Gemini teamwork

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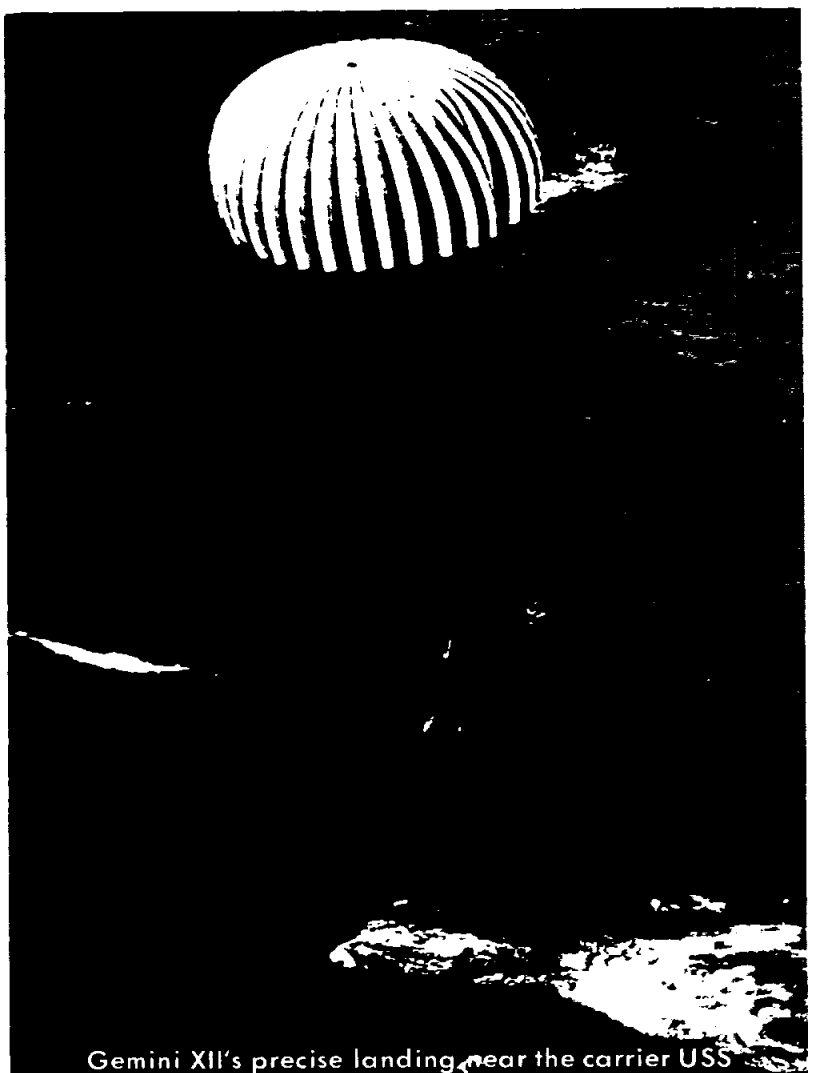


Gemini XII's precise landing near the carrier USS Wasp marked the end of the Gemini Program.

. . . a challenge to the pioneering spirit

Five and one-half years ago in 1961, President Kennedy committed this nation to a flight to the moon and return. He did this not because it was easy but because it represented a challenge to science and technology and to the pioneering spirit that has made this country great.

To go to the moon we had to learn how to operate in space—to maneuver, rendezvous, dock, employ large propulsion systems in space and how to work outside the spacecraft in the hard vacuum of space. We also had to learn how man could endure long duration in the weightless environment and we had to learn how one made precise landings from orbit.

In the Gemini Program's 12 flights we have done all the things that we had to do as a prelude to Apollo. I believe the Gemini Program has been most successful and I am proud of all the people who contributed to it—the employees of MSC, the people in industry and in the Department of Defense.

Having seen the program grow from its early conceptual days to its conclusion, I must say again that I am most happy and proud of everyone concerned.

Dr. Robert R. Gilruth
Director, MSC

A legacy for the future . . .

While Gemini was a fairly complex program, we certainly look forward to even more sophisticated operations. How-

ever, through the design, development, the testing and struggling to get it flying and then into the operational phase, the thing that has always impressed me so strongly is the teamwork of the organization.

So many elements were involved — many contractors, many agencies of the government, our sister centers in NASA—and through all this it seemed like all people were asking was to get the job done. There were no considerations of prerogatives or no parochial aspects. This has been the greatest pleasure for me in the program.

This is one of the few programs where we said we are going to fly 12 missions and then we are going to end it. It was certainly encouraging to come up to the final mission and realize that all these individuals were still hanging right in there and waiting for the last pitch of the ball game to be made. It is gratifying to me as we exalted their efforts that the last flight was so successful.

Charles W. Mathews, Manager
Gemini Program Office

Perhaps the most spectacular mission was the rendezvous of Gemini VI with Gemini VII after a slight setback caused by failure of Gemini VI's [illegible]

[illegible] the pilot [illegible] A time of 12

Northwest Australia looked like this from 741 nm to the crew of Gemini XI. Agena's primary propulsion system was the switch engine that shunted Gemini XI to the high apogee.

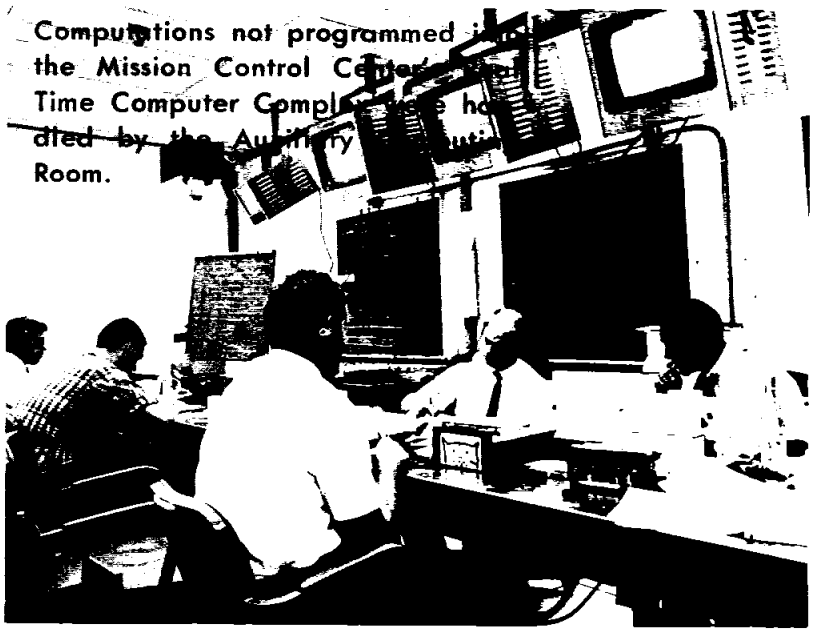
...ector's console in the Mission ...was the focus of many huddles ...ring Gemini missions.

A great team going for us

One of the major objectives of the Gemini Program was to obtain operational experience in rendezvous and maneuvering in flight. Certainly, the entire flight operations organization has gained a vast amount of experience and has developed operational techniques which will serve as the primary base in supporting future space flights.

As a result of Gemini, NASA has developed a team of engineers with which I believe we can approach the flight phase of the Apollo Program with confidence. I think we have a great team going for us.

Christopher C. Kraft, Jr.
Director, Flight Operations



Computations not programmed ... the Mission Control Ce... Time Computer Compl... dled by the Auxiliary ... Room.

Flight Operations conducted and monitored Gemini missions from liftoff through recovery

The term "flight operations" to the average person means flight controllers working at consoles in the Mission Control Center during a mission. In reality, flight operations encompass a variety of activities ranging from trajectory calculations and computer operations to Control Center facility development and operation to recovery operations in the mission landing area.

Each of the four divisions in the Flight Operations Directorate has its own job to do in support of space flight missions from the earliest planning stages through the mission proper and on to the final postflight reports and analyses. Experience gained from the Gemini Program has formed the flight operations groups into smoothly-functioning organizations as the day nears when Apollo is operational.

Flight Control Division

The basic mission of the Flight Control Division during the Gemini Program was to increase the probability of mission success and to insure flight crew safety through real-time ground monitoring of spacecraft onboard measurements.

During actual mission periods, the Division was responsible for manning the Mission Operations Control Room and its associated staff support rooms and to provide flight controllers for stations in the Manned Space Flight Network. In specialized areas, such as aeromedical and spacecraft life systems, other MSC organizations provided flight controllers to the Control Center and to the remote sites.

Between missions, various branches of the Division were responsible for preparing mission documentation for use by flight controllers during the upcoming mission—countdowns, mission rules, operations handbooks and data acquisition requirements—documents which required a thorough functional knowledge of spacecraft hardware. Another group was responsible for spelling out configuration changes in Control Center and remote site equipment to support future Gemini missions.

Realistic training for flight controllers was provided by "devil's advocates" in the Mission Simulation Branch whose job it was to acquaint flight controllers with every possible emergency and failure—few of which ever arose in actual missions.

In-flight trajectory measurements, maneuver and retrofire calculations and monitoring of spacecraft guidance systems were carried out by members of the Flight Dynamics Branch in their roles as flight controllers during missions. In addition, real-time commands were prepared by Flight Dynamics controllers in conjunction with the Real Time Computer Complex.

Flight controllers for monitoring Gemini spacecraft and Agena rendezvous vehicle systems were trained and provided by the Gemini Systems and Agena Systems branches.

Mission Planning and Analysis Division

Gemini support by the Mission Planning and Analysis Division can be grouped into three major areas—mission design and analysis, real time computer program development and operational support.

