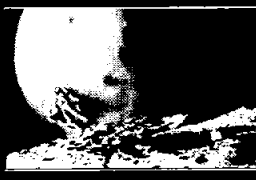


You may be taking time off for the holidays, but some JSC workers will be working Christmas day to keep the center running. Story on Page 3.



NASA's Office of Exploration says modest technology investments today can prepare us for exciting turn-of-the-century missions. Story on Page 4.

Space News Roundup

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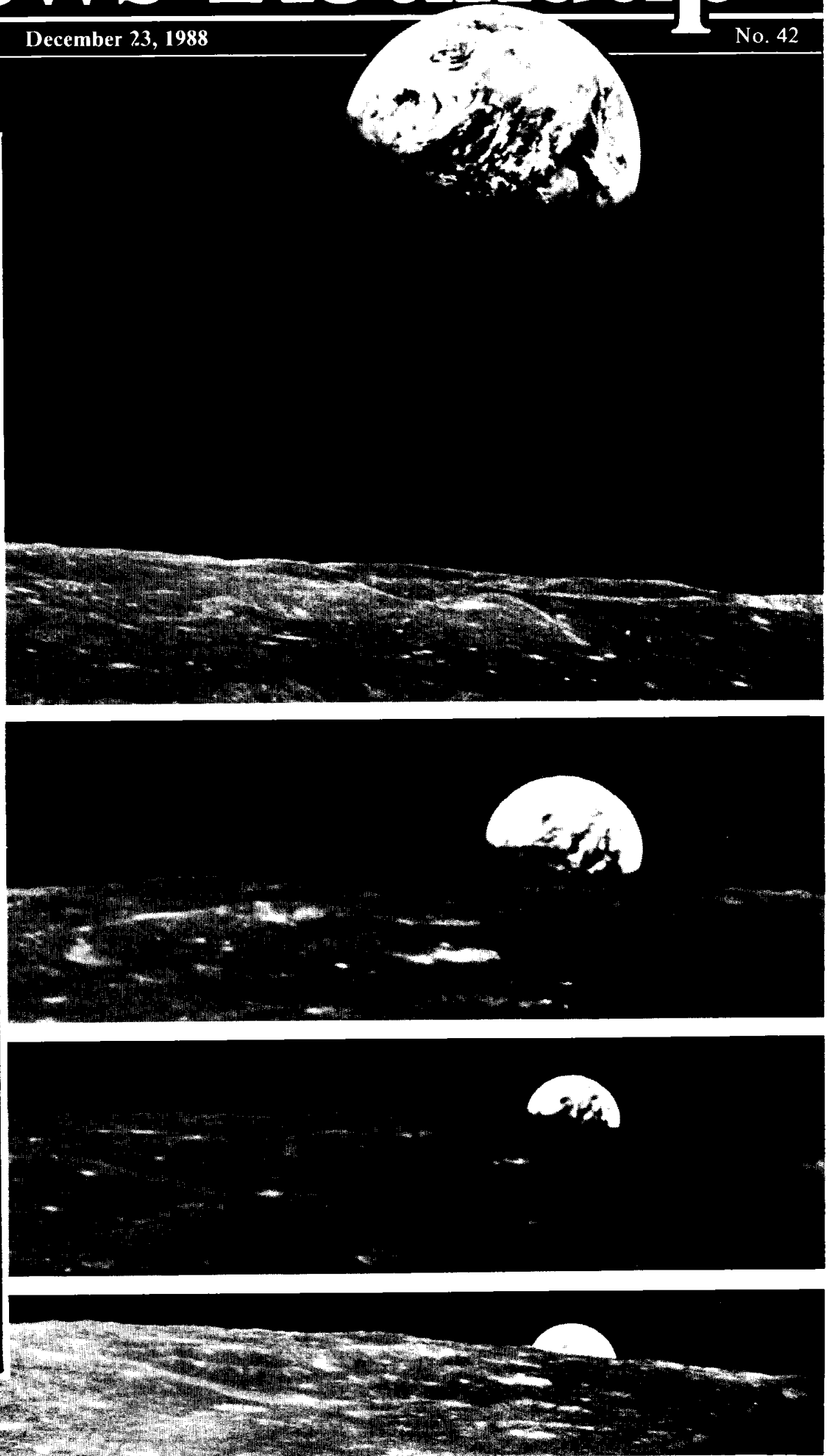
December 23, 1988

