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Blueprint for Tomorrow's Spacecrews

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By Late summer, on the dry and sun-baked terrain of Edwards AFB on Southern California's Mojave Desert, a precisely chosen group of Air Force pioneers is schedules to enter the world's first pre-spaceflight training program.

Selected for their superior mental and physical attributes, their knowledge of flight sciences, and for motivations so strong that their interest in spaceflight — in the words of one Air Force doctor — will be "something they can taste," these airmen will eventually undergo at Edwards and at other Air Force aero-medical centers the closest simulations of spaceflight experience feasible on this Earth.

The Air Force's plan for what will probably be called an "experimental crew selection unit" was described to Air Force Magazine by Brig. Gen. Donald D. Flickinger, head of the Air Research and Development Command's Directorate of Life Sciences. The general is one of the air Force's top aero-medical experts who have been hard at work now for several years on the fantastic problem of preparing man for his important role in the newest and greatest unknown.

The men of the Edwards test unit will be subjected to constant stress simulations and indoctrination over a period of approximately two years, and their responses will provide further answers to the question of man's ability to perform adequately in planned orbital vehicles and their interplanetary successors. Under the pressures of intense training, both physical and psychological, the number of men in the test unit will decrease, and at the end of the program the survivors of the pre-spaceflight course will provide a nucleus of pioneers to man the hardware that will have been under concurrent development by the Air Force.

For, as the men at Edwards train for the extra-terrestrial flights they may some day perform, more immediate answers to man's ability to function and "pay his way" in judgment will be gained in vehicles like the North American X-15 and such successor projects as the Dyna-Soar boost-glide bomber.

As General Flickinger and colleagues like Lt. Col. Frederick S. Spiegel, Chief of the Air Crew Standards Branch in the Air Force Surgeon General's office, point out, the men who will fly the rocket-powered X-15 and its successors — USAF's Capt. Iven C. Kincheloe, Jr., North American's Scott Crossfield, and NACA's Joseph Walker — are themselves undergoing training programs for what is certainly space-equivalent flight. The difference between their intensive preparations and what is contemplates at Edwards is that Captain Kincheloe and his colleagues are readying for *flight* in a scheduled *vehicle*. Hence their regimens, partially prescribed, partially self-designed, are for specifically planned missions, while the Edwards training program aims for the day after tomorrow — for the day when it will have been proved that man is needed and that no "black box" computer can replace him in the business of purposeful spaceflight.

The question of man's ability to withstand the heavy stresses of spaceflight and to contribute to the functioning of the vehicle has now become crucial as the Air Force speeds development as the functioning of the vehicle has now become crucial as the Air Force speeds development of hardware. The question must be answered definitively, because innumerable special provisions and modifications will be required to accommodate personnel.

As of today, most aero-medical authorities believe man can and should be fitted into tomorrow's spaceflight. Much of the evidence on which they base their faith emerges from Air Force experimentation at such centers as ARDC's Aero Medical Laboratories at Wright-Patterson AFB, Ohio (see photos), at Holloman AFB, N.M., at Edwards AFB, at Randolph AFB, Tex. (see Air Force, March '58), and at other military research facilities and university centers across the country. The list of researchers is enormous.

But as Col. Charles H. Roadman, a veteran flight surgeon and command pilot and Chief of the Human Factors Division in the office of the USAF Deputy Chief of Staff for Development, stresses, no human being will be sent into an orbital vehicle before an unoccupied vehicle has been launched, has orbited, entered, and been recovered, and before the same process has been repeated with a primate passenger to observe the reactions of an animal similar to human beings.

And even after these operations are carried out successfully, the first man to board an orbiting vehicle will be going along primarily for the ride. So far as is humanly possible, his flight pattern and reentry will be automated so that full attention can be paid to his physiological and psychological reactions, since these factors will have great bearing on his potential contribution to the space mission.

But, the Air Force points out, there will have to be provision for the man's "taking over" to a limited degree should the automatic system fail in any way. He will have to be able to respond to signals from the ground, delivered directly if possible, or to cue devices built into the vehicle, which would be geared to starting him on a program of earlier-than-scheduled descent. There is no question of the enormity of the problems of successful operations of this kind, but the answers are being searched for daily.

