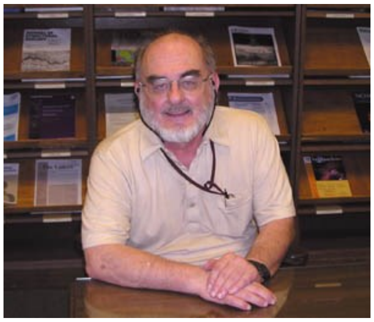
The 1957 Encounter: Robert A. Heinlein and Albert A. Jackson IV

DOUGLAS YAZELL, EDITOR



Above: Dr. Albert A. Jackson IV, in a photograph from the web site for the Lunar and Planetary Institute.

Robert Heinlein (July 7, 1907 - May 8, 1988) took a phone call at his home in 1957 from a 16-year-old Albert Jackson. It is a privilege for Horizons to present advertisements in this and recent issues from the Heinlein estate regarding the Virginia Edition of Heinlein's writing. One of our Horizons Collier's team members, Dr. Albert A. Jackson IV, has a nice Heinlein souvenir, a postcard from Heinlein to Al postmarked August 8, 1957, from Colorado Springs, Colorado.

Al's father was taking the his family by car from Dallas to Colorado for a vacation, which meant fly fishing for Al's father. Mr. and Mrs. Jackson were in the car with their three children, Al, his younger brother, and their sister, the youngest. After they crossed most of Colorado Springs, Colorado, they stopped at a service station. Al looked up the phone number there for the famous author and found Heinlein listed in the book. Al put a nickel in the slot and called him to ask for an autograph for a paperback copy of the novel for juvenile readers, Starman Jones.

Heinlein said sure, I will tell your parents how to drive to my home. Once Al's mother was on the phone to get directions, it became clear that a drive back across town was required, and the parade down their main street would block most of the desired routes. A man at the service station explained how difficult the drive would be, and Al's father did not want to take the time.

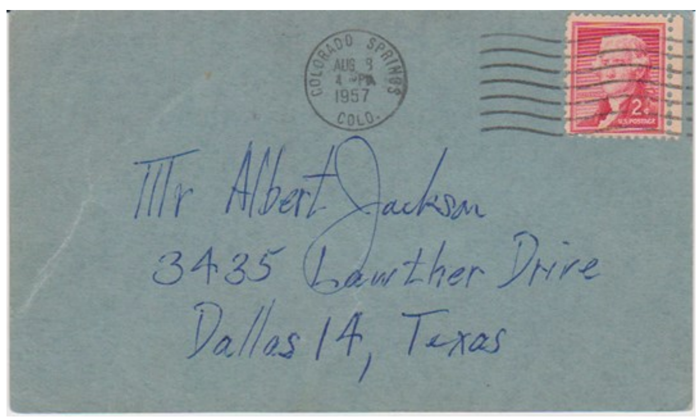
Heinlein then volunteered to make a note of Al's address and send a postcard.

The parade that gave them so much trouble was not a July 4 Independence Day parade, but it was probably July or August of 1957.

In 1979 Al was editor of the newsletter of the San Francisco Section of AIAA. Al was given the task of contacting Heinlein to ask the author to be a dinner speaker. Heinlein's address at his home in California was private, but Al found the address from a graduate of the Naval Academy. Al sent the request along with a copy of the postcard. Heinlein phoned Al to explain that not enough time had passed since his brain surgery, so he would not be able to travel to the dinner meeting.

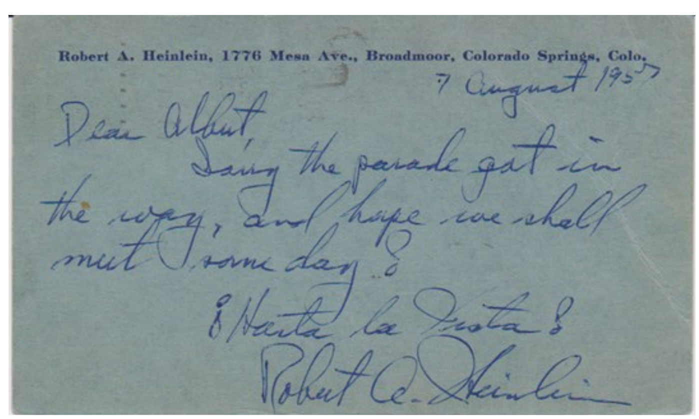
As noted in earlier issues of Horizons, Al was inspired by the Collier's series of articles, Man Will Conquer Space Soon! Al earned his master's degree before working as a crew instructor for the backup lunar module trainer during the Apollo program. He then left NASA to pursue his Ph.D. in physics, taking a short break from AIAA, too. He returned to the NASA / JSC community as a contractor employee, no longer a civil servant.

Al is now an AIAA Associate Fellow, a Fellow of the British Interplanetary Society and a visiting scientist at the Lunar and Planetary Institute in Houston.



COLORADO SPRINGS AUG 8 4-PM 1957 COLO.

Mr Albert Jackson
3435 Lawther Drive
Dallas 14, Texas

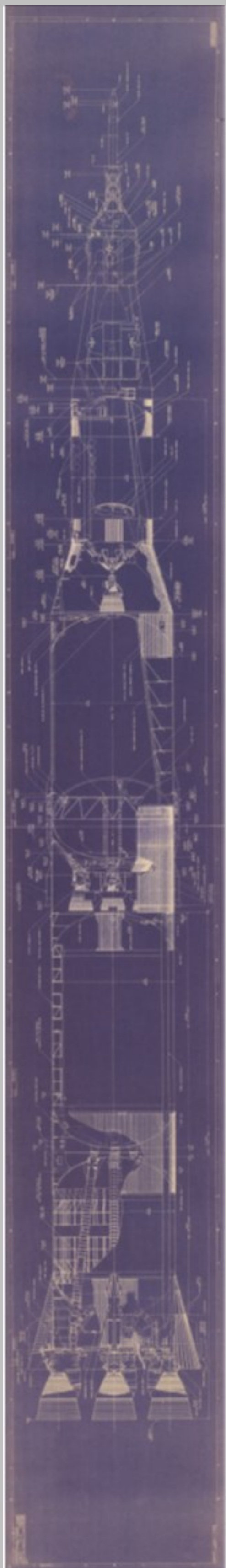


Robert A. Heinlein, 1776 Mesa Ave., Broadmoor, Colorado Springs, Colo.

7 August 1957

Dear Albert,
Sorry the parade got in the way, and hope we shall meet some day!
¡Hasta la vista!
Robert A. Heinlein

Above: The 1957 postcard from Heinlein to Jackson. Image credit: Dr. Albert A. Jackson IV.



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Lunar Module Equipment Locations diagrams

Full color, high quality print of NASA-MSC drawing dated January 1969 showing the Lunar Module and many of the important bits of equipment that went into it.

Prints are about 32 inches/81 cm wide by 18 inches/46 cm tall.

The original was B&W. It has been converted to a full-color "blueprint" using the Saturn V as a color reference.