No. 42

Season's Greetings

Two decades ago today, three men left the gravitational pull of our planet — the first time humans had ever done so. Twenty years ago tomorrow, they became the first people to witness an Earthrise. These were momentous accomplishments for the crew, for NASA and for this center. But we did not stop to rest on our laurels, we forged ahead and landed men on the Moon, built the space station Skylab from spare parts and began the Shuttle era. This past year, we've made some exciting accomplishments — sending 10 men into orbit aboard Discovery and Atlantis, and returning them safely home to us in Houston. But again, there is no time to rest. We must build on our new beginning and keep our Shuttle flying. We must strengthen our bridge to low-Earth orbit and use it to build a permanent space station. From there we can choose where to go next. This holiday season, we can both rejoice at our successes of the past year, and look forward to the challenges of the next. To all of you and your families from me and mine, have a wonderful holiday and a prosperous new year.

Aaron Cohen
Aaron Cohen



APOLLO 8: Elegantly simple solution reenergizes Apollo program

[Editor's note: This is the conclusion of a two-part article on the events and decisions leading up to the Christmas 1968 flight of Apollo 8.]

By Brian Welch

By July 1968, NASA was facing an ever tighter deadline for reaching the Moon. Fewer than 18 months remained before the end of the decade, and problems with the Lunar Module (LM) program threatened to throw the schedule off track. It began to look as if a lunar landing before 1970 would not be possible.

Despite problems with the LM, however, the Command and Service Modules (CSM) program was going well. It was at this point that George M. Low, the Apollo Spacecraft Program Manager, proposed the Apollo 8

mission, originally intended as an Earth-orbit test of both spacecraft, be altered. Under the plan proposed by Low, NASA could save time and turn adversity to advantage by sending the CSM to the Moon.

In early July, Low and Center Director Robert Gilruth presented the idea to the men responsible for flight operations and flight crews: Chris Kraft and Deke Slayton.

"We were taken aback," Kraft remembers. Kraft and Slayton consulted their experts, Low consulted his. Kraft met with a small cadre of his operational troops—Arnold Aldrich, now director of the Space Shuttle program, Eugene

F. Kranz, now Director of Mission Operations at JSC, Clifford Charlesworth, recently retired from JSC after serving as the director of Space Operations, and Jerry Bostick, now an executive with the Grumman Corp. Kraft gave his team two days to respond to the idea.

The plan was surprising, but not shocking for Kranz and JSC Director Aaron Cohen, then working on CSM development.

"I got a call from Kenny Kleinknecht, who was the Apollo Command and Service Modules project manager, saying I needed to meet with George Low," Cohen remembered.