And in keeping with the Air Force concept of concurrency, as the hardware people speed ahead on the vehicle projects for today and tomorrow, the men — not supermen — for the spacecrews of the now foreseeable future will be trained to meet the known general requirements of the space mission. As the answers to the question of what man will be required to do and his ability to do it are gained in the X-15 and later projects, the data will be incorporated into the training concepts of the Edwards group. Men like Kincheloe, Crossfield, and Walker will certainly be contributors to the shaping of the spacemen's training program. Their subjective reactions, in terms of what their successors will face in space, will be invaluable. And to the data they produce will be added continuing research results of experimentation at every center in the county where man-in-space is under study.

What kind of men will be chosen for pre-spaceflight training? What kind of stresses will they have to undergo? And what qualities will be required of them to be considered for even initial screening?

If any quality is supremely required, it is motivation — the "want-to" factor. All aero-medical experts agree space-aspirants must have the most genuine kind of motivations. Their desire for the training must be associated with an intense scientific curiosity and must not be of a primarily romantic nature, or, even more risky, a neurotic desire for withdrawal from the earthly problems

of home, family, finances, and the like. Indeed, the spaceman — when he reaches the void of orbital or interplanetary flight — will have to retain a strong and realistic connection with the home planet, since to a great degree, it will be a frame of reference that will, above all else, be meaningful to him. He will have to be a person fully and continuously knowledgeable of the purposeful quality of his mission, who, though he has left Earth physically, knows Earth as the origin and final destination of his trip once his mission has been performed.

In the psychological sense, spacemen will have to be persons who — more than most well-adjusted people — have resolved the ordinary conflicts of their everyday emotional lives. This is a rare quality, the experts agree, but not unattainable.

Lt. Col. Robert I. Williams, staff psychiatrist and neurologist to the Air Force Surgeon General, suggests that intensive research will have to continue in such speculative areas as the "anatomy of boredom," the loss of the usual sensory stimuli that earthbound people enjoy every day, the interpersonal relationships of crew members on extended missions, the possible deterioration of crew alertness, and the fascination question of whether a man could endure the destruction of what doctors call the "self-image."

In the zero-gravity state in spaceflight a man is weightless. Without special pre-training he might easily suffer real psychic disturbances. Dr. Williams points out, since on Earth we walk under the influence of gravity and thus have weight, our picture of ourselves, our "self-image," is of a vertically oriented mass. We know our legs are at the bottom of us and our feet are on the ground and our arms are at each side and our head is on the top, supplying us through our senses with the information we need to get around. This picture and its reassurances would not obtain in zero gravity. Our eyes alone would be able to serve to orient us. And generally reliable as they are, experiments indicate that the eyes need special training and much practice to overcome the confusion of the zero-gravity state. There are additional problems with the eyes, a notable hurdle being a pseudo-nearsightedness often experienced by high-performance pilots who at high altitude lose the usual landmarks and develop a tendency to focus on the nearest points available. How much of a problem this would be in spaceflight — in view of the contemplated heavily automated equipment — is still another question, and it is being explored.

Another important problem — in many ways the most important of all — is what many aero-medical people call the "breakoff" point. Dr. Williams defines "breakoff" as "the critical point at which a person is unable to distinguish his inner [psychological] life from his outer [physical] environment." Lt. Col. David G. Simmons — who last year ascended to 102,000 feet in a balloon — and others have described "breakoff" in varying terms. To Dr. Simons, it was a somewhat exhilarating experience. When he reached an altitude from which he could see the curve of Earth, he felt a kind of peace and detachment. But he has warned that such detachment could be dangerous, leading to an I-don't-give-a-damn" attitude. And it is significant that the colonel had to be prodded occasionally to check his oxygen and other requirements during his flight. Such loss of alertness may have been due to increased carbon dioxide in his atmosphere, and the matter is being studied.

