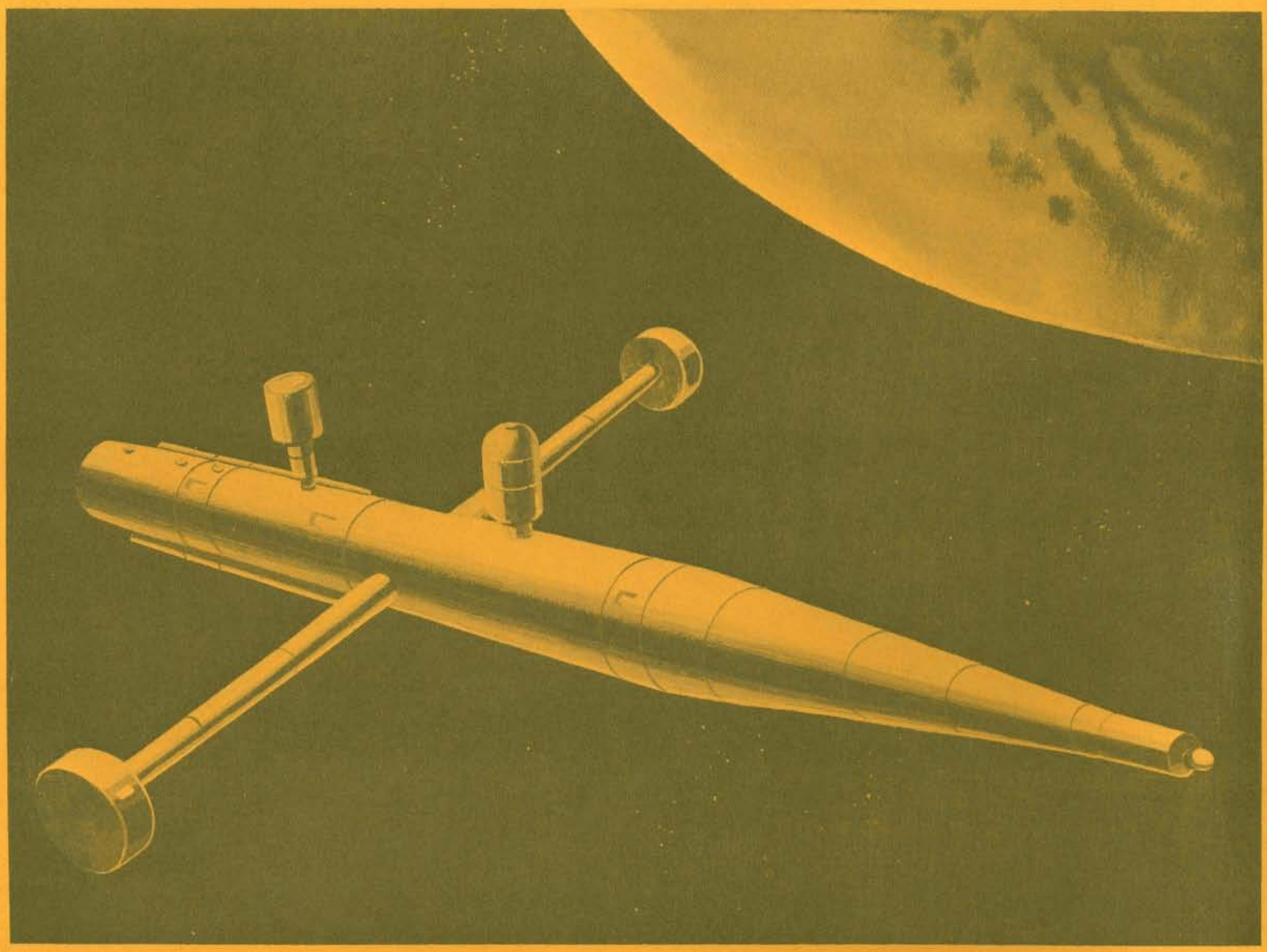
AFTER THE MOON - WHAT?



MINUTES OF THE
MANNED FLIGHT AWARENESS SEMINAR
MANNED SPACECRAFT CENTER
SEPTEMBER 25-26, 1969

FOREWORD

THE PURPOSE OF THIS SEMINAR WAS TO PROVIDE THE GOVERNMENT/INDUSTRY TEAM WITH NEW INSIGHTS INTO THE FUTURE OF MANNED SPACE FLIGHT AND ITS ATTENDANT REQUIREMENTS FOR QUALITY WORKMANSHIP IN THE PROSECUTION OF APOLLO AND FOLLOW-ON PROGRAM ACTIVITIES. GUIDELINES, OBJECTIVES, GOALS AND MOTIVATIONAL INNOVATIONS WERE DISCUSSED, AND PRESENTATIONS WERE GIVEN BY KEY MANAGEMENT PERSONNEL OF NASA AND THE AEROSPACE INDUSTRY.

AGENDA

SEMINAR ON MANNED FLIGHT AWARENESS

Manned Spacecraft Center
Houston, Texas

Thursday, September 25

SESSION I – NASA Management: The Manned Flight Awarness Challenge as NASA Sees it

Session Monitor: Mr. Philip H. Bolger

Opening Remarks	Philip H. Bolger, Acting Director Manned Space Flight Safety
Welcome Address	Dr. Robert R. Gilruth, Director Manned Space Flight Center
Keynote Address – "The Future of Manned Space Flight"	Dr. George Mueller Associate Administrator for Manned Space Flight
Apollo 12 and Beyond	Dr. Rocco Petrone Apollo Program Director
Apollo Applications Program Planning	William C. Schneider, Director Apollo Applications Program
The Management Challenge	Lee James, Director Program Management Marshall Space Flight Center
Astronaut Participation in the Manned Flight Awareness Program	Major Stuart Roosa, USAF Astronaut

SESSION II – Industrial Executives: Industry's View of the Future

Session Monitor: Mr. Philip H. Bolger

McDonnell Douglas Astronautics Company	Walter F. Burke, President
North American Rockwell	William B. Bergen, President
The Boeing Company	Harold J. McClellan, General Manager, Southeast Division, Aerospace Division
Panel Discussion	Moderator – W. C. Schneider

Panel Members

NASA	Industry
W. C. Schneider	W. F. Burke
R. A. Petrone	W. B. Bergen
R. R. Gilruth	H. J. McClellan

Friday, September 26

SESSION III – MFA Concept at Work

Session Monitor: Dr. Preston T. Farish

Moderator	Dr. Preston T. Farish
Space Station Task Group, Manned Spaceflight Center	John W. Small, Assistant Field Director
Reliability and Quality Assurance Office, NASA Headquarters	Dr. John Condon, Director
Industrial Relations and Compensation Service, Texas Instruments, Incorporated	Dr. Charles Hughes, Director
"Innovations in Motivation"	Moderator – Eugene E. Horton

Panel Members

John Millmott – IBM
Tom Scott – The Boeing Company
Dwayne Gray – North American Rockwell
Tony Tocco – TRW
Harold Durfee – Grumman Aerospace Corporation
Gordon Macke – McDonnell Douglas Astronautics Company

Manned Flight Awareness Themes and Program Continuity

1. Central Themes and Awards	Al Chop, Headquarters West Coast Representative, Manned Flight Awareness Office
2. Manned Flight Awareness Working Tools: Posters, Newsletter, Films, Decals, etc.	Eugene E. Horton, Chief, Manned Flight Awareness Office, Manned Spacecraft Center
Summary and Closing Remarks	Philip H. Bolger

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OPENING REMARKS

PHILIP H. BOLGER

Acting Director
Manned Space Flight Safety

The successful lunar landing and completion of the flight of Apollo 11 achieved a national objective in this decade and is a significant milestone in man's continuing progress in space exploration. Historically, achievements of such magnitude, requiring concentrated efforts over an appreciable time period, are followed by a letdown and general relaxation of the personnel involved. In addition, this letdown may be amplified by a serious morale problem when funding cutbacks are experienced. The result is a decline in the required attention to detailed workmanship which can cause a rise in accident rates and potential loss of life.

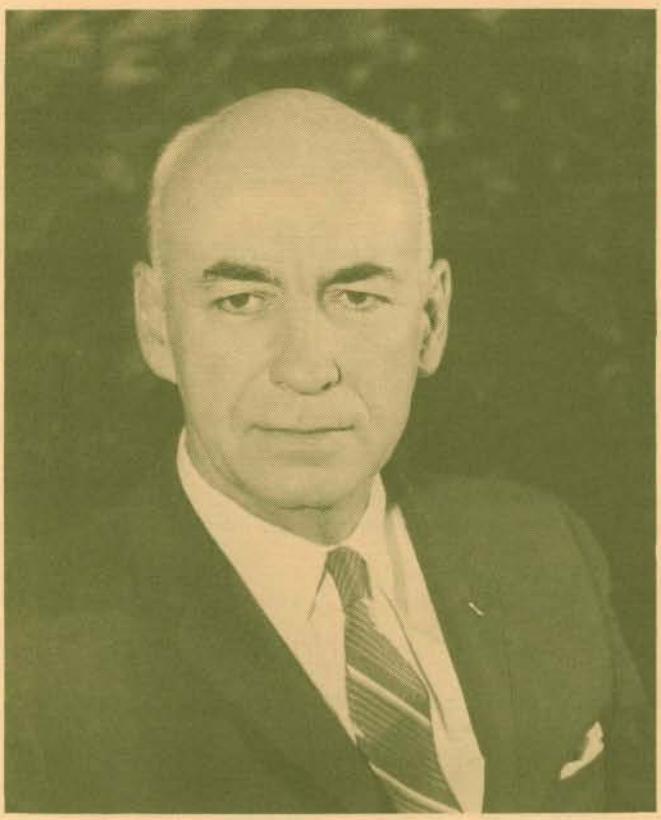
To counter these potential morale and complacency problems in the spaceflight program, this Government/Industry Manned Flight Awareness Seminar is being conducted. The objective of this seminar is the maintenance of high quality workmanship through effective awareness and motivational programs. We intend to do this by outlining NASA's plans for future programs and the resources being made available to successfully conclude these programs. In addition, executives of various industrial firms deeply involved in space work will present their views of the future. In this way we can get the message from NASA Management to the individuals responsible for doing the work that is vital to assuring a high quality of workmanship in the aerospace force.

The proceedings of this Seminar will be transcribed and available to those who are attending, hopefully within one month.

Now, I have a statement from Dr. Paine, who was unable to be here today, but he is quite interested in our Manned Flight Awareness Program and what it is trying to do. Dr. Paine says:

"I wish to express my regret that I am unable to participate in the Manned Flight Awareness Seminar because of previous commitments. The subjects that you will discuss are of the greatest importance to the future of Manned Space Flight. It is imperative that the NASA/Contractor Team maintain its momentum and continue to achieve the highest degree of quality workmanship. I realize that this is a difficult task to achieve in this period of cutback in space activities following the success of the Apollo 11 mission. On the other hand, however, we are entering a new era of relatively stable space flight activity and will be undertaking new programs that Dr. Mueller and his associates will discuss with you. We must impress on the aerospace worker force the fact that our future in space is a bright one and that we will continue to move forward in achieving an ever greater operational capability and broadening our scientific knowledge in space. To achieve these goals we are as always dependent upon the individual worker, his motivation and interest, and ultimately the quality of his workmanship. I know that you support my views on these subjects and will make every effort to bring our future space flight programs to successful achievement. The Manned Flight Awareness Program is one of our most valuable tools in support of these objectives and I hope you will make every effort to utilize its capabilities to the utmost."

Now, we've asked you to come today to discuss some relatively serious problems that are confronting us in this period of instability as we are cutting back after the Apollo 11 success. Our speakers will address these subjects in light of their particular programs.