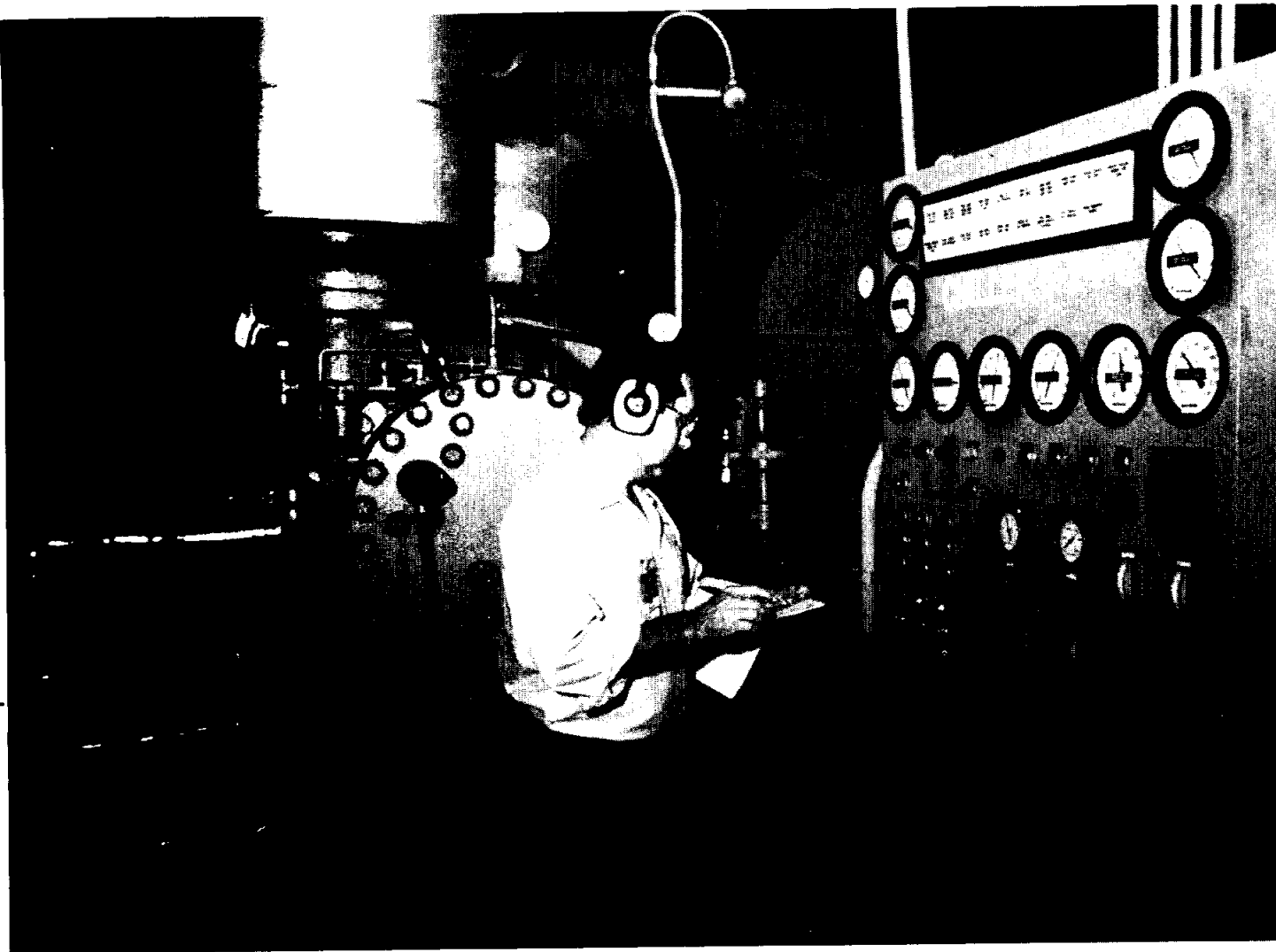
"George Low explained the mission to me and asked me to verify that the Command and Service Modules could do that mission. My role at the time was to validate the hardware. Was it certified? Was it of the integrity that would allow us to do that part of the lunar mission?"

Cohen ended up writing the memo for Low's signature that stated the vehicle was indeed ready to make the voyage.

"It wasn't a tremendous shock, but it was a very bold maneuver, a bold step from where we were. I don't think I was really shocked—more enthusiastic and excited. That was the mood of the center. Everyone thought it was great; they thought it was exciting, they took on the challenge."

Please see LUNAR, Page 4





Ralph Riggs, a utility operator for Pan Am World Services, monitors the operation of heating and cooling equipment in Bldg. 24. Riggs will be working the 3-to-11 p.m. shift Christmas day.

For a few, JSC is home for the holidays

Heating and cooling plant workers will spend Christmas here

By James Hartsfield

The heart of JSC is big, but it isn't pretty.

It pumps steam and chilled water, 24 hours a day, day in, day out, through the center's miles of underground arteries. If it stopped, computers would overheat, laboratories would freeze, America's manned spaceflight center would grind to a halt.

And that's why the workers who keep it running are at their posts around the clock. In Bldg. 24, the Central Heating and Cooling Plant, there's no Thanksgiving, no Christmas, no New Year's Day. Amid its five gigantic boilers and its seven huge water coolers, there are nuts and bolts and sweat.

The buildings of JSC contain

some spectacular high technology, graceful wonders that help put men and women into space. But without Bldg. 24, those buildings—and the people in them—couldn't function.

"This is the heart of the space center," says Warren Colar, Pan Am's chief operator of the facility. Colar's worked at JSC for 11 years. And he's worked on 11 Christmases.

