Horizons

Volume 38
Issue 6

The Newsletter of AIAA Houston Section
The American Institute of Aeronautics and Astronautics

May / June 2013
www.aiaahouston.org

The Biggest Myth about the First Moon Landing

Paul Fjeld, Space Artist

Also, Continuing in this Issue! Part 6 of 8:
Man Will Conquer Space Soon!
(Collier's 1952-54)

Collier's 1952-54

Man Will Conquer Space Soon! (1952-54)

DOUGLAS YAZELL, EDITOR

The Horizons Collier's Team

Douglas Yazell, Editor
Scott Lowther, Aerospace Projects Review (APR)
Dr. Albert A. Jackson IV
Ron Miller, Black Cat Studios
Melvin Schuetz, bonestell.com
Frederick Ira Ordway III
John Sisson, Dreams of Space
Arthur M. Dula
Shirazi Jaleel-Khan

Quite a few more people make these articles possible, including the Horizons team listed on page 2. Thanks to all involved!

Scott Lowther does a great job every issue as we prepare these installments in the Collier's space series. He prepares these scanned magazine pages so that they are ready for publication. I recall that his copy of this May 14, 1953 issue of Collier's has an address sticker covering the spacecraft's needle nose and its pitot tube. In fact, the excellent cover image scan at www.UNZ.org has the same problem with an address sticker in that location. We asked our Horizons Collier's team for a complete scan of that cover image. John Sisson was able to help us fulfill that request. For this issue, Scott mentioned that colors bled through from the other side of several magazine pages, making the cleanup of these scans a bit more difficult than usual.

Horizons Collier's team member Fred Ordway is a priceless addition to the team. We are pleased to have him communi-

(Continued on page 37)

	"Man Will Conquer Space Soon!" in 8 Issues of the Weekly Magazine Collier's 1952-54	Cover Image	Page Count
1	March 22, 1952: Man Will Conquer Space Soon! What are we Waiting For? pp. 22-23, The Editors Crossing the Last Frontier, pp. 24-29, 72, 74, Dr. Wernher von Braun A Station in Space, pp. 30-31, Willy Ley The Heavens Open, pp. 32-33, Dr. Fred L. Whipple This Side of Infinity, pg. 34, Dr. Joseph Kaplan Can We Survive In Space? Pp. 35, 65-67, Dr. Heinz Haber Who Owns the Universe? Pp. 36, 70-71, Oscar Schachter Space Quiz Around the Editor's Desk, pp. 38-39	Yes	25
2	October 18, 1952: Man on the Moon Man on the Moon, p. 51, The Editors The Journey, pp. 52-58, 60, Dr. Wernher von Braun Inside the Moon Ship, pg. 56, Willy Ley	Yes	11
3	October 25, 1952: More About Man on the Moon The Exploration, pp. 38-40, 44-48, Dr. Fred Whipple & Dr. Wernher von Braun Inside the Lunar Base, pg. 46, Willy Ley	No	10
4	February 28, 1953: World's First Space Suit Man's Survival in Space, 10 Contributors & 3 Artists, edited by Cornelius Ryan pp. 40-41 Picking the Men, pp. 42-48	Yes	10
5	March 7, 1953: More About (Continuing) Man's Survival in Space Testing the Men, pp. 56-63	No	8
6	March 14, 1953: How Man Will Meet Emergency in Space Travel Concluding Man's Survival in Space: Emergency! pp. 38-44	Yes	9
7	June 27, 1953: The Baby Space Station: First Step in the Conquest of Space Baby Space Station, pp. 33-35, 40, Dr. Wernher von Braun with Cornelius Ryan	Yes	6
8	April 30, 1954: Can We Get to Mars? / Is There Life on Mars? Is There Life on Mars? pg. 21, Dr. Fred L. Whipple Can We Get to Mars? pp. 22-29, Dr. Wernher von Braun with Cornelius Ryan	Yes	10

This issue

Above: Man Will Conquer Space Soon!, a series of articles from 1952 to 1954, from the weekly magazine Collier's. Source for most of the table: Wikipedia, Man Will Conquer Space Soon!, an article first written by John Sisson.

Collier's 1952-54

(Continued from page 36)

cating with us. As co-author of the book, the Rocket Team, he writes about his acquaintance with that great American, Wernher von Braun, and their discussions about Ordway's work on this book. A later page in this issue contains an advertisement about that excellent book. That page provides a short Ordway biography. Fred Ordway wrote a quick email note to me containing these comments, presented here with his permission:

"I of course have all the Collier's series; and, by the way, was introduced to Wernher von Braun by Professor Fred L. Whipple at a Hayden space symposium in 1952 in New York [City]. Dr. Whipple chaired the Department of Astronomy when I studied the subject at Harvard--class of 1949.

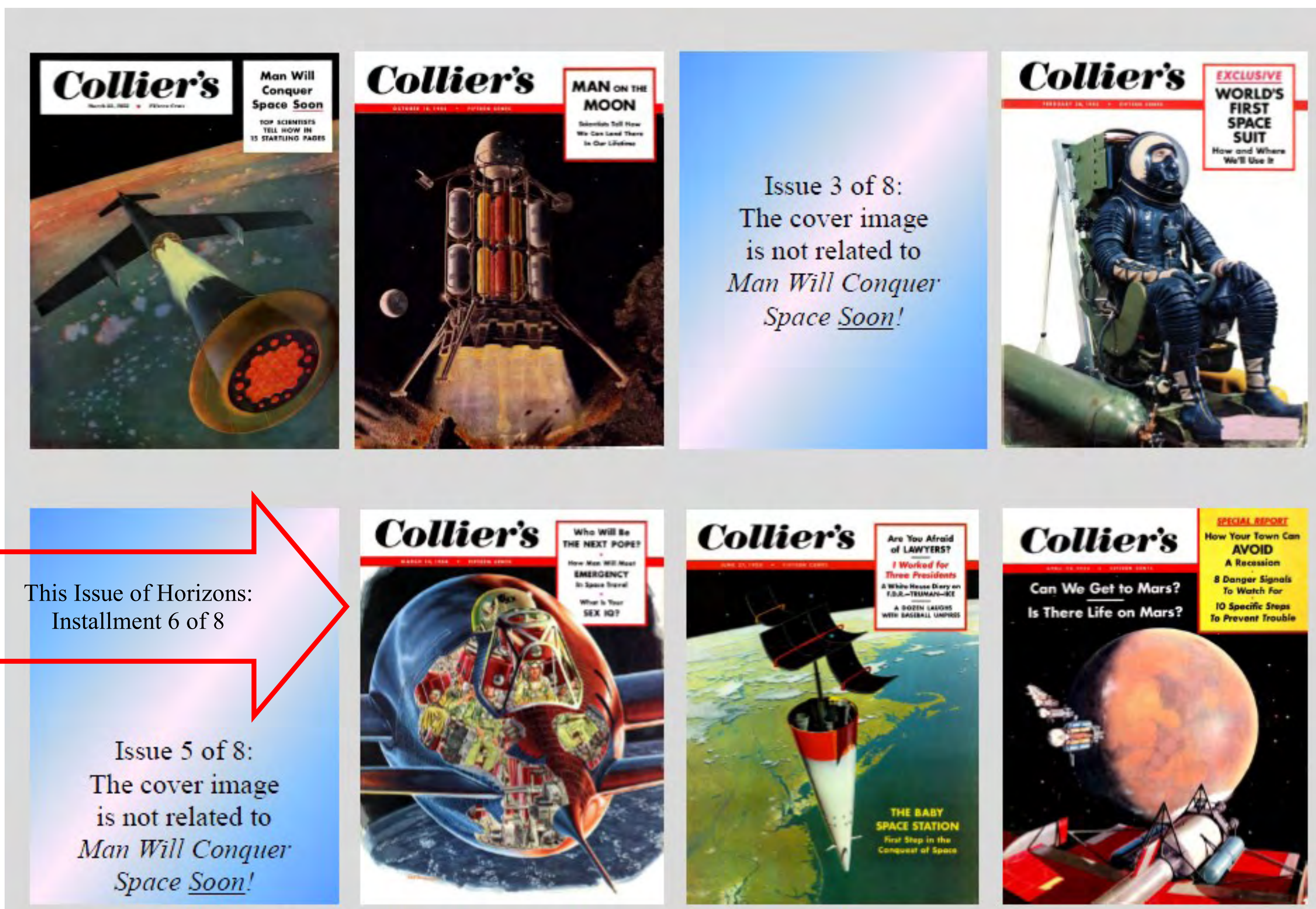
"Back in 1952 I was working at the Guided Missiles Division of Republic Aviation on Long Island and frequently attended American Rocket Society [ARS] meetings in New York; I had joined the ARS as a student member when I was only 13--in January 1941!"

