History of Rocketry and Astronautics

Proceedings of the Twenty-Second and Twenty-Third History Symposia of the International Academy of Astronautics

Bangalore, India, 1988
Málaga, Spain, 1989

John Becklake, Volume Editor

R. Cargill Hall, Series Editor

AAS History Series, Volume 17

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 10

AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 1995

ISSN 0730-3564

ISBN 0-87703-395-1 (Hard Cover)
ISBN 0-87703-396-X (Soft Cover)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198

Printed and Bound in the U.S.A.

Chapter 21

The Aeromedical Field Laboratory of Space Medicine[1]

Gregory P. Kennedy[2]

Throughout the 1950s, the Aeromedical Field Laboratory at Holloman Air Force Base near Alamogordo, New Mexico, was the site of many advances in space medicine.

The laboratory's programs during that period included Project MX-1450R, Physiology of Rocket Flight, Project 7851, Human Factors of Space Flight, Project 7857, Research in Space Bio-Sciences; and Project 7850, Biodynamics of Human Factors in Aviation. Within these projects, sub-tasks included animal and human high-altitude balloon flights, biological rocket flights and rocket sled research. An extremely important result of the rocket sled research was the development of automobile seat belts.

New Mexico is a land of stark contrasts. From snow-capped mountains to scorching deserts, the old and new exist side by side. Within the deserts of the state, one can find thousand-year old Indian cities. And yet it was from the New Mexico desert that the United States took its first steps towards space. This is particularly true in the area of space biology, for much of the pioneering work in this field occurred at Holloman Air Force Base near Alamogordo, New Mexico.

Holloman Air Force Base began in 1942 with the establishment of the Alamogordo Bombing Range near Alamogordo, then a railroad town and ranching community at the base of the Sacramento Mountains in southern New Mexico. The Sacramentos form the eastern rim of the Tularosa Basin. The dominant geological feature of the Basin is White Sands, a 48- by 64-kilometer deposit of gleaming gypsum dunes. It was from this feature that the United States Army derived the name for White Sands Proving

---

[1] This paper was presented at the Twenty-Second History Symposium of the International Academy of Astronautics, Bangalore, India, 1988.

[2] Executive Director, The Space Center, Alamogordo, New Mexico.

Grounds in 1945. White Sands Proving Grounds was established on 10 July 1945 as the testing facility for the United States' rocket research program. White Sands Proving Grounds was the site for the United States Army's Project Hermes, the post-war V-2 research program. With the establishment of the proving ground, the nearby air base became a permanent installation and was named after George Holloman, an early pioneer in the development of guided missiles.

The United States began research in space biology shortly after World War II. Researchers at the Aero Medical Laboratory at Wright Field (today known as Wright-Patterson Air Force Base) near Dayton, Ohio, sponsored many of the first space medicine research projects. Among these were three "Albert" flights, which launched small monkeys aboard V-2 missiles from White Sands Proving Grounds in 1948, 1949, and 1950.[3] Their efforts progressed to include biological payloads aboard Aerobee research rockets and high altitude balloons launched from Holloman Air Force Base. Holloman personnel and facilities supported the early Wright Field programs. By 1951, the activities at Holloman reached a sufficient level to warrant the designation of an "Aeromedical Field Laboratory." At first, the Aeromedical Field Laboratory was subordinate to the Air Force Missile Test Center at Patrick Air Force Base in Florida. However, on 10 October 1952, the Holloman Air Development Center became an Air Force Air Research and Development Command designated center. At that time, the Aeromedical Field Laboratory became separate from Wright Field and was subordinate to the Holloman organization.[4] Early research efforts of the Space Biology Branch of the Aeromedical Field Laboratory focused on the biological effects of cosmic radiation and problems of space capsule design. Other major programs of the Aeromedical Field Laboratory dealt with physiological response to acceleration, deceleration, wind blast, and impact.

In January 1953, Major (later, Lieutenant Colonel) David G. Simons, M.D., moved to Holloman from Wright Field. As a Captain, Simons had been Air Force Project Officer for the first two V-2 animal flights. In April 1953, Lieutenant Colonel (later Colonel) John P. Stapp, M.D., Ph.D., arrived to assume command of the laboratory.[5] Stapp came from Edwards Air Force Base, California, where he had conducted research on the physiological effects of acceleration and deceleration on their rocket sled track since 1947.

The space environment was largely unknown in the early 1950s, and physiologists needed to investigate that environment to assess the hazards it posed to would-be space travelers. Chief among their concerns was cosmic radiation. To determine the biological effects of cosmic radiation, researchers at Holloman used balloons to carry small animals, insects, film packages, and tissue samples to high altitudes. With polyethylene

---

[3] Simons, David G., *Use of V-2 Rocket to Convey Primate to Upper Atmosphere*, Wright Patterson Air Force Base, AF Technical Report 5821, May 1949, p. 1.