"If this building has a problem, then the whole site's got a problem," he says, surveying the noisy, black boilers and yard-thick pipes that surround him, huge machines he knows so well. "Without us, all of the buildings would have to shut down."

Colar will work the graveyard shift this Christmas. But his family's

used to it. "They realize I have to work. Somebody's got to do it," he says. "I'll get off at 7 a.m., and I'll stay awake 'til 1 p.m. Then I'll go to sleep right after Christmas dinner."

He'll have Dec. 27 off, then report back on Dec. 29. "And I'll work on New Year's, too," he adds.

Most JSC employees probably don't know where Bldg. 24 is, much less what it contains or who. In an average month, more than 44 million cubic feet of natural gas warm about 31 million pounds of steam, which, in turn, warm you. Four million one hundred and two thousand ton-hours of cooling is generated each month, on average, in both summer and winter. Most computer rooms on site generate so much heat that they require air conditioning every day of the year.

All of that results from touches on a thousand thermostats.

Unless there's a problem, Bldg. 24 is just another building. And that's the way it's supposed to be; that's the point of shift after shift after shift that clocks in and clocks out there.

Parking's no problem in the center at 3 o'clock on Christmas morning. "We just kind of name our spot," Charlie Pattison says.

Pattison is a Pan Am shift supervisor in operations at Bldg. 24. He'll work the graveyard shift with Colar. "There's nobody else here except for a few from security and the fire department," he says. "Your family adjusts. It's just something you learn to live with—we normally have our Christmas on Christmas morning anyway, and I get off at 7,

so..."

At any given moment during any given year, be it pre-dawn on Christmas or late night on July 4, at least 10 people will be at work to keep the center's temperature just right. At least three work in Bldg. 24, and another person oversees six roving operators who constantly check buildings to make sure their air conditioners are working.

"The utilities are something I think we all take for granted. You only hear from people if the office is too hot or too cold," says Bill Roeh, deputy chief of the Plant Engineering Division. "I consider the people who work there some of the unsung heroes of the site. They're the ones that keep this center up and running."



Above: L.K. Fuller, a Pan Am supervisor in the Central Heating and Cooling Plant, and Don Sims, a utility operator, stand among the Bldg. 24 chillers that—holiday or no holiday—keep JSC buildings cool. Many buildings need to be cooled even during the winter because of the heat radiated by computers. Right: Electrician Larry Miller, a Pan Am World Services utility operator, works on a circuit breaker in Bldg. 24.



JSC pumps \$860 million into local economy

JSC pumped about \$860 million into the local economy during the past fiscal year, and the total number of workers supported by the center hit an all-time high.

According to the annual JSC economic impact statement released Dec. 12 by the JSC Comptroller's Office, the center supported 10,035 aerospace industry and support contractors in fiscal year 1988 which ended Oct. 1. The number easily eclipses the previous high of 9,896

contractor employees reached in 1969 at the height of the Apollo Program.

Civil service employment at JSC totalled 3,457 last year, a figure that is rising but still below the all-time peak for federal employment at the center of 5,261, reached in 1967. Last year, JSC paid out \$147 million in federal salaries.

Other major portions of the center's total contribution to the local economy included \$3 million paid for air travel

and \$710 million paid for goods and services from 1,200 local firms. Center expenditures last year averaged about \$3.3 million each working day.