The American Institute of Aeronautics and Astronautics (AIAA) started in 1963 by merging ARS and the Institute of Aerospace Sciences (IAS). AIAA claims 1931 as its first year when celebrating anniversaries, since ARS was founded in 1930 and IAS was founded in 1932.

The following pages from this installment of the Collier's space series are impressive, to say the least. They must have been amazing to readers in 1953, though we know from letters to the editors that not everyone was favorably impressed. As shown below, the last two installments are number seven, *The Baby Space Station*, and number eight, *Can We Get to Mars? Is There Life on Mars?*

A John Sisson Dreams of Space (blog) advertisement on a later page in this issue presents a von Braun novel, by the way.

(Continued on page 38)



Above: Image credits: Scott Lowther, with help from other Horizons Collier's team members.

Collier's 1952-1954

(Continued from page 37)

Thanks to this blog, we present another von Braun spaceship design, and a surprising look at some 1962 post-Apollo Moon exploration plans.

Above: Image repeated from an earlier page in this issue.

In a Dreams of Space blog post, John Sisson writes about this spaceship: "It is RM-1, designed by Wernher von Braun for the Walt Disney television film called 'Man And The Moon' broadcast December 28, 1955. RM-1 was meant to illustrate what a factual around the Moon space ship might look like. In the film it was portrayed by this model." Image credit: Dreams of Space.

PAGE FOUR AEROJET-GENERAL SPACELINES PAGE FIVE

SPACESHIPS FOR 12 MAN EXPEDITION ON MOON
"Umbrella" on suit protects wearer from solar radiation.

Mock-up of Moon Suit in action.

Moon Man has controls for suit and vehicle.

After Apollo — Exploring the Moon

After the Apollo spacecraft lands its three-man crew on the moon and brings them back safely, what's the next step in lunar exploration?

A 12-man expedition to make a 500-mile research trip across the surface of the moon is proposed by Allyn B. Hazard, an engineer at Aerojet's subsidiary, Space-General Corporation.

It could be done in this decade, he says.

The spacemen would travel to the moon in four rockets — three round-trip passenger vehicles, the other a one-way cargo ship with 30,000 pounds of supplies to support the men and their scientific studies.

Each of the 12 astronauts would be a highly trained scientist or technologist in some particular field; some would be experts in several areas. On the moon, only four of them would make the trans-lunar journey, while the others remained at the rockets' landing site to conduct research.

The four explorers would wear special tub-like spacesuits in which they would have to live and work, eat and sleep, for the entire trip. They couldn't get out of the suits because of the airlessness and super-cold of the moon.

That's the reason for the suit's peculiar shape — the wearer can slip his arms out of the sleeves to eat, adjust controls, make notes, or even to scratch his nose.

Umbilical connections would link each suit to a tractor-like "moon mobile" carrying the oxygen and life support system for two men. These would carry their passengers across the lunar landscape at five miles an hour. A 500 mile journey (for instance, from Crater Gruithuisen to Crater Aristarchus and back) would take 10 earth days. It would be made during the 330-hour lunar night, to avoid exposing the men to the sun's radiation.

CREW / CARGO COMPLEMENT

EXPEDITION WOULD TAKE ALONG EVERYTHING FOR WORK, SURVIVAL ON MOON
Each man would specialize in one or more fields of science, technology.

★ A 500-Mile Trans-Lunar Journey ★

INTEGRATED SPACE SUIT – MOONMOBILE
DESIGN CONCEPT

Moon mobile carries two explorers, life-support systems.

JOURNEY TO ARISTARCHUS

Explorers could train in three-domed moon simulator.

Above: A double-page magazine spread from 1962 showing post-Apollo Moon exploration plans. The magazine is Aerojet-General Spacelines and Rocket Review. Image credit: Dreams of Space.

Saturn V Inboard Profile Prints Now Available

Approximately six feet long, this full-color print is a reproduction of NASA-MSFC drawing 10M04574, the Apollo 8 Saturn V. Looks great ! Hang one on your wall and be the envy of all your co-workers. Available for $35 plus postage at up-ship.com

http:/www.up-ship.com

Lunar Module Equipment Locations diagrams

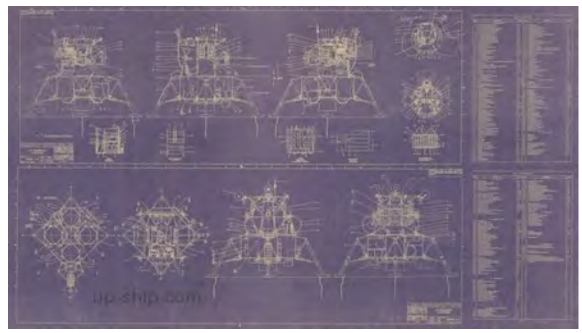
Full color, high quality print of NASA-MSC drawing dated January 1969 showing the Lunar Module and many of the important bits of equipment that went into it.

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.