WELCOME ADDRESS

DR. ROBERT R. GILRUTH

Director
Manned Space Flight Center

Good morning, I am happy to welcome you to this seminar. I would especially like to thank Walter Burke, Bill Bergen, Pat McClellan, and you other leaders in industry for taking time to be with us today, and to bring us views for the future of manned space flight from your perspective in industry.

It is fitting, I believe, that this meeting is being held following the most remarkable expedition of all history—man's first journey to the moon. Neil Armstrong described Apollo 11 as "a giant leap for mankind," and there is no question but that it was a giant leap. It proved among other things that the moon is no longer quite so remote and inaccessible as it had been. It did not assure us, however, that the next step in space would be equally successful. Whether or not it is will depend to a very large extent upon the inspiration and leadership, and the imagination that will be shown by those of us who are in this room today.

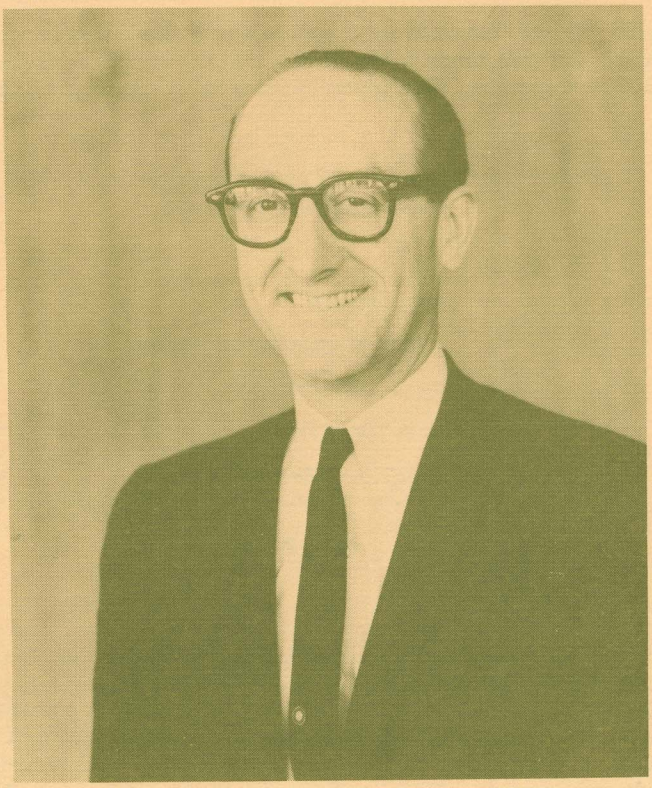
I think this can be a very valuable meeting for all of us. We are going to hear a bit about what is planned, what is possible, both from the viewpoint of NASA and from industry. I believe that this frank exchange of views and comments can give each of us a fresh perspective on our jobs, and a better understanding of what lies ahead in our national space program. I think we are all concerned about the period of let-down that tends to occur following a great milestone, such as has just been completed. We all know that we cannot afford a let-down. There are many important missions to be flown. There are many more flight crews waiting their turn for flights. We know that we are being looked at very critically by millions in this nation and abroad. We must continue to demonstrate to them that success can follow success, and that the words "Made in USA" stand for excellence and worth in leadership throughout the world.

Success results, I believe, from the interaction of many people doing many things. But success can never come about without pride. It cannot come about without personal dedication and a fundamental understanding of the job that is to be done. Unfortunately, motivation is an intangible. It is not something that the Federal Government can write into its contracts. It has to be self-induced. It comes from within. It results from knowing that the work we are doing is important and that the job we have been given is more than just an 8-hour day. It is impossible to get everyone, in all our organizations, to think like this, but if we could just raise the number by 10, 25, or even 50 percent, then I believe we would be working in an entirely new realm, with far greater potential for success and less probability of costly mistakes.

I cannot over-stress the importance that NASA management attaches to the Manned Flight Awareness Program. We know that the program has and will continue to have a very important and positive effect on our flight missions, an effect that can be felt in such vital areas as crew safety, cost, schedules, and new technology. I hope that each of you will find ways in this conference to put the tools of our Manned Flight Awareness effort to use to revitalize and rededicate the efforts of this great team.

I wish this conference every success, and again welcome. Thank you all very much.

MANNED FLIGHT AWARENESS CHALLENGE AS NASA SEES IT



THE FUTURE OF MANNED SPACE FLIGHT

DR. GEORGE MUELLER
Associate Administrator
for
Manned Space Flight

Good morning. It is good to be here. I would like to extend my own personal welcome to each of you for coming to our Manned Flight Awareness Symposium.

I would start out by saying that you all recognize the importance of continuing to succeed in the world in which we live, particularly in the world in which we live in Washington. The success of the Apollo Program thus far has laid a foundation of confidence and credibility that permits us today to propose and to have the Vice President's support, and I hope eventually the President's support, in a program that is at least as exciting as any program that we have contemplated in the history of space. I think that such a program is one that deserves support. But, I think it would not have been possible even to have proposed it had it not been for the outstanding success—as a matter of fact—the incredible success of the Apollo-Saturn program. And I want to take this moment to tell each of you how much we appreciate what you have, in fact, done to make this program so successful. We recognize full well that it is the people who actually do the work on the lines who make the difference between success and failure. It is exceptionally important at this point in time to continue to have those people feel how important they are, not only to the success of a particular mission, but to the success of the space program as a whole. We can't afford a failure.

I would like to discuss a program that we have outlined to the President and to the various other Government bodies in Washington that are interested in the space program. The program we developed has a dual rationale, or dual theme, as shown in Figure 1A. It is the use of space flight to insure increasing returns in science and applications. So we laid out a program that met as many of the objectives, the desires, and the applications of the scientific and engineering communities as possible, and one that is capable of supporting them at a cost that is commensurate with the kinds of costs we have experienced in the past. A second thing that we took as an objective was the exploration of the solar system, and we have tried to structure a program that developed, in an orderly fashion, a true capability for operating in space. We have, in the course of this, looked at the programs from the point of view of what needs to be accomplished in space. You will find that the demarcation between manned and unmanned programs has virtually disappeared as a result of this program, so that many of the discussions that we have had in the past, about whether it is better to do it with an automated vehicle or a manned vehicle, will no longer be an argument. The program approach that we have chosen is one that emphasized cost reduction (Figure 1B). It has been clear for some time that the costs of operations in space are so great that unless we can find a different way of approaching space operations we are never going to be able to build up to any truly large operational base. We have emphasized science, the needs of science, the need to apply the space environment's unique features to the use of people here on earth, and we have emphasized the development of new technology, since, in the long run, that's what makes this nation go. We have concentrated on uses in earth orbit, because, as we see it, most of the direct applications to people here on earth will in fact be initiated, if not eventually be carried out, in earth orbit. So we concentrated on using earth orbit for the applications and technology development areas. In the main, we have set up a very ambitious, I would say,

lunar exploration program; one that is, however, I think, a quite feasible one, and one that also serves as a proving ground for planetary exploration, because it turns out that most of the things that we will need to have when we explore the planets can be developed and tested at the moon, with some considerable savings in time and money.

PROGRAM RATIONALE

DUAL THEME

- USE OF SPACE FLIGHT
  - TO ENSURE INCREASING RETURNS IN SCIENCE AND APPLICATIONS
- EXPLORATION OF THE SOLAR SYSTEM
  - TO STRUCTURE A PROGRAM OF INCREASING CAPABILITY

FIGURE 1A

PROGRAM APPROACH 1970 TO 1980

COST REDUCTION

SCIENCE, APPLICATIONS & TECHNOLOGY

USE OF EARTH ORBIT

LUNAR EXPLORATION

PLANETARY EXPLORATION

FIGURE 1B

The results of this integrated program, as shown in Figure 2A (and I am kind of skipping to the end and then I will come back and fill in-between) are first of all that it fulfills the objectives of the science and applications disciplines, it provides an aggressive planetary program, and a capability for a lunar exploration program leading to the eventual exploitation of the moon. In particular, it provides a reasonable program leading to a surface base. It provides a capability for a program to use earth orbit for science applications and mission operations. It develops a new spaceflight capability of considerable power and it provides a precursor data technology system for manned planetary exploration in the 80's. It also provides a basis for cost reduction.

The capabilities that are developed in the course of carrying out this program include (Figure 2B), in the case of the automated spacecraft (which are still used for those missions where they are more effective), the development of long duration interplanetary spacecraft; the use of special-purpose spacecraft, particularly for those things that require continuing observations; and the operational earth application spacecraft where you are, for example, taking the follow-ons to the Tiros and the Nimbus satellites. Much of the equipment developed is designed for a combination of manned and automated operation. For example, the astronautical observatories are a dual mode type of operation where men will work with the telescopes over a period of time and then allow them to fly freely and operate automatically. Man in this kind of an application will be used primarily for changing instruments. The lunar rover is an example of a dual mode system in which we normally will have a manned operation of the rover, but it will have another mode that will permit it to carry out long traverses in an automated fashion. And then we will have the man-tended satellites of many kinds that have been proposed, including even manufacturing facilities where they can be automated.

INTEGRATED PROGRAM RESULTS
1970-1980

- FULFILLS THE OBJECTIVES OF THE SCIENCE & APPLICATION DISCIPLINES
- PROVIDES AN AGRESSIVE PLANETARY PROGRAM
- PROVIDES CAPABILITY FOR A LUNAR EXPLORATION PROGRAM LEADING TO EXPLOITATION
- PROVIDES CAPABILITY FOR A PROGRAM TO USE EARTH ORBIT FOR SCIENCE, APPLICATIONS AND MISSION OPERATIONS
- DEVELOPS NEW SPACE FLIGHT CAPABILITY
- PROVIDES PRECURSOR DATA & TECHNOLOGY FOR MANNED PLANETARY EXPLORATION IN THE 80'S
- PROVIDES A BASIS FOR COST REDUCTION

FIGURE 2A

INTEGRATED SPACE PROGRAM SPACE CAPABILITY DEVELOPMENTS

AUTOMATED

- LONG DURATION INTERPLANETARY S/C
- SPECIAL PURPOSE S/C
- OPERATIONAL EARTH APPLICATIONS S/C

MANNED/AUTOMATED

- ASTRONOMICAL INSTRUMENTS
- LUNAR ROVER
- MAN TENDED SATELLITES

MANNED

- SPACE STATION MODULE & ATTACHED LABORATORIES
- LM/B CREW CAPSULE

GENERAL USE

- SPACE SHUTTLE
- NUCLEAR SHUTTLE
- SPACE TUG PROPULSION MODULE

FIGURE 2B

In the completely manned area, we have the space station module and its attached laboratories. We also have such things as a crew capsule that can be used for excursions to the moon or for excursions from one orbit to another in the earth orbit.

For general use, we proposed the development of a space shuttle for earth surface to earth orbit and return; a nuclear shuttle for going from earth orbit to lunar orbit and return; and a space tug which, for example, is used for orbit-to-orbit changes near a space station. The space tug, incidentally, also is designed to provide us with the capability of landing that crew capsule on the moon. So it is a multipurpose equipment.

I think the basic strategy that we have developed for carrying out this program is one of first, reusability, and, if you will notice here, we get reusability in two fashions. One, in the case of the space shuttle, all of you know, is a vehicle that takes off from the earth surface, flies into orbit, rendezvous with whatever platform it needs to, transfers cargo and people to that space station module, then returns to earth, landing horizontally on a regular landing strip, and is brought over to a launch pad, refueled, and takes off again. And here we have reusability. In the case of the nuclear shuttle we are talking about a vehicle that can operate from orbit to orbit many times. We expect that we will be able to carry out somewhere between 10 to 50 orbit-to-orbit flights, with a single nuclear shuttle, before we have used up the nuclear material. In the case of the space station we get reusability in a different fashion, and that is through the lifetime. We are talking about space station modules that last ten years and that are in continuous use for that period of time, through supply from the space shuttle.

