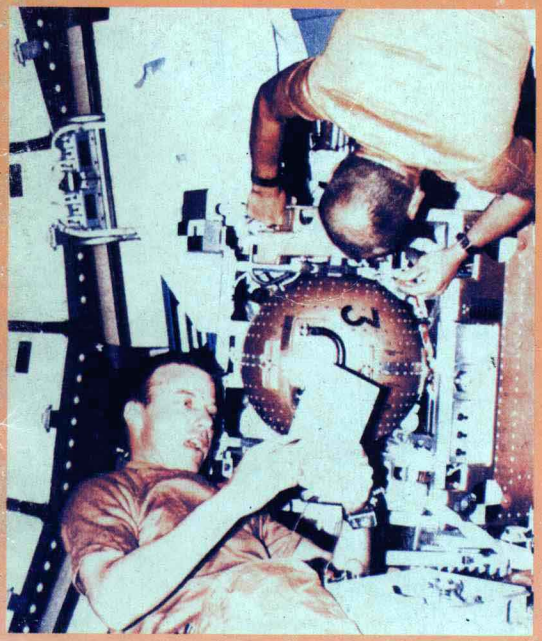
LIVING



人类征服太空的历程 英汉读本

在太空中生活

Don Berliner 著
刘延超 译

广西科学技术出版社

IN SPACE

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作　　者：Don Berliner
译　　者：刘延超
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A photo of Gemini 7 *taken from* Gemini 6 *during a rendezvous maneuver*

INTRODUCTION

When astronauts orbit the Earth, they travel at 18,000 miles (28,800 kilometers) per hour—much faster than anyone can travel in an airplane. The surprising thing is that they have no sense of speed. Astronauts feel as though they're floating, but actually they're falling. But anything falling at such a high speed follows an arc that has the same curvature as the Earth. While in orbit, the spacecraft has no weight. It remains at the same altitude as it "falls" around the earth for days, weeks, or even months. The air inside the spacecraft, however, resembles the air in an airliner—drier and slightly lower in pressure than air at sea level.

Several different types of spacecraft have been launched into orbit or flown to the Moon since the early days of space travel, and the astronauts' living conditions during flights have changed dramatically. In 1961, when cosmonaut Yuri Gagarin became the first human to orbit (circle) the Earth in *Vostok 1*, his personal comfort was of little concern. All that mattered about the huge, expensive, dangerous operation was that it be a successful mission. The goal was to launch cosmonaut (a Soviet astronaut) Gagarin into space to orbit the Earth and then return alive and well. No one worried about whether he felt cold or hot, cramped or uncomfortable, bored or hungry. Gagarin was a pioneer. He willingly traded personal comfort for the opportunity to do something historic, something he considered truly important. After all, he was in space for just 110 minutes. The