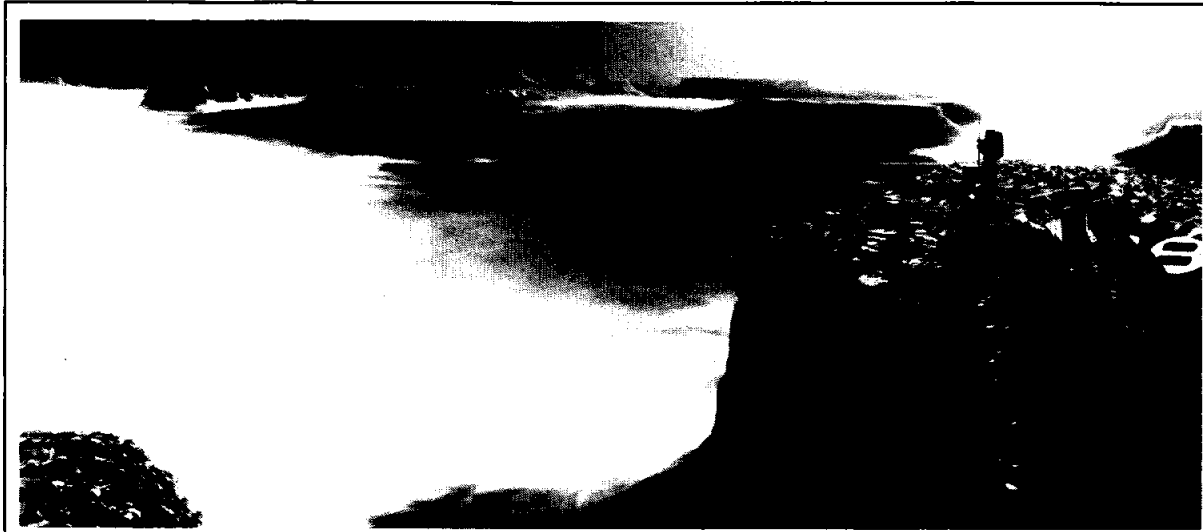
JSC received about \$1.5 billion, or 17 percent, of the total \$9 billion 1988 NASA budget. The majority of that funding, \$1.2 billion, went toward research and development. About \$10 million went for construction of facilities and research and program management, an area that includes salaries, utility bills and maintenance,

among other things, took \$284 million.

With its size, JSC spends a tremendous amount annually on utilities. In 1988, \$1.5 million went for gas, \$6.7 million went for electricity, \$8.2 million went for communications, and \$300,000 went for water and sewer service. Of the total NASA budget in 1988, about \$913 million was spent in Texas, making it the second-ranking state behind California among recipients of agency funds.

Since JSC moved to Houston in 1962, the center has contributed at total of \$35.4 billion to the local economy, including about \$2.5 billion in federal salaries.

Currently, the average civil servant at JSC makes \$42,007 a year, an increase of more than \$1,000 over 1987, and is 43.2 years old. Employees hold bachelor's degrees, 594 have master's degrees and 178 have doctorates or other advanced degrees.



NASA illustration by Pat Rawlings

An illustration from the Office of Exploration's annual report depicts the first two humans to walk on Mars exploring the Noctis Labyrinthus canyon at Valles Marineris.

Exploration office issues report

NASA's Office of Exploration (OEXP) on Monday released the first in what will be a series of annual reports on planning efforts and the nation's current capabilities for future human exploration of the solar system.

The report, entitled "Beyond Earth's Boundaries—Human Exploration of the Solar System in the 21st Century," details OEXP's work during the past year to better understand the efforts required to comply with the National Space Policy directive to "expand human presence and activity beyond Earth orbit into the solar system."

A major conclusion is that the U.S. must now lay the foundation by

pursuing detailed research, technology development, concentrated studies and a strong commitment to ongoing NASA programs. Critical ongoing programs identified are: completion of Space Station Freedom; continuation of Project Pathfinder; pursuit of a critical life sciences research program to be the foundation for long duration space habitation; and continued development of more capable Earth-to-orbit transportation systems.

OEXP examined four possibilities encompassing a broad range of objectives, requirements and capabilities. All addressed the prime directive of expanding human presence and activity beyond Earth orbit,

but each emphasized a different pathway and destination.

They include: "Human Expeditions," studies of a manned mission to Mars or to its moon, Phobos; "Science Outpost," a study of a manned lunar observatory on the far side of the Moon; and "Evolutionary Expansion," a methodical, step-by-step program to open the inner solar system for exploration and permanent human presence, using a lunar outpost as a stepping stone to similar outposts on Mars and its moons.

An in-depth discussion of the OEXP report is contained in a three-volume series entitled "Exploration Studies Technical Report: FY 1988 Status," to be available in early January 1989.

Lunney to manage Rockwell-Houston

Glynn S. Lunney, a former longtime JSC manager, has been appointed vice president and general manager of Houston operations for Rockwell International's Space Transportation System Division and president of that division's subsidiary, Rockwell Shuttle Operations Co. (RSOC).