The second major strategy is commonality. Although it is most difficult in fact to achieve, we are looking at a program where we have only a few basic modules to be developed, and then we modify them to fit particular applications. In particular, we expect the space station module to be the same, whether it happens to be in earth orbit, lunar orbit, or in synchronous orbit. Now that places some constraints on the first design, but once accommodated, it then has a wide range of usefulness. The same thing is true of this space tug propulsion module. We expect to be able to use that same propulsion stage for landing on the lunar surface, as well as for taking the crew capsule from the space station module to one of the man-tended satellites and back again. Now one of the keys to this whole program again is the refueling in space of these various propulsion units. We don't intend to bring them back down to the surface. In most cases, we plan to refuel them in space. And that again means that we have a fair cargo, but a flexible cargo, that we can use in carrying out the program.

The kind of a program that we are now talking about has a schedule that takes off from our present Apollo equipment and its uses, and begins within 1972 (in the case of the Earth Orbit Program), with the Saturn V workshop and a quiescent CSM, as shown in Figure 3A. That workshop is designed to provide us with an understanding of what it takes for men to live for extended periods of time in space. Its first flight is for a month, its second flight is for two months, and it has a third flight for two months, where we will have a three man crew building up our experience about the physiological effects of long-term exposure to the space environment. In addition to that, it has a major scientific instrument, the Apollo Telescope Mount. It is really the first manned space solar observatory, and it will be in use throughout that time period. We have in the integrated plan the ability to fly a second of these workshops in the 1973-1974 time frame, leading up to the introduction of a space station module in 1975. At that same time, we would hope to be able to bring on the line the space tug and the space shuttle.

Now I ought to say a word about these dates, they are indicative of what we can do. The question, of course, is how much do you have in the way of resources? Well, we have carefully structured this program in a way that divides it up into phases. So it is a phased program. The first phase of earth orbit operations is the Apollo Applications Program, which you are all familiar with. The second stage will be the space station module. You have an opportunity to delay that phase, if you wish, in order to conserve near-term resources. And so, these dates represent the earliest possible dates that one could bring these into being. I think if you structure the program on less resources in the near-term, then those dates will stretch out.

In 1976 we plan to introduce the first of the man-tended spacecrafts. In the case of the automated missions between now and 1976 and 1977, there is a very active program in this plan of flights, building up our knowledge of the near-earth environment, and leading to the use of the space station and space tug in 1977 as it becomes available. And here we will first use the space shuttle for carrying the satellites that use to fly on top of regular rocket vehicles. We use them to carry the satellite into orbit, check them out at the space station, and then place them in whatever orbit we really want them eventually to be in with the space tug. This provides us with the opportunity, if something goes wrong with the satellite, to go back over, pick it up, and either fix it there or bring it back to the space station and fix it. In the event of a major failure, we can bring it back down to earth and fix it.

Then by 1979, we would have a space station in some low altitude earth orbit. We would expect that there might well be a space station in polar orbit, and we would expect that there would be a space station in geosynchronous orbit. The space station modules are designed to be coupled one to another, so that one can build up the amount

of living room you have in space. We think that we could use these to build up a space base capable of accommodating several tens or even hundreds of people in earth orbit. The nuclear shuttle would be the mainstay for translation from earth orbit to synchronous orbit, or other widely varying orbits.

In the lunar exploration program (Figure 3B), we have once again a take-off from the Apollo Program. We would expect, in the period between now and about 1975, to continue a program of exploration lunar flights, using the basic Apollo equipment, extended for additional staytime on the lunar surface, and to provide for some observations of the moon from orbit, by using the empty bay in the service module of the orbiting vehicle. We would expect to introduce sometime in the 1972 time frame, a manned roving vehicle that will permit the astronauts to venture some distance away from the landed lunar module. We would expect by about 1976, or some year after the first space station module was put into orbit, to put one into lunar orbit, and to begin then to use it as a mobile base in lunar orbit. It has one great advantage. That is, it is 60 miles from every place on the lunar surface, it's in a polar lunar orbit, and as a consequence, every two weeks one can reach any point on the surface of the moon. For early exploration this appears to be a most desirable mode of operations. It is coupled with the tug and the crew capsule to provide a capability for take-off from the space station module, landing at any point on the moon, staying there for either two or four weeks, and then returning to the space station module. The long term application of this orbiting module is, of course, as an intermediate base. If you think of what we will be doing on the moon sometime in the early 1980's or the late 1980's depending on how we proceed, we would envision a situation in which we had shuttles going from the earth's surface to earth orbit, carrying propellants, cargo, and crew, to this transfer point in earth orbit. A nuclear shuttle would then pick up the cargo, load up on propellants, and take the cargo and crew out to the space station in lunar orbit. Here again they transfer to a third shuttle that goes from lunar orbit to the lunar surface base, and returns to the lunar orbit.

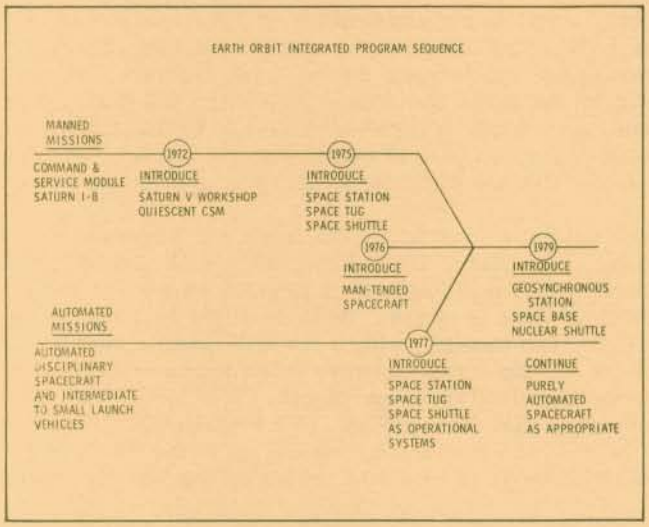


FIGURE 3A

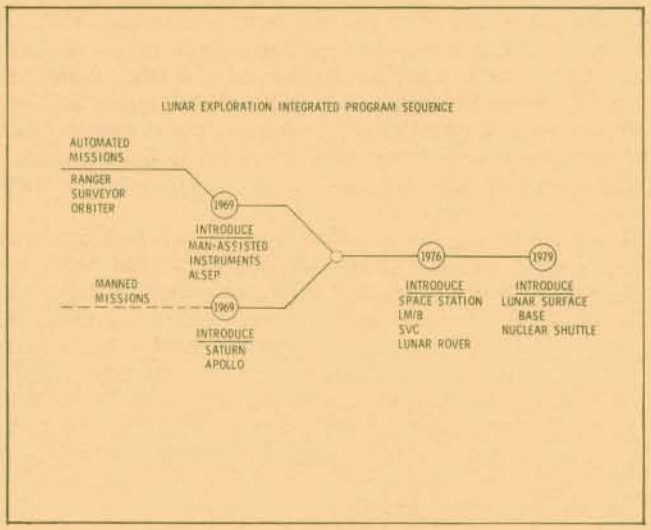


FIGURE 3B

We now have a transportation system that provides for completely reusable vehicles, all the way from the earth surface to the moon surface and return. One of the advantages of this is that you can project cost per pound for such transportation as being something like $200 a pound for a pound carried from the earth's surface out to the moon and back again. That compares with some hundreds of thousands of dollars a pound at the present time.

I have tried to summarize the major events as they take place in the earth orbit part of this integrated space program, in the time frame from 1970 to 1980. I think Figure 4 demonstrates what we have been saying. You find that we do not have very many new pieces of equipment introduced, but instead a build-up in the kinds of things we are doing that is quite impressive. In fact, I believe this program meets all of the objectives that the scientists and the people that have been working on space applications have been able to define for this time period and also provides the flexibility to do many things in addition.

Again (as shown in Figure 5) in lunar orbit you have the same build-up of capability and in the planetary area another build-up capability. Now, we have taken the program out through 1980. We also have looked at what the implications are of this program through 1990. It turns out that by using the same basic equipment of a nuclear shuttle and a space station module it is possible to build in earth orbit a planetary expedition. One of the ideas we have looked at says we take a space station module, plus some planetary peculiar equipment, and attach to it three nuclear shuttles in parallel. The first two of these fire, and drive the third shuttle and the space station

MAJOR EVENTS IN INTEGRATED SPACE PROGRAM, 1970-1980
EARTH ORBIT 1970-1975

	1968	1970	1971	1972	1973	1974	1975
Earth Orbit (New Events)				▲ DWS-I	▲ DWS-II		SSM ▲ Shuttle & Tug
Astronomy (See Lunar also)	OAO ——→ 1973 OSO ——→ 1978 RAE ——→ 1974	SAS ——→ 1973	Soirad	UV Survey ATM-A (DWS-I)		1.5-meter Stellar Tel. (DWS-II) X & γ-Ray Tel (DWS II)	X & γ-Ray Tel's. (SSM)
Physics (See Lunar also)	OGO ISIS ——→ 1972 IMP ——→ 1972 CO-OP ——→ 1974	SSS ——→ 1974		Atmosphere Explorer 1973	Gyro Precession (Relativity)	Relativity Red Shift (exp/ Daughter → 1975	Cluster (Magnetosphere)
Applications	NIMBUS 1970 TIROS ——→ 1974 ATS ——→ 1975 CO-OPS ——→ 1980+		SMS ——→ 1973 GEOS ——→ 1979 (Drag Free)	ERTS ——→ 1974 SATS ——→ 1974	SEA SAT ——→ 1980	Met. ATS ——→ 1977 GARP Data Coll Nav/TRFC Control Broadcast ——→ 1976 Sensors on DWS II	
Life Sciences	Biosatellite			AAP Expts Medical + Bioscience		IMBLMS DWS II	Science/Bio-tech Lab. (SSM)
Engineering & Technology	ATS ——→ 1975			AAP Technology Experiments Phase I Math Processing		Phase-II, Mat'ls Processing AAP Follow-on Expts (DWS II)	

FIGURE 4A

MAJOR EVENTS IN INTEGRATED SPACE PROGRAM, 1970-1980
EARTH ORBIT 1976-1980

	1976	1977	1978	1979	1980	1981
Earth Orbit (New Events)		▲ Operational Shuttle		▲ Synch. SSM (Nuclear Stage)		
Astronomy (See Lunar also)	Servicing of OAO, OSO, etc.)	← Focusing X-Ray Tel. (~1-m)	Prototype 3-Meter Stellar Tel.	ATM-C (Synch.) X & γ-Ray (Low Orbit)		Large Tel's (Stellar & Solar)
Physics (See Lunar also)	Cosmic Ray & High Energy Nucl. (SSM)	Shuttle Expts (Polar Orbit) 1980+ Relativity Expts. (SSM) ——→ 1980+				
Applications	Servicing Unmanned Satellites ——→ 1980+	Sensors on Polar Shuttles ——→ 1980+		Earth Survey From Synch. ——→ 1980+		
Life Sciences	——→ Habitability, Performance, EVA, Increasing Mission Duration,			——→ Release for Planetary Missions on SSM's		——→
Engineering & Technology	Phase-III, Mat'ls Processing on SSM	——→		LASER & Commun's, Synch. SSM		——→

EARTH ORBIT

FIGURE 4B

module with the planetary peculiar equipment off to, for example, Mars. The two outer shuttles, once they have achieved the transfer velocity, leave the vehicle and return to earth orbit for reuse, the remainder continues on out to Mars, and the third nuclear shuttle places the space station module in orbit about Mars. There are excursion modules to the Mars surface and return. They stay there for about two months, then they return past Venus, using the nuclear shuttle for the second time, and use a Venus flyby to reduce the return velocity to earth. Then they fire the nuclear shuttle for the third time, and return the whole assembly, including the space station module and the shuttle into earth orbit, where it can be refurbished and reused. That is the kind of program flexibility that is available once you develop these reusable vehicles.

