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The Weightless Man

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the weightless man

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Weightlessness—space bound (above) by Lt. Col. Robert B. Rigg

Weightlessness—earth bound (below) by Lt. Col. Robert B Rigg

THE TWENTIETH CENTURY has seen many outstanding accomplishments. Among these are the development of the automobile, airplane, atomic fission, television, and great advances in medical science. We are now on the threshold of still greater challenge—the conquest of Space. While scientists knew of the future of Space travel and engineers dreamed of interplanetary rocket flight, it took an eye-opener from behind the Iron Curtain to convince the American public that the time is not too distant when manned vehicles will escape the captive pull of Earth's gravitation and speed into the infinity beyond our world.

When this occurs, the Space traveler will be subjected to the most fascinating condition associated with sustained rocket flight: The condition of zero-gravity, in which he will have no feeling of weight. As everyone knows, weight is the result of the tug of Earth's mass as it constantly pulls us toward its center. However, when the rocket ship cruises freely after burnout, it moves along a so-called Keplerian trajectory in a gravity-free condition. This trajectory is like the orbit of celestial objects such as the Moon or Earth. The speed of the body then creates a centrifugal force which exactly counteracts the pull of gravity. Such a trajectory need not be confined to the outer reaches of Space. Any craft with sufficient speed can fly through a Keplerian orbit a few miles above Earth where air resistance is low and excessive thrust can be used for overcoming drag. In jet aircraft, zero-gravity has been achieved for a maximum of about 43 seconds.

Obviously, before man is to be subjected to the strange and startling reality of zero-gravity for extended periods of time, research must be conducted to investigate the effects of weightlessness on him in order that he be forewarned and prepared to meet this uncanny experience. At first glance, it might seem that weightlessness would be a very simple and pleasant sensation—rather like a relief from the everlasting burden of weight. But this is not necessarily true. On Earth we are never free from weight. Even the swimmer, lazily drifting on a pool of water, is subjected to the force of gravity and so are birds in flight. The dream condition of man floating and drifting weightlessly in Space is only a wish fulfillment which in itself recognizes the consciousness of weight.

Actual weightlessness can be experienced only when the force of gravity seems to be absent or is balanced by an opposing force. The first case occurs when a Space vehicle and its occupants escape beyond the pull of Earth's gravity and thus loses all weight. The second case occurs when the manned craft is orbiting around our planet: either in a rocket ship while cruising after burnout or in an artificial satellite while orbiting around Earth. In either case the result is a condition which can seriously affect the flier's well-being and his ability to respond and to perform his duties. This alone is reason enough for probing deeper into the effects of weightlessness upon man and his chances of survival during a trip into Outer Space.

Many suggestions have been made as to ways of producing zero-gravity and the weightless state associated with it. Since weightlessness can be produced in a free-fall situation, experiments after bail-outs or during jumps into a deep mine shaft have been proposed. Another method suggested was the use of the elevator, which would produce a state of subgravity for a period of time. The "Subgravity Tower" and the "Gravitron" devices for simulating the weightlessness condition by propelling a man up and down in a system of springs or in a U-shaped tube, were proposed and used for experiments in Italy. Moreover, weightlessness was partially simulated by the immersion of a body in water; and other experiments on orientation and equilibrium functions yielded interesting results. In such experiments the directions which we call "up" and "down" ceased to have conventional meaning.

Another, and perhaps the best, method devised to produce the weightless state is the use of jet aircraft. Since men most probably will never orbit around Earth in an aquarium but will penetrate the atmosphere in gigantic rockets, high-speed jet aircraft flying along a Keplerian trajectory seems to be the logical and most realistic approach to such an experiment. In addition, this type of high-speed aircraft provides a long enough period of zero-gravity to enable the experimenter to perform certain tasks and to secure all the measures necessary for his safety. The pilot, on the other hand, needs only to fly the airplane through the weightless maneuver, using experience and skill in order to guide the craft along an ideal parabolic arc.

