Horizons

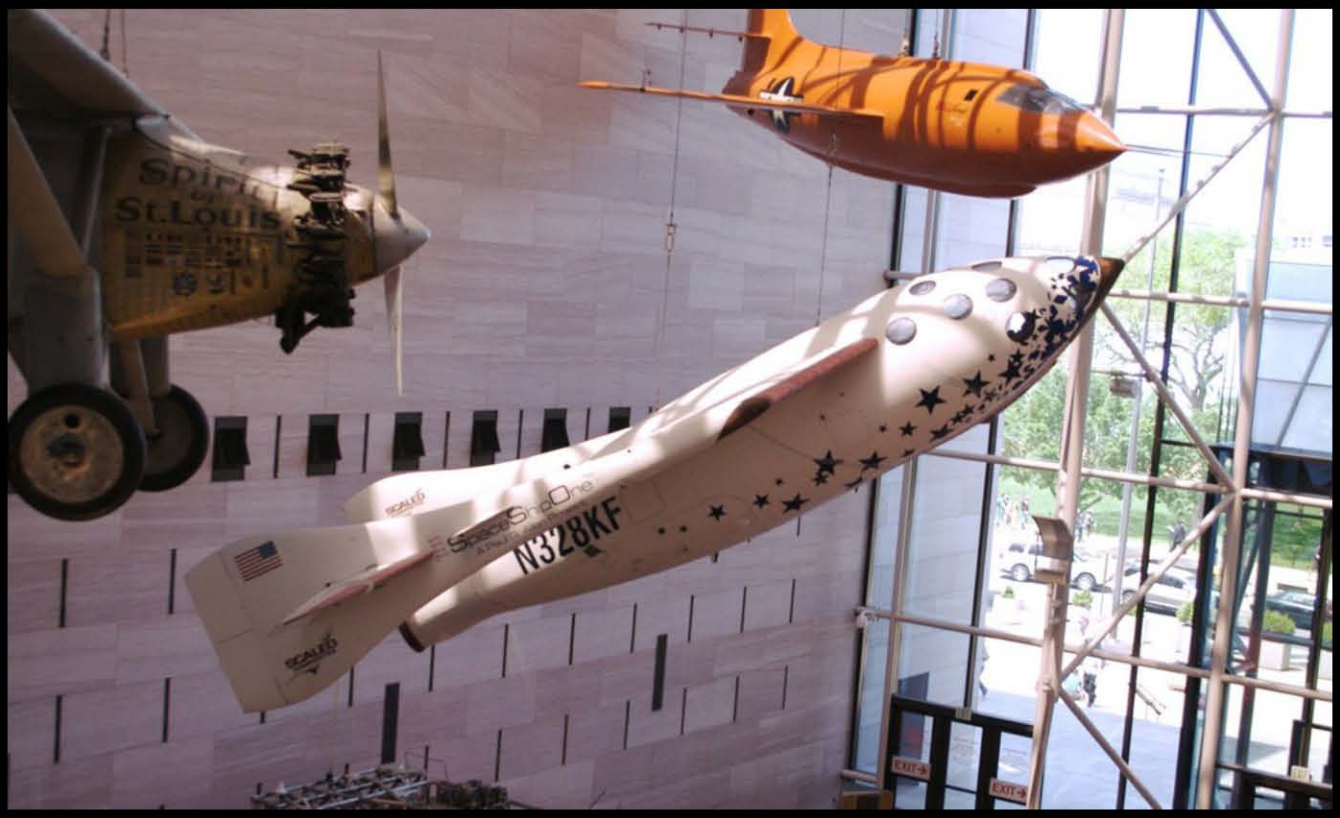
Volume 38
Issue 3

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

November / December 2012
www.aiaahouston.org

The UP Experience - Houston 2012

Featuring Burt Rutan & his Interview with Horizons



Also, Continuing in this Issue!
Part 3 of 8:

Man Will Conquer Space Soon!

(Collier's 1952-54)

MAN on the MOON

THE EXPLORATION

By Dr. FRED L. WHIPPLE and Dr. WERNHER von BRAUN

Collier's 1952-54 Man Will Conquer Space Soon! (1952-54)

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

We reprint in the following pages that part of *Man Will Conquer Space Soon!* which appeared in the third of these eight issues of the weekly magazine Collier's. We can read them already at http://UNZ.org, but the paintings are almost totally blacked out there. These are nine full pages, pages 38 through 48 in the original magazine, where pages 41 and 43 were full page advertisements.

This issue of Collier's was dated October 25, 1952, and it concluded a series of articles in the issue from the prior week dated October 18, 1952. The earlier articles were titled *Man on the Moon*, and these articles were titled *More About Man on the Moon.*

Collier's of December 13, 1952, contained Week's Mail about the issue of October 18, 1952, *Man on the Moon*. That mail appears on pages 4, 6 and 8 as shown at http://UNZ.org. **First** was a very complimentary short letter

(Continued on page 55)

	"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.

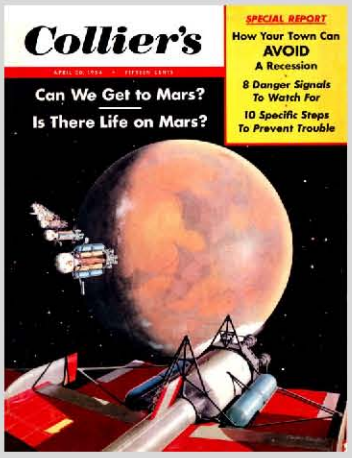
(Continued from page 54)

from Albert B. Dickas of Oxford Ohio about the space stories in both of those October 1952 issues. The **second** letter is from Robert M. Meltzer of Auburn, Maine. He compliments everyone for the space stories appearing in all three issue of Collier's to that point. He states that he is happy to know that more such articles are coming soon. He concludes by stating that everyone he talks with about these space projects, hundreds of people from all walks of life where he lives, is supportive. The **third** letter is thankful that the articles published so far support what they believe to be the first high school science fiction club, The Regis High School Science Fiction Society. The two student letter writers are Gerald Albin of Cahill, NY and Hubert James Horan of Flushing NY. The **fourth** letter is a short one from Lee Thomas (aged 12) of Austin, Texas, saying that since the Moon landing ship is not streamlined, a small amount of air on the Moon will cause it trouble, and the editors reply that Collier's scientists state that there is little, if any, air on the Moon. The fourth letter is from Bobby Stewart of Kirbyville, Texas. "...How many people noticed that in Fred Freeman's cutaway illustration of the Moon ship three of the scientists on the ship are Dr. Wernher von Braun (top floor), Willey Ley (entering engineering deck) and Dr. Whipple (navigation deck)?" The editor replies, *"Several, Bobby."* That cutaway illustration of the Moon ship is on page 45 of our last issue, and we identify those three faces and two more (artists Rolf Klep and Fred Freeman) on page 49 of our last issue.

The **fifth** letter is a short note from Eric E. Hale of El Centro, California, stating that he

(Continued on page 56)

Collier's 1952-54



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

Collier's 1952-54

(Continued from page 55)
likes the *Man on the Moon* articles and urges Americans to complete the project before the Russians. The **sixth** letter is from Clarence Mathews of Clinton, Illinois. He notes that it was written that the astronauts on the Moon would need to be careful of falling since there is no air to break the fall, so he asks how the spacecraft can brake for landing and takeoff. *The editors answer that the rocket ship is the only engine known to science that not only works in a vacuum but is more efficient there than in air.*

The **seventh** letter is from Thomas Pappan of Owosso, Michigan. He asks how nitric acid, hydrazine and hydrogen peroxide make the rocket go. The editors write, *"The hydrogen peroxide drives the pumps which feed the hydrazine and nitic acid into the rocket motor. These liquids burst into flame when they touch each other; they don't require ignition. Combustion of the gases propels the ship in accordance with Newton's third law of motion."* In the **eighth** letter, Ed Giesselmann of El Cerrito, California asks how heat can be dissipated on the airless, waterless and perhaps soilless Moon, heat from things like tractor engines, and turbogenerators. The editors respond, *"The heat has to be dissipated by radiation. The radiating surfaces would be shielded from the Sun."* The **ninth** letter is from Ing. Ismael Sanchez Pardo of Mexico, D.F., Mexico. He quotes the article, *"...with a gentle shove the reserve tanks will disappear out of sight and eventually they will crash on the Moon."* He concludes that the shove must be strong enough to ensure the tanks are caught by another gravitational field, and if the push is not strong enough, the tanks will return to the side of the ship attracted by its gravitational field. The editors reply, *"Theoretically, the reader is correct. Practically, the gravitational field of the ship would be so slight that it wouldn't matter."*

Above: Lockheed L-749A Constellation N6022C "Star of Virginia" TWA at London (Heathrow) Airport with under-fuselage "Speedpack" freight container. September 12, 1954. Image source: Wikipedia. Image credit: RuthAS.