Lunney replaces Robert Minor as RSOC president, and he will direct the performance of two Space Shuttle contracts at JSC—the Space Transportation System Operations Contract (STSOC), and the System Integration and Shuttle Orbiter Vehicle Development Contract.

Minor last week was promoted to president of the Space Transportation Systems Division and transferred to division headquarters at Downey, Calif.

As RSOC president, Lunney will lead the 4,000 employees who manage Space Shuttle operations for

NASA under the \$240 million STSOC. The STSOC contract, awarded in 1985, consolidates 22 JSC Shuttle operations functions previously performed by 17 different contractors.

Lunney most recently had been STSD vice president for Business and Advanced Development. Before that, he was executive vice president of Rockwell's Space Station Systems and Satellite Systems Divisions.

The former manager of both the Apollo and National Space Transportation System Programs joined Rockwell in 1985. He had worked for the National Advisory Committee for Aeronautics (NACA) from 1958 to 1959, and served as a member of NASA's Space Task Group, which developed the Mercury Program to put the first Americans in space, from 1959 to 1962. Lunney moved to JSC in 1962, and spent the bulk of his 30-year NASA career in Houston.

Quality award nominations open

Nominations for the second JSC Quality Partnership Award, to be presented by JSC's Safety, Reliability and Quality Assurance Office (SR&QA) will be accepted until Jan. 15.

The award is designed to recognize professionals who do not work in the quality field, but who make significant contributions to quality. The first Partnership Award went to Gordon H. Stauble, a group manager for the Unisys Management and Training

Software Department.

Presentation of the second award in January will begin a quarterly series. Nominations are now open, and must include the name of the nominee and a brief summary of the person's outstanding contributions. Nominees must be employed by NASA, NASA contractors or involved with NASA-related contracts.

Nominations should be sent to T.J. Adams, Chief of the Quality Assurance and Engineering Division, Code ND.

Lunar orbit insertion plan raises stakes

Tension unbearable as Apollo 8 disappears behind Moon

(Continued from Page 1)

According to Kranz, "By the time we got into early Apollo, the space program had moved to a point of confidence in leadership, and confidence that our leaders had a good sense of timing and direction. This meeting was not unlike other meetings we had in the Gemini program, where all of a sudden the managers came in and said, 'Hey, let's do an EVA on Gemini 4.'" It was, Kranz recalls, "good, quality, gutsy decision making."

But there was a catch. From the perspective of the operational community, a great deal of the risk would have already been taken when the CSM struck out for the Moon. Low's original plan had called for looping around the Moon and coming back to Earth. Kraft's men thought they should go into lunar orbit. That maneuver, after all, was integral to the eventual goal of landing men on the surface. But it would also raise the stakes considerably.

"That's a lot different than just going around the Moon, believe me," Kraft said. "I remember when I told Frank Borman that we were pressing for a lunar orbit insertion, he didn't speak to me for two or three minutes. He just stared."

At the time, the U.S. didn't even have a precise gravitational model of the Moon. A NASA probe called Lunar Orbiter was circling the Moon, photographing the surface and mapping potential landing sites. But its path didn't coincide with orbital predictions.

"We were looking at that data and saying, 'We've got the same problem,'" Kraft remembers.

Later, after Apollo 8, researchers realized that objects orbiting the Moon would always encounter minor—yet critical—perturbations in their trajectories due to the presence of large mass concentrations, the result of millions of years of bombardment by rocky objects.

"It was data derived from Apollo 8 which gave us an empirical method—get that, empirical—for calculating trajectories on later flights," Kraft noted.

But neither the knowledge nor the method were in hand in July 1968. By the end of the

month, the teams investigating Low's proposal had all said it was possible. Kraft, Slayton and Low reconvened in Gilruth's office. It was, Kraft would later say, "a very profound day."

"At this point," Kraft remembers, "Gilruth also thought it was a good idea. He picked up the phone and called Wernher von Braun in Huntsville. This was at 11 a.m. 'What are you doing this afternoon?' he asked him. 'Can we see you about 2 o'clock this afternoon?' Of course, the answer was yes, and we got on the Gulfstream and flew to Huntsville. Before we left, Gilruth found out that Sam Phillips was at the Cape. He asked Phillips to meet us that afternoon in Huntsville."