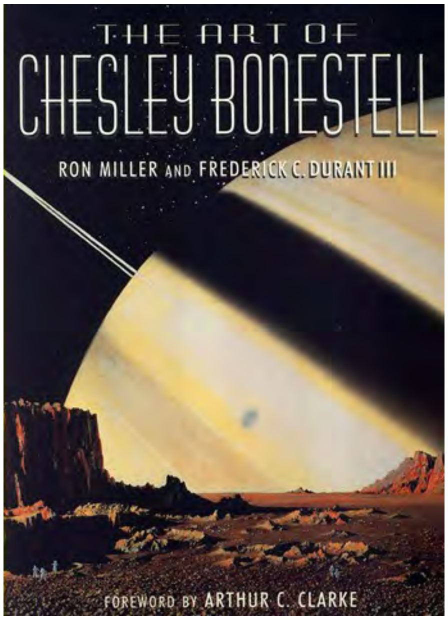
http://www.up-ship.com/drawndoc/saturnvprints.htm

$25



Dreams of Space
Books & Ephemera

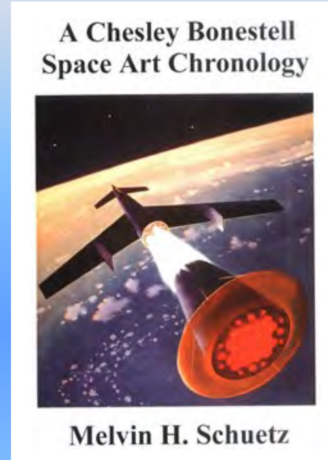
Non-Fiction Children's Books
about Space Flight from 1945 to 1975
http://dreamsofspace.blogspot.fr



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.

Collier's

MARCH 14, 1953 • FIFTEEN CENTS

Who Will Be THE NEXT POPE?

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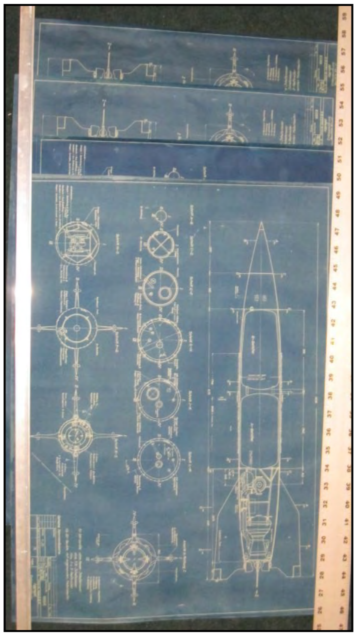
How Man Will Meet EMERGENCY In Space Travel

•

What Is Your SEX IQ?



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March 14, 1953

ARTICLES

FICTION

The characters in all stories and serials in this magazine are purely imaginary. No reference or allusion to any living person is intended.

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The Cover

Inbound from space, a fast-moving rocket ship noses down toward the earth, its crew alert—as always—for signs of danger. Disaster won't occur often in space, but rocketeers will be prepared: most of the paraphernalia shown in the cutaway sections of artist Fred Freeman's picture is emergency equipment. To see how it is used, turn to Emergency! on page 38.

Week's Mail

Survival in Space

EDITOR: Your article of February 28th on the dangers which human beings will encounter in flights at high altitudes (Man's Survival in Space) should go far to debunk the exaggerated fears prevalent in some quarters. Especially significant is the point that cosmic radiation, even at its worst, will not produce an important amount of damage to the hereditary constitution which later generations receive.

Unfortunately, however, the reason for this conclusion is stated in a misleading way. It is true, as your article states, that even a large amount of radiation would seldom produce striking abnormalities in the descendants of an exposed person. Yet this does not imply the absence of important damage. Even though the harmful changes resulting from a high exposure were hard to detect, they would be distributed over so many descendants that the total harm done would be very serious, and would usually include several premature deaths. That is why the present writer has always maintained that in the medical use of X rays more efforts should be exerted to keep the exposures as low as possible.

The real reason why the effects of cosmic radiation on heredity are not to be feared is because it would take so tremendous a time before a person could absorb any considerable amount of this radiation. An X-ray examination of the abdomen by a fluoroscope commonly delivers more radiation to the reproductive cells than six months' continuous exposure to cosmic radiation would give.

H. J. MULLER, Indiana University,
Bloomington, Ind.

In editing Dr. Muller's contribution to the Man in Space symposium, Collier's inadvertently omitted the words "in space" from his statement that a man exposed to radiation for a long time would rarely pass on marked changes to his descendants.

The Barrier of Language

EDITOR: Your editorial Barriers to Western Unity (Feb. 7th) is excellent and timely. The next to the last sentence in the article stands out: "They must cultivate friendly relations and mutual understanding."

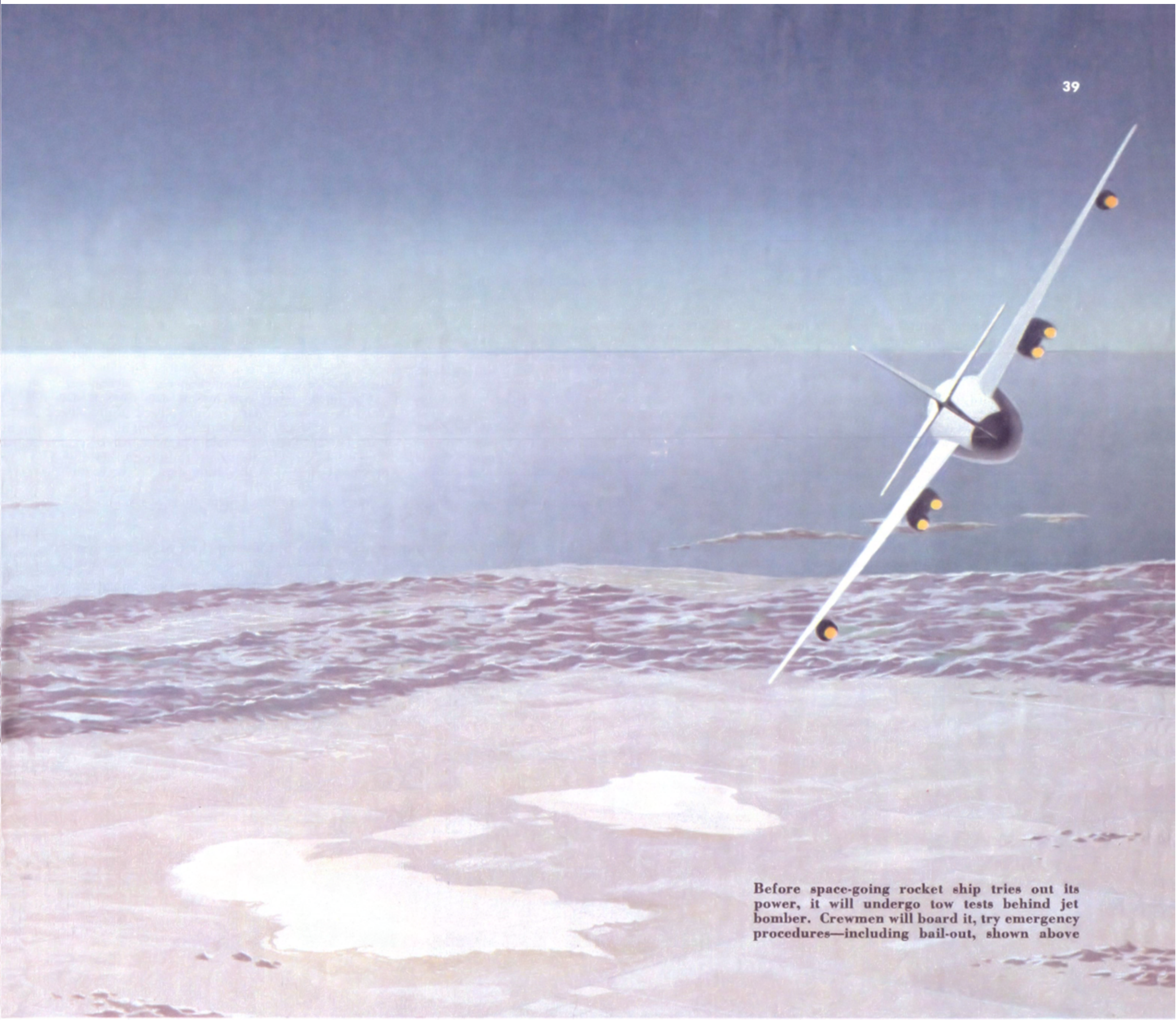
There seems to be one serious problem to uniting the West European nations. They will never cease being suspicious of one another as long as they cannot understand one another. They need a common, easily and quickly learned language that in itself would help bind them together.