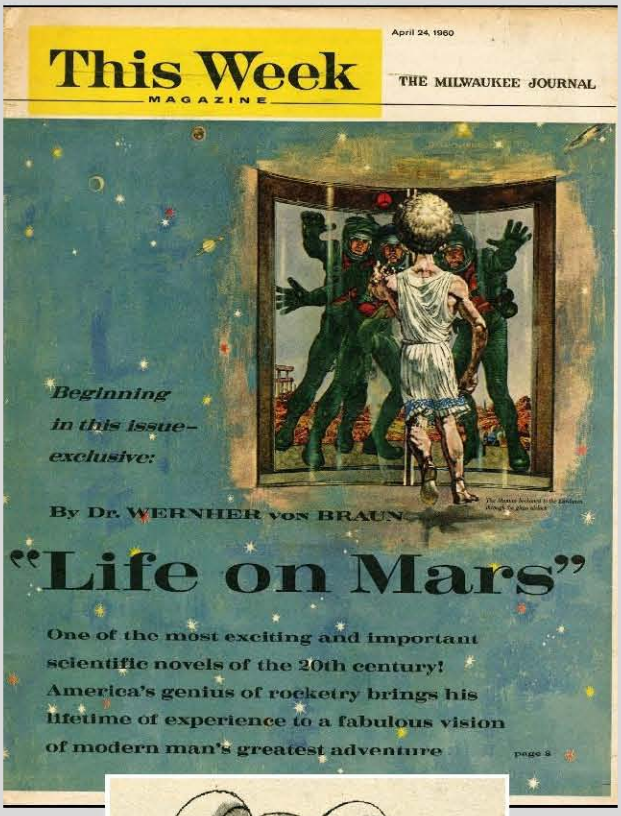
The **tenth** letter is from Ralph S. Damon of New York, N.Y. The Wikipedia article on the Harmon Trophy mentions that Trans World Airlines (**TWA**) CEO Ralph [Shepard] Damon won that prize for 1948. Mr. Damon was also a letter writer for Collier's Week's Mail presented on page 36 of our last issue, and we presented a little more information about him there. Mr. Damon writes that the October [18, 1952] issue of Collier's passed around the world so fast that the day it hit the newsstands in the USA, it was also on display at Nairobi Airport, Kenya, East Africa, traveling on TWA from New York to Cairo, and on Ethiopian Air Lines from Cairo to Nairobi. Below his letter is a photograph (see http://UNZ.org for a grainy black and white reproduction) of Mr. Damon reading that October 18, 1952 issue of Colllier's (its cover showing the Moon ship launching from the Moon) along with two other men. Behind them is a sign, *"East African Airways, Nairobi, Eastleigh Airport..."* The image caption says, *"Mr. Damon (left) is president of TWA. With him are Michael W. Dunford (center), general manager of East Africa Tourist Travel Association, and Malcolm P. Aldrich of New York City."*

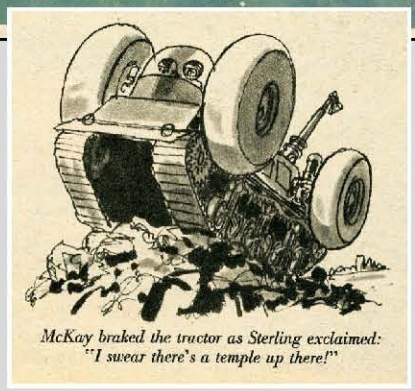
The **eleventh** letter is from C. P. Peppard of Excelsior Springs, Missouri. He says he subscribed to Collier's for years but finds Man on the Moon purely silly and worthy of first prize for wasting paper. The **12th** and **last** letter is from Joseph J. Miata of New York, N.Y. *"I marveled over your article by Dr. Wernher von Braun on the breath-taking possibility of "The Journey." The brilliant concepts illustrated by Chesley Bonestell surpassed those that were so amply displayed in Conquest of Space [March 22, 1952].*

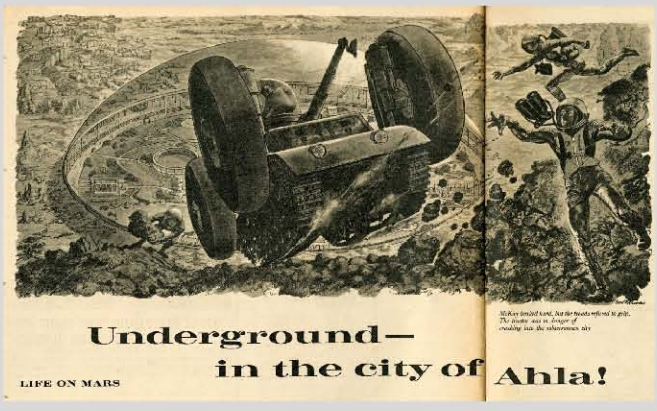
"The article refueled my mental faculties. I could vividly see the entire universe as a final working unit striving together to accomplish this major task. Our problems on Earth, largely international controversies, should be dispelled from our minds and focused on the enormous job before us."