[4] Historical Division, Air Force Missile Development Center, *History of Research in Space Biology and Biodynamics at the Air Force Missile Development Center, Holloman Air Force Base, New Mexico, 1946-1958*, Holloman Air Force Base, New Mexico, 1958(?), p. 91.

[5] *Ibid.*, p. 92.

high-altitude balloons, altitudes as great as 39,600 meters were possible for flights lasting more than 24 hours.

Biological balloon flights began in August, 1951. The first flights carried fruit flies and hamsters in sealed, spherical capsules about 1 meter in diameter, developed by the University of Minnesota. By the end of 1952, five flights had been made from Holloman. Only one was a qualified success, recovered after a six-hour flight. Of the remaining four, two suffered balloon failures during ascent, one gondola failed to hold pressure, and one balloon was lost in a thunderstorm after a 28-hour flight.[6]

The flights began under the aegis of project RDO 695-72 (MX-1450R), Physiology of Rocket Flight. In 1953, the project became known as Biophysics of Space Radiation, and later it continued as Task 79500, Radiation Hazards of Primary Cosmic Particles. After these initial flights from Holloman, which afforded opportunities to develop techniques for launching and recovering balloon payloads, cosmic radiation research flights shifted to the northern United States. The reason for flying from this area was that, at lower latitudes (i.e.: New Mexico), the Earth's magnetic field deflects such radiation. Within the United States, it is only above the northernmost regions that cosmic rays reach low enough in the atmosphere to be investigated with balloons.

During 1954, a new project, "Human Factors of Space Flight," was added to the Aeromedical Field Laboratory's agenda. This project, number 7851, contained three tasks: task 78500, Radiation Hazards of Primary Cosmic Particles; task 78501, Subgravity Studies; and task 78502, Descent and Recovery.

In 1955, when the animal flights seemed to have yielded as much data as possible, Colonel Stapp suggested to Major Simons that a spherical capsule be expanded to a 2-meter cylinder to create a capsule for a human pilot. Simons proposed the name "Manhigh" as a descriptive title for the project. At first the project was "the manned balloon phase of task 78500." However, in January 1956, command headquarters indicated that a manned flight could not be justified based on the requirements of the cosmic ray task, so Manhigh became part of task 78516, "Environmental Control in Sealed Cabins."

Project Manhigh placed a pilot in a small, pressurized capsule above 30,480 meters, in the physiological equivalent of a space environment. Winzen Research, Inc., (then) of Minneapolis, Minnesota, designed and built the Manhigh balloons and capsule for the Aeromedical Field Laboratory. (Today, Winzen Research is headquartered in San Antonio, Texas and still manufacturers high-altitude balloons). The aluminum capsule was 0.91 meters in diameter and 2.4 meters tall (Figure 1).

The project began with six unmanned and animal ascents to provide data on launching techniques, life support system performance, balloon performance and recovery methods. Colonies of small animals in the capsule placed the same demands on the life support system as a human pilot. The smallest mammals used in the high-altitude balloon flights were mice. Thus, scientists at Holloman expressed life support system oxygen supply and carbon dioxide absorbing capabilities in terms of the lowest (smallest) denominator, "mouse units." A guinea pig was 2 mouse units; a human equaled

[6] Historical Division, Air Force Missile Development Center, *Contributions of Balloon Operations to Research and Development at the Air Force Missile Development Test Center, 1947-1958*, Holloman Air Force Base, New Mexico, 1959, pp. 9-11.

about 500 mouse units. Thus, a colony of small animals, totalling 500 mouse units, provided a reasonable approximation of the capsule's performance with a human pilot. (Expressing life support system capacity in terms of mouse units affected the initial decision to proceed with a piloted project. The earlier capsules had a capacity of 200 mouse units. Creating a system for human needs only required increasing what was already in use by two and one half times, which was seen as no major obstacle).[7]