In the mission design and analysis area, MPAD defined and evaluated Gemini rendezvous trajectories for the various modes of rendezvous used in the program, such as tangential orbit, concentric orbit and first apogee.

In addition to rendezvous planning, MPAD developed launch abort procedures and computer programs—procedures which were never called upon but which were vital to crew safety.

Real time computer program development for Gemini advanced the state of the art in two basic ways: first, Gemini required the tracking and data processing of two vehicles in space simultaneously, and second, flight controllers had to become real-time trajectory planners who required more sophisticated and complex real time computer programs to drive displays in the Control Center and to service increased computing requirements. For example, Gemini real-time programs were ten times more complex than those used in Project Mercury.

MPAD branches developed the complete logic and equations for the real time computer programs which enabled flight controllers to compute rendezvous maneuvers. Additionally, the Division supported the flight control teams with computer controllers in the Real Time Computer Complex area, the Auxiliary Computing Room and in the Flight Dynamics Staff Room. This support was also supplied during pre-mission simulations to provide the highest level of realism to network and in-house simulations.

Landing and Recovery Division

All conceivable landing situations had to be covered in the planning and support of Gemini by the Landing and Recovery Division—from an off-the-pad abort to an emergency landing in any part of the world along the spacecraft orbital ground track. It was the Division's philosophy to provide a positive course of action for any and all landing contingencies.

Pre-mission recovery planning entailed such diverse elements as recovery force ship deployment, spacecraft retrieval, handling and transporting, communications nets, and documentation to serve as guidelines for Department of Defense recovery support. During missions, Division specialists served as technical advisors to the DOD aboard recovery ships and at Recovery Control Centers around the world.

Information vital to a swift and efficient recovery of a spacecraft and its crew was funneled into the Recovery Control Room in the Mission Control Room where ship and aircraft movements were closely coordinated with DOD. All Gemini spacecraft and crews were recovered and returned to the United States in an efficient manner, primarily because of close coordination with the DOD and thorough prior planning. Most of the recovery techniques developed for Gemini will be used for Apollo.

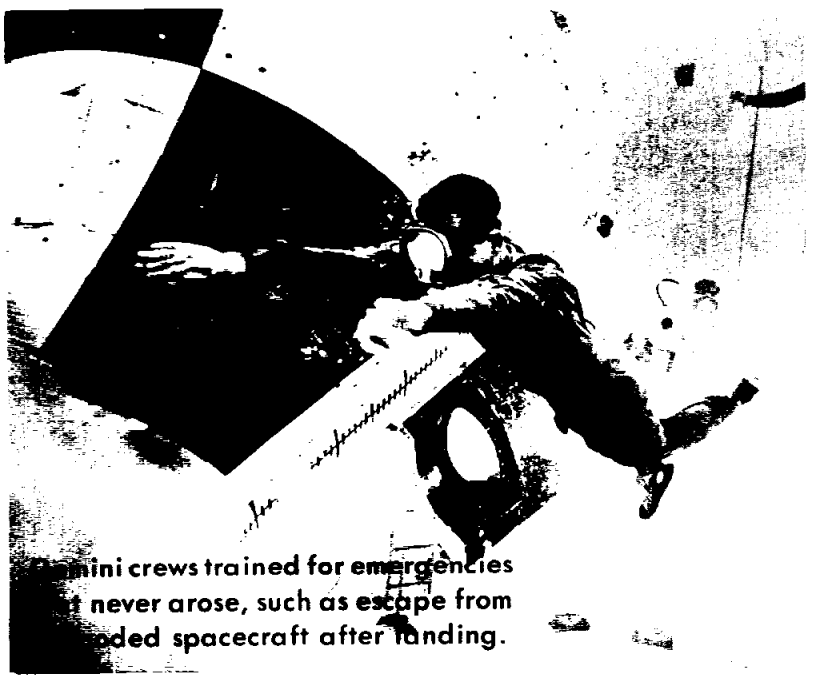
The Division was also responsible for developing and testing recovery hardware such as ship davit cranes, spacecraft cradles, training boilerplates, line-handling devices, hooks and workstands.

Flight Support Division

Control Center development, support documentation, Control Center operations and maintenance and Control Center network scheduling were the prime areas of support to the Gemini Program by the Flight Support Division.

One fundamental criterion in the design and engineering of the Mission Control Center is its ability to respond to data acquisition needs between missions in the same program and between programs, while at the same time providing a high level of flight support continuity.

The Division consolidates the requirements for Control Center and Real Time Computer Complex mission use by other organizations of the Flight Operations Directorate and implements the changes in hardware and software necessary for these changes. The Division monitors the contractual performance in the maintenance and operational phases of the Mission Control Center.



Gemini crews trained for emergencies that never arose, such as escape from flooded spacecraft after landing.

Crews had outstanding training and support

The fine job accomplished by the Gemini flight crews reflects the outstanding support and training they received. The various flight crew operations areas are discussed in more detail below.

A few of the groups that did an outstanding job in the Flight Crew Operations Directorate were the flight crew support teams, the simulator group, flight planning group, the astronaut associated government-furnished equipment support group, the astronaut fan mail support group and aircraft operations.

I think everybody recognizes that the flight crews have done a good job. Someone once asked me, "Why don't we keep flying the same crews because they probably know a little bit more." I think Gemini XII demonstrates pretty well why we don't have to fly the same crews each time. All ten crews have had awfully good support from all people concerned and we sure appreciate it.

Donald K. Slayton, Director
Flight Crew Operations

Groups behind the crews had busy task

Flight Crew Support Division

Getting Gemini crews prepared for a mission required many long hard hours of work not only by the crewmen themselves, but also by training and simulation specialists in the Flight Crew Support Division.

Division support included development of crew-related procedures, execution of crew training plans and development of mission flight plans. Facilities such as part-task and mission simulators, static mockups and special devices such as neutral-buoyancy tanks were mixed with specialized classroom and field training in such areas as water egress, parachute familiarization and celestial navigation.

Training for a specific mission began with crew selection some six months prior to launch date, and included mission simulations in conjunction with the Mission Control Center and the tracking network, spacecraft testing and checkout at the manufacturer's facilities, detailed time-line simulations of rendezvous, EVA and onboard experiments, and spacecraft stowage reviews.

In addition to mission training in simulators at MSC and at Kennedy Space Center, the Division was responsible for designing, developing and procuring crew-related equipment for onboard use—cameras, telescopes, sextants, onboard data equipment—all of which had to be compatible with a crowded Gemini cockpit. The camera systems and the crew training in photography resulted in documentary and scientific still and motion pictures that provide a tangible and enduring record of the Gemini Program. Many of these photos are reproduced in these pages.

Simulators and trainers that played a major role in crew training were the two Gemini Mission Simulators, one at MSC and one at KSC: the Translation and Docking Simulator, the Dynamic Crew Procedures Simulator and the Part-Task Trainer.

Astronaut Office

The contributions to the Gemini Program by the flight crews have included other aspects than flying the missions. For in addition to training for and flying specific Gemini missions, the crews had engineering and technical assignments to follow through which they presented the pilot's viewpoint in hardware development.

Speaking engagements and public appearances during the Gemini Program totaled 947, and some 125,000 pieces of incoming correspondence were processed. Additionally, an average of some 20,000 autograph and photograph requests are answered each month by the Astronaut Mail Room.

Aircraft Operations Office

Conventional aircraft operated by the Aircraft Operations Office supported the Gemini spacecraft in several ways, not only during missions but in the pre-mission training and testing periods.

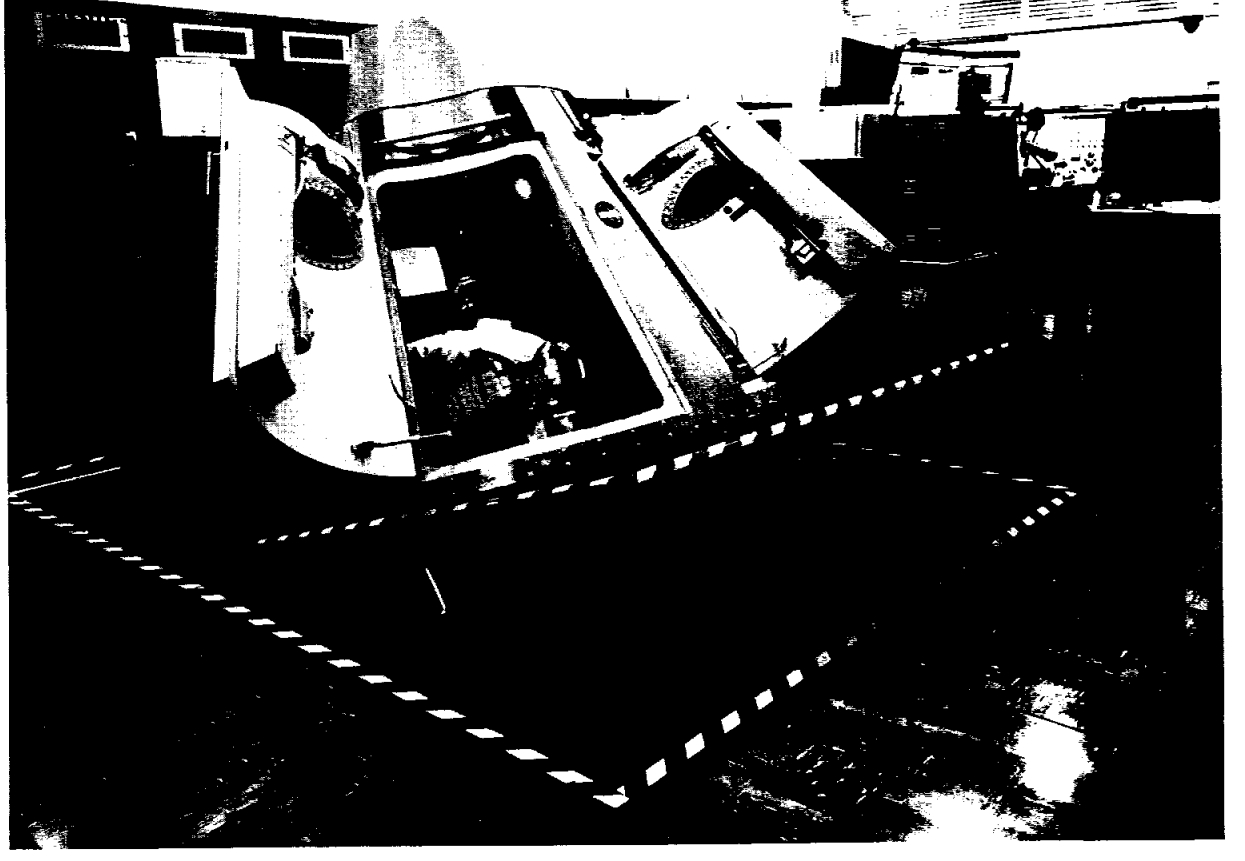
Spaceflight readiness aircraft in which crewmen are required to fly 300 hours per year minimum were operated at the AOO base at Ellington AFB. In addition to local proficiency flying, crews commuted to and from manufacturer and NASA facilities while monitoring spacecraft and launch vehicle testing and development.