Here in Figure 6 is a detailed flight program. I won't dwell on that this morning, but you will notice that there is a considerable program of unmanned or automated vehicles in the early phases. They eventually become reused, utilizing the space station as a base to operate from, and so the numbers decrease. That decrease in numbers, in turn, provides us with a better understanding of how we reach the savings. We are doing something like three or four times as much work in space, by the 1977-1978 time period, but the costs of operations have actually decreased.

I guess the one thing I didn't do was to discuss two very important parts of this program which will, in fact, determine how successful this program is in reducing cost (Figure 7). One of these is the third item where we have tried to provide for a relaxed qualification and checkout criteria. Now, that is particularly true in the experiment area, because once we have a space shuttle, it would seem that one ought to be able to use essentially the same kind of equipment for exploratory research that you use in the laboratories here on earth. If that is true, you can put those things in the space shuttle, carry them up to the space station, move them into position,

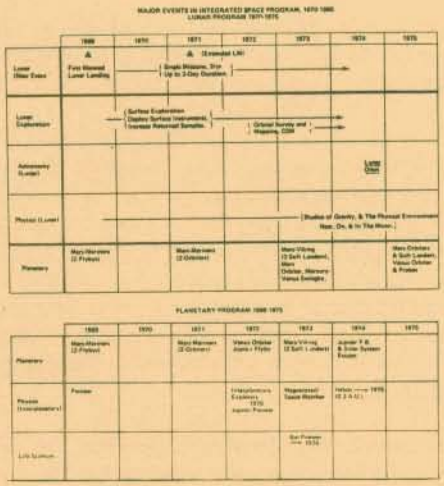


FIGURE 5A

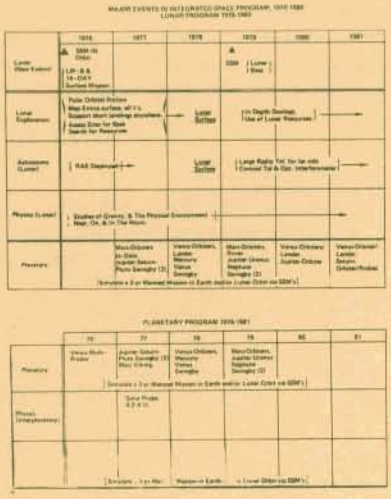


FIGURE 5B

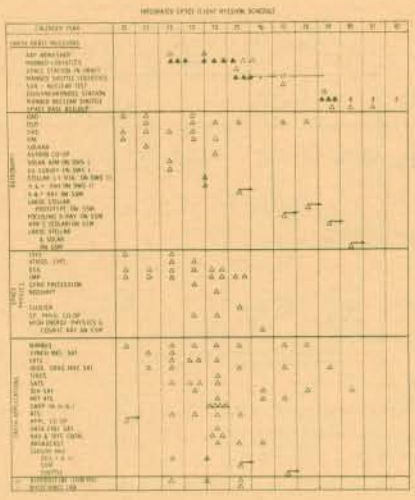


FIGURE 6A

INTEGRATED SPACE FLIGHT MISSION SCHEDULE

CALENDAR YEAR	70	71	72	73	74	75	76	77	78	79	80	81	82
LUNAR EXPLORATION													
APOLLO	▲▲▲												
EXTENDED APOLLO		▲ ▲	▲ ▲	▲ ▲	▲ ▲ ▲	▲							
SVC & LM/B TEST						△							
MANNED LOGISTICS							▲ ▲	▲	▲				
UNMANNED LOGISTICS							△ △	△	△ △				
SPACE STATION IN ORBIT						▲							
LUNAR SURFACE BASE										△			
MANNED NUCLEAR SHUTTLE										▲▲▲▲	4	4	4
UNMANNED NUCLEAR SHUTTLE										△ △	2	2	2
14 DAY SURFACE SORTIES					1	3	4	6	7	8	8	8	8
LUNAR POPULATION	3	3	3	3	3	4	4	4	4 ■ 6	12	12	12	12
RAE							△						
SURFACE ASTRONOMY										△			
INTERPLANETARY & PLANETARY EXPLORATION													
MAGNETOTAIL/SP WEATHER				△									
SML INTPLNT EXPLR			△	△	△	△	△						
O.T. PIONEER, MARINER			△	△	△								
SOLAR PROBE, HELIOS					△	△		△					
BIOPIONEER				△	△								
MARS ORBITER, MARINER		△△											
MARS VIKING				△△		△△		△					
MARS HIGH DATA RATE ORBITER										△			
VENUS ORBITER, EXPLORER			△	△		△							
VENUS FLYBY, MULTI-PROBES							△						
VENUS ORBITER, MARINER									△				
MERCURY/VENUS									△				
JUPITER, PIONEER F&G			△	△									
JUPITER, MARINER					△								
JUPITER, SATURN, PLUTO-MARINER								△△					
JUPITER, URANUS, NEPTUNE-MARINER										△△			

FIGURE 6B

THIS PROGRAM IS DESIGNED TO REDUCE THE COST OF SPACE FLIGHT, BOTH MANNED AND AUTOMATED

- MINIMIZE THE NUMBER VEHICLES, SPACECRAFT AND INSTRUMENTS IN USE.
  - DESIGN FOR LONG DURATION MISSIONS
  - DESIGN FOR GROWTH POTENTIAL
  - DESIGN FOR MULTI-MISSION APPLICATION
  - REDUCES COST OF: R&D, SYSTEM INTEGRATION, REQUALIFICATION, GROUND SUPPORT FACILITIES & PERSONNEL, IMPLEMENTING NEW MISSIONS
- REUSE VEHICLES
  - DESIGN FOR LONG DURATION MISSIONS
  - DESIGN FOR MAXIMUM REUSE CAPABILITY IN EACH VEHICLE
  - DESIGN FOR MAXIMUM USE OF REUSABLE TRANSPORTATION THROUGH OUT THE PROGRAM
  - DETRAY COST OF TRANSPORTATION OVER MANY MISSIONS
- PROVIDE FOR RELAXED QUALIFICATION AND CHECK OUT CRITERIA
  - USE QUALIFIED, LOW COST, HEAVY IF NECESSARY, COMPONENTS
  - PROVIDE FOR EASY RETURN OF SPACECRAFT AND INSTRUMENTATION TO EARTH FOR MODIFICATION OR REPAIR
  - PROVIDE FOR IN SITU ADJUSTMENT AND REPAIR OF SPACECRAFT AND INSTRUMENTS
  - PROVIDE REUSABLE TRANSPORTATION TO PERMIT HEAVY AND MAINTAINABLE DESIGN
- PROVIDE FOR AUTONOMOUS FLIGHT MISSIONS
  - DESIGN FOR INFLIGHT CHECKOUT & MAINTAINENCE
  - DESIGN FOR FLIGHT CREW MISSION CONTROL
  - RESULTS IN REDUCED GROUND CHECKOUT & FLIGHT MISSION SUPPORT COSTS
- ESTABLISH AN INTEGRATED PROGRAM
  - ASSURE MUTAL SUPPORT BETWEEN PROGRAM AREAS BY USE OF COMMON HARDWARE
  - COMMON USE OF TRANSPORTATION AND GROUND SUPPORT FACILITIES

FIGURE 7

and see if they work. If they don't work, you can fix them, because you have the time and people there to do it. That should reduce the very considerable cost that we have associated with making sure that all of this equipment works perfectly once it is launched. And much of the cost of present day equipment is in the qualification and traceability area. We had hoped to be able to eliminate that.

The second thing is that we have tried to provide for autonomous flight missions because, again, a very large part of the cost of our present systems operation is in the actual support cost that goes with it. We have, as you know, some 20,000 people at Cape Kennedy who participate in launching a Saturn V. We would like to end up with a ground crew for our space shuttle that is not larger than that for a 747 aircraft. If we can achieve that, then the cost of operation will plummet. That means though, that we have to do something different about the design of these vehicles. They have to be capable of operating with very small crews and be checked out and be ready for launch with very small crews. That says, in turn, that we have to design the subsystems to operate in that mode, which is quite different than the way they are designed at the present time. Therefore, one of the great challenges is going to be to change the way we are doing business to be much more nearly the kind of checkout and design philosophy associated with aircraft, rather than that which we have developed for launch vehicles and spacecraft.

Another facet of this is the development of a better way of handling information that is generated in the space module itself. One becomes aware of the problem, when you think of the warehouses full of magnetic tapes that now dot the landscape around each of our Centers—magnetic tape that is storing, at the present time, housekeeping data, at not a very high bit rate. And then look at the scientific equipment and the desires of the scientists for new equipment in the next 5 to 10 years. You can imagine that there probably won't be space enough on the surface of the earth to house all the magnetic tapes that would be generated in a few years of operation of some of this equipment. Well, we do need to pre-process data, reduce the volume of data, and increase the quantity of information we get out of these things. That is going to be another challenge in the development of both the space station and the space shuttle (Figure 8A).

We are in this kind of an approach, establishing an integrated program that is capable of meeting the needs of the scientific community and our engineering community as well. In this instance, the equipment we have developed consists of just a few basic kinds that are used to do all of the things that we have been able to think of doing in the 1970 to 1980 time period. Here (Figure 8B) in the case of the cislunar operations we continue

to use Saturn V throughout this time period, since that size of vehicle is necessary to launch many of the modules into orbit. But the major transportation is carried out by the space shuttle itself. The space station module has many uses of course, both as the base for laboratories in space, and also as a way-station for travel to other orbits. As you can see, we have space station modules in several places, each one of which is supported by the nuclear shuttle.

The overall planning schedule that we have talked about is shown on the left hand figure. You will note that one of the things we tried to do in making this plan was to have a continuing flight program both in the lunar area and in the earth orbital area. Doing so, turns out to be not too expensive, and at the same time it provides us with the continuing buildup of knowledge that is so essential for an orderly program.

Now I would like to tell you of the plan which went into the Space Task Group report. Basically, the Space Task Group report came out with three program alternatives (Figure 9). The integrated plan, that I described, is really the one that would require resources shown under the maximum pace in the dotted curve on top (Figure 10). As you can see, it builds up to a funding level that reaches about 10 billion dollars in 1976. That was the most ambitious program presented, and from that program the President's Space Task Group selected certain alternatives. It turns out that the principal change in each one of these alternatives is in the pace of the schedule in which the program is carried out. But there are differences in the contents of the several programs. For example, by the time you get to option 2, or program B, as is the case in the right hand figure, you find that you have reduced from two workshops to one workshop, and so on. There are actual reductions in content, as well as in the schedule of the program as carried out here. But basically, each one of the three options has the same earth orbital build-up of equipment. The third option essentially defers the decision on when one undertakes a planetary mission out beyond the scope of this particular study. Essentially, the difference between option 1 and option 2 is in the time at which you carry out your first manned planetary expedition and the time at which you bring your first station module on orbit. The difference between option 2 and option 3 is that the start of a planetary program does not take place in that funding curve. But, of course, as is true of most programs, you have to recognize that you have flexibility, and these programs are designed to have flexibility so that you can initiate a new program start at any point as you go along.