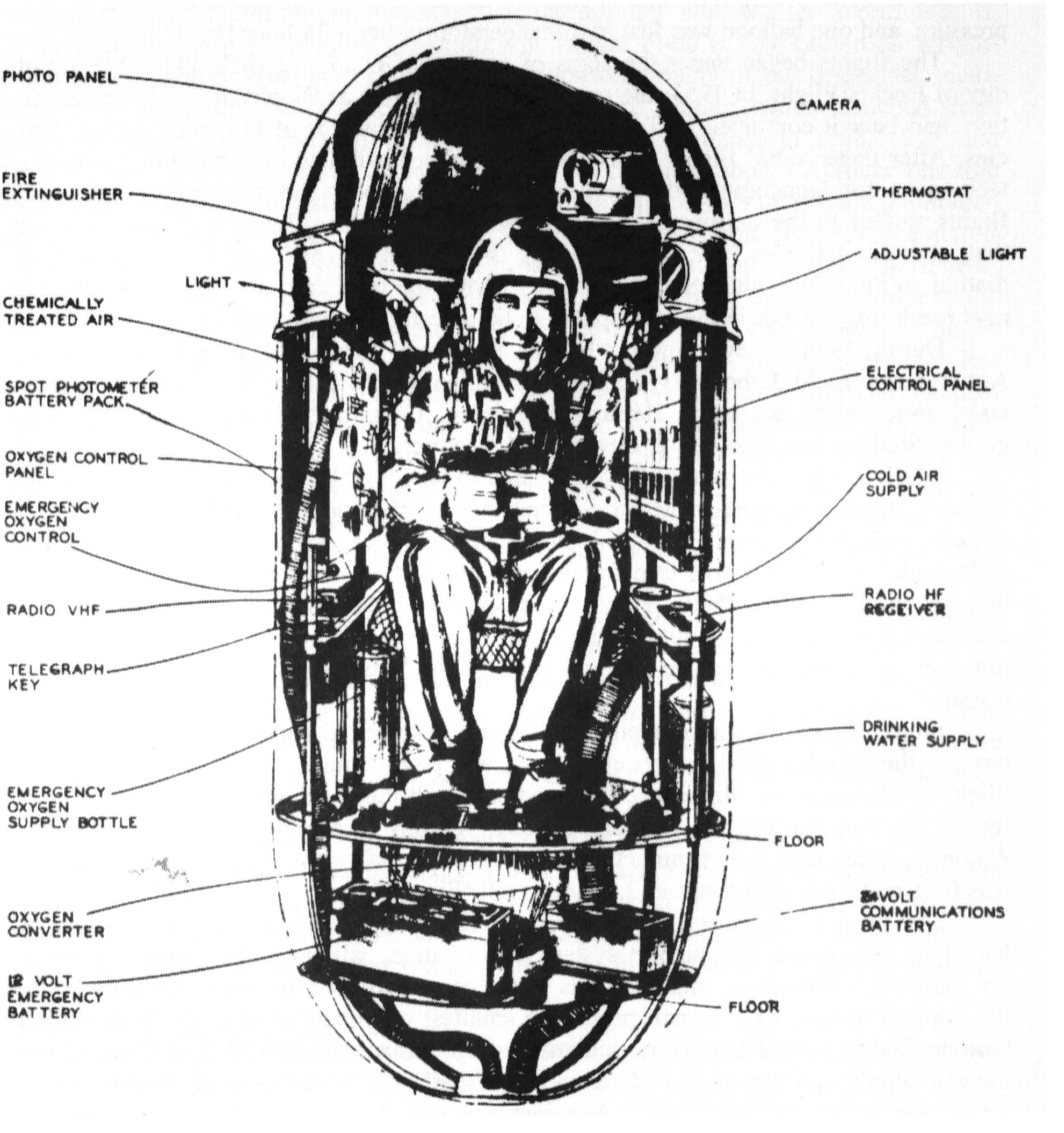

Figure 1 Manhigh capsule schematic (U.S. Air Force photo).

[7] Oral History Interview, David G. Simons by Gregory P. Kennedy, Space Center, Alamogordo, New Mexico, 24 September 1987.

Besides Simons, another individual, Capt. Joseph W. Kittinger had been with Manhigh since its inception.[8] Kittinger was a test pilot assigned to the Air Force Missile Development Center's Flight Test Division. As chief scientist and Project Officer for Manhigh, Simons wanted to make the first ascent. However, Colonel Stapp selected Kittinger for Manhigh I, because he viewed it as the last test flight. Simons would be held in reserve until Manhigh II, the first full-scale research flight (Figure 2).

Figure 2 Colonel John P. Stapp (left) Captain Joseph W. Kittinger (right). Stapp commanded the Aeromedical Field Laboratory, Kittinger piloted Manhigh I (U.S. Air Force photo).

Manhigh I, a planned 12-hour flight, began at 6:23 a.m. on 2 June 1957 from Fleming Field, South Saint Paul, Minnesota. Kittinger reached a ceiling of 29,000 meters slightly less than two hours after launch. During ascent, the voice communications system failed, forcing Kittinger to use the back-up Morse code transmitter. Shortly after launch, Kittinger noticed the capsule internal pressure did not respond to the change in altitude. However, the capsule pressure response rate had never been observed under flight conditions, so he continued the mission. The first real indication of trouble came at 8:07 a.m. when, after reaching peak altitude, Kittinger reported the main oxygen tank

[8] Simons, David G., with Schanche, Don A., *Man High*, Doubleday and Company, Inc., New York, 1960, p. 36.