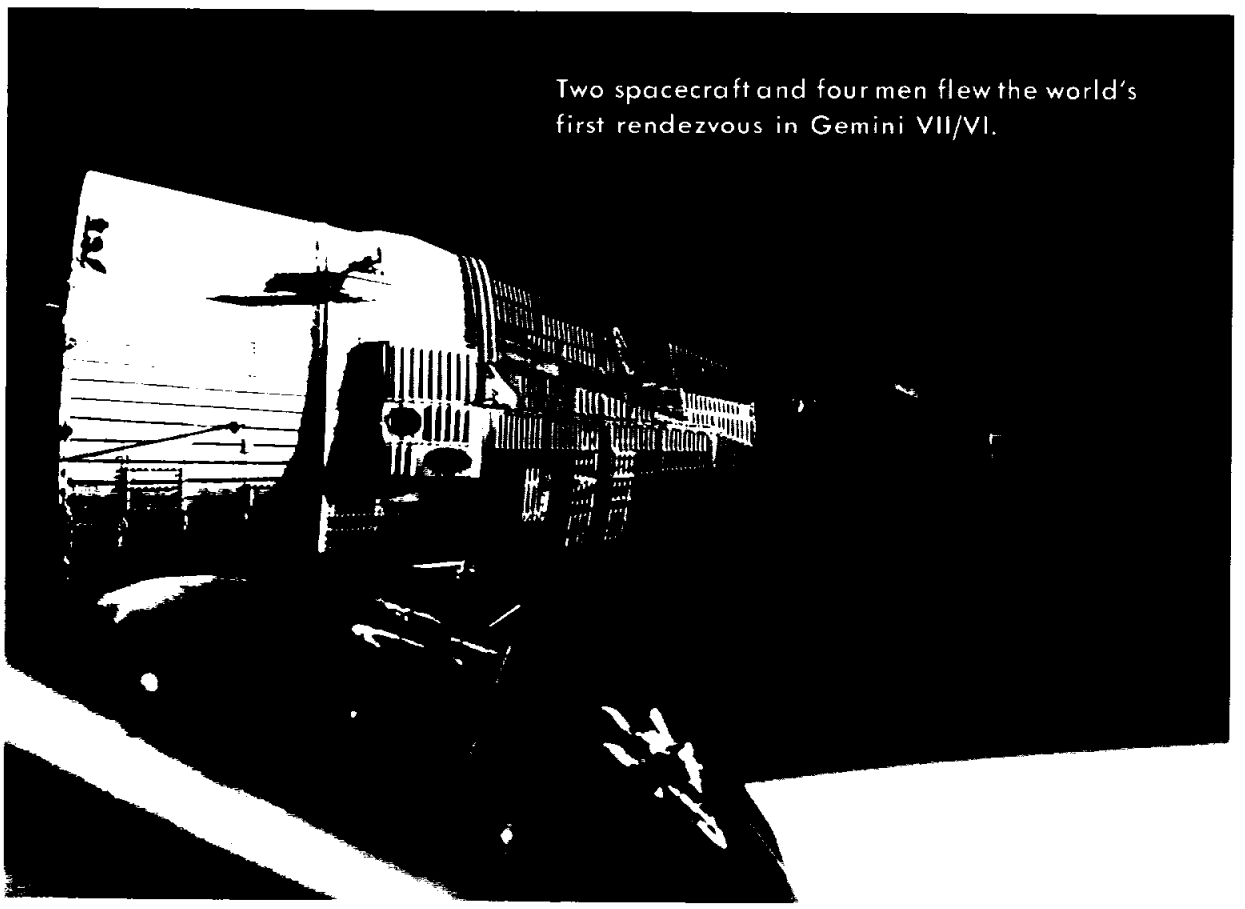
Priority Gemini parts were shuttled to and from KSC by the Gulfstream assigned to MSC, and other aircraft flights in support of Gemini mission data shuttles between MSC, McDonnell and KSC were flown by Aircraft Operations pilots.

Other organizations in MSC requiring aircraft-borne test and evaluation of Gemini hardware and electronic gear called upon Aircraft Operations for support, such as the evaluation of the Gemini rendezvous radar at White Sands in conjunction with IESD, and evaluation of an S-Band orbital tracker in conjunction with Landing and Recovery Division.

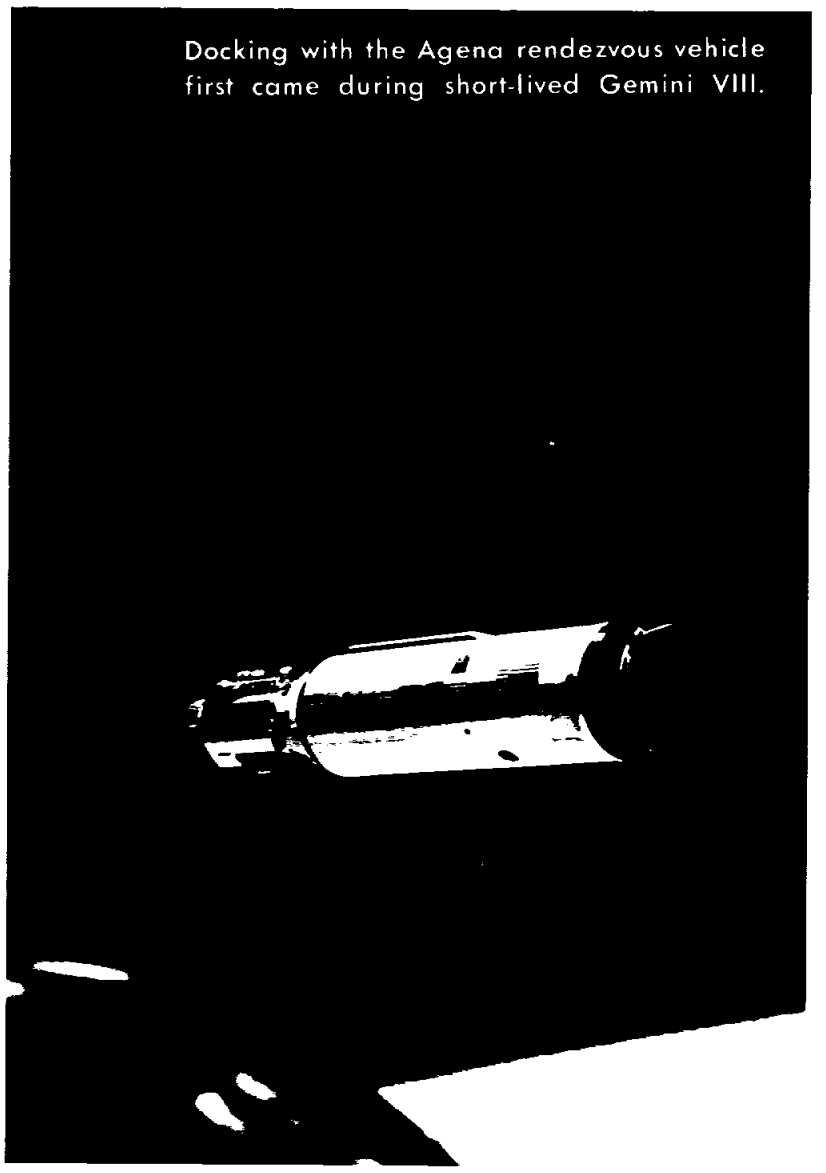
Gemini Mission Simulators at MSC and Kennedy Space Center provided Gemini crews with every flight realism except weightlessness and up Launch terial and Depart- dustrial

The Gemini spacecraft proved to be much better spacecraft than a boat as each crew learned postlanding egress procedures in the choppy waters of the Gulf of Mexico.





Two spacecraft and four men flew the world's first rendezvous in Gemini VII/VI.



Docking with the Agena rendezvous vehicle first came during short-lived Gemini VIII.

There w… …e. Gemini III backup … …offers his services.