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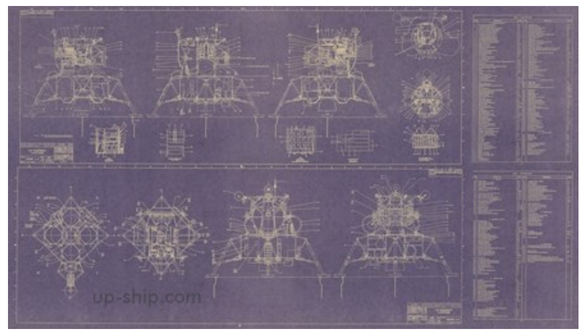
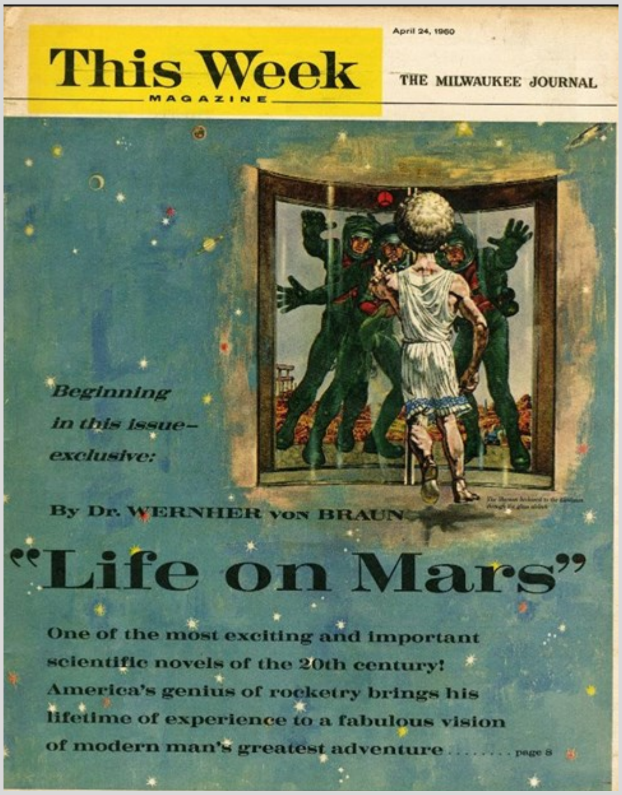
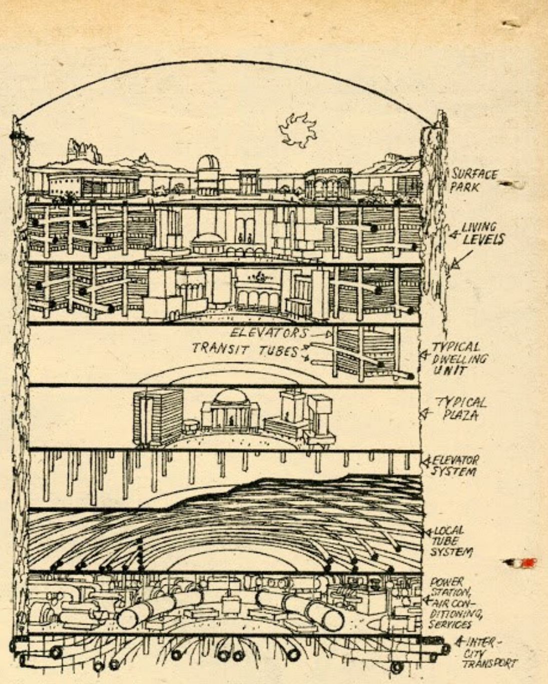


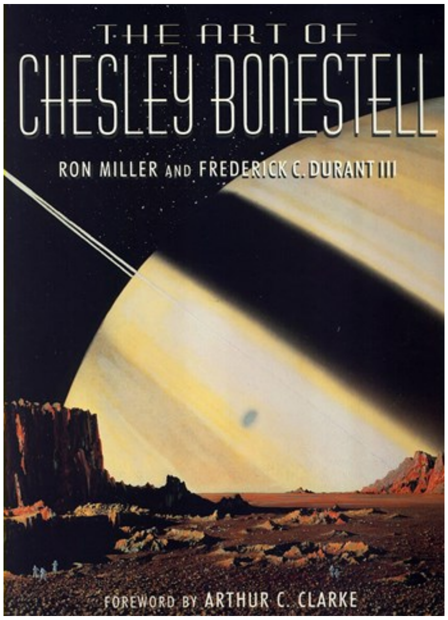
Dreams of Space
Books & Ephemera

Non-Fiction Children's Books about Space Flight from 1945 to 1975
http://dreamsofspace.blogspot.fr





Ahla was built in 15 circular plazas



Award winner Ron Miller & Black Cat Studios

Ron Miller, winner of the 2002 Hugo Award (World Science Fiction Society) for Best Related Work: The Art of Chesley Bonestell

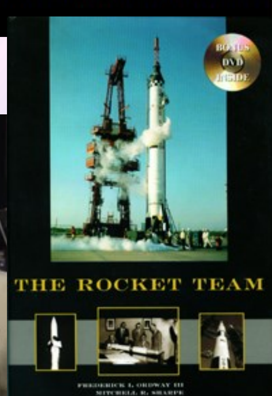
The Chesley Bonestell Archives of Melvin H. Schuetz

www.bonestell.com

A former satellite controller in the U.S. Air Force and private industry, Melvin H. Schuetz has researched and collected publications from around the world containing Bonestell's art for more than four decades. His book, A Chesley Bonestell Space Art Chronology, is a unique reference bibliography containing detailed listings of over 750 publications which have included examples of Bonestell's space art.

Space scientist and well-known author of visionary books on spaceflight. Ordway was in charge of space systems information at the Marshall Space Flight Center from 1960 to 1963 and before that performed a similar function for the Army Ballistic Missile Agency. For many years he was a professor at the University of Alabama's School of Graduate Studies and Research. However, his greatest contribution has been to the popularization of space travel through dozens of books that he has authored or coauthored. He was also technical consultant to the film 2001: A Space Odyssey and owns a large collection of original paintings depicting astronautical themes. Ordway was educated at Harvard and completed several years of graduate study at the University of Paris and other universities in Europe.

www.cgpublishing.com



Frederick Ira Ordway III

Co-Author with Mitchell R. Sharpe of The Rocket Team

Dreams of Space, Books & Ephemera

Non-Fiction Children's Books about Space Flight from 1945 to 1975

http://dreamsofspace.blogspot.fr

Classics Illustrated were comic books intended to educate as well as entertain. They often were fictional "classic" books in comic book form such as Moby Dick. They also had a special series called "The World around Us." These were non-fiction comic books about topics of interest.

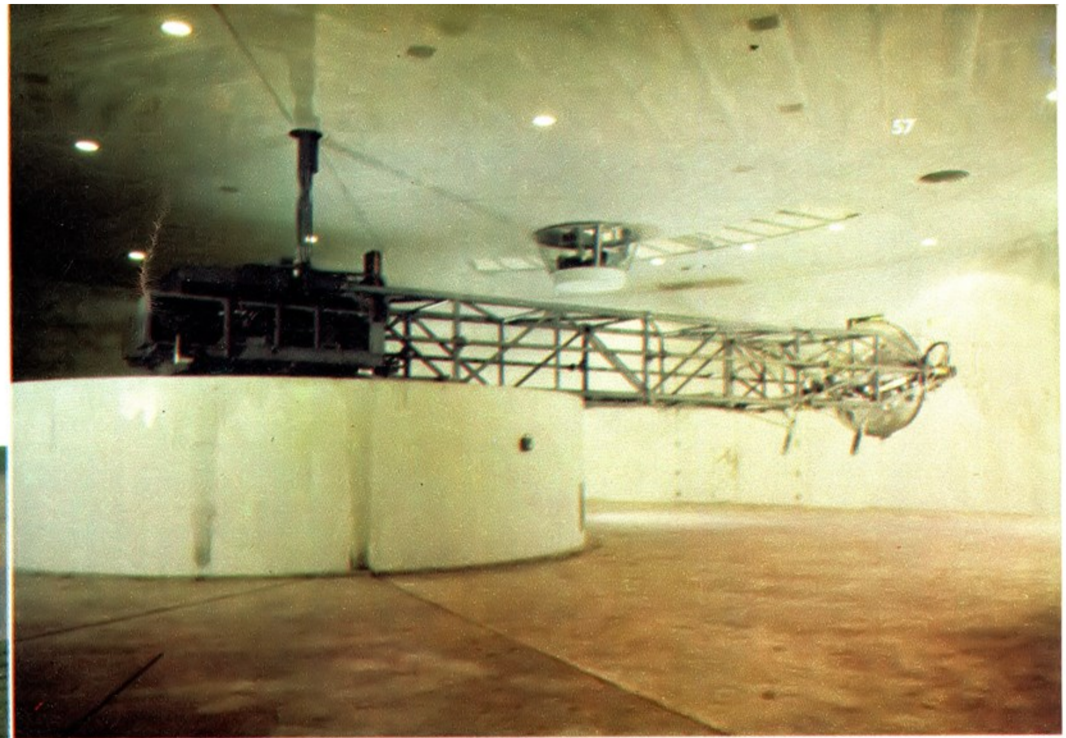
Classics Illustrated. Illustrated by Gerald McCann, Sam Glanzman and John Tartaglione. The Illustrated Story of Space (80 pages), 26 cm, softcover.