Many will say this would take too long and that our present problems are

Man's Survival in Space

EMERGENCY!

Authorities whose papers were the basis for this article, last of a three-part series, are Dr. Wernher von Braun, chief of the Army Guided Missiles Laboratory; Dr. James P. Henry, of the Air Force Aero Medical Laboratory and rocket expert Willy Ley. Contributors to the other two parts included Col. Don Flickinger, Director of Human Factors at the Air Force Air Research and Development Command; Capt. James E. Sullivan, director, Airborne Equipment Division of the Navy Bureau of Aeronautics; and Drs. Hermann J. Muller of Indiana University; Hubertus Strughold, head of the Air Force Department of Space Medicine; Fritz Haber of the same agency; Donald W. Hastings, National Psychiatric Consultant to the Air Force; James Van Allen of the State University of Iowa; and Heinz Haber of the University of California. The material for the entire series was collected by Collier's Cornelius Ryan



Before space-going rocket ship tries out its power, it will undergo tow tests behind jet bomber. Crewmen will board it, try emergency procedures—including bail-out, shown above

What happens when disaster strikes in space? Can the crew of a 15,000-mile-an-hour rocket ship bail out or land their disabled craft? Here, for the first time, famous scientists disclose the answers

A ROCKET ship is cruising serenely through space at 15,000 miles an hour, its crew relaxing within the pressurized cabin. Suddenly the calm is shattered by an explosion: one of the double-paned portholes has blown out; in an instant the artificial atmosphere has vanished and the five men are exposed to the blood-boiling, suffocating vacuum of space. What can they do?

Or suppose the time is shortly after launching; the ship is picking up speed on a vertical flight path—and suddenly the fuel lines feeding the roaring bank of rocket motors burst into searing flame! Can the crewmen trapped inside bail out—or, perhaps, bring their multimillion-dollar vehicle in for a successful crash landing?

What can men do when disaster threatens their rocket ship during a supersonic dash through the atmosphere, or in the strange, airless environment of space?

If the crew is well trained, there are few emergency situations that can't be licked. The captain may have to make hair-trigger decisions; it may be necessary to throw away machinery and equipment that cost millions of dollars and years of work to develop; it may be necessary to take risks. There'll be plenty of excitement. But for almost all foreseeable crises, there will be an emergency procedure providing a good chance for safety. *If* the crew is well trained.

The first space crews will be more than well trained. They'll be selected with infinite care, superbly conditioned, educated in the special problems of space for five years. Every ground training device our scientists can conceive will give them the feel of space flight—and the problems of space flight—before they ever step into a rocket ship (Collier's, February 28, March 7, 1953).

But the big moment, and the best preparation for danger, will come when they get aboard a space vehicle and go roaring skyward.

There will be some preliminaries. Before they start space flights, the pilot and copilot, both jet-trained, will take many hours of transition flying in single- or double-seat supersonic rocket planes like the present Bell X-2 and Douglas Skyrocket.

Rocket flight is different from any other flight, and the important difference is that it's unpowered, except for a few minutes. (Three rocket blasts lasting a total of five minutes will carry a rocket ship beyond the earth's dense atmosphere; then it will simply coast the rest of the way to its destination.)

Flying in small rocket-powered aircraft, the crew captain and his copilot will learn to expect a sudden power cutoff after a brief burst—and will learn to make every landing glider-fashion, without power, as all rocket pilots must.

Then, with the rest of the crew, the two men

PAINTING BY CHESLEY BONESTELL

will climb aboard their new space-going rocket ship—but not for rocket-propelled flight.

The pioneer space crews and the first space ships will be developed together. All the time the men—and women; they'll probably be on rocket crews, too—are taking their training, engineers will be hard at work perfecting the vehicles. Crews and ships will be ready to undergo testing at about the same time. They'll do that together, too.

The vehicle that takes man into space will consist of three sections, or stages. Two of them will simply be power packages which will hurl the third section spaceward at a great speed and then be discarded. Only the third stage will actually enter space; it will carry the crew and cargo, and it will have wings and other control surfaces, like those of an airplane, necessary to make landings on earth.

A Start in Basic Escape Training

Since the third stage poses the greatest engineering problems, it will be the first section built. Once it's considered ready for flight, it will be towed aloft by a powerful jet bomber and put through a series of tests. The crew will board it at that time, to get used to it, to help the engineers perfect the internal layout, and—especially—to start basic escape training.

After each test is finished, the towrope will be cast loose and the two pilots will make the unpowered landing at the home base.

Finally, the day will come when the third stage and its crew are ready for a rocket launching. The ship will be set on a launching platform, tail down, nose pointing skyward. A few final checks, a moment's pressure on a button beside the captain's chair and the four main rocket motors will roar. The needle-nosed ship will rise slowly into the air, picking up speed rapidly until it hits 4,000 miles an hour.

From the moment the craft leaves the ground, the crew must be prepared for breakdowns, for malfunctions, for the early symptoms of danger. The trip—and each such third-stage flight thereafter—will last only about 20 minutes; there's barely enough fuel for a 300-mile trip, up to an altitude of about 30 miles. Into the few minutes of flying time on each flight, the crew members will cram an intense course in emergency procedures.