Gemini Mis

Mission	Crew	Date(s)	
Gemini I		April 8, 1964	
Gemini II		Jan. 19, 1965	
Gemini III	Grissom-Young	Mar. 23, 1965	
Gemini IV	McDivitt-White	June 3-7, 1965	
Gemini V	Cooper-Conrad	Aug. 21-29, 1965	1
Gemini VII	Borman-Lovell	Dec. 4-18, 1965	3
Gemini VI	Schirra-Stafford	Dec. 15-16, 1965	
Gemini VIII	Armstrong-Scott	Mar. 16, 1966	
Gemini IX	Stafford-Cernan	June 3-6, 1966	
Gemini X	Young-Collins	July 18-21, 1966	
Gemini XI	Conrad-Gordon	Sept. 12-15, 1966	
Gemini XII	Lovell-Aldrin	Nov. 11-15, 1966	

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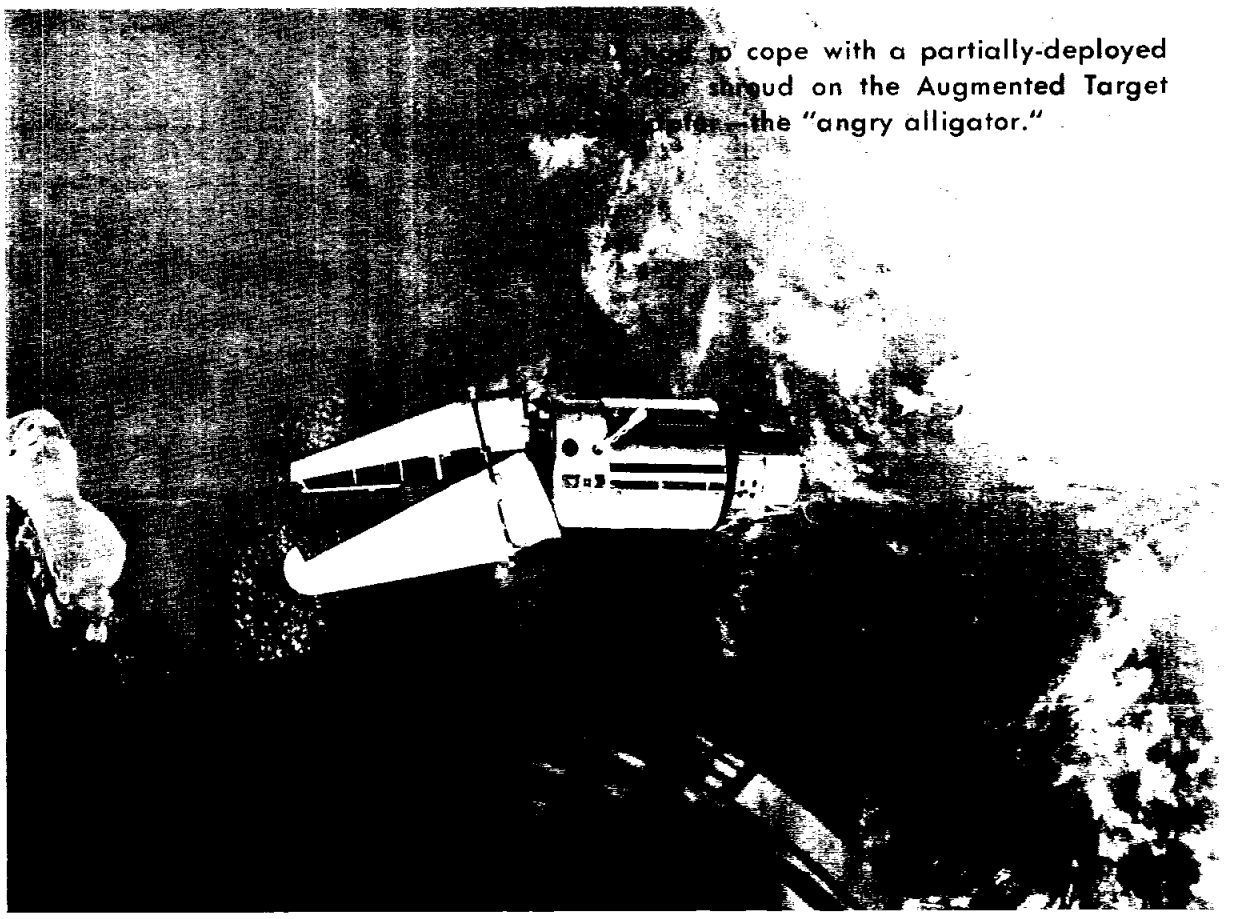
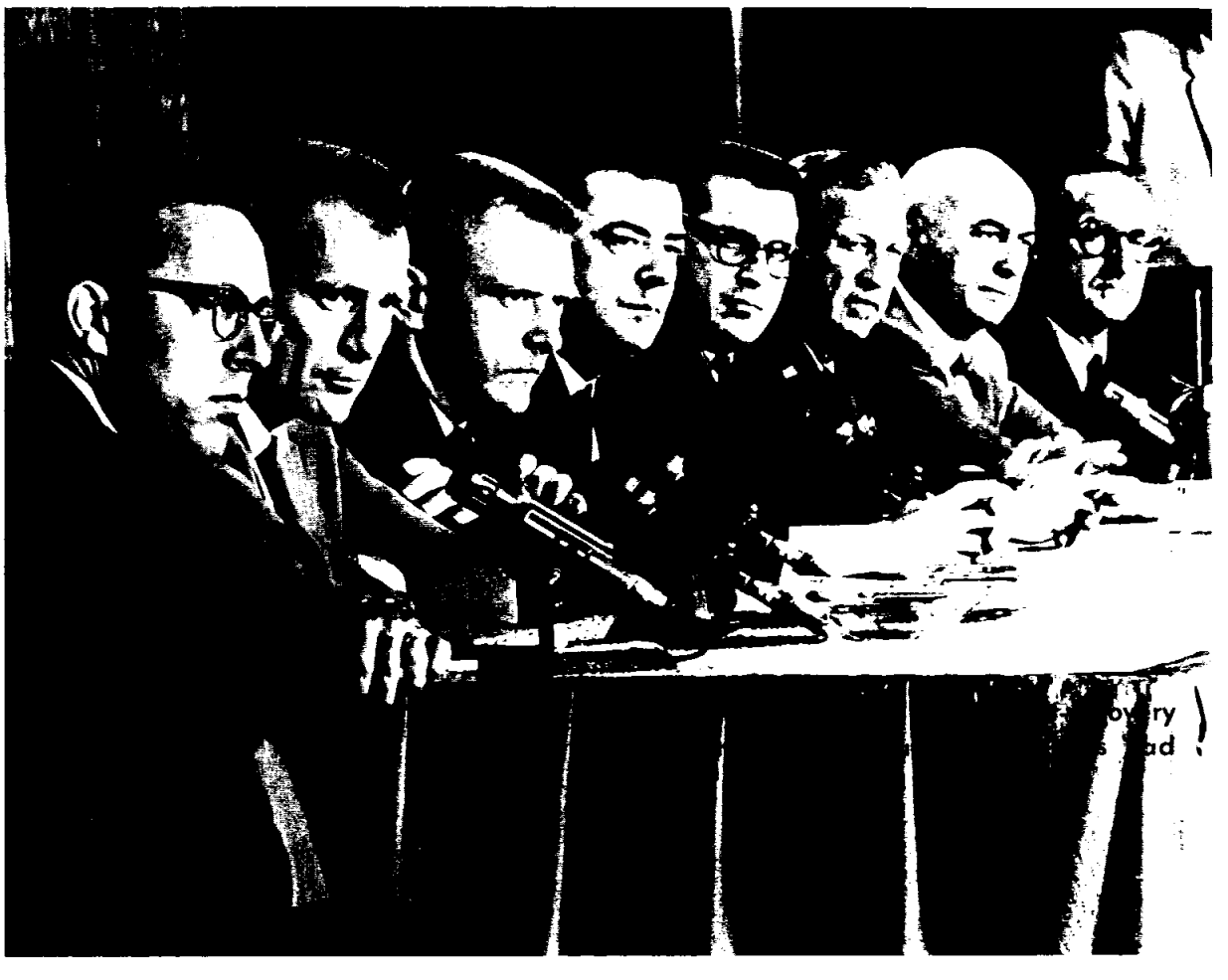
as a great many satisfying victories. Here, cigars and flags in Mission Control mark Gemini VII/VI rendezvous.



to cope with a partially-deployed shroud on the Augmented Target Docking—the "angry alligator."



