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Survival in Space

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survival in space



Siegfried J. Gerathewohl was born in Ebersbach, Saxony, Germany, in 1909. After studying physiology, psychology, and education at the Institute of Technology, in Dresden, and at the University of Batavia, in Munich, he received his doctorate at Dresden in 1936. He also holds a degree as a Diploma Psychologist from the University of Munich.

As a Captain in the German Air Force in 1940, he became chief of the Psychological Testing Center at Hamburg. He has also been chief of the Department of Industrial Psychology for the Bavarian Motor Company in Munich. In 1946 he joined the Aero Medical Center in Heidelberg, Germany, and, in the next year, was transferred to the School of Aviation Medicine at Randolph Air Force Base in Texas.

The author of two books and more than 70 articles on military psychology, aviation psychology, and aviation medicine, he is a member of the National Academy of Sciences, the Aeromedical Association, the American Psychological Association, the Scientific Society for Aeronautics, and the German Rocket Society. He is also an associate professor of experimental psychology at the United States Air Force's Air University. In 1958 he received the Arnold D. Tuttle Memorial Award for his research into the problems of weightlessness.

Ever since Lucian, the satirical Greek writer who lived about 1800 years ago, let his Moonmen set out to vanquish the inhabitants of the Sun, the imagination of Earthlings has been inflamed again and again by the dream of interplanetary travel. Space flight has become one of the fascinating subjects under discussion today. It appeals to everyone regardless of age, sex, or profession. It is the thrill of the ice-cream counter in the drugstore as well as of scientific panel discussions at the Massachusetts Institute of Technology. Publications on this topic can be found everywhere from the comics to science fiction, from pulp magazines to learned journals, from novels to research reports in the Pentagon. Although authorities on this subject have written obituaries for one reason or another, Space flight just refused to stay dead. Moreover, it made its way not only into radio broadcasts, TV

telecasts, and along Sunset Boulevard, but recently into big business. Since the exploitation of this idea proved fairly profitable, the eyes of all sorts of adventurers were magically drawn toward the stars and the infinity of outer Space.

While the lay public followed this development with enthusiasm, the majority of scientists looked upon it with either awe or contempt. The rocketeers, of course, propagated the idea of Space travel from the start with a sense of mission which—as astronaut Frederick I. Ordway put it—"aroused a vaguely uncomfortable recollection of some of the Biblical prophets." Now, that the technological disciplines have finally recognized their newborn child, astronautics, as being legitimate, the medical, social, and psychological sciences are moving to claim it slowly and somewhat reluctantly.

Never in his history of existence has man been faced with a more fateful decision. The venture into Space is more revolutionary and hazardous than the invasion of land by the aquatic animal in the Paleozoic Era. For these creatures were merely migrating from one terrestrial habitat to another, having 100 million years for adaptation. But the Space invader is leaving Earth altogether; and he seems to be in quite a hurry, too. In preparing himself for this gamble, he must overcome a variety of novel and difficult problems of body and soul engineering. As he usually does in case of serious trouble, he turns to the doctor.

By Siegfried J. Gerathewohl

Unfortunately, the human organism has changed but little during its known existence; nor can it be expected to do so in the future. Breeding an entirely new crop of Space travelers seems too lengthy and cumbersome in this time of ours. Hence, we must think of more practical and effective means for fitting *Homo sapiens* to his expedition. Since he was not constructed to expand into verticality, he must be redesigned for survival.

If man should wander unprepared into the void of Space he would suffocate within seconds because of a lack of oxygen. His blood would boil in the vacuum. Mercilessly exposed to the ultraviolet rays of the Sun and the bombardment of cosmic rays and meteorites, his burned and riddled body would be torn to bits by pressure differentials and would drift weightlessly as "Space debris" into the darkness and silence of infinity.

The question of protecting man in a Space environment, then, is the primary one involved in Space travel. Its solution begins with the selection of the specimen who is to venture out.

Many answers have been given, by more or less qualified men, to the question of what makes a Space pilot really successful; and most of the answers are well-meant, intelligent, and sincere. But some of them just miss the point. Because of the tremendous impact of the comic strips upon American civilization, the thinking of some of the contributors must have been centered subconsciously on such famous personalities as Buck Rogers, Flash Gordon, and the Space Cadets. Granted that picking the right man is one side of the story, then training him to perfection is the other. And this training can be done in many ways.