Contains illustrated stories on training for space, the first rocket to the Moon, the history and use of the rocket, the launch of Vanguard 1 and the construction of a space station. "The World Around Us" (#5) January 1959.

Testing the Men

ROLF KLEP

Disaster is the penalty for an error in space. The pioneer rocket crews will practice for perfection on earth, aided by a gallery of wonderful machines



RALPH ROYLE

Navy centrifuge at Johnsville, Pa., one of several in use to simulate acceleration force

Eleven top experts contributed to the symposium, Man's Survival in Space. This part, the second of three, is based on papers done by Dr. Wernher von Braun, chief, Army Guided Missiles Laboratory; Dr. Hubertus Strughold, head, Air Force Dept. of Space Medicine; Dr. Fritz Haber of the same agency; Dr. Donald W. Hastings, national psychiatric consultant to the Air Force; Dr. James P. Henry, Air Force Aero Medical Laboratory; rocket expert Willy Ley. Collier's Cornelius Ryan assembled the material

HOW do you make a space man out of an earth man? The tests a human encounters in space, the tasks he is charged with in rocket flight, are like nothing he knew on solid ground: flattening acceleration pressures; brain-twisting navigational problems; nerve-racking confinement in cramped quarters; the problem of moving from one point to another when you're hovering 1,000 miles above the ground. No man experiences such difficulties on earth. How does he prepare to meet them in space?

He must prepare on the ground. When he actually gets into space, it will be too late to start learning. Massive, dramatic machines are the teachers—and they already are roughly blueprinted.

One machine (you can see it at the left) will whirl crews around at speeds that reproduce the breath-taking, body-crushing pressures imposed by a fast-rising rocket ship. As the trainer rotates, problems will be fed into the cabin requiring split-second, co-ordinated action from the nearly immobilized crew.

A second machine will teach man to move around in the weightlessness of space. He'll spin, cartwheel, fly violently backward, roll and twist until he gets the hang of self-locomotion.

Trainees also will be jammed together for days in a sealed, boilerlike chamber—working, sleeping, eating, relaxing in a confined space and in a pressurized, synthetic atmosphere.

Navigators dare not be wrong in space; a fractional error may put a speeding vehicle thousands of miles off course. So navigators will have the

Crew centrifuge would expose five persons at once to g pressures, while instructors sent in problems requiring immediate solution. In action, cabin nose would swing down, bringing it into line with centrifuge arm. Operators suspended beneath ceiling could rotate cabin to simulate realistic emergency at launching

Numbing acceleration pressures almost immobilize rocketeers at launching—yet they

most complicated—and most striking—trainer of all: a huge globe which will simulate the vastness and stark beauty of space; sitting inside, the navigator-trainee will get most of the errors out of his system before they can do any harm.

Five Years' Hard Study for Trainees

Besides training in these simulators, most of them designed by Dr. Wernher von Braun, the world's top rocket engineer, the crews will get a tough classroom schedule, taking courses in rocket and instrument design, physics, astronomy, navigation (for all personnel) and basic medicine. The training will take five years, and each of the crew members who graduates will have the equivalent of a master's degree in at least one specialty.

How many will graduate? About five out of every 60 who start the training course. But even those 60 will have been carefully selected; so the graduates will be the cream of a carefully chosen group that once numbered hundreds.

We know we can build superbly engineered rockets to carry man into space; in picking our crews we must aim for the same degree of perfection. Before an applicant is accepted, he must meet rigid physical, educational and age requirements (Collier's, February 28, 1953). He must be between the ages of twenty-eight and thirty-five; he must have a college education; he must be of medium weight, and between five feet five and five feet eleven inches tall. (Exceptionally tall or short people tend to have poor blood-circulation control, which hampers them in adjusting to the stresses of space travel.)

Of every 1,000 applicants who meet those standards, 940 are expected to wash out during the stringent medical and psychiatric examinations which precede training. And now, in the training phase, we'll find that 55 of the remaining 60 students can't cope with the physical, emotional and educational demands of rocket flight.

Perhaps the toughest test will be the trainee's ability to function swiftly and efficiently during acceleration.

Flight into space will be made in three-stage rocket ships: vehicles built in three sections, each with a bank of powerful rocket motors. The first stage, or tail section, provides the tremendous power needed to get the rocket ship off the ground; at an altitude of 25 miles, the first stage is cast loose and the rockets of the second stage, or center section, start firing. At 40 miles, the center section is dropped, and the third stage, which contains the crew compartment, continues on into space. All during the ascent, the rocket ship is guided by an automatic pilot. The pilot is operated electronically by a magnetic tape into which precise instructions have been fed beforehand.

How Acceleration Affects the Crew

As each stage takes over the task of propulsion, there is a sharp drop in acceleration, followed by a sudden thrust forward as the new bank of rockets bursts into action. The crew members feel a numbing acceleration pressure, like the pressure you feel against your back when you step on the gas in an auto, but many, many times more powerful.

The first great acceleration shock comes shortly after launching: from a standing start, the rocket surges to a speed of 5,250 miles an hour in 84 seconds. The second stage propels the rocket for 124 seconds, building up to a speed of 14,364 miles an hour, and the third stage, which then takes over, requires another 84 seconds to hit top speed—18,468 miles an hour. At each spurt, the rocket passengers are crushed against their seats with enormous force.

At the two acceleration peaks (about 80 seconds and 300 seconds after launching), the pressure is equal to nine times a man's weight—that is, nine times the force normally exerted by gravity. Scientists call it nine gravities, or nine g's.