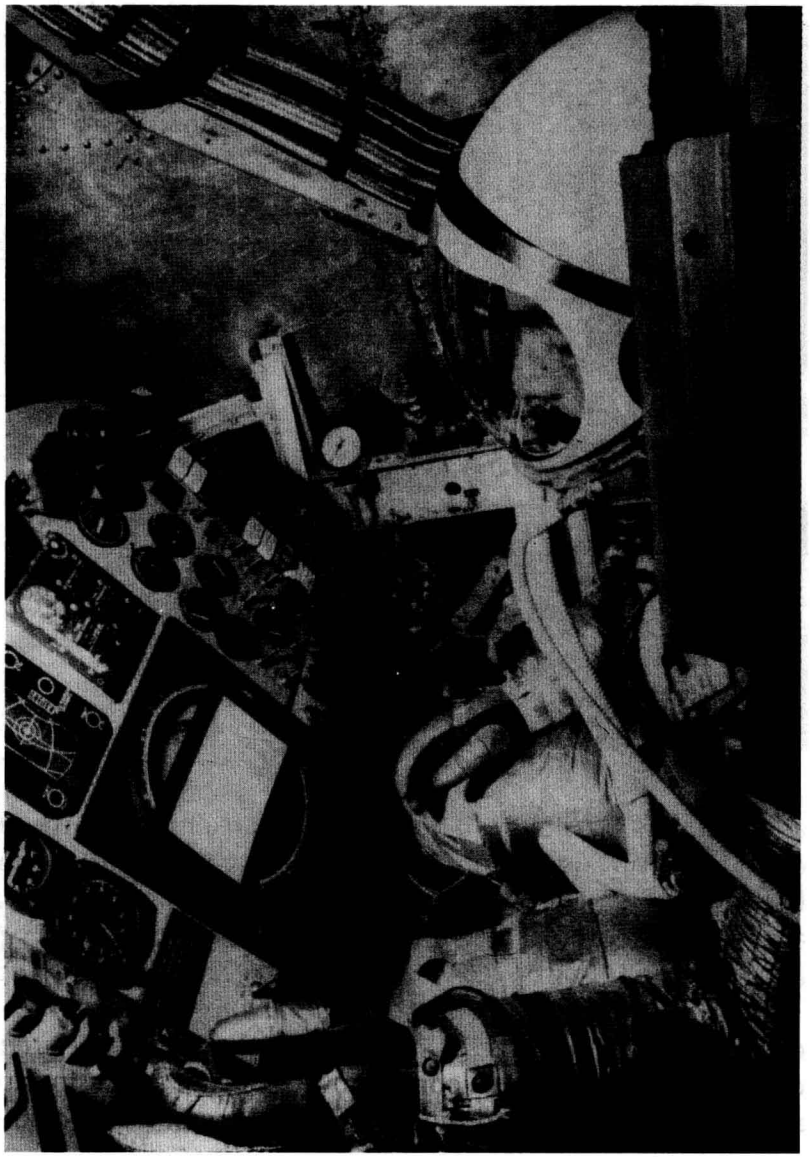
veteran pilot could endure a lot of discomfort during that short time.

The same was true 10 months later when U.S. astronaut John Glenn orbited the Earth three times in a Mercury capsule called *Freedom 7*. He had known for a long time that he would be squeezed into a tiny cabin with barely enough room for him to stretch his legs. He also knew he wouldn't have anything to eat. It didn't matter to Glenn, because he went into space to work and to learn. His five-hour mission was so crowded with important tasks that nothing else mattered. He was an explorer. The important journeys of explorers and pioneers have always been filled with danger and discomfort. That's one of the reasons that astronauts and cosmonauts have been welcomed like heroes when they return from space.

Orbital flights of a few hours were strictly business. Those first crewed flights were in spacecraft that seem very primitive by current standards. In the 1960s, astronauts, engineers, and technicians were just beginning to learn the most basic things about space travel. Much had been learned on the ground through the use of simulators—devices that almost reproduce the actual conditions of a space flight. But many things could be learned only in space.

Scientists and engineers on Earth learned a great deal by monitoring the crew in space. That information helped them improve the next generation of orbital craft so that future crews could fly longer missions in greater comfort. As launch vehicles became more and more powerful, newer and better spacecraft could be boosted into Earth's orbit and beyond. The new spacecraft were bigger, heavier, and much more complicated vehicles. Larger crews could accomplish more during longer flights. A crew's workload usually includes conducting scientific experiments, performing maintenance on the spacecraft and its equipment, communicating with mission control on Earth, and navigating the craft.

But progress also brought new problems. For example, when two astronauts are confined in a spacecraft that is barely large enough for them to work in, tension can develop. What might be a minor disagreement on a short flight can become a serious problem on a longer flight. Making living conditions



Astronaut Scott Carpenter shows the cramped quarters of early spacecraft. He is in a 1961 Mercury *spacecraft simulator.*

Astronaut Paul J. Weitz, left, *helps scientist-astronaut Joseph P. Kerwin,* right, *adjust a blood-pressure cuff during a lower body negative pressure experiment aboard the* Skylab *space station. Kerwin is lying in the lower body pressure device. The purpose of the experiment is to provide in-flight data on blood pressure, heart rate, body temperature, leg volume changes, and body weight.*

as normal as possible can ease some of the tension. As space flights grow longer and involve more astronauts, attention to comfort becomes more and more important.

Apollo 7, which was boosted into orbit in 1968, was the first U.S. spacecraft in which astronauts could move around in the command module, the area in which the crew spends most of its time. But the inside of *Apollo* was filled with technical equipment that was not especially pleasant to look at. Designers had put most of their effort into creating an efficient machine, and they paid little attention to crew comfort or a pleasing appearance. Since its longest flight—to the Moon and back—

Skylab *space station, as seen from the command module. The protrusions are huge solar panels attached to the space station.*

Shannon W. Lucid floats aboard a KC-135 aircraft during zero gravity training.

would last just 12 days, NASA (National Aeronautics and Space Administration, a U.S. government agency) felt no need to make the craft anything but functional.