I think that the position the Space Task Group took is one that is quite constructive for the future of the space program. I find that the alternatives do permit us to build up those basic elements that are essential to a flexible long-term program. In particular, each of the programs provides for the development of the space shuttle, a space station, and a space tug. All of them also have in it the development, but on different schedules, of the nuclear shuttle. So that is the essence of the situation as we stand today.

I am encouraged, personally, with the actions that have been taken over the past several weeks and I believe that we do, in fact, have a sound basis for a continuing space program. I think you all ought to be encouraged. I think you all ought to recognize, though, that our ability to carry forward with such a program as this depends upon the continuing success of the present flight program. There is nothing that will cause some of these dreams to wither on the vine more rapidly than failures in flight. With that in mind, I would like to conclude with just a word about the importance of team work in carrying on in the future and to show a film that we had prepared in time for the Apollo 11 flight. It is a film that we prepared to commemorate the end of the Apollo Executives Group. We invited to the launch all of the top executives of your companies and the service groups who had participated in the program for so many years, allowing us to reach that point when we could take

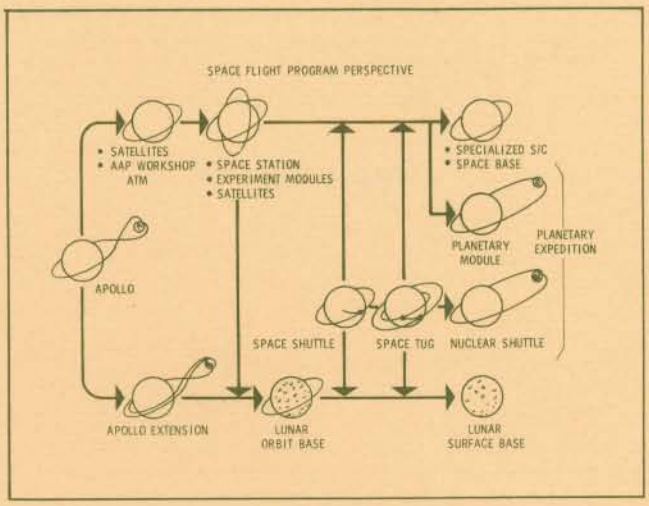


FIGURE 8A

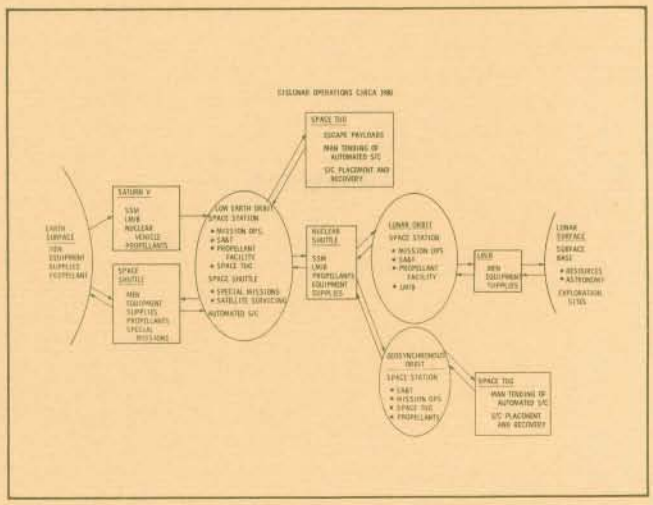


FIGURE 8B

off for the moon for a lunar landing. We tried to show in this film some of the characteristics of the teamwork that made that flight possible. I think that teamwork that was so essential in Apollo is going to continue to be essential in the future, if we are to succeed in this space activity. And so I would like to leave you with the thought that it is the team that is important, and it is our desire and hope that we can preserve that same kind of teamwork in the future that has been so instrumental in the success of the past. Thank you all very much.

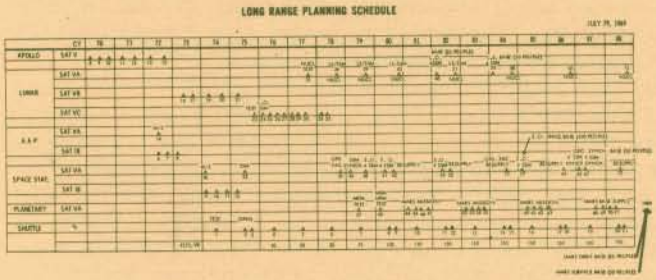


FIGURE 9A

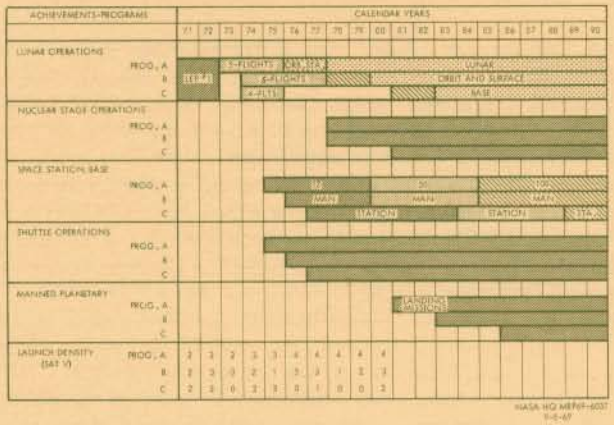


FIGURE 9B

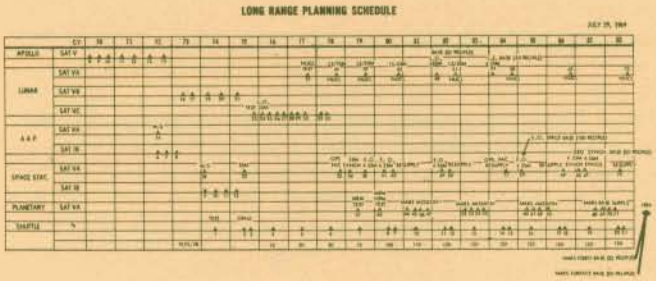


FIGURE 10A

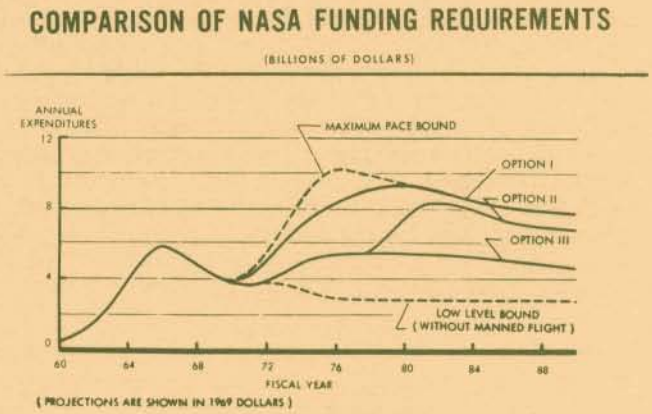


FIGURE 10B

APOLLO 12 AND BEYOND

DR. ROCCO PETRONE
Apollo Program Director

Good morning, gentlemen. It is nice to see all of you here today. In the few moments I have on the schedule I am going to stress Apollo 12 and beyond. I am also going to stress the fact that each bird comes by itself. Before you can talk 13, you have to talk 12. Before you can talk 14, you have to talk 13.

Some years ago, when I was playing football for Earl Blaik, he had a favorite expression that really sank home in later years. He said, "If you want to win, you've got to pay the price." Now, Apollo has its price in order to win and succeed. It is a question of dedication to the job—that little bit extra, that little extra push. It is far beyond what we would call an 8-hour day for those of us who are going to lead the program, and those of you who have to lead others. It is a question of following through on details. That is the price we have to pay in this program, where the smallest detail ignored is going to hurt us. It is a thorough probing of problems. It is a question of not accepting a first answer that comes in. You know, you are so harried and pressed, the first man comes in with a ready answer and, boy, it's the answer to a maiden's prayer. You have to be careful not to take that answer. Probe it! Make sure it is the answer to THE problem, not an answer to get rid of the problem, which could really be some other problem. It is a question of constant review to make sure there are no cracks; and again, that means hours of effort, that means a thorough review on the part of people who can see if there are cracks. And then there is the question of teamwork, the integrated teamwork between the plant and the field. Group all these together and that's the price we have to pay.

Now with Apollo 11, we proved we were willing to pay the price to meet our goal. Many people, some naturally but wrongfully, feel we have paid the price for success and now we can rest on our oars. I want to tell you that the demands on management for the future are really greater than those we have had in the past. When I looked at the future missions this last month, in my new position in Washington, I literally had my eyes opened on the future. We have been busy operating. We have been busy pushing, fighting the details—all of which has to be done. But the missions in the future of Apollo are more demanding. We are talking smaller launch windows. We are talking some launch opportunities that we only have one day to meet. We do not have a nice eight-day spread with maybe three recycles. One day! And on some sites only one day a year! So you can see the demands we are going to have on quality performance of operational follow-through. We are going to be carrying heavier payloads. We want to do a larger number of EVA's. The point to be made: "The demand is on management to make sure no one stumbles." To hit that site which is going to be important to us, demands are going to be greater than ever.

Let us look at the Apollo series from 12 to 15, we call these the H series. H-1 coming up is the Apollo 12 landing site. I am sure most of you know just where it is. It has certain objectives, and one of the new things we are going to do is to run two EVA's. We are going to spend some 32 hours on the surface, and, hopefully, we are going to bring back some new information. It is a very intriguing mission. One of the secondary objectives, not the primary, is that we land near the Surveyor. We are going to be able to see the results of what two and a half years of exposure in the lunar environment can do to equipment. Now, this is very important for the future, as we talk of building shelters on the moon, as we talk of better understanding conditions on the moon. Here now we see that with our second flight we are broadening our grasp. We are reaching for more data, more knowledge. The Surveyor landed there about two and a half years before

Apollo 12 is scheduled to land. This Surveyor did a number of things. One thing it did was to dig a trench. Now we have the unique opportunity on this flight to take pictures of that Surveyor, and analyze what two and a half years of exposure on the lunar surface does. It's quite unique! We will probably not have that opportunity again.

The Apollo 12 through 15 series of missions will go to sites we can use and exploit with essentially the present Apollo hardware, slightly extended. Starting with Apollo 16, we go into an extended lunar exploration. Here, we are making modifications on the lunar module to be able to stay on the lunar surface 54 hours. Also we are planning on three EVA's of four hours on the surface.

What has been intriguing to me is to watch the scientists who have studied every site; they seem to know each site now like you and I would know the back of our hand. By studying the maps made from the lunar orbiter photos and the data brought back from the prior Apollo missions, the scientists have been able to plan traverses where it is very important whether you go North or South, in terms of the data you are going to get. Now to get there in the first place we will require very precise navigation. We will need a very accurate system to get in to each site. Once we get to these sites, the knowledge we can bring back is unlimited. There is a precise reason for going to each site. We are going to be looking for a new crater. In some of the craters we have the advantage that when the meteorites hit, they ejected material from 10 miles below the surface. So we are going to be able to pick up specimens that really represent the interior of the moon. We are going to be able to determine the process which formed these rocks. The techniques we have to analyze these things are very intriguing. You can literally tell when the rock was formed. You can tell how long the rock has been on the surface. These things come together like a giant jigsaw puzzle. And that is part of the message.

The Apollo game is just starting. The information we are going to bring back, the integration of that information, is going to give us a tremendous insight to understanding the moon and the solar system. As Dr. Mueller said earlier, it will give us the first leg up on planetary exploration. These techniques for working on the moon are going to give us the knowledge, the plan, for later exploration of Mars.