The moment man leaves the air behind him and cruises out into open Space, the walls of his cabin must contain an approximation of terrestrial atmosphere. Only if his ship is equipped with all the necessities of life and is protected against the hostile environment outside will man be able to survive. The many functions of Earth's atmospheric shield must be reproduced artificially within the Spaceship. Although the human organism is much more sensitive, demanding, and vulnerable than that of many other living beings, his

higher intelligence and greater versatility are assets for his survival. He can take his own environment along on his trip. As a matter of fact, rocket power, pressure breathing, oxygen systems, temperature control, sealed cabins, meteor bumpers, power steering, antitumbling devices, ejection capsules, artificial gravitation, astro-navigation charts, telescopes and periscopes, radio, radar and television, electronic computers, univacs, and skywatch men—just to mention a few requisites of futuristic travel—already have been tailored to his demands and will be brought to such a state of automation that he may even be bored to death on his venture into Space.

To be a little more serious, the success of a Space pilot is about 90 percent purely an engineering problem, although natural ability and training skill may well account for the rest.

Let's be more specific about this matter. As was indicated before, we seriously believe that Space travel *per se* is not just a somewhat higher form of conventional flying, but something profoundly different. The pilot of a rocket craft cannot take off or land whenever and wherever he desires. He cannot get out of his ship in an emergency. More than in any other type of piloting will he be told from the ground what to do. He will be fired into the air and guided automatically along a predetermined course. He is neither capable nor will he be allowed to control his vehicle during certain phases of the trip. Control input and feedback are mostly absent or qualitatively different. During conditions of sub-gravity and zero-gravity there is no flying by the seat of the pants. Actually, gliding through Space is not flying at all. It is an anonymous push-button affair and a completely unfamiliar type of locomotion. Only when he plunges back into the disturbing turbulence of Earth's atmosphere will some of his flying skills be required.

We are not even sure whether or not a good jet pilot will be a good Space pilot. Things are too different out there.

Thus, the main requirement for a successful Space flyer is his environment. If the engineers succeed in constructing the hardware—and there is no reason to assume otherwise—the problem of Space travel is near its solution.



Dr. Gerathewohl in the F-94 craft used for experiments on weightlessness.

Although there exist only a few hints about the actual working conditions of Space crews, some rather general conclusions about the job requirements can be drawn. Some preliminary designs suggest that the actual Space craft will be much like the imaginative rocket ship. Admittedly, the quarters will be neither spacious nor luxurious, but working and living facilities are expected to be reasonably habitable and utilitarian. Instruments may be numerous and complex, but every effort will be made to take the load off the pilot. Once launched with a catapult-like acceleration which may increase his weight ninefold, the pilot will have to monitor the ship to a certain degree during the cruise, which will include periods of sub-gravity and complete weightlessness that may exert some strain even on previously conditioned crews. Descent and landing, after an extended glide, will be like that of a large jet aircraft or glider plane.

In none of the many scientific and semi-scientific treatises on Space travel has the task of the crew been specified in SOP (standing operating procedures) terms. This, of course, is a remarkable lapse. Perhaps the designers still do not know what it will be. It may be that they are still working on cybernetics and automation. It is not easy nowadays to make things simple. But only if we can formulate a realistic job description for the Space pilot, can we reason intelligently about the specific difficulties with which the future Space ship skipper will have to cope. And only then can we arrive at a set of physiological and psychological requirements. The selection of rocket pilots and Space crews by means of predic-

tors, the significance of which has never been actually established, is purely academic. And so are the statements about preliminary elimination percentages which say that "of every 1,000 persons who can meet the initial rigid educational, physical and age requirements for space training, only five will ever enter Space—just enough for one rocket-ship crew." How can we know? To publish such data before even knowing what tasks will actually be required of the pilot seems to be putting the Space cart before the horsepower.

Fortunately enough, there are some men who have already flown rocket planes. They are not actually Space flyers, but they have reached the border of Space, at least. They do not claim to be supermen, nor do they believe their problems to be unsurmountable. They have made this point clear in many a conversation, and some of it was brought to light in a panel discussion on "Sky Unlimited" a few years ago. Their main concern is technical. Only if provoked do they touch their body and soul problems. This is what test pilot Scott Crossfield thinks about selection:

As far as selecting pilots during the war, for two years I was on carrier-type training in the Navy. I spent that whole two years trying to find men whom I could pick for my students. Everytime I was made out a liar. Who can tell who is going to be a good pilot, or the best pilot?