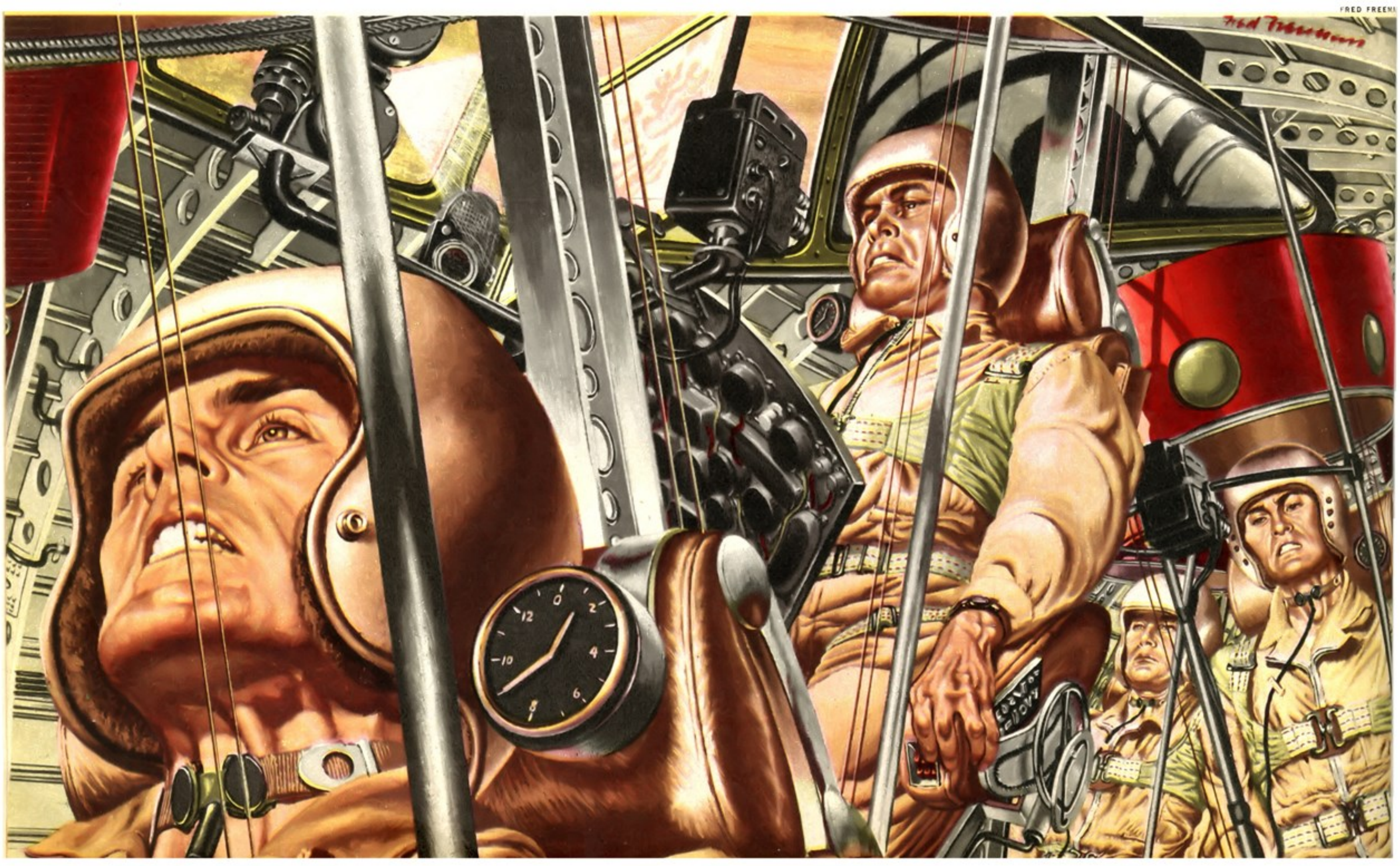
Position Governs Time of Blackout

Can a man operate under such pressure? Yes, if he's sitting in the proper position. If the direction of the pressure is from his head to his feet, the blood drains from his brain, and he blacks out at only four or five g's. If the direction is from foot to head, the blood rushes in the other direction, and he can take barely 2½ g's. But if the pressure is from chest to back, some men can withstand as many as 17 g's without difficulty. How do we know? We have a machine that exposes men to g-forces, a centrifuge consisting of a cage on the end of a long arm, which whirls around like a bucket on the end of a string. Just as a stone in such a bucket will be pinned to the bottom, so a man in the centrifuge is pinned back against his seat. The faster the cage goes around, the more g pressure the man experiences.

Dr. James Henry, one of the Air Force's top physiologists, has found that men spun in the centrifuge at the Wright-Patterson Air Base in Dayton, Ohio, can take up to 10 g's, chest-to-back, and still move their arms and legs.

That's important. It means that if something goes wrong during the first five minutes of rocket

Within cabin of swiftly rotating centrifuge, crew is subjected to terrific strain like that of rocket acceleration. Force sustained equals nine times a man's weight, or nine g's. Problems calling for group action are fed into trainer; crew responds by using fingers to strike armrest buttons



must act fast in emergencies

flight, the crew will be capable of taking emergency action, up to as many g's as they're likely to experience.

But emergency action in a rocket ship calls for split-second co-ordination among several people. So we'll train our crews in a bigger, more complicated centrifuge; the cage will be a near replica of the cabin of a rocket ship. The crew members will sit in contour seats so adjusted that the simulated acceleration pressure will strike them from chest to back, and during the test runs they will be fed emergency problems by instructors on the outside. The training probably will go something like this:

The captain and crew strap themselves into their chairs. Ahead of them, projected on the frosted glass of the cabin canopy, they see a color film showing a blue sky dotted with white clouds.

After a last-minute instrument check, the captain presses a button on the armrest of his chair. The rockets of the first stage begin to mutter; a muffled rumble emerges from hidden loud-speakers in the cabin.

The instructor at the remote-control board outside now gives the captain the launching signal. A light flashes in the cabin, and the captain pushes another button, turning the motors on full power.

The noise from the loud-speakers grows to a roar. The centrifuge begins to spin, simulating the lift of the rocket ship. The sudden surge throws the crew members back hard into their seats. As the white clouds on the canopy race toward the ship and disappear, the faces of the occupants begin to strain under the mounting pressure.

The sky darkens quickly to a jet black that is broken only by stars, glinting cold and sharp directly ahead. As the centrifuge picks up speed, the breath is driven from the bodies of the crew members, and their muscles become almost powerless against the g pressure; yet they watch the orange-red illuminated dials which register a multitude of performance signals. If anything goes wrong, they must be ready to act.

And suddenly, as the peak pressure of 9 g's approaches, something does go wrong.

Danger from Jamming of Fuel Pumps

A high-pitched klaxon horn blasts over the motor roar, and a light flickers near one of the dials on the engineer's panel: one bank of fuel pumps has jammed, and the lines providing the pumps with pressure may burst. Squeezed almost immobile between the chair backs and the tremendous pressure bearing down on their chests, the crew members must act—decisively and quickly.

The engineer's thumb gropes for the interphone switch on his chair arm. "Engineer to captain. Series five pumps are stuck!" The captain must make a hasty decision. The rocket trouble is sure to affect the ship's flight path; yet in a few moments the troublesome first stage is due to be jettisoned. Should he try to keep going? Or should he plan a forced landing or escape procedure? In the last, he can either gain more altitude for safety's sake, or get rid of both the first and second stages immediately and head back for the earth. He decides to continue.

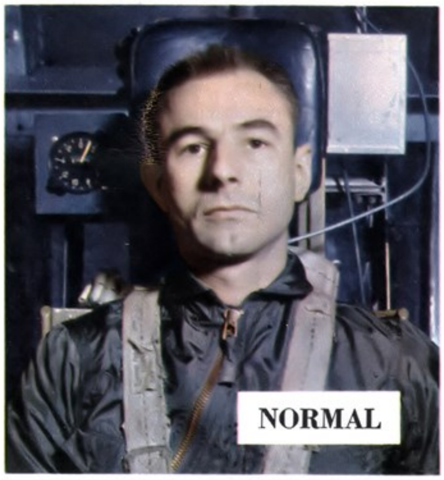
"Captain to navigator. Check flight path with ground station."

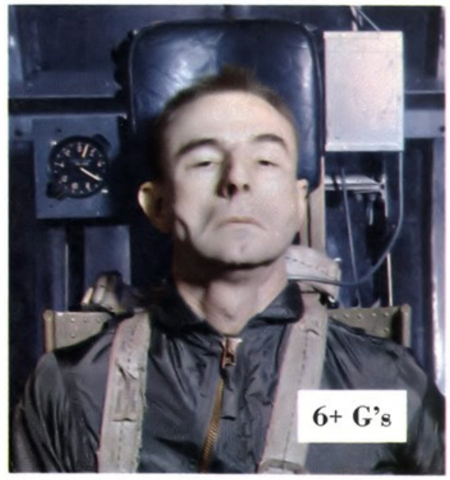
The radio operator, hearing the order, gives the navigator direct contact with the earth. The navigator speaks briefly, listens, then switches his set back to intercom with a movement of his finger. "Navigator to copilot. Tape 13."