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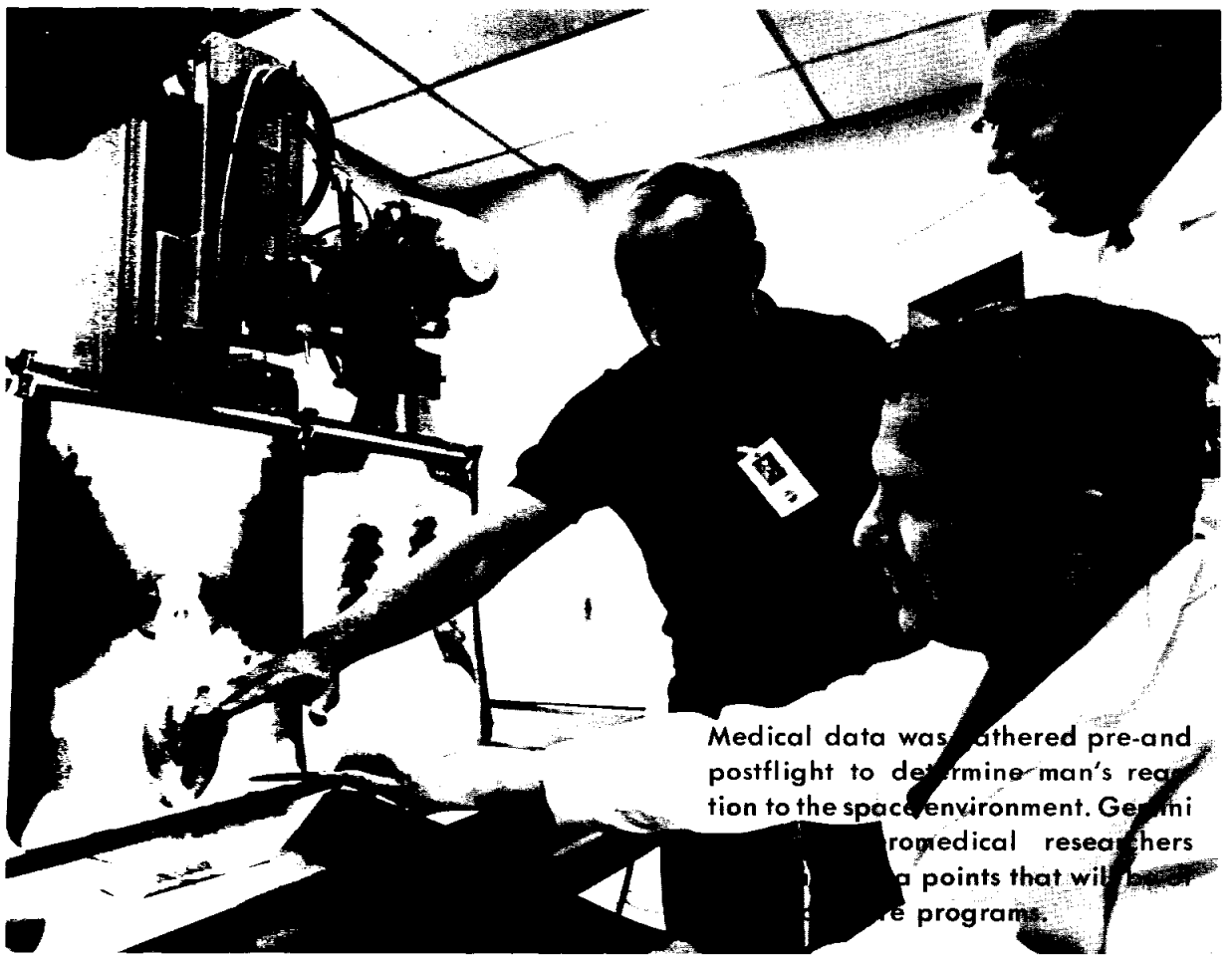
Duration (Hrs:min:sec)	Revolutions	Objectives Accomplished
3 revs	Reentered rev 64	Demonstrate s/c structure, GLV systems performance
18:16	suborbital	Demonstrate s/c systems performance
4:52:31	3	Manned qualification of Gemini s/c
7:56:12	62	Demonstrate s/c systems and crew capability for four days; demonstrate EVA
0:55:14	120	Demonstrate long-duration flight, rendezvous radar and rendezvous maneuvers
0:35:01	206	2-week duration, shirt-sleeve environment, rendezvous vehicle for Gemini VI, controlled reentry
5:51:24	16	On-time launch procedures, closed-loop rendezvous, station keep with s/c VII
0:41:26	7	Demonstrated rendezvous and docking with Agena, multiple Agena restart in orbit, controlled landing, emergency recovery (mission terminated early because of control system electrical short.)
2:20:50	45	Demonstrate three rendezvous techniques, EVA with detailed work tasks, precision landing (0.38 nm from planned landing point)
0:46:39	43	Dual rendezvous using Agena propulsion for docked maneuvers, retrieval of experiment package from Agena during EVA; demonstrated feasibility of using onboard navigation for rendezvous
1:17:08	44	First-orbit rendezvous and docking with Agena, 741 nm apogee using Agena propulsion, 161 minutes total EVA, tether exercise, automatic reentry.
4:34:31	59	Three EVAs, gravity-gradient tether exercise, rendezvous and docking with Agena, rendezvous with solar eclipse



Medical data was gathered pre-and postflight to determine man's reaction to the space environment. Gemini biomedical researchers [illegible] points that will [illegible] programs.

From concept to completion in five years

The Gemini Program Office was conceived at the Manned Spacecraft Center five years ago — mid-December 1961 — and was born in January 1962 with Dr. Gilruth's appointment of James A. Chamberlin to manage GPO.

In those five years, the Mercury follow-on program first known as Mercury Mark II and finally named Gemini—"the Twins"—grew into a 12-flight program that included 10 manned missions and contributed a wealth of information to future space flight.

Chamberlin, a member of the Space Task Group, charged with forming a concept of American space exploration, when he was appointed GPO manager at MSC, was succeeded by Charles W. Mathews on March 19, 1963.

Chamberlin was reassigned as senior engineering adviser to Dr. Gilruth, Mathews from chief of the Spacecraft Technology Division.

Meanwhile, back at the beginning of the GPO chronology: in April 1962, negotiations were in progress between GPO and McDonnell Aircraft Co. for definition of the Gemini spacecraft letter contract; these called for fabrication of four static articles and 13 spacecraft.

The paraglider and its resulting capability to land on the ground rather than in the water never flew in Gemini, the only original goal not achieved in the program.

GPO reported in February 1963 that MSC Crew Systems Division had completed investigation of extravehicular activity capability and that McDonnell was to review the study for application to Gemini.

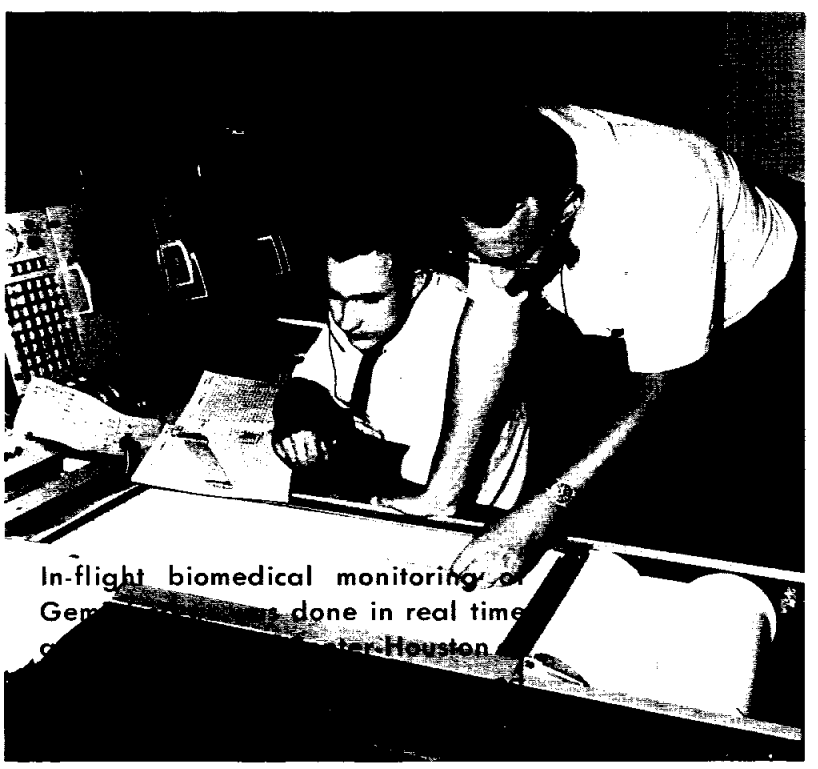
Mathews announced in March that the first two Gemini flights would not be manned. Earlier scheduling had hoped for a manned one-day flight on Gemini II. The new planning was amplified upon in April with announcement that the third flight in the series would be a short one, probably of three orbits, that the fifth and seventh through twelfth would be rendezvous missions, and that the sixth would be the only 14-day flight in the series.

GPO presented the proposed flight schedule to NASA headquarters; the plan called for unmanned flights in December 1963 and July 1964 with the first manned mission in October 1964 and subsequent flights at three-month intervals. That scheduling would have completed the Gemini program in January 1967 instead of November, 1966.

One exhausting but bright note showed up in March 1964 when GPO, still working toward the first launch of its spacecraft, moved its paperwork and problems from downtown Houston to the Clear Lake site.

The new offices were barely weeks old when, on April 8, 1964, Gemini I was launched successfully into a four-day orbit.

Gemini Program Office and all of NASA celebrated briefly, then went back to work to complete their three-year-plus flight program in 31 months.



In-flight biomedical monitoring of Gem[illegible] done in real time [illegible]-Houston.

Man is no barrier to exploration

The Gemini Program has served as a major vehicle in providing significant knowledge concerning man's adaptability, both physiologically and psychologically, to the space environment.

The program has provided us biomedical data proving that man can function in space and readapt to the earth's environment after 14 days without undue symptomatology. No abnormal psychological reactions have been seen, and there have been no vestibular disturbances related to flight. EVA has been found to be within physiologic tolerance if the astronaut is properly tethered and the work is programmed.

The physician's role in supporting normal spaceflight is a complex one requiring the practice of clinical medicine, predictive and preventive medicine, research, and diplomacy. The physicians and research scientists and operations, both civilian and military, have performed this role superbly. In addition, my thanks also go to all personnel of the directorate. Any success we might have enjoyed as a directorate is to their credit.

The entire manned space flight program, as a matter of fact, is a tremendous tribute to the management of an enormous team effort. It has required the strictest cooperation and understanding between biomedical scientist and engineer, and this has been accomplished to an amazingly successful degree.

As great as Gemini was in terms of flight experience, it literally only scratched the surface. Much remains to be learned about man working in space for extended periods and much remains to be explored, but man is no barrier to that exploration.