Dreams of Space
Books & Ephemera

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







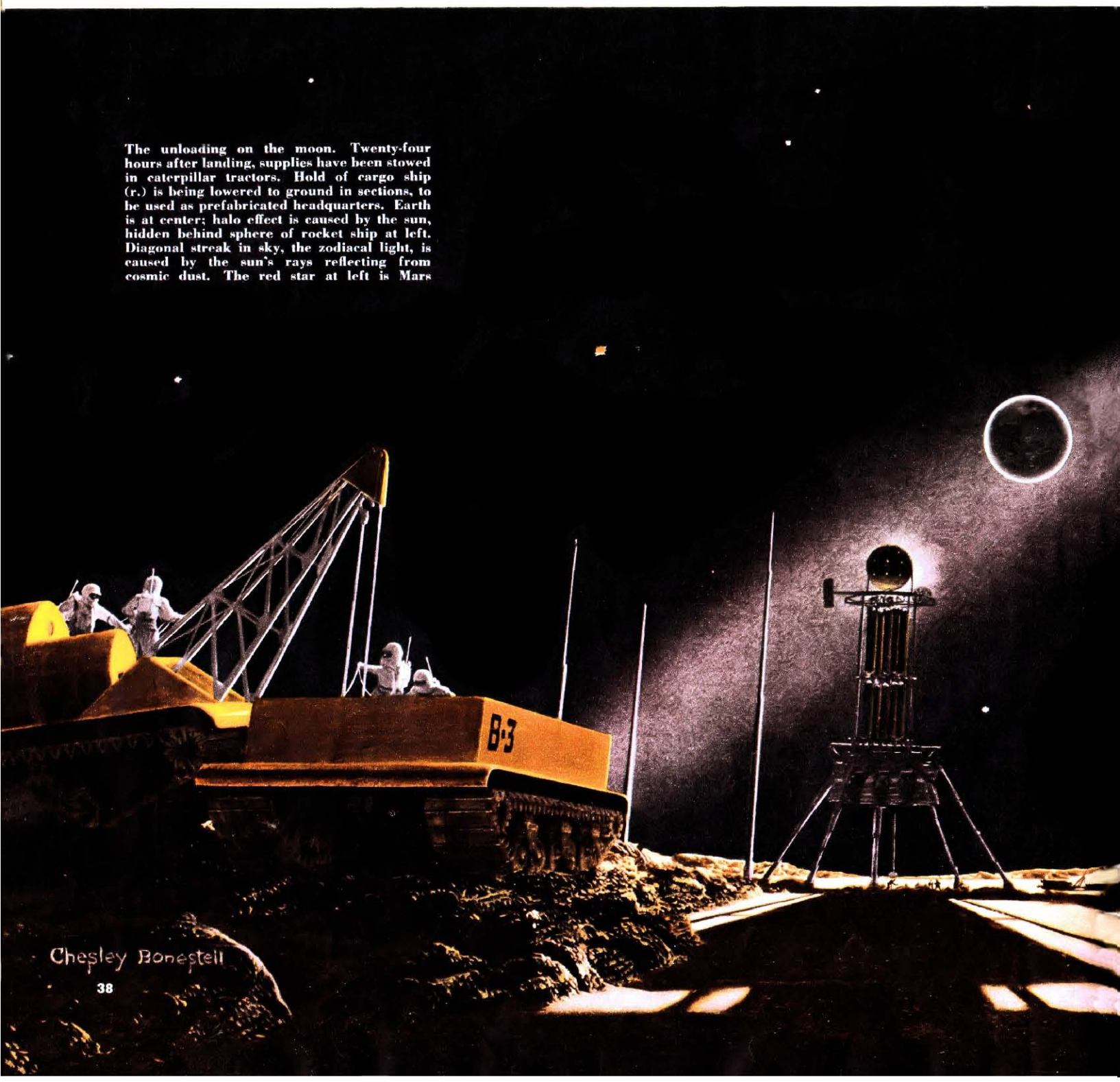
THE EXPLORATION

By DR. FRED L. WHIPPLE and DR. WERNHER von BRAUN

CHAIRMAN, DEPARTMENT OF ASTRONOMY, HARVARD UNIVERSITY

TECHNICAL DIRECTOR, ARMY ORDNANCE GUIDED MISSILES DEVELOPMENT GROUP, REDSTONE ARSENAL, HUNTSVILLE, ALABAMA

Our top scientists say we'll reach the moon in our lifetime. What do we find when we get there? What are the secrets of this ball of rock five times the size of the United States? Here's expert testimony



The unloading on the moon. Twenty-four hours after landing, supplies have been stowed in caterpillar tractors. Hold of cargo ship (r.) is being lowered to ground in sections, to be used as prefabricated headquarters. Earth is at center; halo effect is caused by the sun, hidden behind sphere of rocket ship at left. Diagonal streak in sky, the zodiacal light, is caused by the sun's rays reflecting from cosmic dust. The red star at left is Mars

THERE is danger on the moon—the danger of the unknown. Our first expedition, which can land there in the next 25 years, must be prepared. Tissue-damaging cosmic rays—invisible, deep-penetrating atom particles—unpredictably streak in from space, with no atmosphere to impede them. Meteorites, from microscopic grains to mountainous boulders, hurtle down. On the lunar surface, thin layers of crust might cover great crevasses, making travel perilous. Jagged rocks threaten the fabric of the pressurized, oxygen-equipped space suits essential to life.

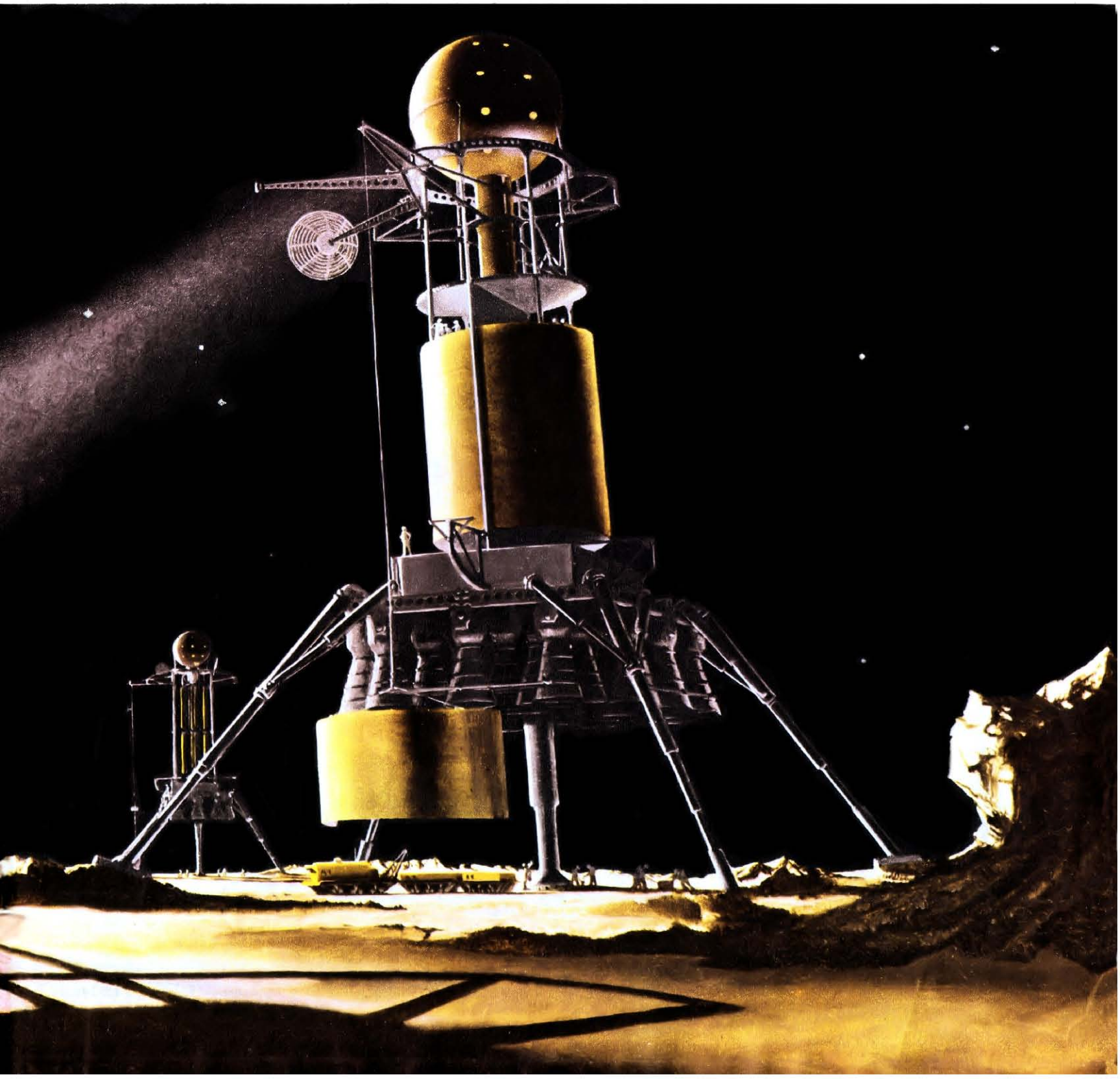
How great are the hazards? We don't know exactly, but we do know how to take precautions. Until we can measure the severity of the cosmic radiation, we shall stay under cover as much as possible. Our headquarters must be located in a deep crack in the surface, protected from both rays and meteorites. Brief exposure to cosmic radiation probably won't hurt us. Exposure to large meteorites will hurt us—but we don't expect to encounter them; the smaller meteorites will shatter against the two thicknesses of our space suits. The keen eyes of experienced geologists will guard us against break-throughs in the crust. Caution should be ample protection against rips in the precious space suits. We can explore the moon safely.

Our first step after arrival is to unload equipment and prepare for a six-week stay. Three awkward-looking but efficient rocket ships (none of them streamlined, because there is no air resistance in space) have carried us to the lunar surface from a man-made satellite 1,075 miles above the earth. On this voyage, two of the craft carried passengers and propellant for a return trip; the third, a one-way cargo vehicle, must be dismantled and converted into living and working quarters for the 50-man expedition.

We have arrived just at the beginning of the two weeks of sunlight that comprise the lunar day. From the catwalks of the ships, 130 feet above the moon's surface, the scene is dismal. The pitted surface of the landing area—a place known to scientists as *Sinus Roris*, or Dewy Bay, not far from the lunar north pole—stretches to the south like a vast, discolored expanse of broken ice.

On the other three sides, we are surrounded by towering mountains. The rays of the rising sun

CHESLEY BONESTELL



have painted the great mountain range a blinding white against the pitch blackness of the sky. But elsewhere, there is none of the brilliant color we are used to on earth—just dull, lifeless browns and grays. There is no cloud cover, no wind, no rain or snow—no weather of any kind. Overhead, pinpoint stars shine steadily; they don't twinkle, for there is no blurring atmosphere, as on earth.

Dust-covered, drab, silent, the panorama has the frozen stillness of a faded backdrop.