The copilot turns his wrist until his hand is over a tape selector panel, then punches button 13.

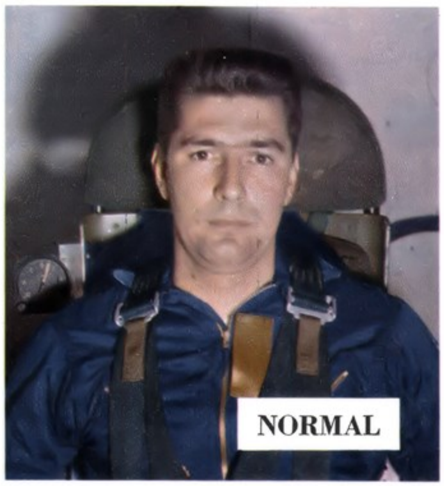
The engineer, meanwhile, has applied a partial corrective for the faulty rockets. "Increasing the speed of remaining pumps," he announces, as soon as the intercom is open.

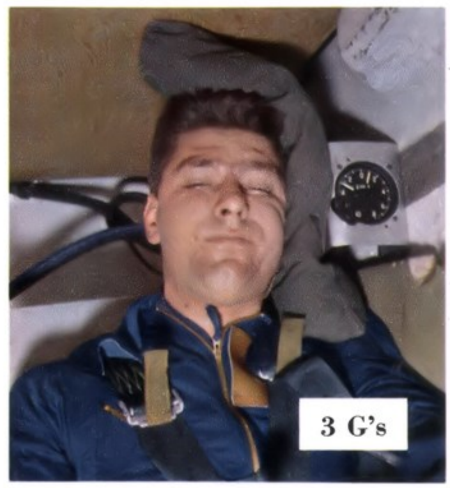
The navigator in turn prepares to call the ground for another heading, to compensate for the increased power put in by the engineer. The infor-



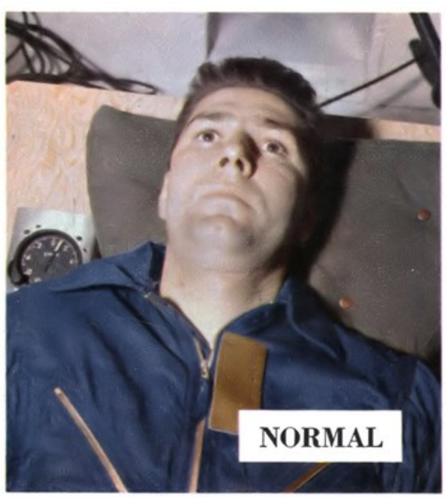


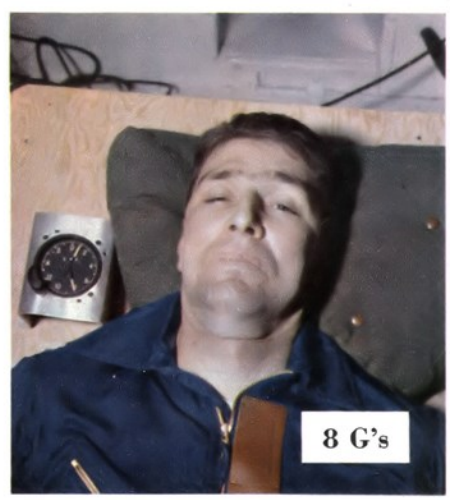
Here's what happens to a man subjected to head-to-foot g pressure, the kind an airplane pilot experiences in pull-out from a dive. Force drags facial muscles downward, drains blood from head, causing average man to black out at 5 g's. A rocket crew member would feel such force if he leaned forward during launching





Foot-to-head force pulls muscles upward, causes blood to rush to man's head. A normal man can take only about 2 g's in this direction before he experiences the condition called red-out. Aircraft pilots performing difficult outside loop know this feeling, as would a rocket crewman leaning too far back at acceleration peak





Problem of g force can be licked if direction of pressure is from chest to back. Men in centrifuge tests have endured up to 17 g's of this kind without blackout or red-out, and space vehicle crews will be seated so acceleration forces strike them this way. All of these photos were made in Navy and Air Force centrifuges

PHOTOGRAPHS FOR COLLIER'S BY RALPH ROYLE

Moving around in weightless space is tricky; you can spin, cartwheel, or tumble

mation he gets will affect the copilot, and the captain will have to take the actions of both into account in making further plans.

And all this time, the radio operator has been busy sending step-by-step reports back to the ground station, so the people there will know what happened in case the rocket ship crashes.

All this action has occurred in seconds. Inside the whirling cage, television cameras have caught the whole scene. Outside, instructors have watched TV screens and light panels, and have timed and recorded every move. By the time the first stage is cast loose, 84 seconds after launching, the emergency is over. Two more accelerations, as the second and then the third stage rockets open fire —and the centrifuge slows down and finally stops.

Many Wash Out in Centrifuge Training

There will be many centrifuge tests before a trainee steps into his first real rocket ship. Many of the students never will see the inside of a space vehicle, because they will wash out in centrifuge training.

Some people are more susceptible to g pressures than others; some will be able to take the pressures, but will falter when their judgment is tested in the spinning cage. They will be eliminated.

Still more will fail because they can't cope with the next machine, the personal-propulsion trainer.

What's so tricky about personal propulsion? The answer is almost everything—in space.

When a space vehicle circles the earth at the right distance and speed, it becomes a satellite, like the moon. A rocket ship 1,075 miles away, traveling 15,840 miles an hour, would circle the earth endlessly. Its speed at that distance would exactly counterbalance the earth's gravity. Once moving at the right speed, it wouldn't need power, because there's nothing in space to slow it down (as there is near the earth, where the atmosphere ultimately brakes the speed of any falling body). The ship would just stay up there, making one trip around the globe every two hours.

Suppose a man stepped out of the vehicle (protected by a space suit, of course). He, too, would be a satellite, spinning around the earth in the so-called two-hour orbit. He would remain in space, hovering near the rocket ship.

But suppose there were two rocket ships, and he wanted to move from one to the other. There's only one practical way for him to do it: each visitor to space will carry a small rocket motor in his hand. By firing it dead ahead, he'll make himself fly backward. When he wants to stop, he'll fire a short burst to one side. That will make him spin part way around. Two more pulls of the trigger—one to stop the spin, the other to halt his flight —and there he is.

It's complicated, and with a couple of hidden traps. What if he fires a trifle too high? He's apt to start tumbling end over end. If he holds his arm a little off to one side, he will spin like a top. If he fires sharply to the left or right, he may start cartwheeling. And it might be hard to stop.