Skylab, America's first space station, was launched in 1973. In terms of comfort, *Skylab* was a big step forward. Weighing 44,000 pounds (20,000 kilograms), it had plenty of room for its three-man crew to work and to relax. Those involved in space research learned a great deal from studying *Skylab* and the larger, more complicated craft that followed. Both NASA and the former Soviet space agency strove to make their future crewed spacecraft better places for men and women to spend long periods of time.

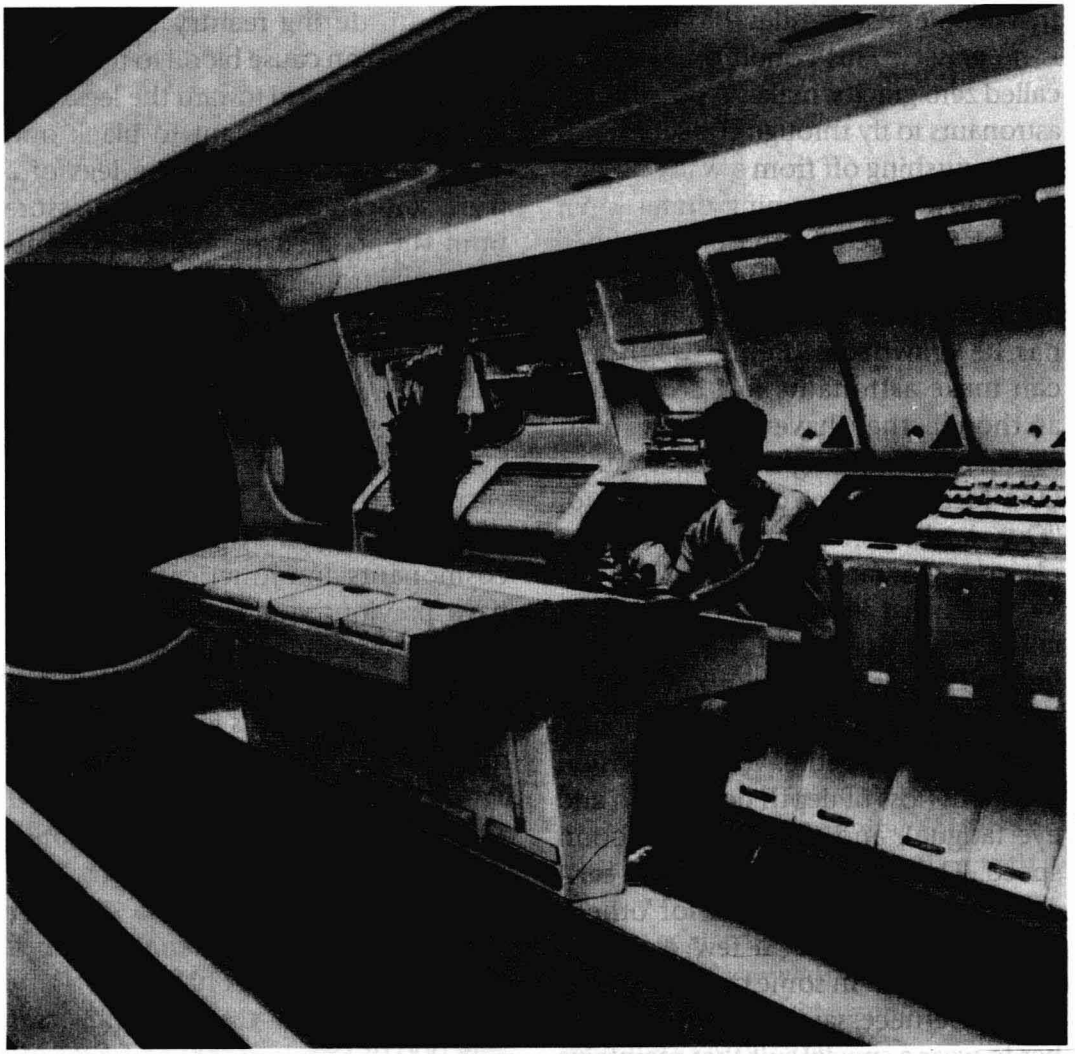
Perhaps the strangest and most interesting feature about living in space is

that people are weightless because there is no gravity. This condition, which is called zero gravity, makes it possible for astronauts to fly through the cabin simply by pushing off from a wall or chair. It's almost like swimming underwater, except that there is no up or down.