Dr. Charles A. Berry
Director, Medical Research and Operations

Gemini showed that man is adaptable

The successful and safely conducted Gemini program has provided the medical research and operations directorate with the first significant knowledge concerning man's capability to cope with the space environment.

This capability marks fulfillment of one of the major objectives of the Gemini Program . . . man's adaptation to long-duration space flight . . . as well as outlining the contribution of the biomedical specialists involved.

In the early stages of our flight program many people expressed legitimate concern about man's possible response to space flight. None has proved valid to the point of restriction.

Simply stated, medical objectives of the program were to provide medical support for man, enabling him to fly safely in order to answer these questions:

1. How long can man be exposed to the space flight environment without producing significant physiologic or performance decrement?

2. What is the cause of the changes which are observed?

3. Are preventive measures or treatment needed, and if so, what is best?

Some of the predicted problems and the results learned from our programs to date are as follows:

Cabin Atmosphere

Concern was expressed whether the 100 per cent oxygen would prove to be a hazard. There have been no incidents involving fire, and we have seen no gross effects upon man.

Cabin and Suit Temperature

The maintenance of adequate cabin and suit temperature in the EVA astronaut was a matter of concern. The cabin temperature has been maintained within the comfort range of about 70 degrees. EVA astronauts have been generally warm inside the spacecraft because of additional suit layers.

Radiation

The onboard radiation measuring system has confirmed that the environment is at the low end of the calculated range.

Light and Darkness

Many predictions were made concerning the effect of the changing light and darkness producing a day and night every 90 minutes. No overt effect was observed on our short missions.

Gravity

Gravity in the environment was expected to produce effects due to its increase at the time of launch and reentry and due to weightlessness during the actual flight. The loads at launch and reentry have proved well within man's tolerance. There also has been no evidence of a decrease in gravity tolerance following weightlessness.

Special Senses

There have been many predictions regarding visual capabilities and vestibular function. Many have suggested a reduction in visual acuity, disorientation and motion-sickness, as a result of weightless flight. We have no evidence of any disorientation visual acuity or motion sickness in flight.

Crew Performances

Strange reactions to "the isolation" and the monotony of space flight were predicted. Hallucinations and the "break-off phenomenon" were predicted along with space euphoria. There has been no evidence to date of the presence of any of these.

Drugs

A number of predictions were made that man would require the assistance of drugs. We have used aspirin and APC inflight without difficulty. We have used a decongestant and anti-motion sickness medication because of seasickness. No injectionable drugs have been used.

There were problems encountered, but most of a minor nature. We did have problems of fatigue in connection with extravehicular activity, but at no time was the crewman over-stressed. The Gemini program in general and Gemini 12 in particular have given MSC biomedical specialists confidence in man's capability to perform EVA work if he is properly tethered and if the tasks are programmed with proper rest periods.

In summing up the medical aspects of the Gemini program, Dr. Charles A. Berry, Director of Medical Research and Operations, spoke for all personnel of the directorate when he said, "We have been privileged to observe the human body adapt to a new and hostile situation and to readapt in a surprisingly effective manner to our normal one-gravity earth environment."

Gemini's technological challenge met

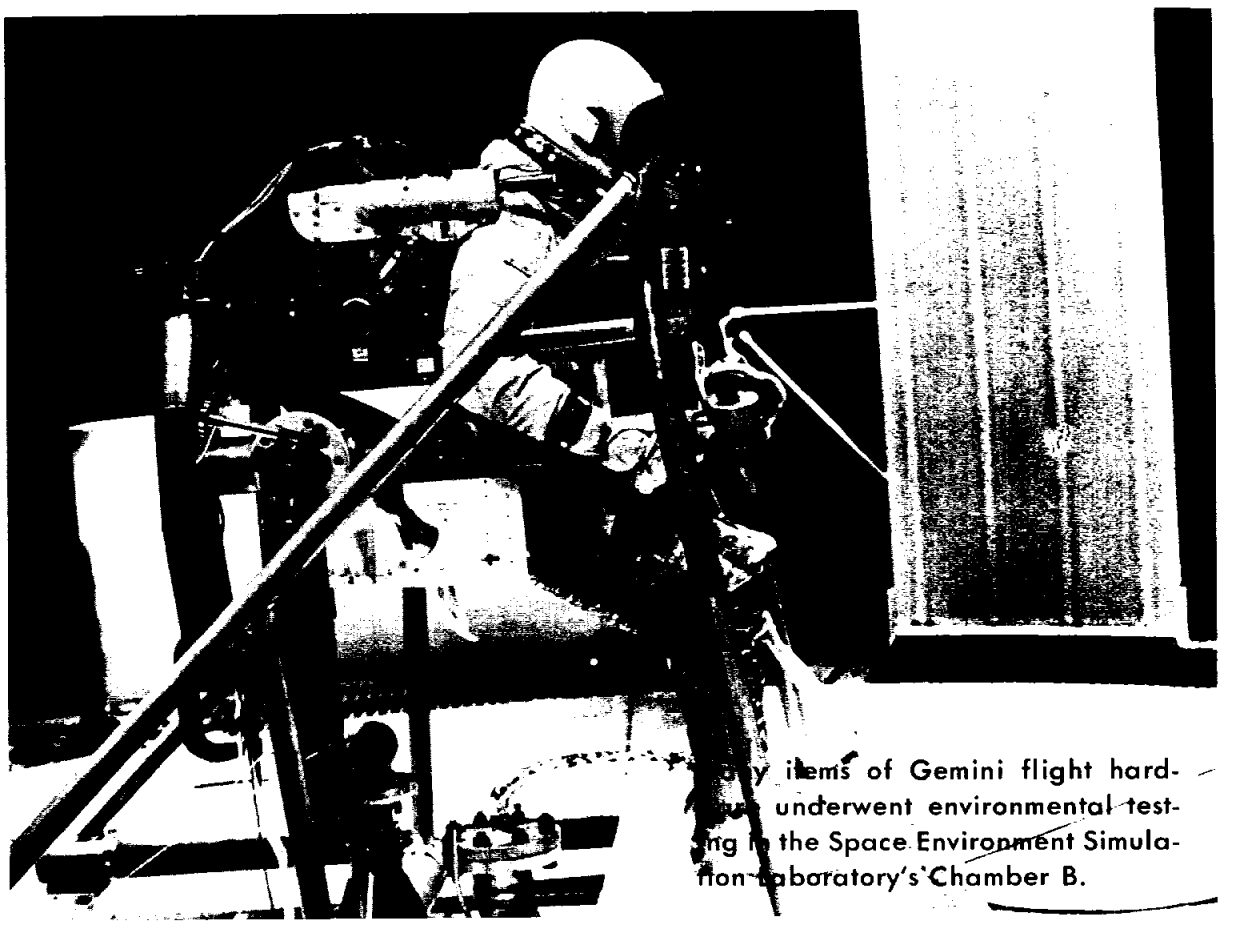
The successful completion of the Gemini Program truly serves as a major milestone in our more sophisticated manned space flight efforts.

The systems requirements of the Gemini program over those of the Mercury program were many orders of magnitude more stringent and complex. The technological challenges presented by Gemini's bold mission plans were met with obvious success. Significant technical problems involving advanced systems and/or hardware were solved resulting in numerous advanced developments having direct application not only to Apollo, but other advanced programs.

Particularly note-worthy was the development of the fuel cell, guidance and navigational system, and maneuvering rocket engines. Gemini's new increased crew requirements, the extra-vehicular activities, and more complex longer-duration missions involved innumerable engineering problems for which effective solutions were found.

Thus, the advancement of the "state-of-the-art" experienced in Gemini will be long recognized as a key element in the success of future manned space flight efforts.

Maxime A. Faget, Director
Engineering and Development



...y items of Gemini flight hard-... underwent environmental test-...ng in the Space Environment Simula-...tion Laboratory's Chamber B.

E&D organizations found solutions for Gemini's engineering problems

Crew Systems Division

As man explores new and strange environments in his quest to conquer space, it becomes necessary to design, develop, and manufacture more sophisticated equipment to insure his safety and comfort and to permit him to function in alien surroundings.

This development task is a function of the Crew Systems Division of the Engineering and Development Directorate. The division played a major role in the Gemini program, providing a variety of equipment ranging from space suits to such utility items as flashlights, scissors, sunglasses and tissue.

Perhaps one of the major contributions was the EVA equipment used on Gemini 4 and all other Gemini EVA missions. The division was also responsible for the development of space food and the space feeding concept employed on Gemini.

Propulsion and Power Division

One of the most significant contributions by the Power and Propulsion Division of the Engineering and Development Directorate to the Gemini Program test program conducted was the stratification testing of three Gemini cryogenic supply systems.

The tests were conducted by the Power Systems Test Section of the Thermochemical Test Branch at the Power Systems Test Facility at Building 354. The tests were carried out during the period June 12 through July 15, 1965.

The tests showed that with proper pressurization procedures pre-launch thermal stratification was minimized to the extent it represented no serious problems in terms of pressure decay during Gemini missions.

Advanced Spacecraft Technology Division

The Advanced Spacecraft Technology Division of the Engineering and Development Directorate performed an analysis of the Gemini abort system and its capability and provided conceptual alternate mission designs.

The abort system analysis consisted of a dynamic analysis of the man/seat combination at various altitudes. A failure effects analysis was accomplished and related to the abort capability. Also, the explosive phenomena (fireball, blast and toxicity) was defined. The results of all these studies were combined and a recommended abort procedure defined for the entire Gemini launch phase.

Throughout the Gemini Program the ASTD devised and documented alternate missions for the Gemini/Agena for possible use.