One of the very important tools we are looking at is a Rover. I am sure many of you know about it. But the ability to go out some 10 kilometers in a precise direction, stopping at certain "science stations" (as we call them) along the way, picking up specimens, making observations, recording in pictures, and bringing back this information from each trip, or traverse is important. And each traverse has a particular job to fill a certain piece of a puzzle.

We are now talking of nine landings—nine more that have been approved. The science groups have looked at the lunar surface and have put together the puzzle that they would like to see filled. These science groups met at the Woods Halls Conference sponsored by NASA and the National Academy of Science. The purpose of that meeting was to bring together people in this country who could look now at this tool we have. Apollo had developed a tool unique in history. This group has recommended we adopt a flight program of between 10 and 15 landings to fill the puzzle and to bring home the pieces to fill that mosaic to give us the picture here in the years ahead of us. We also, as we look at these missions, are trying to explore the thing we call orbital science. This is quite detailed. We are going to put experiments aboard the command module. We are going to integrate here what the man can do with what the machines can do. Quite a bit of picture taking. Each one of these experiments is intriguing in itself, again to give us more knowledge, all leading to an integrated exploration of the moon. And clearly we are committed to that.

In the FY 1970 budget process, the authorization bill has passed both the House and the Senate. The appropriation bill so far has only passed the House, the Senate yet is to consider it. We are talking follow-on buys, which is very important, of course, for our future. We are talking some five Saturn V's. Again we are looking for missions beyond Apollo 20. We also are making plans for follow-on spacecraft. One of the steps we are taking, again in line with the comments Dr. Mueller made, is cost reduction, which is essential for the future of space exploration. Refurbishment of command modules is one of the methods we think offers us some opportunity. So, starting with Command Module 106 now at Downey, there will be—let me call it—prototype refurbishment, hoping that with Spacecraft 112 we will be able to take command modules and refurbish them. This will save a considerable cost in each follow-on mission. Again, these are some of the steps and thoughts we have in order to get more for the dollar in the exploitation of space.

The point I want to make with these remarks is that the future of Apollo is just beginning. The exploration and exploitation phases are just now here. There are many ways to prepare, like the football team that practices through the long, hot summer, with sweat in its eyes, and with hard knocks. But now comes the payoff. We have played the first game. We have achieved a goal. But we have no time to relax. The goal of Apollo was not just to land on the moon and return. Those were the key words in President Kennedy's address to the Congress. But other words were that we are going to learn to sail on these seas. We are going to learn how to operate. And that's the payoff, and that's the phase we have yet ahead of us. Can we operate? Can we be successful? Can we deliver hardware in the quality manner on time? Can the people prepare for launch? Will it do its job? The question of can we do the job, of course, means we have got to keep our eyes on the future.

But let us review our recent experiences to see where we need more practice. Where do we need more integrated teamwork? Where do we need more scrimmaging, to make sure we don't come up short when we face what I like to call the moment of truth? When this gear is committed for launch and we reach T -0

at the launch site, there is very little human hands can do to change anything. A wire that wasn't crimped right, a plug that has an intermittent short in it, all the many things that you have faced, once the moment of launch has been reached and we commit that hardware with our crews aboard the flight, there is very little human hands can do after that moment. Now the moment of truth is really faced many, many times at the plants, at the vendors, long before that hardware reaches the launch site. When the workman is putting that O-ring into the valves. How many times have you seen that undersized O-ring go in, that doesn't leak, until the moment you need it? Or maybe that battery cell that goes into that cage never to be seen again. But that battery cell could have a crack in it; and you are not going to see it until launch day or maybe until it is in flight when it leaks in vacuum. These are moments of truth. But you are not going to see that. You are committed at that time. The upper deck of the spacecraft? When that's closed and that heat shield goes on? We are committed at that time! Those parachutes, the mortar, the ordnance in there—the moment of truth is reached when that technician and that QC signed off. When we string our harnesses and wrap them up, any nicking that goes on, any wires that are near short, you will always find your problem. If the wire is shorted, you will know that. But what about the wire that's nicked, ready to be vibrated, and then short, which will only happen in flight? These are the moments of truth when the shop, and when the quality, really are out to commit that hardware to launch. And we have to continue to impress upon those people that those things, done at that time, are what allow us—done right—to commit with confidence, as we have been able to do with six of Saturn V Apollos, and the IB Apollo previous to that.

Now the question is how do we keep that up? We have the problem of attention to detail. On the Apollo 11 launch, we had a leaking liquid hydrogen replenishment valve. That was caused by two bolts being put in that were approximately one quarter inch oversized. They bottomed out. The torque values were proper because the bolt was bottomed out, not really giving torque. But, gentlemen, that quarter inch almost prevented us from going a quarter million miles. We came close to a scrub. If we had not been able to isolate and work around it, get it warm so she would seal and then not use it, that quarter million mile journey that you saw would have been stopped. And now when you recycle, you might catch that next window or you might not. You might sit there one month, with a spacecraft totally fueled, and you know reliability is not being improved sitting there under those conditions. How important a quarter inch can be. And no way to find it, except when the bolt was put in. Because after that the torque values look good, the clearances look good.

I have another case on Apollo 11 with the small seat in the regulator. Fortunately, this thing had come up at the Countdown Demonstration Test. This seat, about the size of a dime, a quarter of an inch thick, which was the point at which the poppet came to rest, failed on countdown demonstration. We looked into it and found it was a certain type material called Kel-F1. I am not up here to advertise, but I do want to use these names you can recognize. When we went to the drawings to find out what should be in there, we found that the drawings allowed the vendor an option! Now the qual test had been run a certain way. The qual test proved that regulator could be used. This was a ground regulator, but still important to start the journey of a quarter of a million miles. The qual test had been run with one type of material. We found in it another. We checked the regulator that had been used to launch Apollo 10, and we found a third material! And at the vendor's plant his drawings allowed the engineer at that level to make a change, and not reflect it as a dash number change, which means when it hit the field, that went in. As far as the people at the plant were concerned they were happy because they were using the same valve, the same part number. But what we really put into a system is something different. Attention to detail. Where can that happen to us? These are things we have to look for.

In the Apollo, there are two factors in my estimation that have given us the success that we have seen, and one is the rigorous detail of our qual test programs. I believe never in the history of hardware development have we ever seen as rigorous a qual test program. And yet it can be lost, by the engineer at the medium or lower level in the structure or hierarchy, who can make a change in the material. It can be lost by a process change, where a man on the floor has the option of how much heat he puts into a weld. It can be lost in the simplest deviation in a spec change of material buying. Now, attention to these details certainly is going to take time and money and we have got to get costs down.

The message I have for you is that we have to look at these things and make sure there are no open doors because we have spent billions to get here, and we can lose it for dollars. And if we lose it for dollars, that program you saw this morning is going nowhere. We can only sell that program if the leaders of our nation have confidence that we can deliver. To date we have delivered. But I want to tell you we are close to losing that if we don't pay attention to these details and watch them at the lower level. Don't let these things happen, because those small items will not only bite us, they can literally lead to catastrophe.

I mentioned that there are two elements in the program that led to success that have most impressed me. I mentioned qual test. The second is the malfunction failure analysis. I have seen great rigor applied in Apollo at the development centers and at the plants, where the hardware is designed and put together, and where they have said that any anomaly has to be explained. In searching for that anomaly never fall prey to that first answer, the easy one. Keep looking!

Now through the years in doing that, I know we have learned a lot. But I also know we are going to continue to learn. And when there is a failure, we have got to go after it right down to the roots. Why did it fail? Why didn't it fail before? Are we subjecting it

to a new environment? Have we lost control of our process spec? We have to make certain that we never accept the first answer. It's also true in our tests. It is so easy in testing that sometimes you will see a glitch on the record. "Well, yeah, we understand it," or "It couldn't be important." If that glitch was never there before, you must understand it. You must pursue it. Now there are times you cannot get to the bottom of it. But they have got to be few and far between. And then it has to be the right management level that accepts it. Don't let these things be bought off at the middle management. If they are not explained properly, where you can go back and audit later, they have to come to the higher level for acceptance. I believe those two items, the qual test program and malfunction analysis, have really contributed in a tremendous degree to the success we have seen of the Apollo hardware.

We have always facing us the question of quality. There are many people who believe, and they believe wrongly, that quality is something that depends upon the inspector to insure. Nothing could be further from the truth. Quality is a three-legged stool. It's that engineer who did the design or laid out the test, it's that engineer running the operation of the shop, and then the quality inspector. And those three functions must hold each other up. You are not going to have a good test because you have run it through a procedure if the test engineer lets you down in setting up the procedure. These three elements are vital. Yet I have seen many times when people thought, as long as we cover the item of quality, we have got it made. That's wrong. It has to be covered with good engineering, good shop operations, and then good quality.

I have seen in my experiences at the Cape a number of failures to do the job correctly. One of the ones that hounded us was the matter of crossed pressure lines. It is so easy to cross a pressure line. In designing this equipment many of the connectors all have the same diameter. Human engineering for different values often means weight, and of course weight is at a premium with the hardware we are working with. So very often you'll find we have the same quick disconnect, maybe 3 or 4 in one bracket, they are all quarter-inch quick disconnects. These quick disconnects have the same serial number. But they all have different designation numbers. In general, this has not happened once—it has not happened twice. You will find two lines crossed connected. You pressurize in one tank, you believe, and you are reading your gage out, but your pressure goes into another tank. We have come very close to blowing tanks at the launch site.

Now say, "What is the problem?" There are always two failures, a minimum of two. And these are the things that should never happen. We can understand human error. As long as there are human beings in this system, we are going to have some degree of human error. We don't bank on two human errors in succession. And what invariably happens when that job is sent to us, and whether it is a cross connector, or a valve that has to be open or a valve A and valve B arrangement and a man opens up the wrong one, you will usually find that quality has let the shop down. Now how do I mean that. There is always a problem. You know, if I am good I don't like anybody looking over my shoulder telling me what to do. So the quality man wants to be nice to his buddy of ten years. And okay, if Joe sets up that job, it must be good, because Joe set it up. The quality man will sometimes sign off in the blind. It has happened more often than you would care to think. When that quality man is letting that happen, he is being Joe's worst enemy. The shop needs the protection of the quality men to check every step. And yet in our structure, the errors we see cannot have happened if two eyes had looked at the same job. One eye made a mistake and the second eye bought it without looking.

We have looked at a little bit of the future, looked at a little bit of our experiences and said, "Where have we got to go now? What have we got to do to make sure we keep pressure on the people? The pressure to produce the quality, to produce the right engineering, the question of keeping everyone reaching for the goal?" And as I have said, "We have not achieved our goal yet." We have shown we can do the job. I think that is clear. We have shown we can do it. But this does not mean success is ours automatically. The fact that you won last Saturday's game doesn't mean you are going to win next Saturday's game. I don't care how good you are. You win the next game on what you put into that game.

Apollo 12, sitting on its pad at the Cape, doesn't know Apollo 11 ever made the journey to the moon and returned to earth. Apollo 12 sits there alone. And Apollo 13 is soon going to sit there alone. And whether those missions succeed or not, depends on what has been done at the Denver plant, what has been done at the home plant, the test sites, and, finally, what has been done at the Cape. We have got to approach each spacecraft and each launch vehicle with the idea that this is the big one. And what was done last month, or 6 months ago, does not guarantee any success for the future. If we keep our eyes focused on the ball, and the job to be done, and if we apply the lessons we have learned, there is no question in the future that success will be ours. Thank you.

APOLLO APPLICATIONS PROGRAM PLANNING

WILLIAM C. SCHNEIDER

Director
Apollo Applications Program

I was particularly intrigued by Rocco's analogy with the football team, and it led me to think if Apollo has just had their opening game of what promises to be a long and exciting season, AAP is in the business right now of just forming the league. We have the teams beginning to form, and we are beginning to get our hardware going, but we are writing some very new and different rules.