Although it might sound like weightlessness is great fun, the condition also has its drawbacks. Being weightless can make astronauts feel congested, as though they have colds. Also, an astronaut's face might become puffy. One former Soviet cosmonaut said, "Our weightlessness isn't that much of a pleasure. Our faces have begun to swell, so much that looking in the mirror, I fail to recognize myself. I keep bumping into things, mostly with my head."

Others report short-term hallucinations, loss of appetite, vomiting, vision problems (loss of depth perception and eye fatigue), and changes in reaction speed. These problems are more serious for some people than for others. Most symptoms last a few days and then disappear. In some cases, however, it may be necessary for a crew member to wear a special suit that maintains pressure on certain parts of the body. For example, the force of gravity that builds up during reentry into the atmosphere can cause blood to flow away from the head and toward the legs. This can cause an astronaut to black out. To avoid that situation, the legs of a flight suit can be inflated. The pressure from the inflated pants legs prevents blackouts from happening.

After the eight-month *Salyut 7* mission, cosmonaut Oleg Yur'yevich Atkov said, "Our adaptation to weightlessness was surprisingly easy and fast. Virtually by the second day aboard the station, we no longer felt the painful throbbing in our heads from which many Soviet cosmonauts and American astronauts have previously suffered. The special training sessions we underwent at the Cosmonaut Training Center probably better conditioned us for this extended mission."



This is an artist's rendering of the galley, or kitchen, for a permanently crewed space station. At right, an astronaut, who is held in place by restraints, sits at a workstation while another crew member prepares a meal.

1
FOOD AND CLOTHING

In space, as on Earth, eating is an important part of life. Every living creature, from a single-celled amoeba to a 325-pound (145-kg) football player, eats several times a day from birth to death. Not only is eating absolutely vital for survival, it is also enjoyable, and it can even affect morale. If you don't eat enough food, or if you don't like the food you eat, your mental and emotional well-being can be affected. When that happens, you won't be able to work efficiently.

Eating in Space

During the early space flights in the 1960s, crews did not complain about their food, even though it didn't taste very good. Designed for practicality, food on spacecraft was compressed, processed, and packaged to take up a minimum amount of space and to last for a long time without spoiling. The only problem, as one official said, was "to influence the crews to eat [it]!" In preparation for the first flight to the Moon, a NASA official—known as a man who would eat almost anything—ate only the food planned for the Apollo mission for four days. He found it *very* unpleasant, and his experience led to more concern for the crew's needs.

Dietitians and experienced astronauts now test the types, amounts, and varieties of food for each astronaut. They test the food both on Earth and in space to see if it provides energy and nutrients and satisfies the personal needs of crew members.

The larger size of current spacecraft has made meal planning much easier than it was in the early days of space flight. The tiny capsules of the Mercury and Gemini programs had little space to store bulky food and a limited ability to sustain more than the weight of the craft and its crew in orbit. As a result, the astronauts were stuck with food and drinks that they found rather disagreeable. Since flights were fairly short, however, the crews put up with the discomfort and made plans to gorge themselves with "real" food when they returned home.

On one *Gemini* two-man flight, a carefully planned experiment was ruined when one astronaut playfully asked the other for his favorite sandwich. He was promptly handed a smuggled corned-beef-on-rye. Scientists on the ground were furious to see their experiment, which dealt with the effects of a special diet, wrecked—but the astronauts were amused.

Types of Food

Meals on the most recent crewed flights have included food the astronauts would ordinarily eat on Earth: meats, dairy products, baked goods, fruits, vegetables, eggs, soups, beverages, desserts, and snacks. Dietitians now try to make space food resemble Earth food as closely as possible. Unusual tastes and textures tend to make the astronauts feel less "at home" in space. Meals are even scheduled much the same as they are on Earth—the crew has breakfast, lunch, and dinner—even though sunrise and sunset are only 45 minutes apart in orbit.