was less than half full. Major Simons, Colonel Stapp, and Otto Winzen (President of Winzen Research) conferred, and they decided the problem lay in the cabin pressure controller. At 8:54, they ordered Kittinger to descend immediately. His initial response of "Come and get me" shocked ground controllers. They first feared he was suffering from the so-called "breakaway phenomenon," a feeling of detachment from the Earth reported by high-altitude aircraft pilots. Stapp's reply was that if Kittinger didn't begin his descent immediately, ground controllers would cut the gondola away from the balloon, forcing a parachute return. Kittinger's initial response, however, had been a joke, and he began his descent. At 12:57, he landed on the bank of Indian Creek, about 130 kilometers southeast of the launch area (Figure 3). Upon landing, Kittinger released the balloon, and the capsule toppled into the shallow creek. The liquid oxygen tank was nearly empty. Post flight examination showed someone had accidentally reversed the pressure supply and oxygen vent lines to the pressure regulator, so oxygen was dumped overboard instead of being supplied to the capsule.[9] The communications malfunction proved to be nothing more serious than a loose channel selector switch.

Figure 3 Manhigh I recovery after "splash down" in Indian Creek.

[9] Winzen Research, Inc., *Manhigh I*, Air Force Missile Development Center, Holloman Air Force Base, New Mexico, Report AFMDC-TR-59-24, June 1959, p. 11.

On 19 August 1957, Simons took off at 9:22 a.m. CDT from a 130-meter deep open pit iron mine near Crosby, Minnesota. Two hours and eighteen minutes later, he reached 31,090 meters. Simons spent the day making observations, taking photographs, and measuring sky brightness. He attempted to observe aircraft flying beneath him as a test of high-altitude observation. Photographic plates taped to his body would show cosmic ray tracks.

After sundown, the balloon cooled and descended to 23,600 meters. During the night, a line of severe thunderstorms rolled beneath the aerostat. Simons observed that the storm clouds towered higher than previously believed. The balloon continued to cool and descended to 21,340 meters. At one point, Simons looked out of the portholes and couldn't see any stars. The conclusion was obvious: the storm clouds were above him and he was dangerously close to the thunderhead. Suddenly the capsule gave a strong twist. The balloon was in a region of turbulent air! At high altitudes, polyethylene balloons freeze and become brittle. If it encounters too much turbulence, a balloon can shatter. Also, Simons feared lightning might strike the capsule.[10] He lightened the craft by dropping his last ballast, two 23-kilogram batteries, and rose to a higher, safer altitude.

After sunrise, the balloon heated and rose to 27,430 meters. As the storm continued, a new problem surfaced. Because the flight had gone on longer than planned, and the lithium hydroxide air scrubbers had cooled, lowering their efficiency, carbon dioxide in the cabin reached a symptom-producing level of 4 percent. Simons donned the faceplate to his helmet and breathed pure oxygen for ten minutes. This gave the air scrubbers time to work, and he removed the face mask until carbon dioxide built up again. By 11:00 a.m., the chemicals were warm enough to keep the carbon dioxide level just below 3 percent.[11] However, by this time, the batteries were running low, so Simons had to turn off the capsule cooling system to conserve electricity. The temperature in the gondola reached 28.8°C., which was extremely uncomfortable for someone in a skin-tight partial pressure suit.

By mid-day, the balloon drifted clear of the storm and Simons began his descent. But, each time he descended, the balloon would heat up and rise again. This continued until 2:00 in the afternoon, when he began a steady descent. Unfortunately, the descent rate was twice what he wanted. Simons had to be extremely careful about valving off helium; the batteries he jettisoned during the night were the last ballast he had. If he started descending too fast, he had no way to lighten the craft and slow his return. Also, the initial descent rate would double when he hit the tropopause. Simons braced himself for what was sure to be a hard landing.

Finally, 32 hours and 10 minutes after launch, Major Simons landed in a South Dakota alfalfa field. Everything in the cabin that could come loose, did. As he waited for the chase helicopter to land and the recovery team to help him from the capsule, Simons smelled an acrid, burning odor. He feared the bromine fire extinguisher, which

---

[10] Simons, David G., "A Journey No Man Had Taken," *Life*, vol. 43, no. 10, 2 September 1957, p. 23.

[11] Simons, David G., "Pilot Reaction During Manhigh II Balloon Flight," *Journal of Aviation Medicine*, vol. 29, no. 1, January 1958, pp. 1-14.

was extremely toxic, had discharged in the cabin during impact. He fired the pyrotechnic squibs which cut the wires between the upper and lower capsule halves and effected an emergency egress. Fortunately, the fire extinguisher had not discharged. The smell was from the lithium hydroxide in the carbon dioxide scrubbers. (Partly because of this experience, potassium hydroxide was used in Manhigh III). As Simons stood alongside the capsule, clad in a partial pressure suit and looking like a visitor from another planet, the farmer who owned the field came running over with his young son, "Oh look Daddy! A helicopter!" the boy exclaimed, totally ignoring the physician who had just ventured to the edge of space[12] (Figure 4).