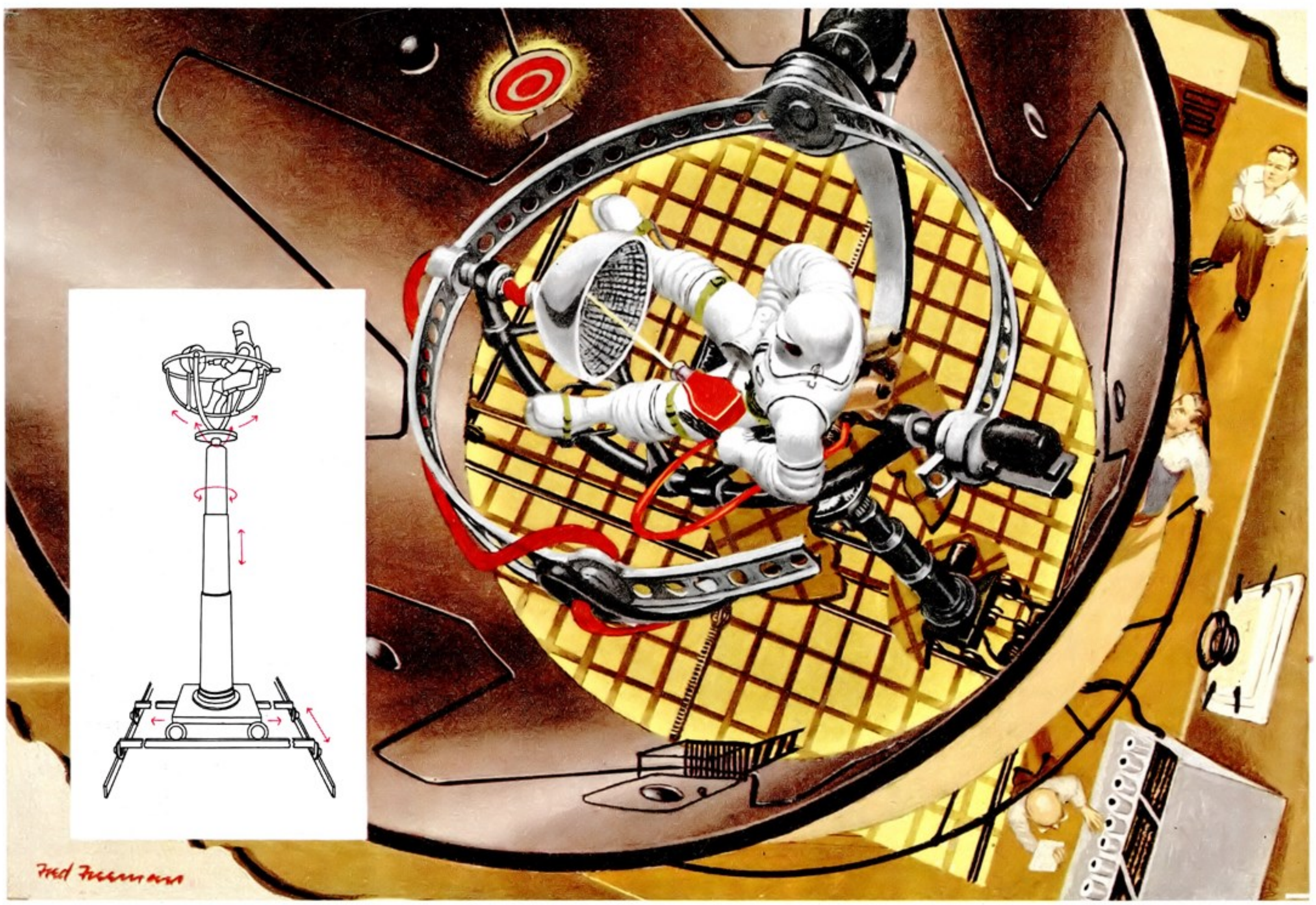
The way to prevent such mishaps is to train the crew members before they ever get into space. We can't duplicate the weightlessness man will experience as a satellite. But we can almost duplicate the spin, roll and pitch hazards of personal propulsion.

Instruction in Personal Propulsion

The student of personal-propulsion training, garbed in a bulky space suit, sits on a chair at the top of a slender telescoping pole. The chair is mounted within rings which enable it to roll sideways, or rock forward and backward. A system of rollers, elevators and gears also makes it possible to move directly backward and forward, or to either side; to go up and down, or to spin to right or left. In front of the student are concentric wire mesh screens studded with photoelectric cells which react to a light ray from the student's propulsion gun. The cells are connected to electric motors which set the chair in motion.

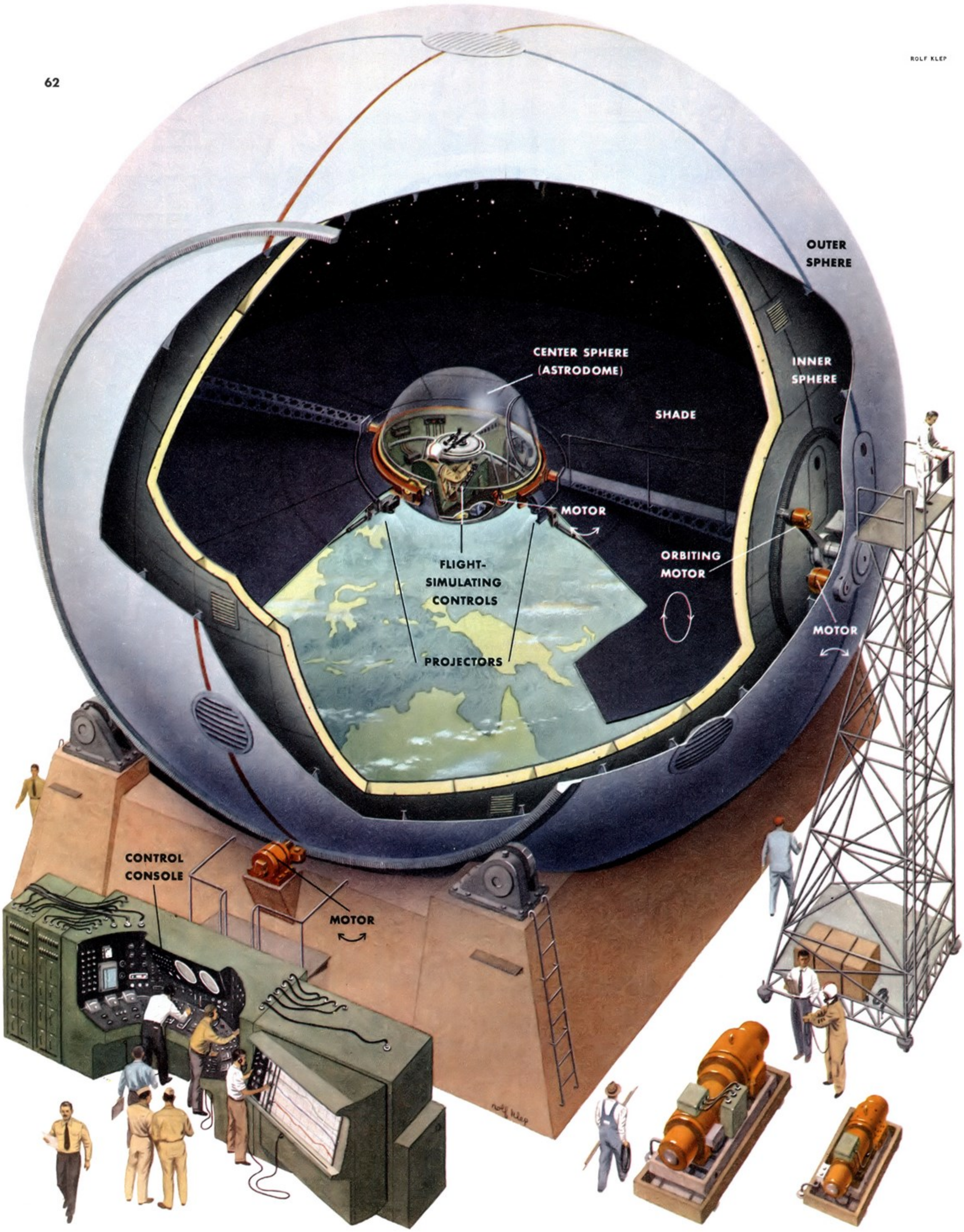
By firing directly in front of him, the student will propel himself backward. Any slight error in his

Crew trainees will stay for weeks on end in this sealed tank. Experts will observe how students react to each other—and to an air mixture of 40 per cent oxygen and 60 per cent helium (on earth, it's 20 oxygen, 80 nitrogen) ▶



Man wanting to go from one rocket ship to another in space will propel himself with rocket gun. This trainer teaches him to aim properly, avoid gyrations. To reach target, trainee shoots light ray—instead of rocket gun—at electric-eye dish. Bad aim makes him spin and roll

DRAWINGS BY FRED FREEMAN



Navigator students will use this trainer—three concentric globes, all movable to simulate space flight. Trainee sits in center sphere, takes sights on stars and earth, which are depicted on inner sphere. Shade keeps light from the filmed earth picture from reflecting above aim will have the same effect as a comparable error in space: he'll spin, cartwheel or tumble.