Experiments Office

A total of 40 experiments were conducted during the Gemini program with satisfactory results. Most experiments were flown several times in the course of the program. There were 17 scientific experiments scheduled, eight medical, 17 technological and 10 Apollo support for a total of 52 planned experiments.

Experiments are regarded as an extremely important aspect of the manned spaceflight program. The presence of the crew to exercise discrimination to set up and operate equipment, and to aid in the interpretation of results has proved extremely useful.

Instrumentation and Electronic Systems Division

One of the organizations within the Engineering and Development Directorate which has made significant contributions to the success of the Gemini Program has been the Instrumentation and Electronic Systems Division (IESD).

Personnel of the IESD supported the Gemini program in the areas of Communications Tracking and Instrumentation Systems by participating in the spacecraft review at the McDonnell Aircraft Corporation. This entailed the witnessing of integrated system tests and approving the systems flight readiness. They also participated in the post-flight analysis of each of the Gemini missions.

Probably, the most significant contribution by the IESD, to the overall success of Gemini has been in the Rendezvous Radar Program. In the spring and summer of 1963 personnel of the IESD were instrumental in bringing about a complete change in the Gemini rendezvous radar test program. Up to that time it was impossible to verify the radar performance due to the limited capabilities of available anechoic chambers. IESD setup a series of tests flying instrumented aircraft over specifically prepared facility at the White Sands Missile Range. Successful completion of this test program verified the Gemini radar performance.

Guidance and Control Division

The Guidance and Control Division began its support of the Gemini program in early 1964 as a result of a Gemini Program Office – Engineering and Development Directorate support agreement which called for test monitoring support at the subsystem and spacecraft levels.

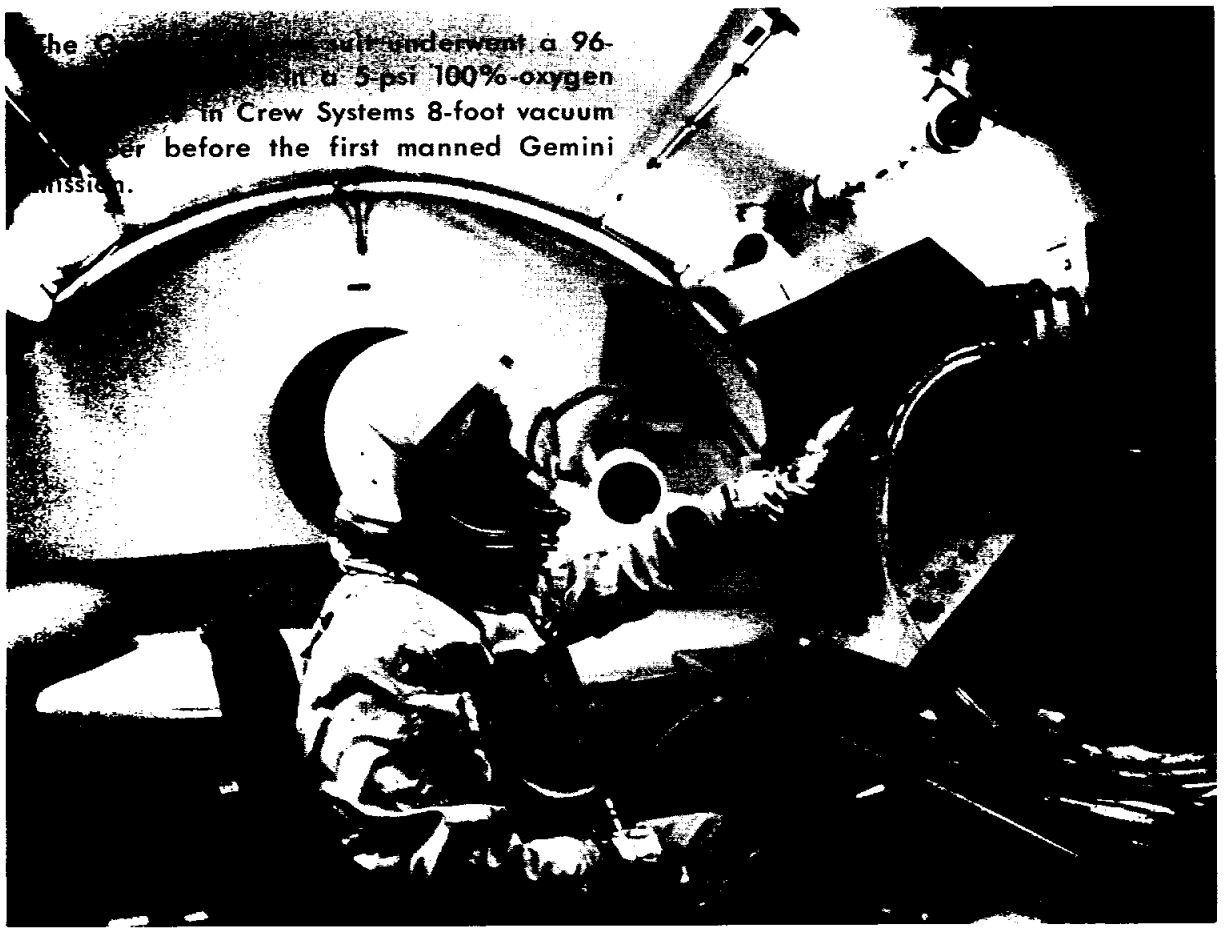
G&C engineers participated in this effort and monitored the early predelivery acceptance tests at Honeywell Incorporated on the Intertial Measurement Unit; at IBM on the on-board computer; and at Advanced Technology Laboratory on the horizon sensor. The early Inertial Guidance Systems were integrated at IBM prior to delivery to McDonnell Aircraft Corporation for installation in the spacecraft.

Concurrently with the test monitoring effort, the Guidance and Control Division participated in the development of the Auxiliary Tape Memory (ATM), the device utilized on Spacecraft 8 through 12 to augment the on-board computer memory and which allowed additional operational capability to be programmed into the Inertial Guidance System.

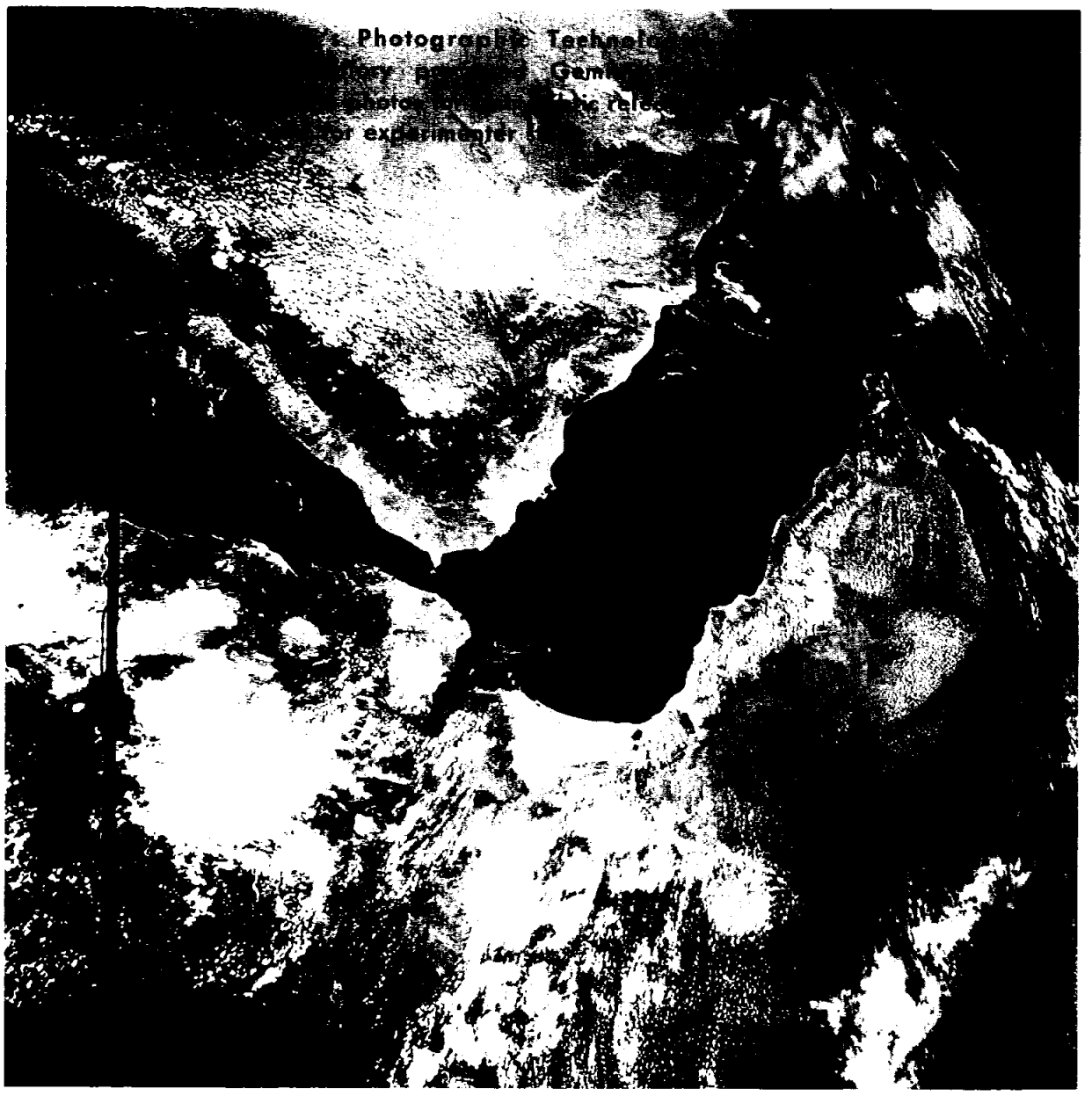
Throughout the Gemini program, the Guidance and Control Division provided support to the real-time mission monitoring and post-flight analysis teams. G&C support, in addition to the benefits gained by the Gemini program, provided inputs to the Apollo program in many areas. Among these is the experience gained by the personnel that were involved in spacecraft checkout, real-time mission monitoring, and flight evaluation. The techniques and capabilities developed in these areas are being applied directly to Apollo thereby avoiding much of the learning process normally encountered.