Figure 4 David G. Simons in his Manhigh II capsule (U.S. Air Force photo, courtesy of David G. Simons).

[12] Simons, David G., Interview, 24 September 1987, *op. cit.*

One of the first actions of the medical team from the helicopter after landing was to draw samples of Simons' blood. These were to provide measurements of his adrenal response to stress, and for Dr. R. Lowery Dobson of the University of California, who was looking for bi-lobed lymphocytes as a result of exposure to cosmic radiation. Such manifestations had been noted in the blood of workers exposed to low-level radiation at the University of California cyclotron.[13] The film plates taped to Simons' body registered several cosmic ray hits on his arms and chest. Several months later, a few gray hairs grew at locations corresponding to the hits. Other than this, there were no lasting physical effects from his flight.[14]

Following the success of Manhigh II, Brigadier General Don Flickinger, Director of Human Factors of the Air Research and Development Command, approved a third flight. General Flickinger suggested that candidates be screened to meet the physiological and psychological criteria anticipated for future space crews. Since there were no astronauts at that time, qualifications for space men of the future would be established by Manhigh.[15] During this activity, in April, 1958, Lieutenant Colonel Stapp was promoted to Colonel and transferred to the Wright Air Development Center to head the Aero Medical Laboratory. The new Commander, Lieutenant Colonel Rufus Hessberg came to Holloman in June, 1958[16] (Figure 5).

Lieutenant Clifton McClure, a 25-year old Air Force officer with a degree in ceramics engineering, was selected to pilot Manhigh III. This flight used a new, larger capsule and was planned to take place in Minnesota. However, by the time everything was ready, the Minnesota weather had deteriorated for the season, so the flight was moved to Holloman. Shifting the flight to New Mexico effectively eliminated gathering any cosmic ray data, but this was not necessarily a bad thing. Without the cosmic ray exposure, Manhigh III could serve as a control to judge the effects of the other flights.

The flight took place on 8 October 1958. Shortly after boarding the capsule, McClure accidently opened his personal parachute. Rather than report the mishap, McClure remained silent and re-packed the parachute! After re-packing it, he realized the closing pins were backwards, so he opened it again and repeated the process. This time, he packed it properly. By 6:51 a.m., when he took off, he was perspiring so heavily he overloaded the moisture removing capacity of the life support system. The excess moisture reacted with the potassium hydroxide in the air scrubbers, producing heat.[17]

---

[13] Historical Division, Air Force Missile Development Center, *Major Achievements in Space Biology at the Air Force Missile Development Center, Holloman Air Force Base, New Mexico, 1953-1957*, Holloman Air Force Base, New Mexico, 1958, p. 42.

[14] Simons, David G., Interview, 24 September 1987, *op. cit.*

[15] Simons, David G., "Psychophysiologial Aspects of Manhigh," *Astronautics*, vol. 4, no. 2, February, 1959, pp. 32-33.

[16] Bushnell, David, *Aeromedical Field Laboratory: Mission, Organization and Track-Test Programs, 1958-1960*, Holloman Air Force Base, New Mexico, 1961, p. 12.

[17] Air Force Missile Development Center, *Manhigh III USAF Manned Balloon Flight Into the Stratosphere*, Aeromedical Field Laboratory, Holloman Air Force Base, Report AFMDC-TR-60-16, April, 1961, pp. 199-203.

Ground controllers realized something was wrong when McClure's voice sounded sluggish at 1:00 that afternoon. Asked to report his rectal temperature, he replied it was 38.3°C. Telemetry indicated McClure's pulse rate was 140 beats per minute. Yet, telemetry also indicated that cabin temperature was only 24.4°C., less than what would normally produce an elevated temperature and pulse rate. Asked to read the mercury thermometer inside the cabin, McClure reported a temperature of 35.6°C. At 1:30, McClure's body temperature had reached 39.1°C. Lieutenant Colonel Hessberg terminated the flight and directed McClure to return. During descent, the groggy McClure broke the radio foot switch when he dropped the photometer. Still, McClure retained control of the aerostat and finished his descent from 30,400 meters at 6:30 that evening. His temperature was an incredible 42.5°C., yet he remained lucid and walked by himself to the recovery helicopter![18]