What emergencies?

Most of the troubles that can crop up in rocket flight are fairly easily handled. Instrument failure? The ship has double sets of instruments—two sets of flight instruments for the captain and copilot, and two of functional instruments for the engineer. Pump trouble may affect a space-bound rocket ship so that it can't make its destination; it will remain aloft long enough to burn up its heavy fuel load, then, light enough to land, it will return to base.

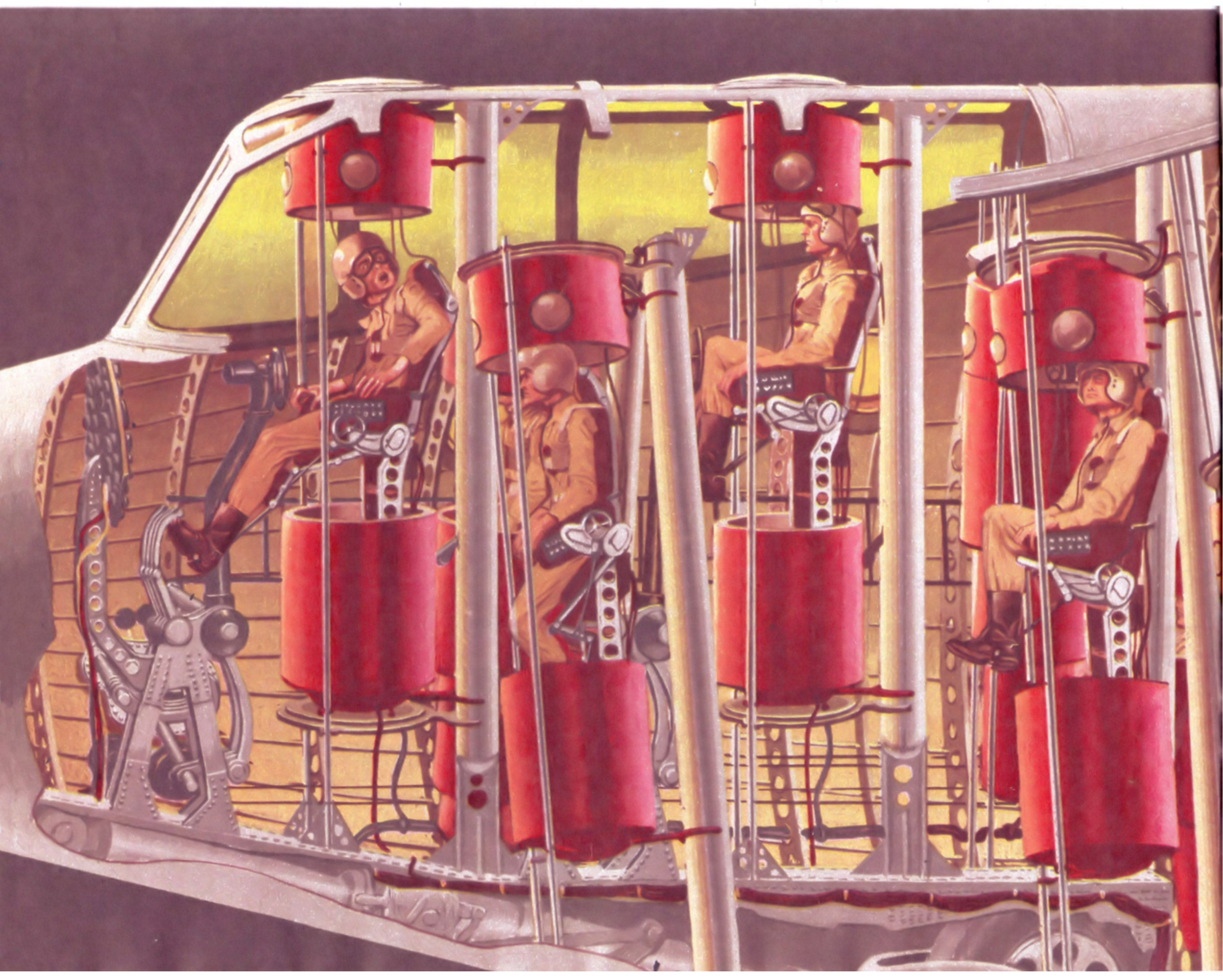
But four difficulties may spell real danger: mechanical trouble in the power plant or hull; failure of specific pieces of electrical equipment for which there are no duplicates; fire, and the sudden loss of cabin pressure. Fortunately, all such breakdowns should be rare.

Effects of Sudden Decompression

Swift decompression could be caused by the accidental opening of an escape hatch or by the sudden blowout of a porthole. It would subject the crew to an enormous pressure change: from the normal cabin pressure of eight pounds per square inch (equal to a 15,000-foot altitude) to the complete vacuum of outer space.

Can men stand such instant decompression? Tests have proved that carefully picked men can. The change would be uncomfortable but not fatal. But unless the crewmen could find swift protection, they would quickly die from exposure to the low pressure, which provides little or no oxygen for breathing, and which very quickly causes the blood, saliva and other body fluids to boil. Space

In emergency (as when broken porthole lets cabin pressure escape, as pictured), crewman and passengers press buttons on chair arms; contour seats straighten automatically, capsules clap shut, seal. Capsules are connected to cabin pressure system, also have own pressure for bail-out



suits? They'll be invaluable in space, to keep men supplied with pressure and oxygen outside their pressure cabins, but they won't be worn inside a rocket ship; they're too clumsy in such cramped quarters under conditions calling for fast movement. And they take a long time to put on.

The solution is a fast-closing personal pressure cabin for each man. Such a cabin already has been designed by Dr. Wernher von Braun, one of the world's foremost rocket engineers. The moment a crew member becomes aware of the cabin leak, he will press two buttons, one on each arm of his contour chair. One button would do, but two will force the crewman to pin both arms to his sides. That's important, because the instant the buttons are pressed, the chair will straighten slightly, and two metal cylinders will zip out of the floor and ceiling and snap shut around the man, encasing him completely in a sealed tube. The tube, called an emergency capsule, is connected to the ship's central air supply. It also has its own pressure-atmosphere system, if needed.

The capsule protects the crew member from the low outside pressure—but isn't he helpless?

Far from it. All the control switches he has been using to do his assigned job are located on the arms of the chair, and the chair arms are inside the capsule with him. Even before the cylinder clapped shut, the control wires were connected to the ship's electrical system through breakaway plugs at the bottom half of the capsule. Chances are good that, even encased within their capsules, the crew members can save the ship.

At the very least, the captain can start back for the earth; when the space craft descends below 20,000 feet, he and the other crew members can emerge from their metal shells and bring the ship in for a normal landing.