Phillips, the Apollo Program director, later wrote that a quickly scheduled meeting of the Apollo management team was

held in Huntsville that afternoon. "The three-hour conference didn't turn up any 'show stoppers.' Quite the opposite; while there were many details to be reexamined, it indeed looked as if we could do it. The gloom that had permeated our previous program review was replaced by excitement."

All was now dependent on the success of Apollo 7. On Oct. 11, 1968, the new Block II CSM, carrying Walter M. Schirra, Donn Eisele and Walter Cunningham, lifted off from the Cape atop a Saturn 1B. "During the 163 orbits of Apollo 7 the ghost of Apollo 204 was effectively exorcised," Phillips wrote.

The stage was set for the next step. Debriefings were held with the Apollo 7 crew. Management teams met in lengthy meetings. Data was reduced, flight plans were put forth, excitement began to grow. Finally, on Nov. 11,

Thomas O. Paine, the new acting administrator of NASA, conducted a go/no-go review of the lunar orbit plan.

"By this time," Phillips wrote, "nearly all the skeptics had become converts. At the end of this climactic meeting Mueller put a recommendation for lunar orbit into writing, and Paine approved it. He telephoned the decision to the White House, and the message was laid on President Johnson's desk while he was conferring with Richard M. Nixon, elected his successor six days earlier."

The decision to go ahead, Kraft says, "was the boldest decision of the space program. But the gains were worth the risks. It was the first manned launch of a Saturn V. It was the first burn of an S-IVB into a lunar trajectory. It was the first time men had left the gravitational influence of the Earth. It was the first time we had tried to navigate with onboard systems to the Moon. It was the first time we went into orbit around another planet. It was the first time men had looked down on the Moon from a distance of 60 miles. It was the first time we came out of orbit around another planet. And it was the first time we did a 36,000 foot-per-second reentry, the same as you would encounter in returning to the Earth from any planet."

Shortly thereafter, elaborate invitations were sent out for the launch with the inscription, "You are cordially invited to attend the departure of the United States Spaceship Apollo VIII on its voyage around the Moon departing from Launch Complex 39A, Kennedy Space Center, with the launch window commencing at 7 a.m. on December 21, 1968."

"I remember when I told Frank Borman that we were pressing for a lunar orbit insertion, he didn't speak to me for two or three minutes. He just stared."

—Dr. Christopher C. Kraft Jr.

At 7:51 a.m. CST Dec. 21, the world watched for the first time as a manned Saturn V, majestic yet ponderous, arose from the coastal wetlands of central Florida, the grandeur of the spectacle made even more pronounced by the presence of humans, by the purpose of their mission. Frank Borman, James Lovell and William Anders were on their way.

Two hours, 27 minutes into the flight, Capsule Communicator Michael Collins told the crew, "You are go for TLI." The obtuse acronym had never before been uttered during a space mission. It meant that Mission Control had given the go-ahead to perform the trans-lunar injection burn. Humans were about to leave the cradle.

The burn lasted five minutes, 19 seconds. Apollo 8 reached a velocity of 24,200 miles per hour and left the bonds of Earth. From the back row of consoles in Mission Control, Chris Kraft was overheard to say, "You are on your way. You are really on your way."

On Christmas Eve, Apollo 8 went around the far side of the Moon and the longest loss of signal anyone ever remembers in Mission Control. It lasted for 34 minutes. During that time, unobserved by Earth, the critical burn of the Service Propulsion System engine took place and Apollo 8 went into lunar orbit. At the appointed time, CapCom Gerald Carr began trying to establish voice contact with the spacecraft. "Apollo 8, Apollo 8, Apollo 8 ..." The tension, all present there that day agree, was unbearable.

"Go ahead Houston," Lovell said at last, and Mission Control, as is tradition, went momentarily wild before calm returned and the operators continued to monitor their data.

As the day progressed, those operators, and the world, listened in rapt attention as the astronauts described the "vast desolation" of the Moon. That evening, one out of every four people in the world, nearly 1 billion people in 64 countries, heard the special message from the crew of Apollo 8 to their fellow sojourners back home on "the good Earth."

"In the beginning, God created the Heavens and the Earth"