Within minutes after the landing, big cranes on the sides of the passenger ships swing out and start lowering expedition members to the ground. In our cumbersome space suits, we plod through the quarter-inch dust layer toward the cargo ship, whose crewmen are already starting the unloading operation. Our movements are restricted by the suits, yet we feel light. The moon's gravity is about one sixth that of the earth; a 180-pound man weighs only 30 pounds now. We wear weighted shoes to help pin us down.

The first equipment brought out of the cargo ship is one of our three surface vehicles, tanklike cars equipped with caterpillar treads for mobility over the moon's rough surface. The pressurized, cylindrical cabins hold seven men, two-way radio equipment, radar for measuring distances and depths, and a 12-hour supply of oxygen, food, water and fuel. Power is provided by an enclosed turbine driven by a combination of hydrogen peroxide and fuel oil (oxygen escaping from the hydrogen peroxide enables the fuel oil to ignite). The vehicle goes 25 miles an hour on flat ground.

As soon as the moon car has been set down and checked, a search party boards it to scout out a suitable crevice for the campsite. They drive off in a spray of dust which settles almost immediately, like the bow wave of a motorboat (there is no air to hold the dust suspended, as on earth).

The area around the cargo ship bustles with activity. Through our earphones, we can hear a stream of orders from the engineer in charge of unloading. All orders are addressed to numbers, rather than names; faces are not visible through the heavy antiglare glass of the helmets, and we wear numerals for identification.

By the time the search party returns, the ground around the cargo ship is littered with supplies: containers of water and liquid oxygen, canned and frozen food, scientific equipment, high explosives, rockets, the other two lunar cars and nine trailers (three per car) also track-equipped.

Ship's Hold Is Converted into Huts

In all, the huge cylindrical cargo hold, 75 feet long and 36 wide, has held 285 tons of supplies (less than 50 tons, moon-weight). But the silolike hold is itself part of the cargo, and must be unloaded from the framework of the ship. Its walls are laced with wiring, air-conditioning ducts, and water and sewage pipes; split lengthwise, the cargo cabin will become two buildings like Quonset huts, and the horizontal floors which separated it into compartments will be vertical partitions. We'll live in one hut; the other will be a laboratory.

Engineers direct the unbolting of the hold from the framework, and cranes lower the huge cylinder in sections onto trailers. Two of the lunar tractors hitch up to three trailers each, and the double convoy moves silently off for the headquarters site. A third convoy, loaded with supplies and personnel, brings up the rear.

The framework of the cargo ship now stands stripped and forlorn on the barren plain, only its personnel sphere left intact. We'll leave it there and use the sphere, with its expensive radio equipment and big disk antenna, as a station for communication with the earth—lonely, but essential, duty for the radio operators.

The crevice picked for the campsite by our search party is deep—we require a depth of 65 to 100 feet for safety—with almost vertical sides. Cranes attached to the rear of the lunar tractors lower an advance squad to the floor of the chasm. It's fairly level down there, but some big chunks of rock may have to be moved to clear the way for the two prefabricated huts; pickaxes and small explosive charges do most of the work, and the cranes do the rest. Now the sections are lowered.

The front ends of the tractors are firmly anchored to the moon's surface, and one by one the hut units are eased down the side of the gully. They are quickly assembled at the bottom; electrical circuits are joined, air conditioning, water and sewage pipes hooked up—and we're ready to move in. A power unit like those on the rocket ships—a solar mirror which heats mercury to produce vapor (like steam) for a turbogenerator—is set up at the lip of the chasm.

We have now been on the moon 48 hours. There has been little sleep for anybody, but the preparatory work is over. Supplies (including our store of high explosives) are now safely out of the way of vagrant meteorites; our living quarters and laboratory are ready to use—and we'll be ready to explore as soon as we've slept.

Sinus Roris, our landing area, was selected partly because of the opportunities it offers for exploration, partly because its temperature is livable—40 degrees Fahrenheit during the lunar daytime (at the lunar equator it hits a blistering 220 degrees), and 240 degrees below zero at night. That's mighty cold, but it's bearable on the airless, waterless moon, and we have heaters inside the huts.

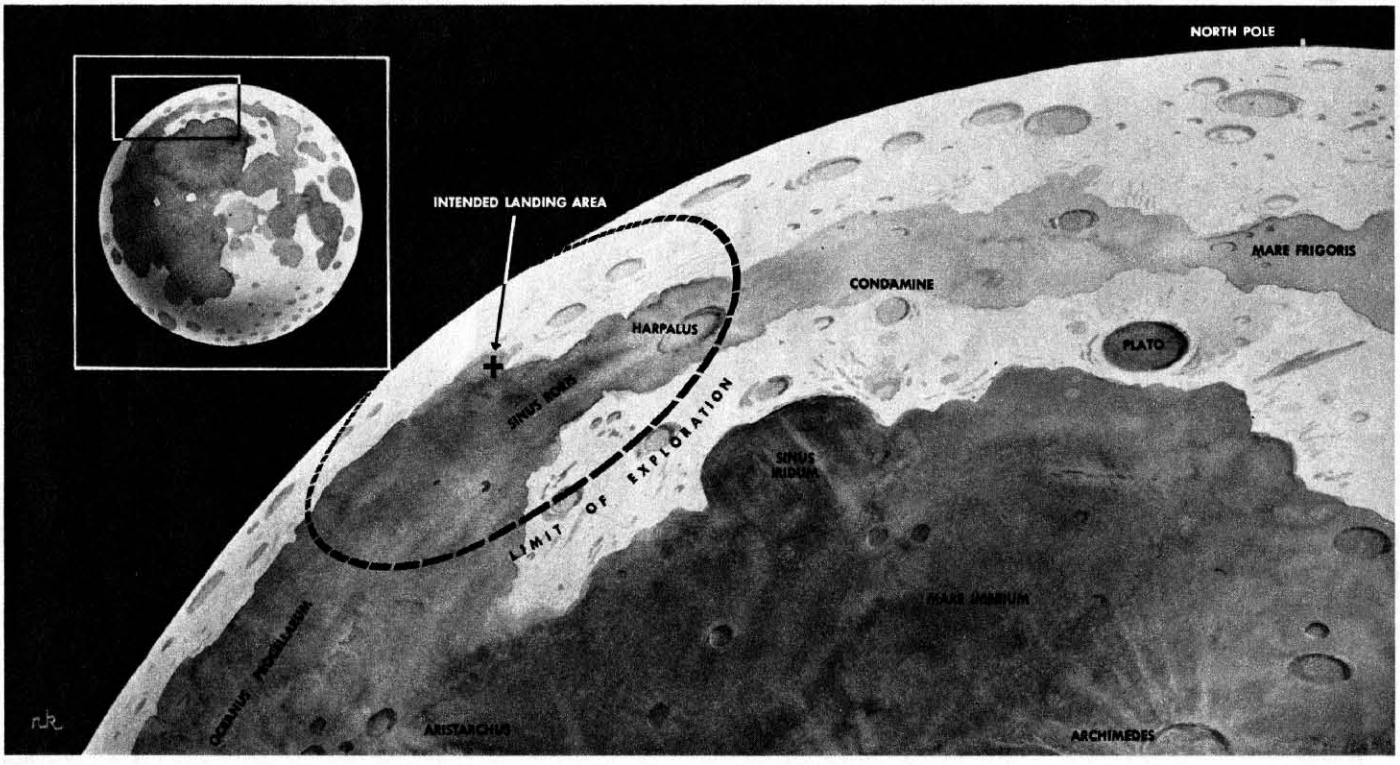
From our headquarters site, we can explore any place within a range of 250 miles, and all the lunar features of interest to our scientists fall within that area. It may require some long trips, though—the region involved is approximately as large as the whole northeastern part of the United States, north of Washington, D.C.; in other words, the size of the six New England states, New York, Pennsylvania, New Jersey, Maryland and Delaware. Besides looking over selected sites on the side of the moon visible from the earth, we'll also be able to see a part of the unknown side—the part always turned away from the earth.

What will we be looking for?