There's one more aspect of personal propulsion which the simulator can't duplicate exactly. Suppose a man blasts himself backward and suddenly finds his gun is jammed or out of fuel. Unless other men become aware of the danger in time to rescue him, won't he go plummeting off into space with nothing to stop him? No, he'll wear a protective life line, tied to the rocket ship. Not only will it keep him from becoming lost; it also will extend his range, because he can use up the fuel in his gun, then float back to the ship with one tug on the line.

Personal propulsion is a problem space men and women encounter outside the rocket ship. They'll also have to adjust to life *inside* the vehicle, and another trainer will help prepare them for that.

What difficulties will they face? A much lower atmospheric pressure than they're used to; personality conflicts resulting from long periods spent in close quarters with the same few people; psychological reactions to a monotonous existence in a small area. Those are the main problems; there are also a few minor ones.

All of them (with the exception of weightlessness, which can't be reproduced on the ground) will be simulated in the next trainer, a crew pressure chamber. Ten to 15 men at a time will spend several consecutive weeks in the chamber, getting used to the cramped quarters—and to one another.

Why so long? A trip to the two-hour orbit, where we someday hope to build a permanent station, will take only about an hour. Why force the trainees to spend weeks together?

Because they probably will be the crews which—after the space station is built—will pioneer in interplanetary flight. A trip to Mars will take eight months, one way. The men of a crew will be under severe stress during such a trip, and we must know *now* which ones are able to take it.

Reasons for Ban on Women

Women, who may beat out men for certain crew jobs, won't go along on interplanetary journeys, where privacy will be lacking for long periods. So they'll take the chamber tests separately, and briefly, in preparation for the shorter flights that they will make.

The chamber will be like the interior of a rocket ship—functional, pressurized and cramped. Most of the pressure problems have been worked out by the physiologist-engineer team of Drs. Hubertus Strughold and Fritz Haber. The chamber's interior pressure will not be that of the earth at sea level, which is about 14½ pounds per square inch, because such pressure would impose too much of a strain on the junctions where pipes and tubes pass through the sides of a rocket-ship cabin. A pressure of about eight pounds will be used, equivalent to an altitude of 15,000 feet.

After a short adjustment period, most men can breathe comfortably at that altitude. Increasing the percentage of oxygen in our artificial atmosphere, from the 20 per cent a man is accustomed to on the ground to about 40 per cent, will make it easier.

There will be another change in the atmosphere, suggested by Willy Ley, noted rocket expert and writer. Instead of nitrogen, which makes up about 80 per cent of the earth's air, helium will be pumped in. Nitrogen in the blood tends to form bubbles when there is a rapid change in pressure (which might occur by accident in space), producing the painful—and possibly fatal—affliction known as the bends. Helium does not form bubbles in the blood as easily as nitrogen does, so it poses no problems.

The psychological problems of the sealed cabin are even more interesting than the physical. Men working under strain for long periods tend to become irritable and less efficient; in long-distance aircraft they generally start growling at one another after about eight hours, and show a marked loss of efficiency after about 15 hours. Some do better than others, and tests in the pressure chamber will enable us to pick the top men.

How about those who show signs of early strain, those who start sulking and finally lapse into an unsociable silence? Are they finished?

No, but special efforts will be required to match them to the proper crewmates. Psychologists have found that they can almost eliminate friction on aircraft crews by choosing men with like interests, background and education.

Cases of Claustrophobia Are Rare

Besides indicating their ability to work as a team, the trainees may display other psychological reactions to the chamber tests. A few rare cases of claustrophobia may develop, for example, although Dr. Donald W. Hastings, the Air Force's chief psychiatric consultant, expects such fear of confined space to be rare. The ability of the men to act in crisis situations may be tested again; if a man becomes sick, his fellow trainees will care for him (unless an emergency develops, of course). Temperature and atmosphere changes will be fed into the room to test the physical—and emotional—responses of the students. Routine flight problems will be passed to the trainees to keep them busy, and exercise machines will be available inside the chamber to keep them fit.

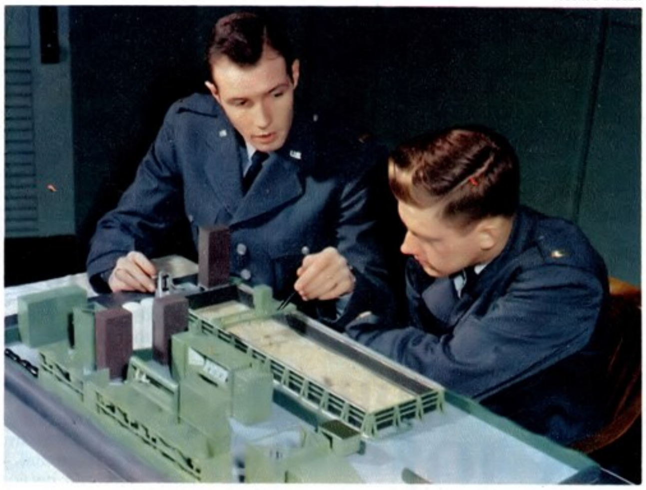
But no problems that a navigator solves in a pressure chamber will prepare him for those he encounters in flight. The fourth simulator is aimed primarily at him, although other crew members will use it.

The navigation simulator consists of three spheres: a large globe, 30 feet in diameter, with two concentric spheres inside. The smaller of the two inner spheres, measuring about six feet across, is the navigator's compartment, or astrodome. The larger, which fits just inside the exterior globe, is, in effect, a great picture of the universe, with the earth looming large below.

The inside of this middle sphere is pitted with small holes through which light shines, to simulate the constellations. The earth is depicted by color movie film, projected against the inner skin of the sphere.

The big picture-sphere makes a complete rotation every two hours, so that the student navigator gets the illusion of starting in the two-hour orbit.

GEORGE WISLER



Air Force officers with model of new navigator-training plant, Wright Air Development Center, Dayton, O. Huge trainer is latest step in direction of navigation simulator on facing page

For the navigator, rocket flight will differ from aircraft flight in several important respects.

First, he won't have the usual landmarks and radio aids; his only points of reference will be the earth below and the stars above.

Second, during the outward flight, the normal navigational problems have been solved in advance and worked into the automatic pilot; so almost all the navigator's work will occur just before and during the rocket ship's return earthward from space.

The homeward journey is begun by cutting the speed of the rocket ship, so it no longer is moving fast enough to continue as a weightless satellite; it then starts to fall out of the orbit, toward the earth. The speed is reduced by turning the vehicle tail-end-to, so that the rocket motors point in the direction of movement, and employing a short burst of power. The strength and duration of the rocket thrust—if properly aimed and timed—will put the vehicle precisely on course for its destination on the earth.