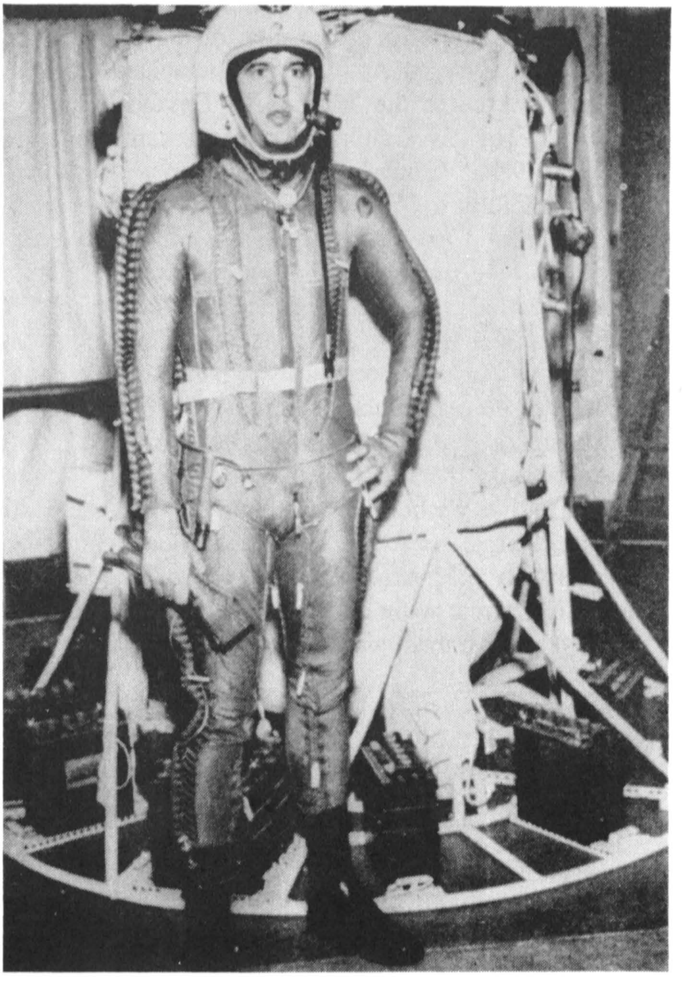

Figure 5 Clifton McClure, pilot of Manhigh III in front of his capsule (U.S. Air Force photo).

[18] *Ibid.*, p. 132.

The Manhigh program, which took humans to the edge of space, brought considerable attention to the Aeromedical Field Laboratory. However, the research performed on the high speed test track was even more spectacular. But this work was not performed for the sake of being spectacular. Rather, it sought to determine the human limits to rapid acceleration and deceleration.

Colonel Stapp began his research using the Holloman rocket sled track under the aegis of the Air Research and Development Command Test Directive 5200-H1, "Biophysics of Abrupt Deceleration." This directive, dated 15 April 1953, called for a program of experiments to study tolerance and survival limits for deceleration, windblast, tumbling and combinations of these factors. The major thrust of these investigations was to study escape from high-speed, high altitude aircraft. In 1955, Dr. Stapp's research was incorporated into project 7850, Biodynamics of Human Factors in Aviation, which became Biodynamics of Space Flight in 1958.

There were only three manned runs on the Holloman high speed track, all of them made by Stapp. However, there were numerous tests with anthropomorphic dummies and animals to support project 7850. Between 1950 and 1956, aeromedical research projects accounted for more runs on the track than any other single program.

Initially, the track was used for project MX-775, the Snark missile. The first test run on the Holloman track was on 23 June 1950. A Snark missile on a special sled reached a maximum speed of 45.4 meters per second.[19] Snark testing continued until 28 March 1952. Other early test programs included the Q-2 Firebee and OQ-19 target drones.

On 19 March 1954, Colonel Stapp made his first run on the Holloman track. This was his 27th rocket sled ride. Stapp used a rocket sled known as the "Sonic Wind I." The sled was constructed in two parts: a 907-kilogram test sled, which carried the solid-fuel rockets. Sonic Wind I was fabricated from chrome-molybdenum tubing by the Northrop Aircraft Corporation, and it could withstand 100 g's, with a 1.5 safety margin.[20]

The first test run of the Sonic Wind I was made on 24 November 1953. The third run, on 28 January 1954, was the first to carry a live passenger, a chimpanzee. After three more runs (two with chimpanzees, one with an anthropomorphic dummy), the Air Research and Development Command authorized Stapp to proceed with human experiments.[21]

Stapp's 19 March run, which reached a top speed of 187 meters per second, subjected him to 22 g's. The purpose of this test was to evaluate human reactions to exposure to about 15 g's for about 0.6 seconds' duration. Owing to a different water brake system at the Holloman track, this was about double the duration possible at the Edwards track for the same magnitude of force.

---

[19] Bushnell, David, *Origin and Operation of the First Holloman Track, Volume I, History of Tracks and Track Testing at the Air Force Missile Development Center, Holloman Air Force Base, New Mexico, 1949-1956*, Holloman Air Force Base, 1960, pp. 25-30.

[20] *Ibid.*, pp. 66-67.

[21] *Ibid.*, p. 67.