To start with, our scientists want to know whether any faint traces of atmosphere are present, what minerals there are (maybe we'll find some rare, useful ones), whether the moon has a magnetic field like the earth and how the temperature varies beneath the lunar crust. Sheer curiosity suggests other questions and will play a large part in our explorations. We're the first people who've ever been here, the first ever to peer into the mys-

Exploration area, within dotted line, covers 195,000 square miles, about equal to New England, New York, New Jersey, Maryland, Pennsylvania, Delaware. It lies in lunar northern hemisphere and can be seen by naked eye from earth at full moon (see inset, left)

ROLF KLEP



Hubble Meets Skylab

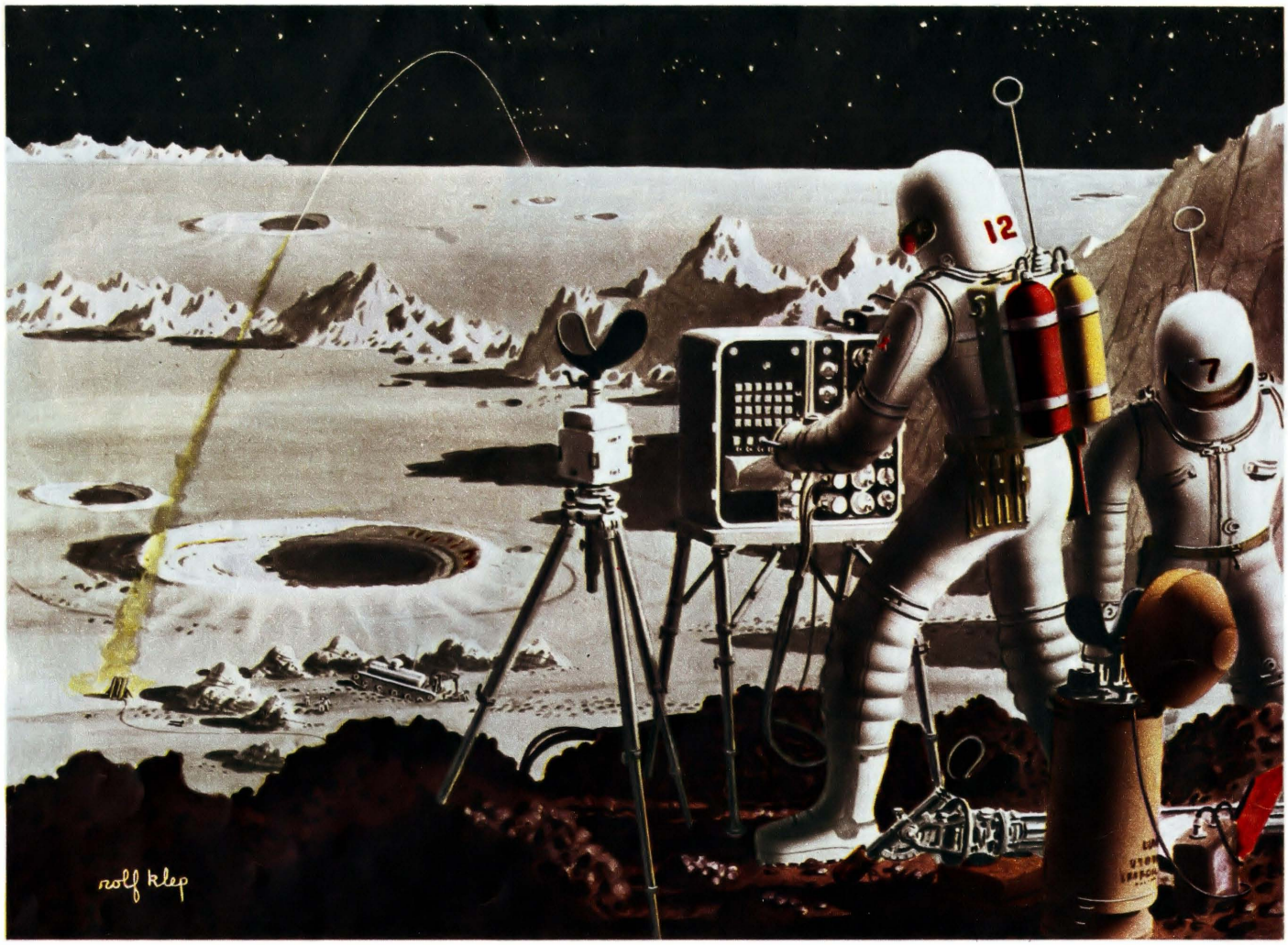
SCOTT LOWTHER, AEROSPACE PROJECTS REVIEW

A number of apparently completely independent space projects have been linked, even if only briefly. Two such programs were Skylab and the Hubble Space Telescope. For a brief period in 1970, there was work on joining the two together.

The idea for a large orbital astronomical telescope originated in the late 1960s as a logical outgrowth of the ongoing growth in orbital telescopes, both astronomical and military. Until well into the 1970's, the only effective ways to return telescope imagery to the surface was via television (which produces grainy low-resolution images in real-time) or via film (which produces high quality images, but very slowly). Since astronomical satellite telescopes have a much greater need of high quality pictures than fast images, large space telescope designs of the late 60's and early 70's tended to utilize film. A number of spy satellites used film that would be dropped to Earth by way of small capsules, but this entailed considerable risk of loss and limited the total

(Continued on page 70)

Aerospace Projects Review



ROLF KLEP

Causing moonquakes. Rockets with explosive war heads are fired off and scientists check vibration waves caused by distant blast, to determine interior composition of the moon. Seismograph in foreground is push-button controlled and surveying instrument to its left has cupped headpiece, to accommodate hand hooks and helmets of expedition members

terious lunar valleys, the first to examine the mountains and craters of the moon close up. Who knows what we may find on this virgin ball of unexplored rock, about five times the size of the United States?

The possibilities are exciting. Suppose we turn up a great store of raw materials; maybe then we'll want to recommend setting up a permanent community. We can make it practically self-supporting, securely encased inside a great plastic dome with its own synthetic atmosphere. Such an establishment could serve as a superb scientific laboratory —especially for astronomy and for research work requiring a vacuum; as a springboard for further ventures into space (if we can manufacture our own fuel on the moon, which is a possibility, we can make tremendous savings in the launching of a space ship); perhaps as a military base (the moon would be fine for launching military rockets, but hard to hit from the earth).

But the principal aim of our expedition during this first lunar exploration will be strictly scientific —and very important. Our investigations will help us unravel the secret of the universe: how the moons and planets were born and what they're made of. Up to now, all our information on that subject has come from examination of the earth and from surveying the heavens from observatories. The moon will give us a new perspective: a different look at the astral bodies and the story of its own birth as a clue to the birth of other satellites, planets and stars.

We know that the moon didn't form in the Pacific Ocean and get hurled into space, as was generally believed 50 years ago. It *is* possible that it was an independent planet which came from outer space, fell into the earth's gravitational field, smashed into the Pacific and then ricocheted back into its present orbit. But the most likely explanation is that the moon originally consisted of a belt of gases and minerals that girdled the earth—much as Saturn's ring surrounds that planet today—and eventually fused into a solid mass.

That's the theory we'll check.

First, if there are faint traces of such heavy gases as xenon and krypton, we'll know the moon was never a completely molten, hot mass (for extreme heat would have dispelled *all* gases), and so could not have been an independent planet. We'll find out by using a rotary pump which will compress whatever gases may exist and capture them in a bottlelike container. It probably will take many days to accumulate enough of whatever gases there may be, but checking them will be fairly simple.

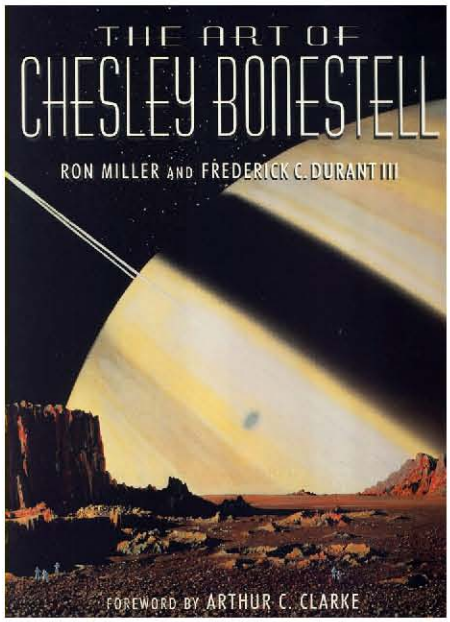
Does the Moon Have an Iron Core?

Then we'll look for a magnetic field. If we don't find it, we'll have another indication that the moon doesn't have an iron core, as an independent planet would. Compasslike magnetometers will do the trick for us; if the moon has magnetic poles as the earth has, they will show up (isolated iron deposits also will register, but they will be easily distinguishable from a core).