The navigator's main job is to make the aiming and timing as nearly accurate as possible; if that's done correctly, the rest of the homeward navigation will virtually take care of itself. If his initial calculations are wrong, there may be trouble, for the rocket carries very little fuel on the return trip and it may prove difficult to correct the course. Obviously, the departure timing depends on what part of the earth is opposite the vehicle; under certain conditions, the problem is so complicated that the navigator must wait for a better moment.

A Test in the Astrodrome

In training, the student navigator will take his seat within the astrodome, and instructors outside will set up a problem by moving the stars to a certain position and by selecting a specific picture of the earth to be screened below him.

From then on, the trainee operates the simulator. He determines his present attitude (*attitude,* not altitude) by taking sights on the stars and the earth. Then he decides on his desired attitude for time of departure, and aligns the ship properly, by pressing buttons on a control panel at his right. In a real rocket ship, the buttons would cause the ship to tilt to the desired position; in the simulator, the pictures of the stars and earth shift instead.

The navigator then checks his exact location in space by radioing to the ground, confirms his timing calculations—and is ready to go.

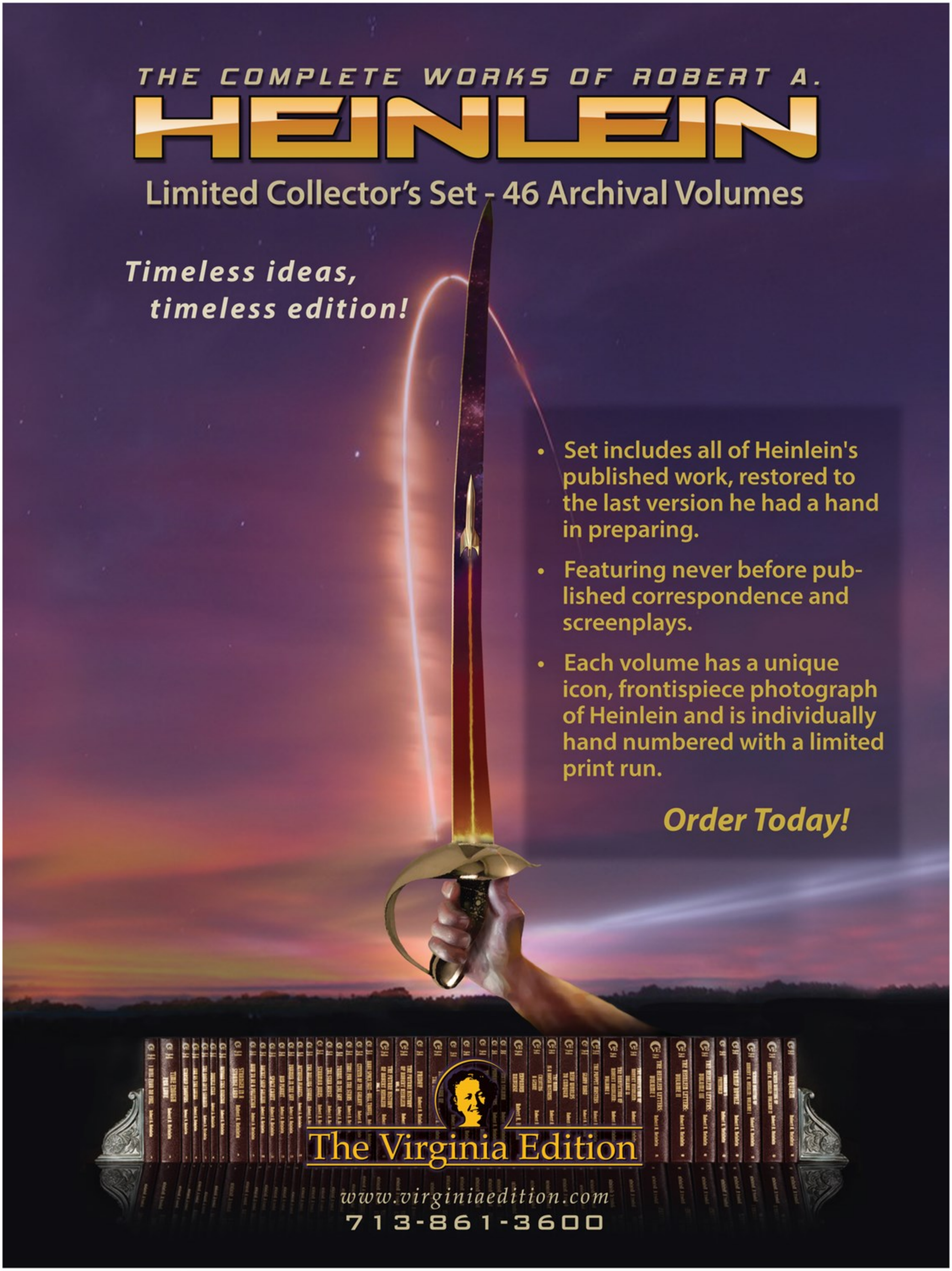
Every move that he makes will be charted on the panel outside. New problems and emergency situations may be posed by the instructors, and careful measurements will be kept of his position, to determine the degree of error in his calculations.

For most of the crew members, the navigation trainer will be an interesting machine whose main purpose will be to familiarize them with the kind of scenery they'll see in space. For the navigator trainee, fighting to keep from being eliminated, it will be a major obstacle. Some navigator students will wash out.

By the time all the trainees have passed through all the simulators, only five will be left of the 60 who started the course (and of the 1,000 who originally applied for it).

Now comes flight training.

Next Week **Disaster can strike in space, as it can anywhere else. How does a rocket crew save itself when its vehicle starts blowing up at a speed of 15,000 miles an hour, 1,000 miles from solid ground? Scientists tell the answers**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Exerpt from "Ray Guns and Rocketships"
first published in 1952

It was suggested that I comment on the writing of science fiction for children. I am not sure just how to do this as I am not sure that I have written any sciene fiction for children. It is true that I have a group of books which are catalogued as being intended for "boys of ten and older"—but I have found that this list is read by adults as well as by boys (and girls!) and that my books intended for adults are read by my younger readers as well as by adults. Science fiction is quite ambivalent in this respect. A book so juvenile that it will insult the intelligence of adults is quite likely to insult the intelligence of the kids.

When I was a child myself I used to get quite annoyed at authors who "wrote down." When I was first asked to do a book intended for kids I swore a solemn oath that I would never "write down"—it is better by far that a child should fail to grasp some portion of a story than it is to patronize him. So I believe and my experience seems to bear me out. In my own work I make just two minor distinctions between copy intended nominally for adults and copy intended nominally for not-yet-adults. In the boys' list I place a little less emphasis on boy-meets-girl and a little more emphasis on unadulterated science—but these are matters of slight emphasis only. On the first point I am obeying a taboo set up by adults, it being my own recollection that kids get interested in boy-meets-girl at a very tender age. On my second point it is my recollection and my more recent observation that kids are more interested in "how" and "why" than their parents usually are. The kids really want to know how the spaceship operates; the adults frequently don't care—so I try to give the kids enough detail in matters technological to satisfy them without giving so much that it will bore an adult. In any case a science fiction story should be a story first of all; it is not intended to replace science text books.

But most especially in writing for kids the science in it should be valid. When they spot an error they are not likely to forgive it.

In many ways science fiction belongs to the kids. They know that "it hasn't happened yet"—but they believe that it will happen. They expect to grow up to build space ships, to pilot them. They still believe in change and they are undismayed by the wonderful and terrifying future we have in front of us. If an adult enjoys science fiction, it is almost a guarantee that he has managed to carry over a youthful point of view, a mind not yet calcified, a belief in change and the future. It is for the youngster and for this adult who still has something of youth about him that we write.

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