For others, "breakoff" has been a good deal more unpleasant. In experimental isolation chamber, subjects have reported hallucinations and feelings of confusion. The subject is fertile for research.

The psychological problems of spaceflight are simply the extremes of stresses we all experience every day. For example, anyone who has ever spent a few day bedded down with a cold in an empty house has had to cope with the loss of his usual frames of reference — the people he normally sees, the regularity of his meals, the sounds of conversation. The greater

his psychological strength, the easier the experience. And as long as he knows and continues to know and feel that soon the cold will be better and that he will resume his everyday functions and relationships, his daydreams will not take over completely.

In fact, Dr. Williams suggest, for most of us the everyday problem of stimuli is one of *too much*, not too little. We get addled or upset because we have too many stimuli, too many things to think about and act upon. But since, even in the briefest initial flights of the orbital vehicles, “breakoff” could be a problem, the need for high and healthy motivation in spacecrewmen is again indicated.

The beauty of scientific research is that it constantly enlarges our knowledge of scientific problems. For example, General Flickinger believes that the projected training program for spaceflight will add significantly to medical knowledge of the chemical and psychological combinations that could indicate a person’s ability to face extraordinary stress situations of all kind.

Glandularly speaking, says the physician-general, people fall into two general categories, in terms of the secretions of the vital hormones that nature uses to fortify the boy for situations of stress. These two categories are roughly analogous to the beasts of the field — those who run away and those who chase or stand and fight. In human terms, these two types are called regressive and aggressive. Regressive types are generally resistant to change and often react with strong fear at new and stressful situation. Aggressive types react less emotionally to change or hazardous situations.

Research indicates that persons whose hormonal secretions under stress show a heavier proportion of adrenal hormone tend to fall into the first regressive category. Conversely those who show a greater proportion of what doctors call the “nor-adrenal” hormones under stress fall into the aggressive category. We all secrete the adrenal hormone in stress; it is the proportion of nor-adrenals in the total secretion that matters.

These nor-adrenal secretors, in the view of General Flickinger, indicate a greater potential for successful training in spaceflight. In terms of their glandular functions, they start with a *plus* profile. But that is only a beginning. At Edwards, such a group, which will also have passed the intensive screening tests for motivation, their flight science knowledge, and their general well being, will enter a training period that will repeatedly subject them to maximum stress simulations. It is hoped that eventually all the needed simulation equipment will b available at Edwards. Probably at the outset, the trainees may have to go to other centers such as Wright-Patterson and Randolph for part of their exercises, pending installation of the best possible equipment at Edwards.

Their training — in addition to subjection to isolation tests, zero gravity, periods in pressure suits, and centrifuges — will include survival tests in the field, continuous physical conditioning and psychological testing.

Diet, an important factor in physical conditioning, will be carefully followed, since, as General Flickinger points out, every possible means of exploiting the *plus* factors of each spaceflight trainee will be used. Performance checks will be constant throughout the program, aimed at screening out any candidates whose weaknesses reveal themselves at any stage. For a key to the success of the program is the reliability factor of each space candidate. The nucleus of successful candidates to emerge at the end of the two years of training will have eaten, slept, and breathed spaceflight and will be ready for assignment. Their number — anyone’s guess. Their quality — the absolute best.

This planning for the human requirement of tomorrow's spacepower is nothing new to the Air Force. It is, rather, an orderly progression of events, which has proceeded as aviation has reached higher and higher in and to the edge of the atmosphere. As USAF Chief of Staff Gen. Thomas D. White has asserted, air and space are indivisible.

Months before Sputnik I, for example, a dispassionate and highly readable study was completed by an Air Command and Staff College student group at the Air University at Maxwell AFT, Ala., on the subject of human requirements in future airpower. One of its conclusions was the strong statement that "man is an integral part of the weapon system [and that] engineers must consider man more and more as a prime factor in aircraft design."

Recognizing possible human limitations, the Maxwell study's conclusions suggest the realistic view that the men who are eventually trained for spaceflight missions will not be mass-production items, but the elite end product of highly specialized training. This is an indication of how proportionately great will be the individual contribution of each man who does serve as spacecrewman when space vehicles become manned.