Computation and Analysis Division

The Computation and Analysis Division provided three major types of Data Processing to the Gemini Program.: Scientific Computations, Flight and Test Data Processing Support, and Theory and Analysis Support.



...he G... ...suit underwent a 96-... in a 5-psi 100%-oxygen ... in Crew Systems 8-foot vacuum ...er before the first manned Gemini ...ission.



SEASON'S GREETINGS

The *Roundup* extends to all MSC and on-site contractor employees best wishes for the Christmas season and a Happy New Year.

Roundup will resume its normal format of employee news, features and late developments in manned spaceflight with the January 6 issue.

—The Editor

Management and technology profited

The successful completion of the Gemini Program represents another major step forward in man's exploration of space. The conduct of the Program has resulted in many advances in the technology required to support future manned flight programs. At the same time, the Gemini Program has contributed greatly to our understanding of how to effectively manage major development programs of this type. The effective use of incentive contracts on this Program has directly contributed both to the success of the Program and to our better understanding of the management of large-scale development programs. In many areas the success of Gemini has been a product of close cooperation among Gemini Program Office personnel, MSC technical divisions, and the administrative and technical services support provided by the Administration Directorate. We have learned during the Gemini Program to better coordinate the many diverse skills required to effectively carry out mission objectives. The Gemini Program Office has provided the essential leadership to bring together all of these resources so essential for Program success.

The Gemini Program therefore, represents a major advance in both that technology required for manned flight and the management techniques required for the successful conduct of a major development program. MSC's experience on the Gemini will directly contribute to a better understanding of how to effectively carry out the Apollo Program.

Wesley L. Hjornevik
Director, Administration

Gemini challenged MSC's technical and managerial skills

Resources Management Division

The Resources Management Division was associated with the Gemini Program from its very beginning and supported it in a variety of ways ranging from getting the checks to its personnel and contractors and accounting for its funds to being a part of the Program Office control function. The lessons learned in the Gemini Program were substantial and fortunately this experience has been transferred to the Center's current and future programs.

Management Services Division

Throughout the Gemini Program the Management Services Division provided support in the areas of security and transcription and publishing services and in addition the technical information personnel of the Division made significant contributions to the overall success of the program.

Technical Services Division

TSD has been an active participant and a major contributor to the Gemini Program in providing mockups of spacecraft, equipment for inflight experiments and providing technical personnel for numerous support operations including on-site maintenance supervision and support to field test operations.

Photographic Technology Laboratory

The PTL in addition to providing photographic support of research development hardware furnished photo and lab support to the Gemini Experiments Office, installed and maintained the closed circuit television camera system, and provided processing, duplication and filing of all photo items related to the Gemini Program.

Procurement Division

There were four major areas of contribution to the Gemini program by the Procurement and Contracts Division of the Administrative Directorate. These areas included Gemini procurement, flight crew operations, flight operations and contract administration.

In the procurement area, the division was responsible for the spacecraft contract, the pressure suit, EVA life support system and inter-agency agreements. Gemini procurement actions resulted in a program valued at $1.3 billion during the five and one-half year program.

Personnel Division

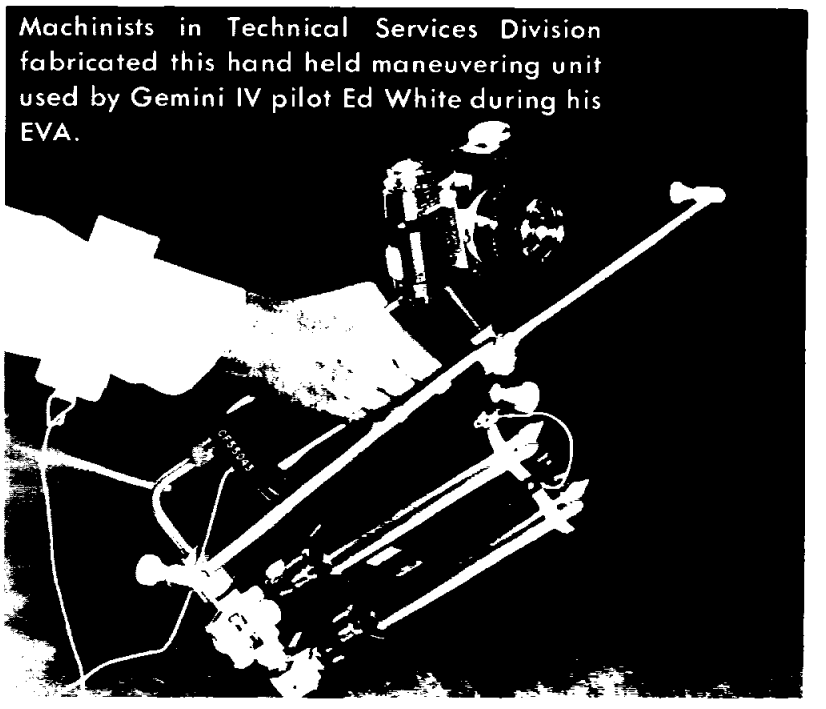
The participation of this Division in the Gemini Program has resulted in a level of experience and maturity in personnel management that would not have otherwise been possible to achieve. This most unique research and development program presented an unusual challenge to the Personnel Division to attract and retain the highly critical skills and talents (technical and managerial) acquired to accomplish the objectives of a program of this magnitude.

Administrative Services Division

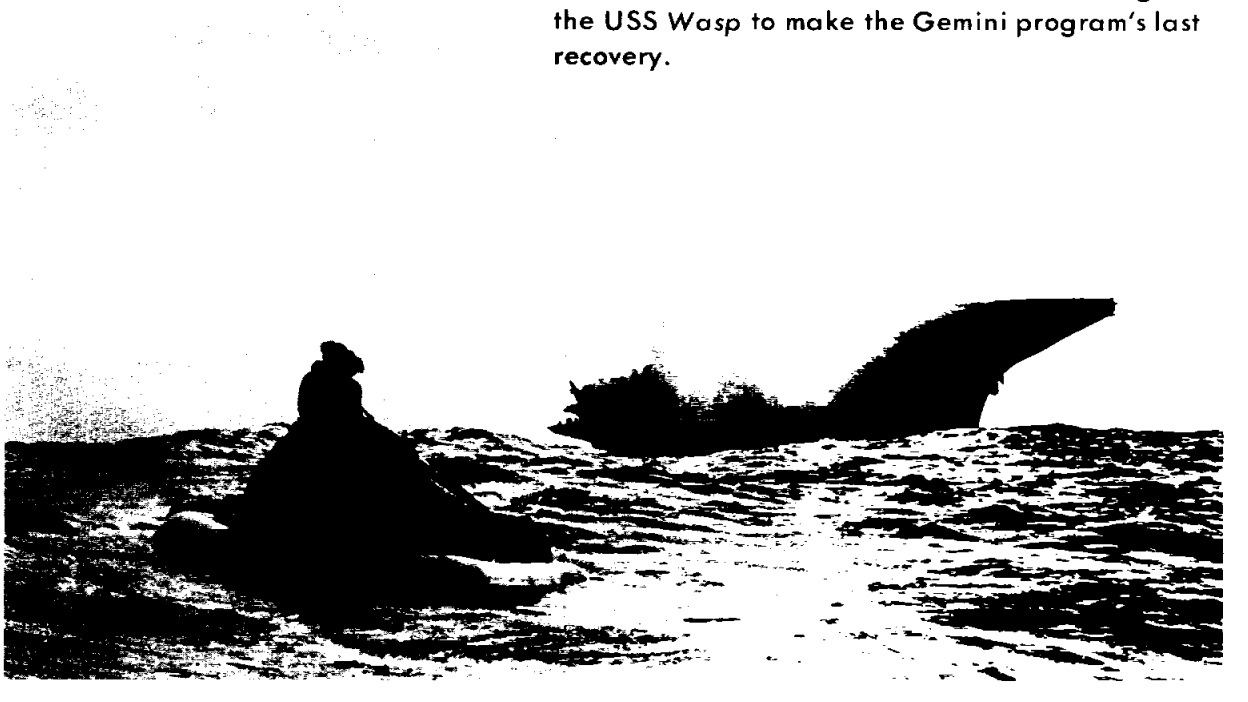
The Administrative Services Division played a very significant role in providing several types of support services from communications and office support equipment and services. This included providing communications and office equipment and support services, transportation for equipment and personnel, timely delivery of needed equipment and supplies, and original art work and duplicating services.

Engineering Division

The Engineering Division provided general engineering support to the Manned Spacecraft Center in the areas of experimental test equipment and facilities. This wide field of endeavor required a staff of professional personnel ranging from architects and engineers to designers and draftsmen. This division provided engineering support in the design of experimental test equipment and systems and participated in the development of models of flight equipment.



Machinists in Technical Services Division fabricated this hand held maneuvering unit used by Gemini IV pilot Ed White during his EVA.



Gemini XII rides Atlantic swells while waiting for the USS *Wasp* to make the Gemini program's last recovery.