Just to give you an illustration, I was looking at a plant newspaper Bob Gilruth's people put out here last week and I copied this ad out of it. It said, "Available for rent, 2 bedroom cottage, kitchen, bath, living room, solarium, air conditioned, approved water supply, beautiful view, attached garage. All utilities supplied. Available March 1972 for suitable tenants. Reasonable rent. Apply the Apollo Applications Office." Well, I am going to tell you about that two bedroom cottage, because we are really entering in AAP into an entirely new era. We are a bridge.

Figure 1 shows what our official objectives are as laid upon us by NASA management, and really what that says is "You, AAP, are a precursor space station, and you are also a precursor space shuttle." Now, our objectives are to prove that, again, man can stay in space flight longer and longer, and what's more he can do some very useful work. So we have some very key tasks in the medical area to extend the qualification of man, if you will, on out to where we end up with 56 days and hopefully even longer than that. At the same time, we are doing some very key things in the area of habitability. What do you need to keep a man alive in orbit for 2 months at a time? Yesterday, for example, Dr. Mueller told me, "Gee, why don't we have rugs on the floor?" Well, we are not quite going to have rugs on the floor, but maybe we will end up with wallpaper on the walls! These are very key elements, and they are leading directly into the space station and space shuttle activity.

In the area of work we have about 70 different experiments, and they range from fairly simple minded—take a camera and take some pictures—to some extremely complicated experiments that are costing in the neighborhood of 70 to 80 billion dollars. They cover a wide range of technologies. And, of course, a whole batch of other things are going to keep the tenants that we will have up there busy for their period of time.

For those of you who may not be familiar with AAP, I prepared Figure 2 to summarize what the missions

APOLLO APPLICATIONS BASIC OBJECTIVES

- LONG DURATION SPACE FLIGHTS OF MEN AND SYSTEMS
  - UNIQUE CAPABILITIES OF MAN
  - HABITABILITY
  - BIOMEDICAL/BEHAVIORAL
  - SYSTEMS DEVELOPMENT
- SCIENTIFIC INVESTIGATIONS IN EARTH ORBIT
  - SOLAR ASTRONOMY
  - EARTH OBSERVATIONS
  - STELLAR ASTRONOMY
- APPLICATIONS IN EARTH ORBIT
  - METEOROLOGY
  - EARTH RESOURCES
  - COMMUNICATIONS
- EFFECTIVE AND ECONOMICAL APPROACH TO THE DEVELOPMENT OF A BASIS FOR POTENTIAL FUTURE SPACE PROGRAMS

NASA HQ ML68-6013
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FIGURE 1

are. We recently made a change from what we had termed the wet workshop into the dry workshop, and we are now launching the dry stage of a Saturn S-IVB stage on top of an active two stages of the Saturn V. That will be pre-outfitted as a workshop and will be put into about a 235-mile-high orbit by the two stage Saturn V. It will then stay there for about one day, unmanned, at which time the solar rays will deploy and the systems will automatically get ready to receive the first three man crew, which will be launched on top of a Saturn IB. (You remember the Saturn IB's? They're at Michoud, and they will stay there until 1972. Now there is a reliability and quality problem for you as those vehicles sit there for that period of time, are taken out of storage, and are then used to put man into orbit!) The men will then go up and join the workshop. They'll stay there for about 28 days. I have a thing about 28 days. I have set for myself, as a program goal, to change that to one month. And then we go to launch on 31-day months. But anyway, after about 28 days — 28 is a magic number, it's twice 14, and we had 14 day missions in Gemini — the crew will return to earth after having put the workshop into a standby mode, and it will sit there and wait about two months later when the second three man crew will go up and rejoin the workshop. They again will reactivate the systems, and they this time will stay up for two months, at which time they will come back down and then about a month later the third crew will go up, and they will repeat the cycle, doing new experiments and repeating some of the old experiments. They will currently stay up there for a period of 56 days. I don't know whether I should announce it here, because it certainly isn't official or hasn't been worked yet, but we are trying to extend that mission to an even longer duration. I personally would like to see it go up to 120 days, although that's just in the study phase. Right now 56 days is our goal.

So now what are we talking about? What is the reliability goal that you people keep shooting for? This

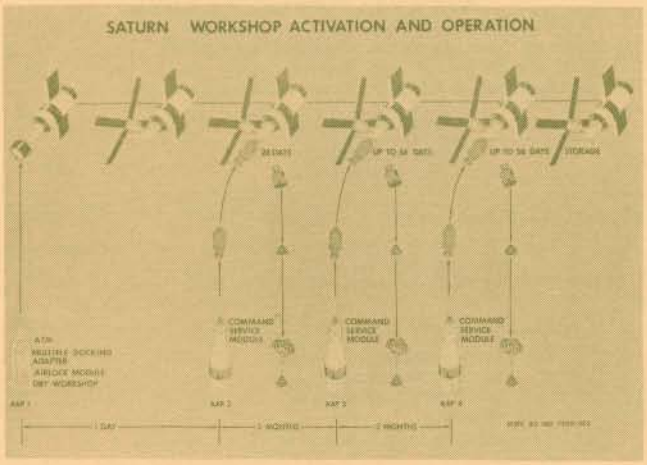


FIGURE 2

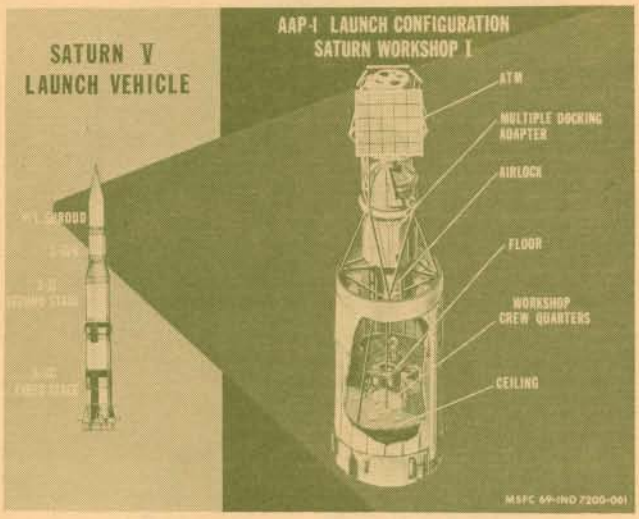


FIGURE 3

program initiates a whole new era. The cluster has to work for 8 months. It has to survive being activated and deactivated repeatedly, and all of this at minimum cost! Now, let me go into a few of the other systems.

I will show you some of the problems that we have. Figure 3 is the workshop. The first launch is Saturn V, two stages fueled. Third stage is the S-IVB, in this case emptied and used, outfitted on the ground as the workshop. There will still be minor things to be worked up—and it is set up as this cottage that I spoke of before. There are two active floors right now, that is, the floor of one side is the floor of the other side. In other words, people stand toe to toe when they are standing on the two floors, and equipped with experiment areas and various components. This is the major experiment that we have on top, which is the Apollo telescope. It is a solar observatory, and its task is to observe the Sun on a long-term basis bringing back observations in a photographic sense, as well as in the astronaut's mind, as to what has happened at the Sun. Very interesting experiments for astronomists.

Looking at the pieces of equipment one at a time kind of outlines for you the types of problems you are going to be faced with, or we are being faced with. Figure 4 is the air lock module, and its particular problem is that most of the active systems in this, or a good number of the active systems in this, are Gemini equipment. That is what I said, Gemini 14-day qualified systems, and we are now having to take those systems and assure ourselves that they are now going to be available and working for this eight month period, of which five will be manned. So it represents a very significant problem for the R&QA people. Not only do we have to worry about whether that nick in the line, that Rocco talked about, is going to give us a short on lift-off, it now also has to work up there for that long period of time—a particular R&QA program.

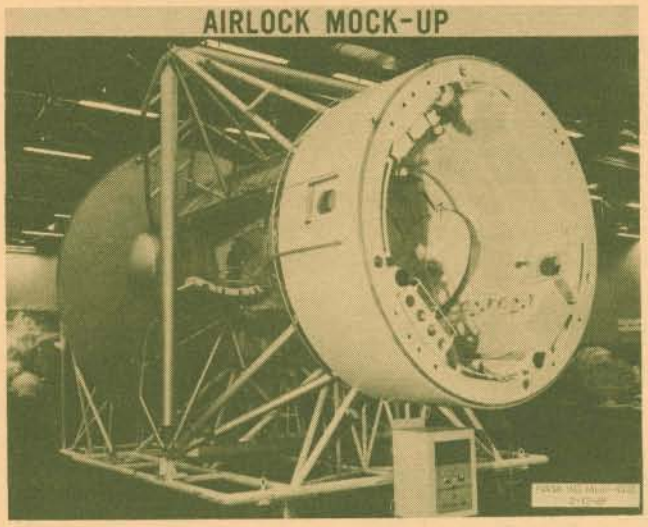


FIGURE 4

The next bulk on the front is the multiple docking adaptor (Figure 5). This represents a NASA problem, and your NASA R&QA people have a good task in that Marshall is currently building the multiple docking adaptor, and this means that we are interfacing with the contractors, giving us interface problems, as well as our own R&QA problems.

And I might also add, there was a lot of experiments and pieces of equipment that are put into that, that are fairly major in themselves, and I will show you one as we go on (Figure 6). Up on the front is the Apollo telescope mount. This too is being assembled in-house at Marshall, with some considerable help from many contractors. The experiments themselves are provided by the principal investigators. The biggest contractor being Ball Brothers building at least two of the experiments, with some of the others being built in-house, and others being built by other contractors. Very peculiar R&QA problems are involved here because these are scientific instruments. They are being run by scientists who have different inclinations than perhaps our system's engineers, and are requiring considerable effort on our part to make sure that they are indeed good equipment, that they are going to work for those eight months. This is very complex equipment as well.

And I might add, regarding the Apollo telescope mount, we feel that it has to work, because if that doesn't work, I think that the space station will lose all of its support from the scientific community. Because in that piece of equipment, we are proving to the scientists that really, when we undertake a manned space flight, we undertake a scientific task for the scientific community and we are going to deliver. And it's of very major importance to us that that does work.

Now the AAP shuttle is the Apollo command and service module (Figure 7). And for the uninitiated who look at it from the outside, it looks pretty much like the Apollo command and service module. But there are some very important hardware differences, which are brought about by the even more important differences in the way that we are using this equipment. This equipment will be used to take the men into orbit. They will then transfer over into the workshop, at which time the command and service module is powered down. That is, it is then allowed to remain there in a very quiet state, without all of the power on, and only those systems operating that we have to keep heated up, and things like that. And it must be available for any emergency, so the crew can return and come back. Obviously, then, it must be capable of being turned on and returned to earth safely. So it looks the same, but it is doing a vastly different job, in a different manner. And that brings us into some very fine subtilities in the qual program and the verification program that feed into our design and have led us to some changes in the command module.

Particularly in the command module (Figure 8) we are adding a backup RCS tank so that we can have alternate means of deorbit. Hopefully this will save a lot of money in the qual program, because now we won't have to qualify the basic service propulsions system, which is what we will rely on mostly to bring us back from orbit, quite as hard as it would if we didn't have a backup system. Now the workshop areas are in here, the experiments area, the air lock, the multiple docking adaptor, the ATM with its solar rays deployed, of course, these are the solar rays in the workshop and the command and service module. In orbit the major power supply is solar rays.

The workshop itself (Figure 9), as I said, is a two-bedroom house. And it is. I'm not particularly pleased with the layout that I am showing you here. This is the layout we had for the wet workshop, and I am sure that now that we don't have to have hydrogen compatibility, we can make it a lot more livable. You can see the view of the experiments area here, with some of the experiments, a view into one of the bedrooms, the food area, the waste management area, and the other bedroom is over here.