We'll also shake up the moon's surface a bit. Scientists have learned a lot about the earth from earthquakes. The vibration waves of a quake travel freely through solids, but some of them cannot pass through liquids—which is how we know that the center of the earth is molten iron. We can't count on having moonquakes, so we'll make some: we'll send off rockets with high-explosive war heads and then read the story of the waves from our seismographs. The explosions, occurring about 100 miles away, will show if the moon's core is molten (in which case, our waves will be stopped), solid (they'll go right through), or a jumble of rocks which never have been molten (muffled waves).

There is another clue to the moon's origin: the scars on its surface. The plains of the moon are rough and scored by fissures. Close examination will disclose whether these score marks are cracks or wrinkles. Wrinkles will indicate that the moon was molten at birth, and has cooled since. Cracks will be evidence that it was cool to begin with and has since been heated, perhaps by radioactivity. Fortunately, these lunar birthmarks have not been washed away by erosion, as has happened on earth.

So much for the moon's past. There are also some facts we want to learn about its present. One of the most important is the exact intensity of the cosmic rays which strike it. As soon as we're settled in our quarters, we set out instruments to measure the rays. Another is the frequency of meteorite hits. Careful measurements also will be kept of the surface temperature caused by the sun, and we'll want to measure the subsurface tempera-



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

A Chesley Bonestell Space Art Chronology

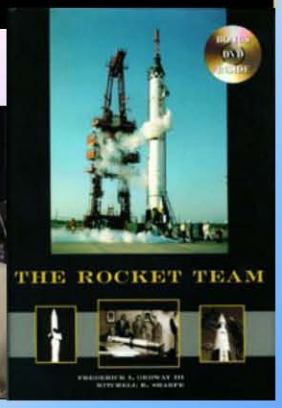
Melvin H. Schuetz

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

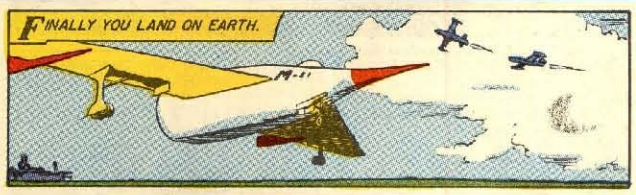
Non-Fiction Children's Books about Space Flight from 1945 to 1975

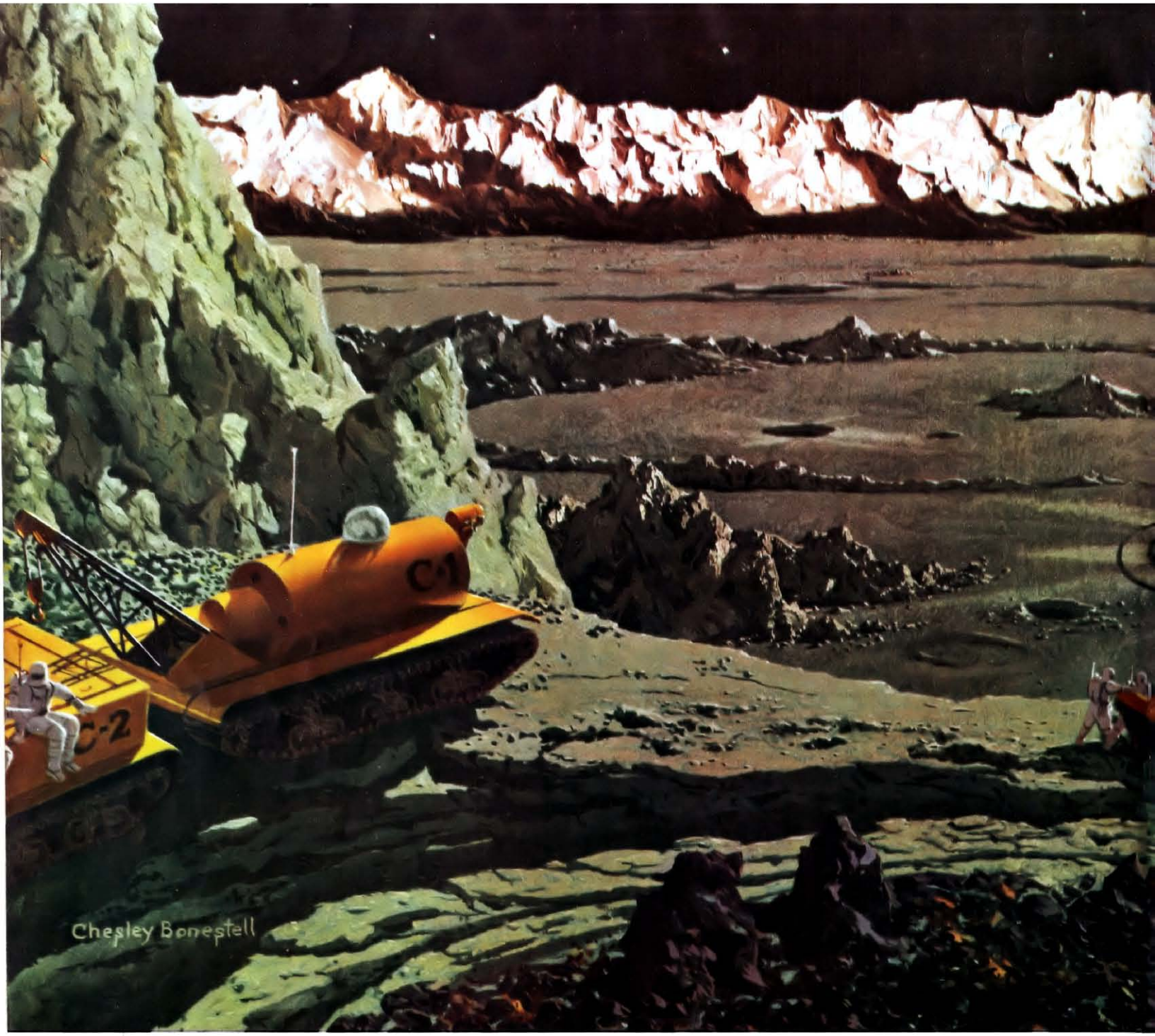
http://dreamsofspace.blogspot.fr

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.





At end of two-week-long lunar day, convoy of tractors, each pulling two of its three trailers, moves cautiously across rough terrain near plain

ture at varying depths (it may be considerably warmer than the surface, due to radioactivity).

For two weeks, we devote ourselves to research on these points, past and present. The expedition breaks up into teams, each with its own assignment. Most of the investigating during this period is done within a 10-mile radius of the base. It's difficult, dangerous work. We climb across meteor pits, into chasms, up great rock piles, struggling in our bulky suits, always fearful of snagging ourselves on sharp outcroppings, always nervous about stray meteorites and watchful for thin crust.

Because we'll never be really certain how safe we are on the moon, however long we stay, we keep up a chatter over our walkie-talkie radio transmitters, not to bolster our courage, but for a practical reason: if something happens to us, the people back at headquarters will have a record of our findings.

For the same reason, lunar headquarters maintains constant contact with the earth. Back there, a special panel of scientists remains in constant session, as it will all during our six-week stay. A dozen specialists in fields like astronomy, astrophysics, geophysics, mineralogy and geology follow our every move by radio (as, indeed, does the entire world), keeping track of our findings, suggesting new leads and occasionally asking for the repetition of an experiment. Television transmission is impractical, but every day dozens of photographs are radioed back to earth.

For those of us on the moon, the work is endless and fascinating. We collect samples of everything in sight—dust (where did it come from; what's it composed of?), mineral specimens, rock and lava fragments. Besides scouring the lunar surface, we make test drillings several hundred feet into the moon's ground, and collect more samples that way.

We work in almost frantic haste during these two weeks, trying to make the most of the brilliant sunlight. We eat and sleep in shifts, so that there will be no halt in the research, no break in the flow of information back to the earth.

But soon the sun begins to slip over the horizon. For a while, there's still plenty of light; work slows down, but not entirely. For several days after sunset, we live in a kind of twilight, with a cold, but fairly bright, illumination cast over us by the earth (it reflects about 60 times as much sunlight on the moon as the full moon reflects on the earth). The browns and grays of the lunar day take on a green tint; mountains throw long shadows; craters and chasms appear jet black. The light grows dimmer as the "full earth" becomes a "half earth."