And he underlined General Flickinger's statement:

The process of selection is a natural one in which those individuals with the requisite flying schools, motivation and technical knowledge gravitate toward the work That is probably the oldest method of selection we have for test pilots A good quality to look for in a research pilot is successful tactical experience. A man must know his airplane and be interested in what he is doing.

And Major Arthur Murray says:

. . . as was pointed out, pilots just gravitate into these jobs We rely on a man's aggressiveness, rather than his inherent ability, physiological age and other factors We work with pilots such as you see here today.

Thus it seems we do not have to worry about the selection of Space pilots today because there are enough candidates who are eager to apply whenever the need arises. Even if we wanted to, we cannot do very much about this problem because there are no tests

available which would select the successful test pilot or Space cadet. The Air Force tests are of no help either. There is no known example that they ever succeeded in picking the best, or the most capable, or the outstanding man for a particular job. They come out with a usable average, at best, but Space ships need more than statistical probabilities. On the other hand, there exists quite a reservoir of capable, experienced, and highly motivated combat, test, and research pilots. Take Scott Crossfield, who said recently on TV, that he would give his left arm if he could fly the X-15. Perhaps we start at the wrong end again. It seems more important to pick the right men to direct the program than to pick at our ever-eager pilots.

Being finally afloat in Space, the crew may face grave psychological adjustments. Some doctors think that "by far the greatest problem involves the implications of a seemingly complete break from the Earth and the protective societal matrix in a small, isolated, closely confined container with a few companions. Little is known today about the effect of confinement and social isolation on individual and group behavior, particularly under the hazardous and threatening conditions of flight." In a recent publication on the "Break-

off Phenomenon," Clark and Graybiel describe this effect as "a feeling of being isolated, detached, or separated physically from the Earth." (*J. Aviat, Med.*; vol. 28, pages 121-126, 1957.) They let test pilot Bill Bridgman describe his sensations during a flight at the borderline of Space while he experienced the break-off:

Fifty-nine thousand, sixty thousand, reeling off sixty-one thousand. I have left the world. There is only the ship to identify myself with. Her vibrations are my own, I feel them as intensely as those of my body. Here is a kind of unreality mixed with reality that I cannot explain to myself. I have an awareness that I have never experienced before, but it does not seem to project beyond this moment

This is interesting; but, although this effect was experienced by about 35 percent of the jet pilots interrogated, it was not considered generally to have a significant influence on their ability to operate a plane. Captain Ivan Kincheloe, who held the altitude record, did not think much of it either. And Lt. Col. David Simons, who rode in a small gondola longer than any other person, was scared only when he struck an electrical storm. Nobody will deny that the experience of being high up in a small capsule may produce uncomfortable feelings, but it does not make much

Major H. D. Stallings, Dr. H. Strughold, and Dr. Gerathewohl discussing experiments in front of the Air Force T-33 used for early experiments on weightlessness.