Landing May Be on Space Station

Suppose he has a destination in space. Once scientists have the first space-going ships in operation, they will start building a permanent station 1,075 miles from the earth, as a combined military observation point and astronomical observatory (Collier's, March 22, 1952). The station will circle the globe endlessly, once every two hours—an unpowered satellite, like the moon. If our decompressed rocket ship is on its way to the satellite, it might be wise to continue on course. After its arrival, the crew members in their capsules will be removed from the damaged vehicle by space-suited men from the satellite, and taken to the pressurized station. The rocket ship will be repaired before its return flight.

With proper emergency equipment, decompression can be licked fairly simply.

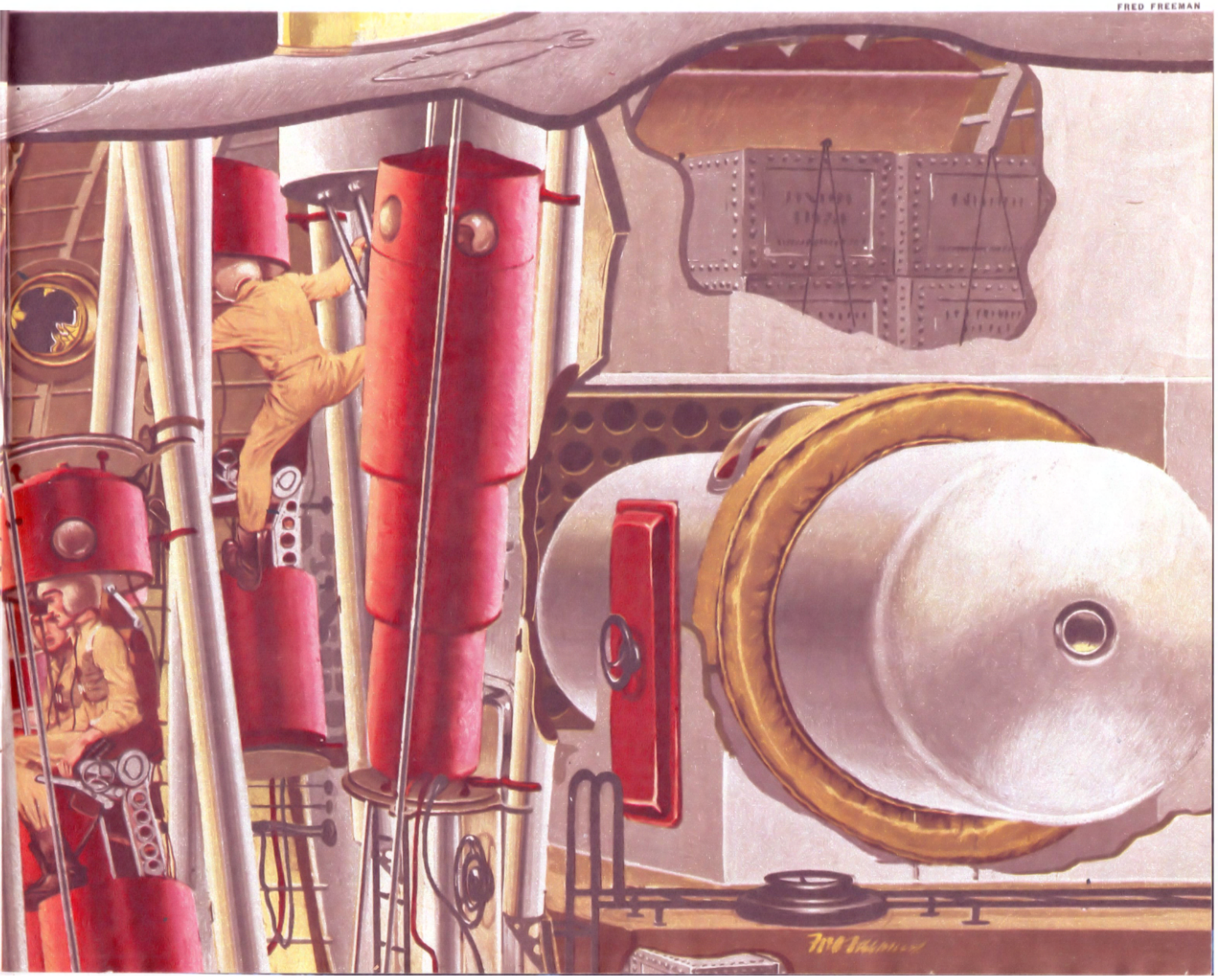
Fire is something else again. Suppose the turbine driving the fuel pump flies apart and a hot splinter rips through the fuel tanks. A stream of ammonialike hydrazine would engulf the motor and fuel systems in searing flame. What then?

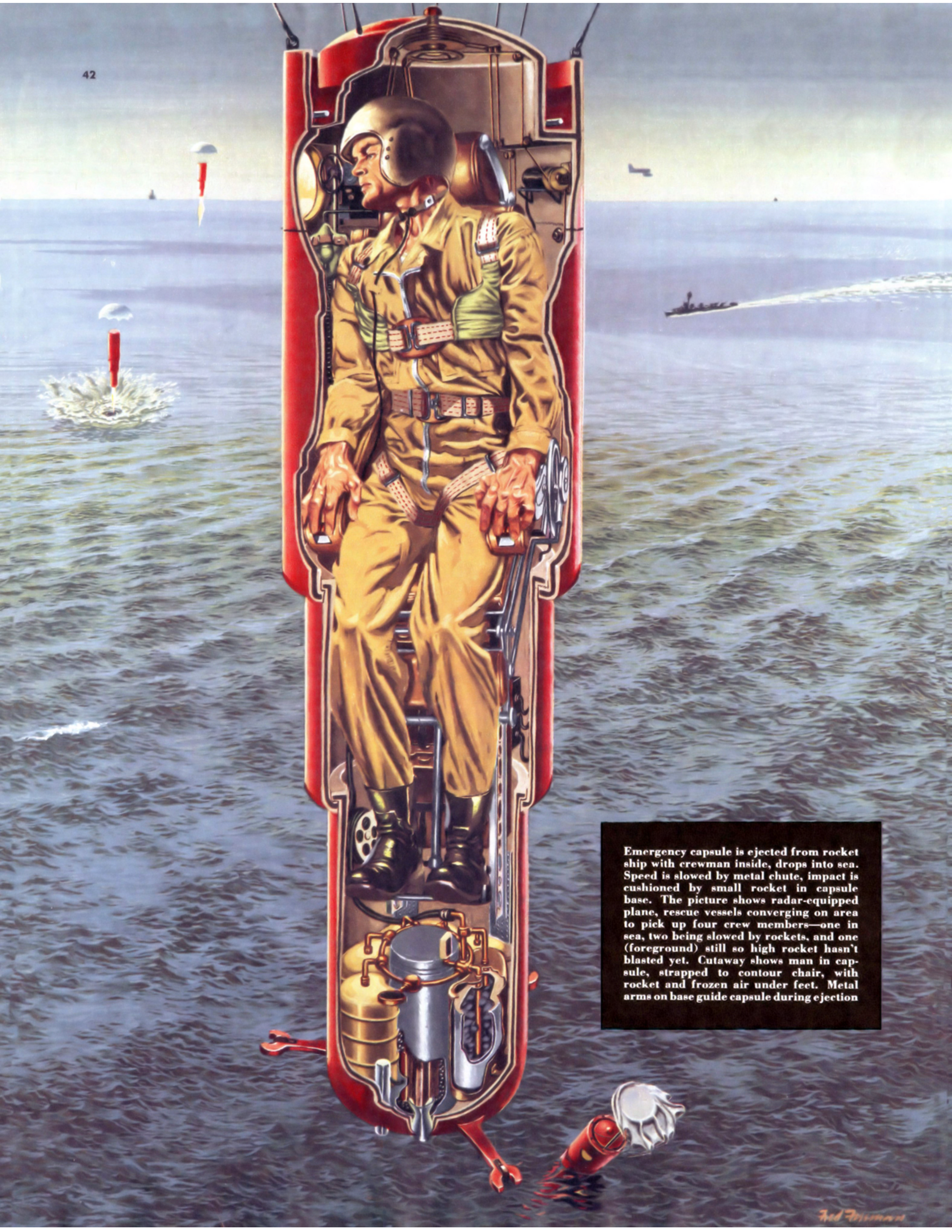
It depends on where the fire is located, how bad it is, how bad it's likely to get—and where the rocket ship is in space. The ship starts its flight from the ground with three sets of rocket motors, mounted one behind another. The first part of each flight is over the ocean. The bottommost, or first, stage provides power until it runs out of fuel, then drops into the sea. The second stage takes over, to be discarded in turn two minutes later. If fire occurs in either of the first two stages, the pilot will immediately jettison it. If he works fast enough, that will end the danger. He will glide the third stage back to earth, after dumping most of its fuel.