Now comes an exciting moment: the start of our longest expedition. We've had to wait to make it, because all the vehicles have been in constant use for the vital explorations near the base; as a result, we'll have to travel outbound in comparative darkness. That's not desirable, but it's possible, and we have no alternative.

of *Sinus Roris* (Dewy Bay). Glare of mountain range to north is caused by setting sun. Remainder of scene is illuminated by greenish earth light

Our destination is a crater about 195 miles away as the rocket flies, but about 250 miles off by lunar tractor. This crater, called Harpalus, is the most interesting one within reach—24 miles across, with a surrounding ridge 3,100 feet high, and a depth of almost 11,000 feet from peak to bottom.

It must have taken a monstrous meteorite to smash into the moon with such force—or was it a meteorite? That's one of the questions we want answered. All we know before we start is that a meteorite *could* make such a crater—if it were the size of a small mountain, and traveling at a speed of thousands of miles an hour. Another mystery we can solve on this journey is the nature of the great white marks which radiate for tremendous distances from the most perfect (and perhaps the newest) craters. Maybe they're powdered dust, shot out by the impact of meteorite against moon; maybe their origin is volcanic. We'll soon know.

Our expedition consists of two tractors, hauling three trailers each. Ten men are making the trip, and we carry supplies and fuel enough to last about two weeks. The outbound trip should take a little less than five days, the return journey, made in sunlight, perhaps four; we also want to spend a day or two at the crater. That's 10 days. We carry an extra four days' emergency supplies.

The trip is slow and difficult. The two vehicles cautiously pick their way around great rocks and deep pits, making about two miles an hour over the rough ground. Powerful searchlights and radar probe for major obstacles; at suspicious places, a geologist hops out to scan the ground for thin crust and feel his way afoot. When, despite our precautions, one of the tractors gets stuck in a rut, the other hauls it out.

At selected points along our course, we stop and plant explosives—part of our vibration-wave experimentation—which technicians back at headquarters will fire later by remote control (the explosions will be visible from the earth through strong telescopes).

After four days, the perimeter ridge of Harpalus looms ahead. As we press on, the first rays of the sun—marking our second lunar day on the satellite—glare off the side of the ridge and the mountain range to our left. By the time we get to the base of the ridge, full sunlight pours down on us again.

From a few miles away, the crater rim is measured with surveying instruments and photographed with special cameras. As we move closer, lava samples are collected, and holes are drilled for additional specimens. Other members of the expedition take temperature readings, check for magnetism and gather dust specimens.

Scaling the crater wall is a hard job. In some places, where the ridge is rough, we can make slow progress with regular mountain-climbing equipment; elsewhere, steep walls compel us to shoot grappling hooks up the sides by means of rockets;

PAINTING BY CHESLEY BONESTELL

rope ladders then enable us to reach the rim. The party descends as far as it can into the mouth of the crater. When no further progress is possible, we lower one man by rope to examine the floor and gather lava specimens. It's tricky, dangerous work; despite the relatively slight gravitational pull, a tumble would be just as dangerous as on earth, for there's no atmosphere to retard a falling body.

We work swiftly, for our time is limited. After a day or two at the crater, we start back, making a detour to examine the mountain range to the northeast, where there are interesting rock and lava formations and cavelike holes of unknown origin. The trip home is faster than the journey to the crater; the vehicles are heavily laden with specimens, but there is light to drive by. In a few days, we're back at the headquarters crevice.

Now the six hectic weeks of exploration draw to a close. At the landing site, electronic engineers set up automatic recording instruments which will radio scientific observations to earth after we've taken off. These stations (not much larger than an office desk) house delicate instruments which record cosmic radiations, tremors caused by the impact of meteorites hitting the surface, temperature changes and other scientific data. They are connected by cables to the skeleton of the cargo ship, which we're leaving behind. The ship's solar mirror generates power for the instruments, and the dishlike antenna will flash the readings to earth. Unless these automatic stations are destroyed by meteorites, they will operate for years without human supervision.

Engineers and technicians clamber over the passenger ships, checking pumps, rocket motors and electrical connections. The day before take-off, specimens for later study, oxygen and any remaining food are loaded onto the trailers at the lunar base. The entrances to the two huts are left open, permitting the synthetic atmosphere to escape; all material in the living quarters and laboratory will now be preserved by the vacuum of space.

During the next few hours, the cranes of the two ships haul up supplies. Each lunar tractor, when finally unloaded, is parked beside the skeleton of the cargo ship, to remain until the next lunar expedition. At last the cranes complete the loading

INSIDE the LUNAR BASE

By WILLY LEY

NOTED ROCKET SCIENTIST AND AUTHOR

THE first visitors to the moon will travel 239,000 miles through space—and then go underground at their destination. For their six-week stay, their home will be in a deep chasm, for protection against meteorites and cosmic rays. The cylindrical hold of the cargo-carrying rocket ship is split into lengthwise halves, 75 feet long and 36 wide, and lowered in sections by the cranes of our lunar tractors. One of the halves becomes a laboratory; we live in the other.

In the picture at right, one tractor is seen at the lip of the crevasse, lowering scientific specimens from the surface. Expedition members may also use the crane to enter the chasm, or they may climb down the light extension ladder at the left. Between the ladder and the tractor is a power plant like those on the rocket ships: a solar mirror focuses the sun's rays on a mercury pipe, creating vapor which drives a turbogenerator.

Each of the two buildings has its own air-conditioning, oxygen and water-recovery systems (the latter captures and cleanses for re-use all the moisture in the synthetic atmosphere we have provided within the huts). The air-conditioning and water-recovery plants of the laboratory building (rear) are visible just behind the ladder, on the first floor. Next is the chemical analysis room, and, to its right, the photographic darkroom. The radio operator works in the compartment next door, keeping in constant touch with fieldworkers, and recording their reports on tape. (The tapes are passed on to the radio operator in the cargo ship for transmission to the earth.) The upper floor at this end of the building is used for supplies and water storage (note the cylindrical water tanks).

The central unit of the hut contains a two-story screen for viewing color photographs, slides and films made in the course of the scientific investigations. At the far side of the room is a physical laboratory; experiments to determine whether the moon has an atmosphere are made here, and mineral samples are checked for magnetism, radioactivity and so forth. The projection room is visible under the pipes; next to it, through the open door, is a small conference room. To the right of the conference room, behind the small ladder, is a dispensary. Records are kept on the balcony above it.

The entire right-hand section of the lab building is an entry chamber, with space suits suspended by pulleys overhead. To get in and out of the huts, we crawl through air locks. A man is shown entering the laboratory air lock; the spring-loaded outer hatch will clap shut behind him, and a twist of wheel will open the inner hatch. (The wheel can be seen in the air lock of the other building, through which a man is about to leave.)

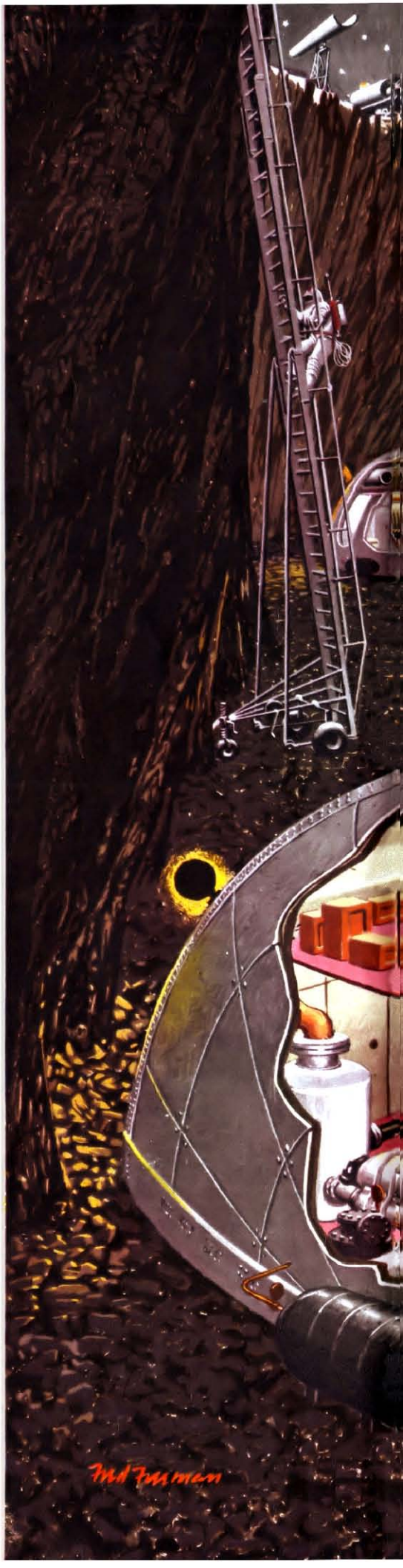
An airtight pipe connects the two huts; in an emergency, it can carry either water or air from one building to the other.