The continuity of Air Force advancement from the early days of flight to the threshold of space is further borne out by another study, which provides actual specifications for the ideal spacecrewman.

To quote from that second study, produced recently by two veteran aviation psychologists:

"The space pilot must be able to perform the following functions with alertness, speed, and accuracy: pilot a high-performance, ultrasonic aircraft through the atmosphere during boost, control the vehicle in orbit and reentry glide, and guide it to a landing; obtain and interpret information concerning vehicle operation, cabin environment conditioning, personnel functioning, and external conditioning; and make rapid and accurate computations and decisions, anticipating difficulties by advance planning and action; check, test, and observe and report for scientific study, data concerning the spacecraft, its personnel, and the [cabin] environment."

The report goes on to suggest that it would be "un-economical to consider any personnel for this program who are not already highly experienced in high-performance or jet or rocket aircraft…proficiency in high-performance flight and in the engineering, physiological, communications, scientific, and navigational skills required would reduce the selection problem greatly."

The report talks realistically, too, of the problem of "making up the difference" between the absolutely reliable sealed cabin environment that will some day enable "sport-shirt" travel minus protective suits and the early manned vehicles that — for safety — will require protective gear.

Such gear puts time limits — in terms of hours — on present day spaceflight. And it requires personnel to have tiptop cardiovascular (blood circulatory) system. Other areas of training and indoctrination suggested by the report include the preparation of spacemen for unusual work cycles, possible deprivation of such comforts as tobacco, and strange new diets. The list is long. Again, Air Force experience is ideally suited for such training. For who but today's jet pilots have shown the aptitude, motivations, and tolerances that will be called for in the space age?

No one can say exactly, of course, what tomorrow's spaceman's training program will be like, but the stages following suggest a picture:

First, a careful check of experience, based on careful evaluation of personnel and flying records, effectiveness reports, recommendations and ratings by fellow pilots and superior officers; second, physical examination, review of medical records, detailed medical history, comprehensive flight physical examination, special tests for tolerance to accelerations, heat stress, and pressure-suit wear; psychiatric examination, including testing to check personality, conflicts, and such important items as psychological dependencies on others; psychological tests for intelligence and aptitudes.

After initial screening, all this data would be retained for constant checks during the actual training program. Many good men would fall by the wayside, an indication of the elite qualities of the survivors of the course.

Using many of these techniques and certainly others that will emerge as the program advances, the training that will start at Edwards will be a milestone in education and in aviation medicine — a giant leap in the history of flight that stated at Kitty Hawk.

The men at Edwards who emerge successfully from these long months of arduous and unique training will — pending their actual service in manned space vehicles — be as close to the ideal of trained spacemen as is possible to produce today.

In their curriculum, they will have learned to face and *want* to face fear and the unknown, to accept such unrealities as the weightless state, to control their physiological and psychological functions and attitudes. The will have learned to observe their own reactions coolly and scientifically, to cope with all foreseeable emergencies, to survive deprivation, and to tolerate fatigue.

They will be the very best of the best — combining intelligence and health and genuine motivation.

In great part, they will meet the stringent specifications of one science writer, Ernst Stuhlinger, who in a recent magazine article called for men: "… in excellent health,…[of] great stability." Stuhlinger added: "They will be persons of the scientific type who combine the love of adventure with the craving of scientific knowledge…men who can set aside their personal desires in favor of the idea of a great technical and scientific achievement."

In those areas, they will be idealists, as every man who as embarked on great adventure is an idealist of one kind or another. So, in a sense is the skilled craftsman.

Not long ago, Maj. Gen. Dan C. Ogle, Surgeon General of the Air Force, wrote down his conception of the ideal spaceman. It is accurate and eloquent.

He spoke of the USAF spaceman as "all that the best aviator is today as well as constitutionally and emotionally suited to the physical and emotional traumatic influences of sealed cabins, speeding heaven knows where, through the awful silence of a timeless and darkened sky."

Airmen being what they are, there should be no shortage of volunteers.