As space flights stretch into weeks and months (the longest flight, by a Soviet *Soyuz*, lasted 366 days), astronauts tend to tire of some foods, crave other foods, lose their appetites, or want foods that are spicier than usual. Mission planners have learned that they must work out compromises between food value and crew morale.

Amounts of Food

While the particular foods each astronaut eats vary from day to day, the total food value is carefully monitored and controlled to make sure that each crew member has a healthy diet. Soviet experience has shown that astronauts, or cosmonauts, need about

3,000 calories per day—about 140 grams of protein, 100 grams of fat, and 400 grams of carbohydrates. These amounts differ from recommended diets on Earth because the workload in space is different from that on Earth.

An astronaut should consume about 1.5 pounds (700 g) of food in one day. Conditions in space also require that crews drink 2.5 quarts (2.4 liters) of water each day, which is much more than most people usually drink in a day.

Individual Preferences

Each astronaut is an individual. The longer the flight, the more important individual differences can become, and the more important it is to deal with them.

In April 1990, space shuttle *Discovery* carried the Hubble Space Telescope and launched it into orbit. The five-member crew on mission STS-31 (Space Transportation System flight number 31) expressed a wide variety of food preferences. For example, here is what the crew aboard *Discovery* ate for breakfast on the fourth day of the mission:

Commander Loren Shriver: sausage patty, Mexican scrambled eggs, blueberry yogurt, apple cider, and decaffeinated coffee with sugar.

Pilot Charles Bolden: chicken consommé, dried apricots, beef patty, seasoned scrambled eggs, blueberry yogurt, and grapefruit drink.

Mission Specialist Bruce McCandless: trail mix, beef patty, oatmeal with brown sugar, orange juice, and plain tea.

Mission Specialist Steven Hawley: sausage patty, scrambled eggs, grapefruit drink, and chocolate instant breakfast.

Mission Specialist Kathryn Sullivan: pineapple, oatmeal with raisins, orange juice, and black coffee.

None of these breakfasts may be what you would have chosen to eat, and some of the items—such as chicken consommé—may seem strange for anyone's breakfast. But remember that the meals were designed to fit each astronaut's own tastes, and breakfast may have been eaten shortly after sunset.

The experience of both American and Soviet crews and scientists suggests that it is okay to repeat meals every five or six days without creating great dissatisfaction among the crew.

Seven-Day Diet

To show how one astronaut's diet can vary from day to day, here is what Mission Specialist Kathryn Sullivan had for dinner during the week-long flight:

Days 1 and 6: chicken teriyaki, rice and chicken, asparagus, and black coffee.

Days 2 and 7: meatballs with barbecue sauce, potatoes au gratin, green beans with mushrooms, and black coffee.

Day 3: sweet and sour chicken, green beans, broccoli, strawberries, and black coffee.

Day 4: beef tips with mushrooms, rice pilaf, Italian vegetables, and black coffee.

Day 5: beef goulash, creamed spinach, and black coffee.

While Americans and the former Soviets have generally agreed on how to plan meals, their menus do reveal some cultural differences. For example, here are two breakfast menus for cosmonauts: (1) chicken with prunes, bread, candy, and coffee with milk; (2) pork with sweet pepper, Russian cheese, honeycake, prunes, and coffee. Cosmonauts have more and smaller meals than American astronauts do. Typical Soviet dinners might include sauerkraut soup, roast beef with mashed potatoes, bread, prunes with nuts, and candied fruit; or ham, borscht (thick soup) with smoked foods, beef with mashed potatoes, rye bread, cookies with cheese, and apple juice. A cosmonaut's diet is much more of the "meat and potatoes" kind than is an astronaut's. All travelers in space get vitamins and food supplements, but only cosmonauts get a small amount of vodka and brandy to add to their diets.

Space shuttles are equipped with pantries where food, including snacks, is stored. Astronauts enjoy snacks and eat them whenever they feel a bit hungry, or sometimes when they're a little bored. On STS-31, the array of snacks included almonds, dried apricots, brownies, butter cookies, candy-coated chocolates and peanuts, cashew nuts, chocolate-covered cookies, crackers, granola bars, macadamia nuts, shortbread cookies, and trail mix.