In the foreground of the hut used for living is a close-up view of the air-conditioning and water-recovery systems. The compartment behind it contains berths and lockers for most of the expedition members and, on the right, a washroom. (Bunks for the remaining personnel are on the second floor, which runs the length of the building and is otherwise used mainly for supplies.)

The large middle compartment has the expedition's kitchen and dining room. A dumb-waiter leads to the storehouse on the upper floor. The table-and-bench units in the dining area can be raised to the ceiling when not in use (one is shown in raised position). Against the right-hand wall of this section are washing machines, a hot-air drying room and a shower closet. The rearmost stalls on this wall are clothes lockers.

Oxygen supplies for both buildings are contained in the cylinders shown on the outside walls of the huts (they're placed there to save space). Also on the outer walls are floodlights to illuminate the dark interior of the chasm.

Here, 65 to 100 feet below the surface of the moon, the visitors from the earth spend most of their time during their lunar visit.



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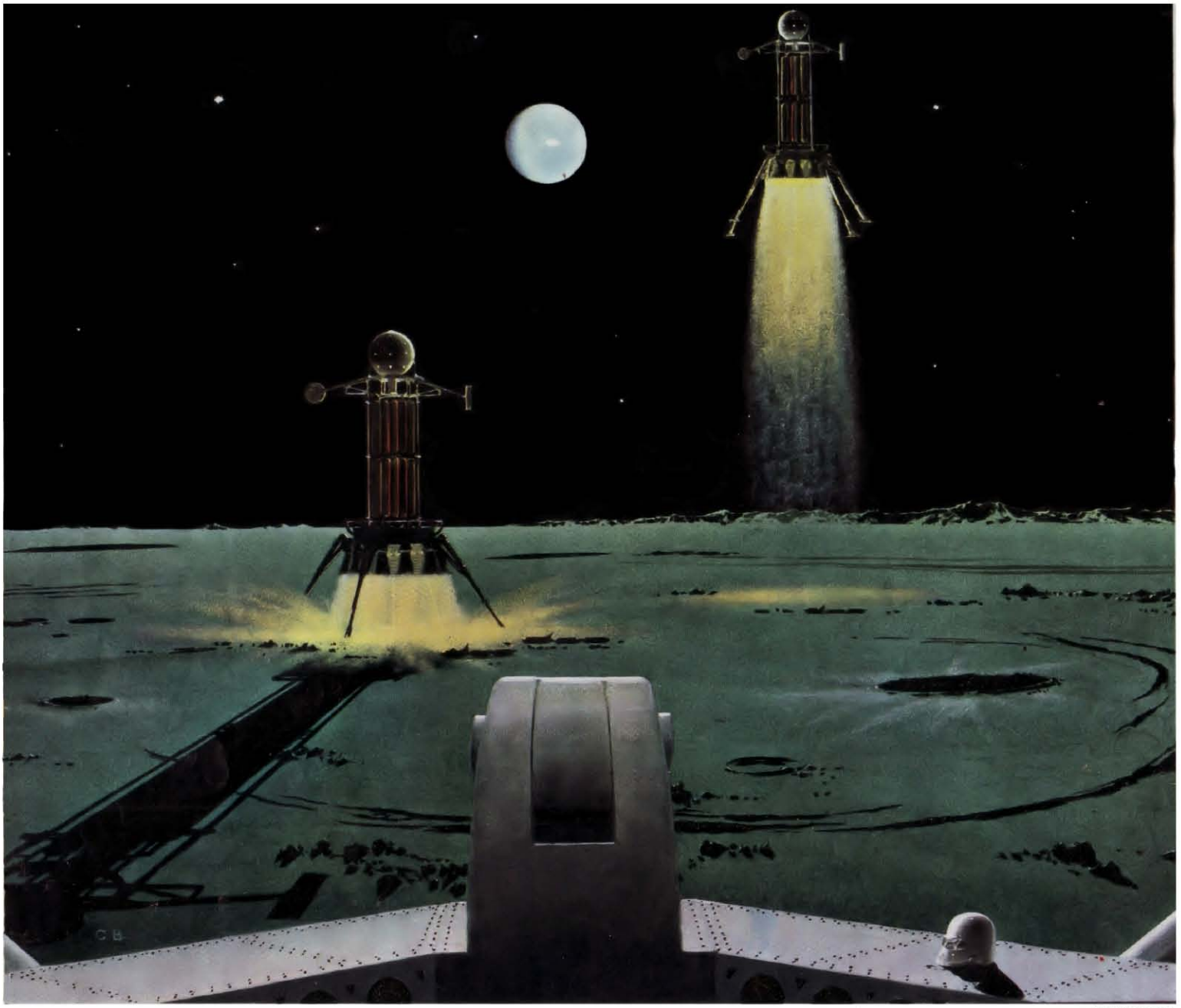

CHESLEY BONESTELL

Seen from abandoned cargo ship with "full earth" shining in sky, passenger ships take off for return trip from the moon to space station's orbit

of equipment and start hoisting men up to the catwalks of the two rocket ships. Then the cranes are folded against the framework, ready for flight.

Through the intercom, the commander of the fleet counts off the seconds to take-off. At X minus 4 seconds, a thunderous rumble sounds in the passenger spheres: the rocket motors have been started. The turbopumps are switched on, forcing hydrazine and nitric acid into the motors.

One by one, the ships slowly lift from the surface. An automatic pilot performs the complicated take-off maneuvering which will set us precisely on course for the space station circling the earth 239,000 miles away. We have timed our departure so that we shall arrive at the space station at the precise moment when its orbit is lined up with the direction of our travel.

Immediately after leaving the ground, the ship's four spiderlike corner legs are jettisoned to save weight; soon afterward, the central shock-absorbing leg is burned away by the fierce heat of the rocket motors around it.

By now, our earth-weight has returned, and we feel astonishingly heavy. As the ship picks up speed, we are made heavier and heavier by the force of acceleration, until at an altitude of 40 miles from the moon, about 2½ minutes after take-off, we weigh 3½ times normal earth-weight.

We have reached maximum powered speed at this point: 4,200 miles an hour, sufficient to counteract the moon's gravitational pull and its 2,280-mile-an-hour speed in its course around the earth. We can now cut our motors; momentum will carry us beyond the moon's gravity, and from that point on we'll simply fall toward our destination. As the flame of the rocket motors dies away, we become weightless once again.

From here on, the flight is routine. The navigators keep constant check on our flight path (we can change course by using our rockets), fixing the position of the ships in relation to star constellations and the steadily growing globe of the earth. Far behind us, and to the right, the moon becomes correspondingly smaller.

Once past the neutral point between the gravitational fields of the moon and the earth, we start our fall, picking up speed constantly. At a distance of 131,000 miles from the space station's orbit with 20 hours of travel to go, we hit a speed of 4,300 miles an hour. Eighteen hours later, a little less than 17,000 miles from the orbit, our speed reaches 10,500 miles an hour, and we start to think about slowing down. We cartwheel our ship (by using a flywheel which, turning in one direction, causes the ship to turn in the other), so the rocket motors point toward the space station. Now we watch our speed carefully. Ahead, the man-made satellite, looking like a bright star, is traveling around the earth at 15,840 miles an hour. When our speed reaches 22,200 miles an hour, we turn on the motors. Because they point in the direction of our movement, they act as brakes.

Gradually we slow down. As we get closer, we cut the motors to half power. The needle of the speed indicator backs across the dial. When it hits 15,840, our motors are off. We are now a satellite of the earth, traveling in the 1,075-mile-high orbit at just the right speed to counteract the earth's gravity. A few miles away is the space station, endlessly circling the earth at the same speed.

We are back at our starting point. Man's first exploration of the moon has ended. Space taxis speed toward us from the station. Other men pour out of the satellite's air lock to greet us.

Our next trip will be a short one: two hours to the earth, aboard one of the sleek rockets parked nearby. There, the members of our scientific panel await us—and, without question, a great crowd of earthlings, come to see the first men ever to set foot on the ancient, mysterious soil of the earth's closest neighbor in the heavens.