But what if the blaze starts just after departure, with the ship only a few thousand feet off the ground? A jettisoned stage, especially if it's aflame, might wipe out the entire launching installation—and hundreds of men. For the rocket captain, it's a tough decision: if he waits too long, he and his crew (and their costly vehicle) might be lost; if

To abandon ship, men push another button. Capsules, guided by rails, are ejected by powder charge, drop safely into ocean with men inside. When possible, men will remain in ship, operating controls from within capsules, until they are close enough to the earth to land normally

FRED FREEMAN





Emergency capsule is ejected from rocket ship with crewman inside, drops into sea. Speed is slowed by metal chute, impact is cushioned by small rocket in capsule base. The picture shows radar-equipped plane, rescue vessels converging on area to pick up four crew members—one in sea, two being slowed by rockets, and one (foreground) still so high rocket hasn't blasted yet. Cutaway shows man in capsule, strapped to contour chair, with rocket and frozen air under feet. Metal arms on base guide capsule during ejection

An ingeniously engineered bail-out device gives the rocketeer his margin of safety

he acts too quickly, he may cause catastrophe on the ground. His best bet is to turn the rocket into a shallow flight path, and attempt to cast loose the burning section where it can do no harm.

Luckily, fires are likely to be rare. Most of the risk comes during launching, and for the five minutes after launching, when the motors are operating and quantities of fuel remain. How about an explosion? The two propellants, nitric acid and hydrazine, are in separate tanks; a hot fragment of metal wauld have to pass through both sets of tanks, causing the propellants to mix, before an explosion could occur. The fragment would have to be traveling at terrific speed.

Yet it *could* happen. If it did, there probably would be no emergency procedure: rocket ship and crew would be blasted to bits instantly.

If fire or explosion should occur, it will probably be on the way up, while the ship is still in the atmosphere—almost never in space, or in the atmosphere on the way back. First, after the ship has left the atmosphere outbound, there will be little fuel left to burn—just enough for brief maneuvering and to provide insurance against a bungled landing attempt on the return to earth. Second, there's no oxygen in space to kindle the flame. Third, the motors won't be running, which means no pumps to spray fuel out of a leaky connection, and no working parts to start a fire even if there is a flow of fuel.

If decompression and fire are both unlikely—and easily manageable when they do happen—what other dangers are there?

Helpless Without Electric Power

Electrical equipment can fail. If the equipment isn't duplicated on the rocket ship, the failure could cause serious trouble. Some of the navigator's most vital instruments are electrically operated, and could not be easily replaced in flight. If one of them suddenly broke down, the navigator might be almost totally unable to operate; he would have to depend on advice from the ground. But the radio is electrical, too. It could fail, halting all communication with the home base. Even under the most favorable circumstances, the navigator relies on some ground help for difficult computations; if he were deprived of this help, he could use only rough estimates for the exceedingly tricky navigational problems of space flight.

Or the electrically operated valves between fuel tanks and pumps could break down, stopping the motors.

Actually, motor trouble could be caused by many kinds of breakdown. Among the possible hazards of space flight, it falls in a major category of its own, posing problems something like those caused by fire.

If motor failure occurs during the first seconds after take-off—catastrophe. If it happens later during the ascent, the captain probably would jettison the stricken stage, pump out excess fuel and head in for a landing.

The most complicated situation occurs when the third stage is out in space and lacks the power to maneuver into a circular orbit around the earth. What happens then?

Eventually it would start back around the earth, pulled by gravity into a lopsided orbit, about 1,100 miles from the earth on one side and 60 on the other. On the low side of the orbit, the ship would drag briefly through the atmosphere, and that would slow it down slightly. After perhaps 24 hours, and a dozen round trips, it would be low enough so that the control surfaces would take hold in the denser air. The pilot might then be able to land the ship like an airplane.

During this long flight, the damage which caused the power failure could prove much greater than first believed, possibly bad enough to ruin any chance of landing. Other rocket ships would hurry to the rescue. They would be launched into the same orbit, their departures timed with scientific care to enable them to overtake the disabled vehicle. All the vehicles and their crews would be weightless in the uneven orbit, so it would be a fairly simple matter to transfer the men from the stricken craft to a rescue ship. Space-suited rescue crews would remove the crew members of the damaged rocket vehicle, capsules and all, through escape hatches, and would then carry the cylinders to the safety of the pressure cabins in their own craft.

But what if rescue is impossible? A rocket crew which found itself in a lopsided orbit would stay in the ship as long as possible, even if it began breaking up as it swept through the atmosphere. They would have little choice. Rocket expert Willy Ley estimates that crew members who bailed out would stay in the uneven orbit for almost three days; after the first half hour, they would be dead inside their capsules for lack of oxygen.

At best, bailing out of a disabled space vehicle is far more difficult than parachuting from an airplane. A man who jumped from a rocket ship at thousands of miles an hour would almost certainly collide with part of the vehicle. That would mean instant death. Suppose he was thrown free of the ship. At an extremely high altitude, he would die anyhow, and almost as fast—his lungs gasping for air, his body fluids set aboil by low pressure. Would a pressurized space suit save him? Only for the moment. Plummeting earthward, he would plunge into the dense atmosphere at terrific speed; the friction would toast him, scorch him and finally set his clothing furiously ablaze.