In the late summer, on 20 August, Colonel Stapp made his second test run on the track. For his first run, he was protected by a windshield, so the only physiological effects would be those from deceleration. Objectives for the 20 August test, however, focused on the effects of sudden wind blast. Stapp wore a special helmet which protected his entire head. The Sonic Wind I carried an opening-door windshield, which could abruptly expose him to wind blast. This duplicated the effects of ejecting from a high-speed aircraft. During the run, Stapp reached a speed of 224 meters per second and was exposed to a wind pressure of 36.7 kilopascals. Other than a few blood blisters from wind-blown grains of sand, which penetrated his clothing, Stapp suffered no ill effects from the test.[22]

Colonel Stapp's last, and most famous, rocket sled ride took place on 10 December 1954. Several chimpanzee runs preceded Stapp, to verify the sled's performance at speeds of more than 966 kilometers per hour. Sonic Wind did not carry a windshield for this test; the added weight would keep the sled from reaching the desired speed. Stapp was protected only by the helmet and clothing he wore. He was strapped tightly onto the sled, his arms and legs secured to prevent their flailing at high speed. This was known to occur at high speeds, and it could cause severe injuries. He was strapped in, and sat there in the New Mexico Sun listening to the countdown, Stapp later described the wait as "that firing squad sensation."[23]

Nine 20-kilonewton thrust JATO bottles powered the sled. He reached a peak velocity of 286 meters per second, or Mach 0.9. Windblast reached 52.4 kilopascals. The water brake stopped the sled in 1.4 seconds, subjecting the doctor to 43 g's. When he hit the water brake, his vision became a "shimmering salmon," the sensation in his eyes being compared to a tooth extraction without anesthetic. As the sled stopped a scant 50 feet from the end of the track, safety personnel and ambulances scurried to Stapp. As they helped Colonel Stapp from the Sonic Wind, he at first thought his worst fears had been realized: he was blind! However, about eight minutes later, his vision returned. Then, aside from some nasal congestion, hoarseness, coughing from congestion of the larynx, and burning from strap abrasions, the only thing Dr. Stapp felt was relief that the test was over and his vision unimpaired.[24] He did have two black eyes, which healed after the normal amount of time (Figure 6).

Following the 10 December run, Dr. Stapp became known as "the fastest man on Earth," and his portrait appeared on the cover of *Time* magazine. He appeared on the television program "This is your Life," and he was deluged with speaking requests.

Work with the Sonic Wind I continued, but this was the last manned run. After that, tests continued with chimpanzees and dummies, exploring the effects of wind blast, deceleration, and aircraft crash forces.

In all, there were 56 aeromedical tests conducted on the original 1082-meter long Holloman test track. In March 1956, Holloman managers awarded a contract for the

---

[22] *Ibid.*, pp. 68-69.

[23] "Stapp Honored at ISHF," *Space Log*, vol. 4, no. 3, July, 1987, p. 2.

[24] Bushnell, David, *Origin and Operation of the First Holloman Track*, *op. cit.*, pp. 70-71.

construction of a 10,668-meter track. On 29 March 1956, the 226th and last test run was made on the 1082-meter track.

Figure 6 Colonel John P. Stapp, M.D., Ph.D.

After the Sonic Wind I sled, Holloman researchers contracted the Northrop Corporation to build a Sonic Wind II. This sled was lighter and faster than its predecessor.[25] Sonic Wind II was used first at the Navy's SNORT (Supersonic Naval Ordnance Research Track) facility at China Lake, California. Once the new track was ready at Holloman, the sled was brought to New Mexico and prepared for operations there. The first Sonic Wind II SNORT test occurred in February, 1957. Three more runs were made, each of which carried anesthetized chimpanzees at speeds around Mach 1.7. The apes wore special helmets and garments to protect them from the windblast. On each run, however, there was some failure and the passengers were killed. In those cases where

[25] Bushnell, David, *Aeromedical Field Laboratory*, *op. cit.*, p. 24.

the garment was torn away and the chimpanzees' skin exposed to the airstream, there were second or third degree burns with no evidence of carbonization, a previously unseen pathological phenomenon.[26]

The first Sonic Wind II run at Holloman was on 6 August 1958. This was the first biomedical run on the new track. The sled used a gigantic solid-fuel rocket motor called the "megaboon." The motor was 6.7 meters long and produced a thrust of 445,000 newtons for ten seconds. During the 6 August run, Sonic Wind II reached 530 meters per second and traveled 6,100.3 meters down the track. The chimpanzee passenger sustained some burns on its right arm where layers of the protective garment had to be cut away to make it fit. Otherwise, the garment had fully protected the chimp from the supersonic windblast.

