oxygen supply becomes exhausted. If the man simply steps out of his wrecked craft, he will continue indefinitely in the same direction it is traveling.

He will not plummet downward, gathering speed rapidly as he would if he bailed out within our atmosphere. He will himself become a celestial body, circling the Earth at orbital speed or traveling toward whatever was his destination.

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The problems of rescuing this man are enormous. If he follows a satellite orbit around the Earth, the rescue ship must be sent into exactly the same orbit at exactly the right instant with exactly the same velocity.

If he is not in orbit, but traveling onward in space, the rescue operation becomes vastly more complex. He steps out into an airless, black void, pierced by innumerable blinding points of light, where his only tenuous link with life is his pressure suit and a rapidly dwindling oxygen supply. He will be exposed to meteors, as was his ship. If he is not rescued almost immediately, he will certainly perish.

Rescue chances are much brighter if the damaged craft is one of several in a convoy. Survivors can then be plucked from eternity by companion ships. The School's Division of Space Medicine, headed by Col. Paul A. Campbell, is working on such solutions to the question of space-rescue operations.

Perhaps the most far-reaching of all space age research at the School is found in its "Mars Jars." Begun two years ago, this project aims to learn whether life as we know it can exist on other planets, and--if so--what kind of life.

In a collection of glass jars, the Department of Microbiology has evidence that primitive life could exist on Mars. Bacteria collected from arid desert regions have managed to survive and grow in an atmosphere similar to that which is found by spectrographic analysis of our ruddy neighbor.

The studies have now been expanded to include lichens--elemental green plants commonly found growing on rocks, in parched or icy soil, or on tree trunks.

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"We're still in the preliminary stage of this work," reports Lt. Col. John D. Fulton, Chief of the Department. "We don't know yet whether lichens can survive as well as the bacteria, if at all."

If they can, the experiment may go a long way toward settling the controversy over whether the seasonal green areas on Mars are vegetation or something else not so attractive.

From such research might eventually come a clearer understanding of what life basically is, and of its ability to spring up and perpetuate itself in surroundings that now seem to us as inhospitable as the bleak face of the Moon.

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