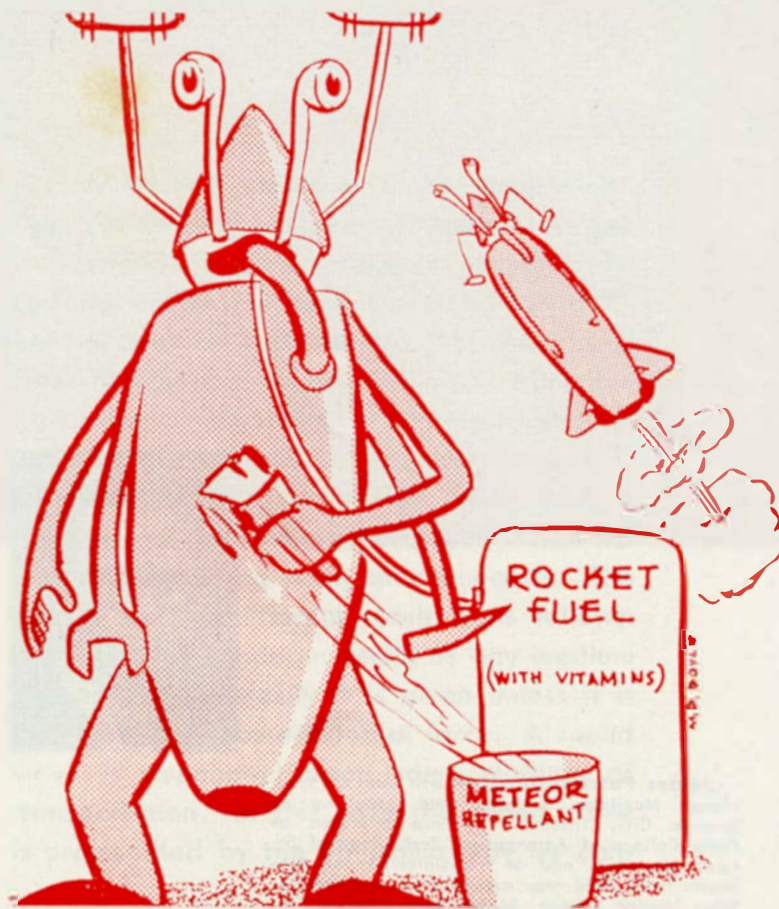
difference whether one is 100,000 feet or miles from the ground, if the chance of survival is about the same. The Space flyers will be in continuous contact with Earth. They can listen to the radio, call whenever they feel like it, have radar pictures and eventually television for their orientation and entertainment. Hundreds of small boats, submarines, light houses, observatories, and outposts are manned and maintained under extreme conditions of isolation and danger; but their unselected inhabitants do not crack. It seems that Columbus was more detached and desperate in his trip across the ocean than the Moon traveler will be five hundred years later.

Moreover, the point is not that people get scared, but that they snap out of it. Most men can adjust to a certain degree of danger, and only a few crack up; but again we are facing a dilemma because there is no test that would predict them with certainty. Says Scott Crossfield:

If a test pilot has real psychological problems he would never be in this business. I have never been able to get anyone to tell me what they are. You're darned scared. Unfortunately, perhaps, it seems to be the characteristic of most aggressive pilots that they more or less sustain this apprehension. To my knowledge, in the past, none of the flight test pilots has had a physical checkup prior to a mission, unless there had been some reported difficulty. All pilots are required by military regulations to obtain physical examinations.

And Crossfield is completely normal. So are the others who have seen blood, sweat, flak, and disaster. However it seems that the people on the ground are more inclined to worry than the men in the air. How did Lindbergh feel when he made his way over the northern seas? Of course, we can spend a million dollars on soul searching, but there seems to be some other worthwhile projects to sink the money in. The soul is not the weakest link in Space flight.

What is most impressive of all these preliminaries is neither the human factor nor interplanetary Space, but the powerplant that will make the ship akin to a celestial body. Seeing a rocket on the test stand is a unique experience; it is terrific and horrifying. To imagine that a man will ultimately walk over to such a three-stage, man-made volcano, board it through an elevator, calmly check his instruments a hundred feet atop the deadly furnace, and launch it with a roar, has still something of the science fiction about it. This



Dr. Gerathewohl's ideal space man, having four arms and hands (two hands developed into tools) to do the many things necessary for survival in Space, would include antennae instead of ears, telescopic eyes, direct oxygen supply from built-in tank, rocket fuel intake, and legs which act as fins during flight.

task, however, may be modern man's real crossroads of decision. It seems unlikely that we will have any real test other than letting him try it. It is a test of courage, not of skills. This thought is like that of Tony LeVier who said about the requirements of flying the F-104:

This bird is easy to handle and can be flown by a child. But you must be conditioned to it. I have looked at the faces of a bunch of test pilots when they saw the bird for the first time. Some just liked it. Some looked pleased. But some looked terrified. They were frightened. I could have picked the ones who can fly it just by looking at their expression.

To condition these men seems to me the most important thing of all . . .

No better comment can be made than this: We have the men and they are eager to go. They will be thoroughly conditioned through their experiences of test and research flight. They are ahead of the engineers and the fiction writers. They do not take these stories seriously about the "psychotic Russian Space girls," who are said already to have an edge on them; and they are not alarmed about manning the Space craft "with male and female pairs of unmarried psychotic midgets." (*Time*, September 16, 1957.) They know that they are the crop to choose from, and that one day they will take off. But this will not take place before they have at least a 99 percent chance of returning safely to Earth.