It was not until the early part of 1955 that the United States Air Force's School of Aviation Medicine, located at Randolph Air Force Base, Texas, received a T33 jet plane to be used for zero-gravity research. In the beginning, practically no information was available on how a Keplerian trajectory could be flown other than the experience of several pilots who had known short periods of weightlessness during an outside loop or push-over maneuver. There was theory and some expert opinion; but we—that is, myself as pilot and Dr. Gerathewohl as chief investigator—began a series of exploratory flights to devise a flight profile that would give us the longest and most stable period of virtual weightlessness. Thus, trial and error within the theory of the ballistics of flying objects and artillery shells gave rise to the following flight pattern. At approximately 20,000 feet we nosed the T33 into a dive of approximately 45 degrees, throttle set at 96 percent engine power. Upon reaching an indicated airspeed of 350 knots, we began a pull-up which produced a radial acceleration of about 3Gs for 3 seconds, allowing the aircraft to be pulled into a steep climb of approximately 60 degrees from the horizontal. With wings level, sufficient forward-stick pressure produced a weightless state for approximately 28 seconds. We applied power on the upward portion of the arc and progressively reduced it at the peak of the curve and during the descending leg; this resulted in a constant velocity and zero-acceleration

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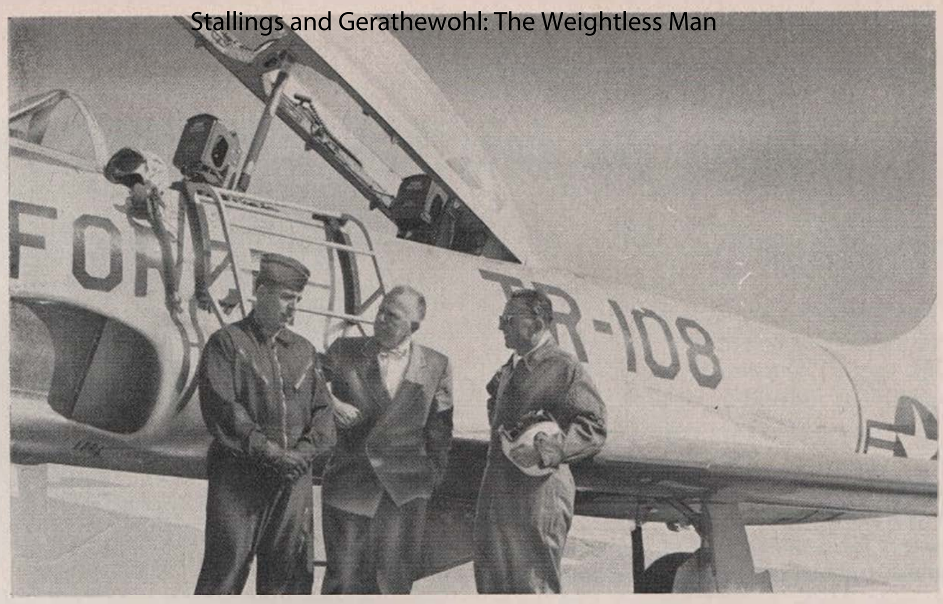

Major Stallines, Dr. Strughold, and Dr. Gerathewohl discussing a problem in front of the Air Force plane used in early weightless experiments.

throughout the arc. Roll and side sway were practically negligible throughout the maneuver provided aileron and rudder actions were absent and the air was calm. Only minute stick movements were necessary to keep the craft on its path.

The T33-parabolic curve was limited by several factors. Structurally, the aircraft was designed for subsonic flight. Because of its low Mach rating, entry speed and break-off points had to be determined so that maximum speed and climbing attitude could be attained without reaching the top of the curve below its stalling speed. The pullout also had to be completed before the plane oversped its Mach limit.

Fuel tank configuration produced another disconcerting condition. The T33 has a main fuel cell with the engine fuel pump located at the bottom of the tank. A portion of the top of the tank contains an air or expansion space connected to an overboard vent line. Zero-gravity allowed the fuel to float within this reservoir and permitted air and fuel to change places. Sustained zero-gravity replaced the fuel supply by air. The end product of this chain of events was a flame-out.

The acquisition of an F94C Starfire jet aircraft by the School of Aviation Medicine early in 1956 enabled the experiments in weightlessness to continue with a more stable, safer, and longer period. By modifying the flight profile according to the higher thrust of the F94C, the period of virtual weightlessness was extended to 43 seconds. With this new aircraft we have been able to log an accumulative total of over 37 hours of weightlessness.

Many a reader may wonder about the benefit of this expensive and time-consuming type of research. Many may argue about the identity of the kind of weightlessness we produce, and the kind existing outside of the gravitational field of Earth. And some may still doubt that Space flight will be accomplished at all. To us, these objections are as familiar as the gravity-free state itself; and to us, the answers are obvious.

Today, only ignorance or prejudice can keep man from realizing that the Space Age has already begun. If people still consider the Sputniks, Explorers, Atlas, and Lunik nothing more than unimportant pieces of metal flying through space, they then do not understand fully the signs of our time. There *will be* manned satellites in the not-too-distant

Dr. Gerathewohl seated in cockpit of plane.