Captain (later Major) John D. Mosely wanted to make a Mach 1.6 run on the Sonic Wind II with the megaboon motor. On 29 October 1958, a successful test was made with an anthropomorphic dummy wearing a protective suit. Despite the success (or, because of it), Headquarters, Air Research and Development Command felt that enough data had been collected, so that the need for a human test could not be justified compared to the risks. This effectively ended the windblast research program at Holloman.[27]

However, biomedical track runs were far from over. The anatomy of certain animals is remarkably similar to that of human beings. For example, the spinal column of the bear is very close to man's. For this reason, Colonel Stapp started a veritable menagerie at Holloman. Chimpanzees, small monkeys, bears, and even pigs were used for research. Thus, when the National Aeronautics and Space Administration needed chimpanzees to fly in the Mercury spacecraft before the astronauts, it was logical to have Holloman provide them. The first chimpanzee in space was named Ham. His name was an acronym for Holloman Aero Med. Ham's flight, on 31 January 1961, was suborbital. Later that year, Enos orbited twice in a dress rehearsal for John Glenn's mission (Figure 7).

Before the chimpanzees flew, they underwent training at Holloman. Part of this program involved having them placed in capsules identical to the ones they flew in and launching them on the test track to determine their response to acceleration and deceleration. Several runs were made during August - October, 1960.[28]

By this time, man was ready to embark on his first sojourns into space. This was made possible, in large measure, to the foundation laid by the Aeromedical Field Laboratory. Their research during the 1950s resulted in the first sustained manned flight into a space equivalent environment (Manhigh); tests of human tolerance to acceleration, deceleration, and windblast (test track runs); first "astronaut" screening and selection (Manhigh); and investigations of the biological effects of cosmic radiation (balloon flights).

---

[26] *Ibid.*, pp. 24-25.

[27] *Ibid.*, pp. 25-29.

[28] *Ibid.*, pp. 47-52.

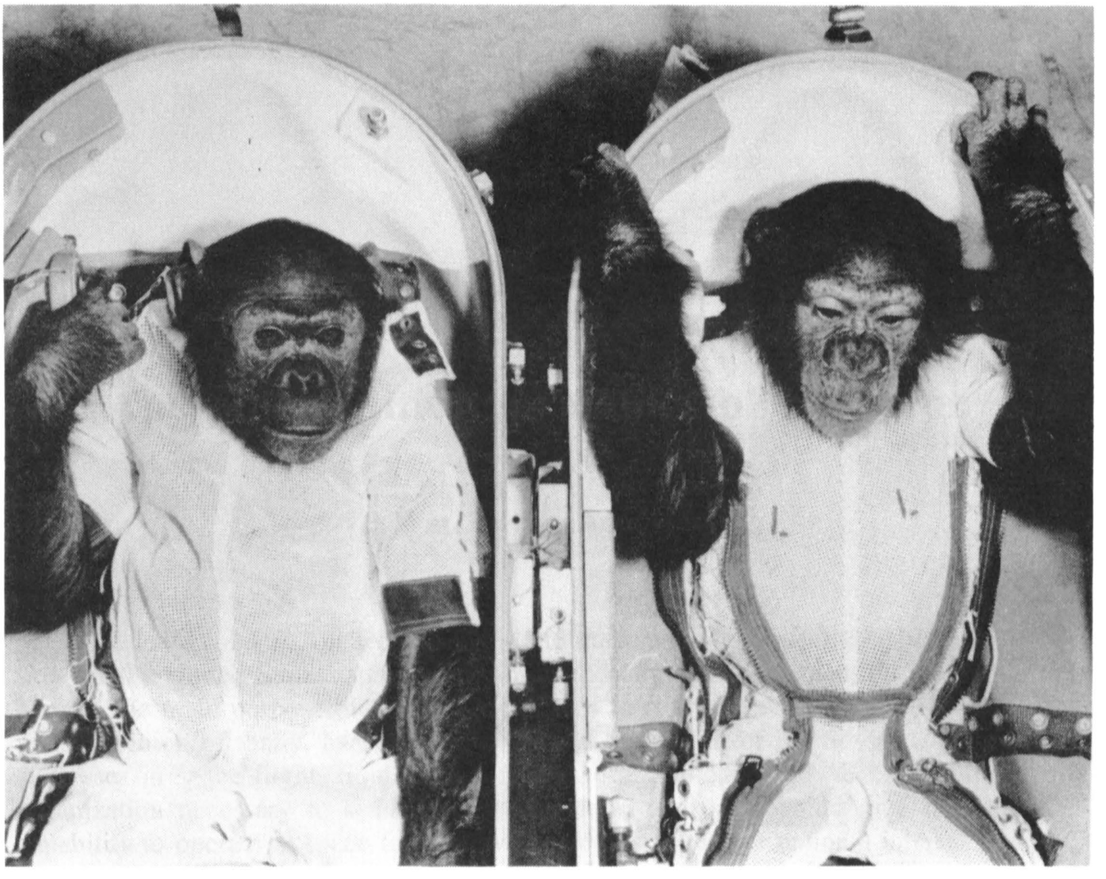

Figure 7 Enos (left) and Ham (right). The first two chimps in space (U.S. Air Force photo).