Then how would he bail out?

In the same emergency capsule he uses inside the cabin. A powder charge hurls him away from the speeding ship. As he tumbles through space, artificial atmosphere guards him from the dangers of low pressure. A light steel parachute steadies the

U. S. NAVY PHOTO

Ejection seat, similar in principle to escape capsule, being tested by Navy. Military services use ejection for bail-out from fast jet planes

Will the escape cylinder work in the upper altitudes? A similar capsule already has

capsule and brakes his speed as he enters the earth's envelope of air. Insulation keeps him cool. Just before he strikes the earth, a self-starting rocket jet cushions the landing. If he lands at sea, the capsule floats easily on the swells, and a radio signal beckons rescuers.

Suppose an earthbound third stage runs into serious difficulty at an altitude of about 50 miles, and it's impossible to land. The captain immediately slams the bail-out bell. Within seconds, the crew members have clapped shut their capsules. Once encased, they can operate the ejection buttons—and at a hasty signal from the captain, they do so. The powder charge hurls each cylinder free of the disabled ship, through a hatch. The opening is promptly sealed tight by a lid which closes automatically behind the departing capsule.

At the moment of bail-out, the rocket ship has been following a course which almost parallels the earth's curvature. The cylinders take the same course for several hundred miles before they start down, their progress slowed by a four-foot steel-mesh parachute.

As the capsule plows through the dense atmosphere, it begins to glow, and soon it becomes red hot. Inside, the crew member is protected by glass-wool insulation, and by lumps of solidified air, which has been frozen at a temperature of 363 degrees below zero F.

Approaching the earth's surface, the capsule falls at a rate of 150 feet per second. That's too fast; a man striking ground at that speed probably would be killed. But 150 feet off the ground, a proximity fuse sets off a small rocket in the foot of the capsule; the blast of the rocket slows the rate of fall, and the landing is fairly gentle. It's especially gentle if it occurs in the ocean, and rocket-ship captains who have the choice will attempt to bail their crews out over water.

Equipment in the bottom of the capsule serves as ballast and gives the cylinder stability in high seas. An automatic radio system guides rescue boats to the floating tube. A release catch opens the capsule's portholes, to let air in.

The emergency capsule will be used only rarely for escape. When they can, the crews will attempt to bring damaged ships back to land, and usually it will be perfectly practical to do so. Not only will emergency landings save many millions of dollars' worth of machinery and equipment—they will also protect the crew members from certain hazards of capsule bail-out.

For example, a man who ejects his capsule from a rocket ship which is speeding earthward at too steep an angle might be killed by the jarring impact of his collision with the atmosphere, or by the tremendous friction heat. Wherever possible, the captain will pull up his injured ship, so the crew members will be cast out at an angle which will permit them to enter the atmosphere gradually.

Then suppose the capsule, instead of landing in water, strikes down on solid ground. The touchdown will be gentle, but the man inside could be badly shaken up as the big tube flops over on its side. Or suppose it lands on a mountain, or on the roof of a house, and goes tumbling down the side?

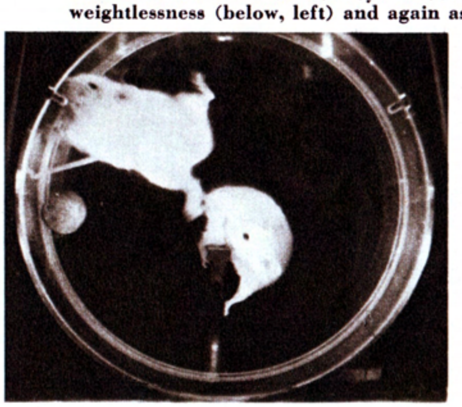
Those landing risks will be extremely slight, statistically. Yet they'll worry the crew members. So will the possibility of equipment failure within the capsule. So will almost everything else about the cylinder.

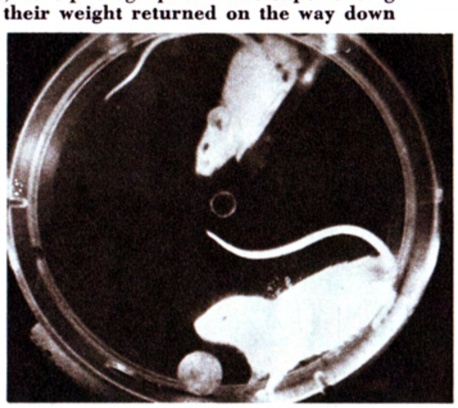
The mental hazard will be one of the most important deterrents to the use of the capsules for bail-out. They will be psychologically offensive: coffinlike, cramped, stuffy and uncomfortable. The men inside them, once ejected from the ship, will be completely helpless. It will be a horrible feeling.

RALPH ROYLE

Monkeys Pat and Mike (shown with Lt. Johnie Reeves and A/1c Marshal Ross) went to 35-mile altitude in rocket like one in photo, were safely ejected in capsule

Two mice traveled with monkeys in rocket, were photographed while experiencing weightlessness (below, left) and again as their weight returned on the way down





U. S. AIR FORCE PHOTOS

Saga of Two Monkeys—Pat and Mike

But the capsule *will* work when nothing else does. In fact, it has worked—at least, a capsule very much like it has.

Last May, two monkeys were sent to an altitude of 35 miles aboard an Air Force Aerobee rocket, at a speed of 2,000 miles an hour. The animals, named Pat and Mike, were seated in the projectile's nose, which was triggered to break away shortly after the rocket started back to earth. The nose capsule, with the monkeys slightly anesthetized to keep them from becoming excited, broke loose on schedule. It hit a peak speed of 1,000 miles an hour before a parachute (serving the same purpose as the steel-mesh umbrella on the man-sized capsule) broke the fall. The breaking impact was equal to about five times the monkeys' normal weight, but they were unharmed. They drifted safely back to earth, and are still alive and healthy (so healthy that they're too big to get into the capsule now).

The test, conducted by a team of biologists and engineers headed by Dr. James P. Henry, Air Force physiologist, proved the practicality of escape by capsule, and gave scientists other information about space travel as well. Both the monkeys and a couple of mice, who also were passengers in the capsule, experienced weightlessness for about two minutes, with no ill effects. They also endured an acceleration shock at launching far greater than that man will experience: they were flattened by a force 13 times their own weight, compared with the ninefold weight increase man can expect on his journeys spaceward, and the tenfold pressure he might feel as a capsule smashed into the atmosphere.

Pat and Mike were among the first living visitors to the extreme altitudes. The two creatures briefly experienced all the major difficulties of space travel—acceleration pressure, weightlessness, life in an artificial atmosphere. Nothing bothered them. Many more animals are sure to be rocketed into the earth's newest frontier.

After them will go the men.