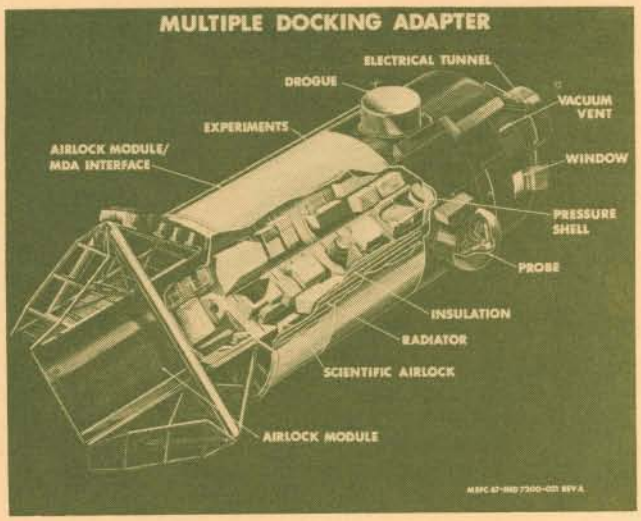


FIGURE 5

This is what we in our space wisdom call the space waste management area (Figure 10). I have taken steps to rename this "The Head." I don't know whether I'll be successful in that. You know we kind of get hung up—everyone has their own little hang-ups—and in space business we kind of have hang-ups on names. But it is the "head." It is giving us some major developmental problems because it obviously must work, and it is tied directly into our experiments because part of our problem in the medical area is to bring back the waste material from the men, the feces and the urine, so they can be properly analyzed on the ground, so the medics will indeed say to us, "Yeah, you guys can go on and put up a long-duration space station."

Some of the experiments that we are doing are quite interesting. I won't dwell on them, but as I have said there are some 70 of them. But this is one that I find particularly interesting (Figure 11). We are going to be flying around inside of the spacecraft in an attempt to learn a little bit about extravehicular activities. Hopefully, out of this we will figure out those constraints that there are on men, in these and other EVA experiments, such that EVA's become a fairly routine thing. You know, in the future in the space station you won't pucker nearly as bad as you do now.

One of the experiments is complicated and large. Figure 12 is the control display for the Apollo telescope mount, and it will be mounted in the multiple

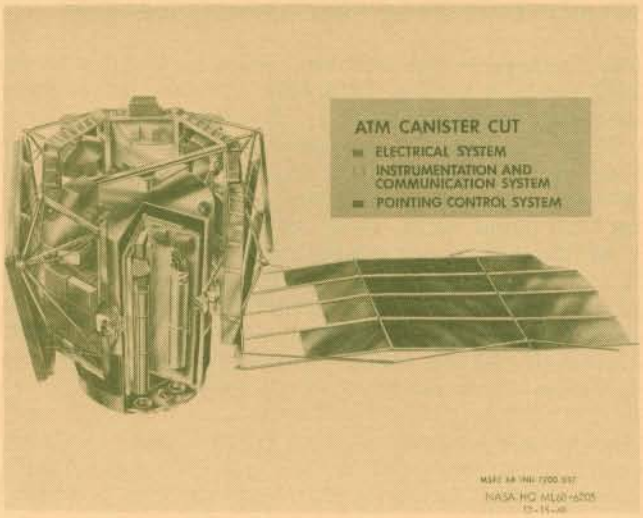


FIGURE 6

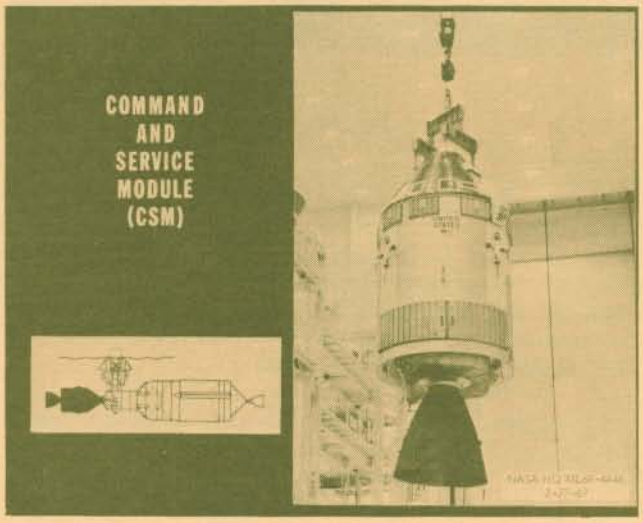


FIGURE 7

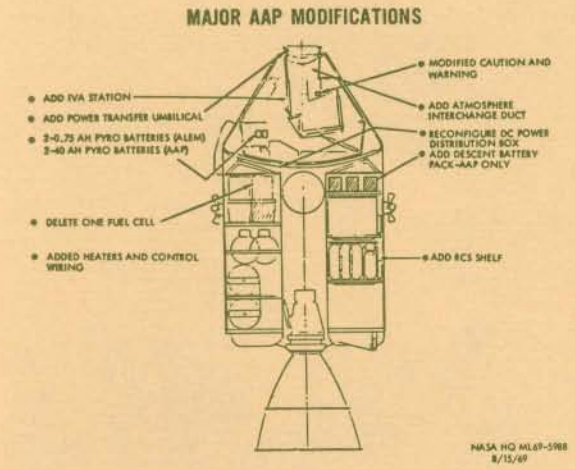


FIGURE 8

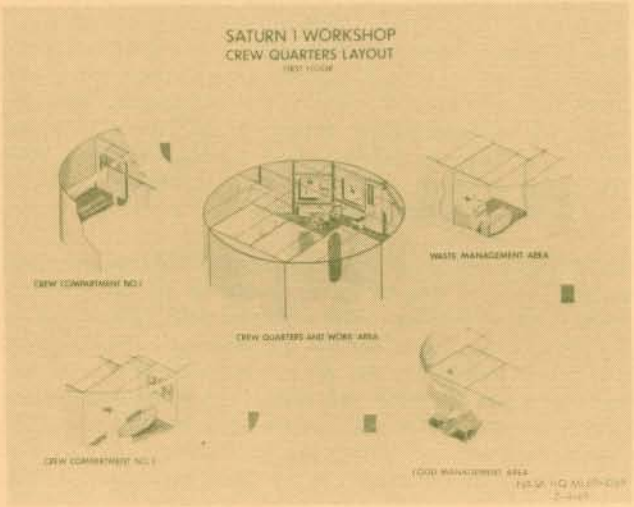


FIGURE 9

docking adaptor. It is kind of like the complexity of a DC-8 console, and you can see all the switches and all the indicators that are necessary to run these five ATM experiments, control the vehicle, control the ATM, and watch what you are doing. The astronaut looks at what the Sun is doing on these displays here, and then records the activity on film.

And we too have our own moments of EVA which are going to give us our moments in R&QA. Our EVA is necessary in Apollo Applications in order to retrieve the film from the ATM (Figure 13). So we will still have EVA as a part of our program, and it should prove as interesting as previous EVA's.

When are they going to do this? (Figure 14.) George said we have a schedule that officially we say we are committing ourselves to Congress for July 1972. In order to achieve that July of 1972, we have set our internal goal of March of 72. I've been asked "Is that just a fictitious goal? Is it just a pad?" Believe me, we will go in March of 72, if the hardware is ready. And we have established as a program policy that we are not going to allow sandbagging on equipment deliveries. If Part "A" falls behind its delivery schedule to the Cape, we are not going to relieve all other equipment of their delivery dates. We are going to, as best we can, keep things in storage and wait for all of the things to come up. We do, indeed, want to

FIGURE 10

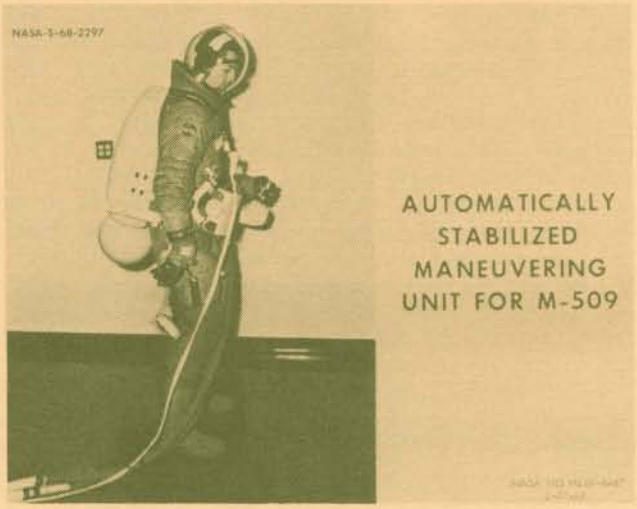


FIGURE 11

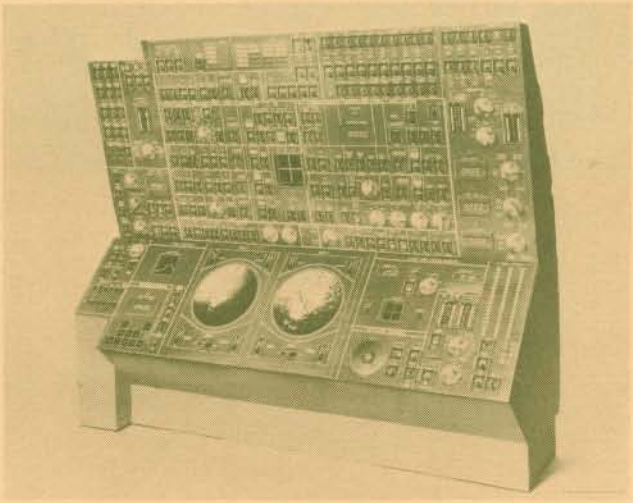


FIGURE 12

FIGURE 13

hit that March of 72 date. We have three revisits planned, as I said, and we have one backup command and service module. In the cards, hopefully, as Dr. Mueller showed you in the integrated plan, is a second workshop. Now that second workshop is basically the backup equipment, refurbished and with some modifications on it for which our current planned launch date is in January 1974. That too would have some refurbished command and service modules as this one again and we will re-engineer it and rebuild it, and put it back in, and fly that up for three 120-day missions.

Now, I did mention in passing, refurbishment. I guess we in AAP are paving the way, although we did a little bit of this back in Gemini and some has been done in Apollo. Part of our command and service module philosophy is to reuse parts, and some considerable parts on those command and service modules right there are things that have gone to the moon and back. This is providing quite a revelation to our public affairs people who are wondering where they are going to get all the Apollo spacecrafts to put in the museums. We told them, we want parts of them, and they are just not going to have them for display. But seriously, we are planning on flying many parts that have flown before—key parts, not TV cameras, hatches, and things like that. We are even looking at, although a decision hasn't been made, not by a long shot, "Can you reuse heat shields?" I'm sure you can recognize what kind of implication that has in the R&QA area.

Well, I've said this before, and I'll say it again real quickly, AAP is to space station, what Gemini was to Apollo. We are the bridge. We are paving the way. We don't expect that we will solve all the problems, but we have undertaken to provide answers in a number of areas, and we have that objective of being transitory, of transferring our manned space flight thinking from event — being a launch, a lunar mission and return — to living and working in space (Figure 15). So we are writing the rules right now, and we need a lot of help in the R&QA area, and in every area, in what the proper rules are that we should apply to make our spacecraft more like aircraft, things that are designed for multiple purposes, multiple uses and, of course, long duration.

Well, gentlemen, that concludes my brief discussion of what AAP is. Thank you very much.

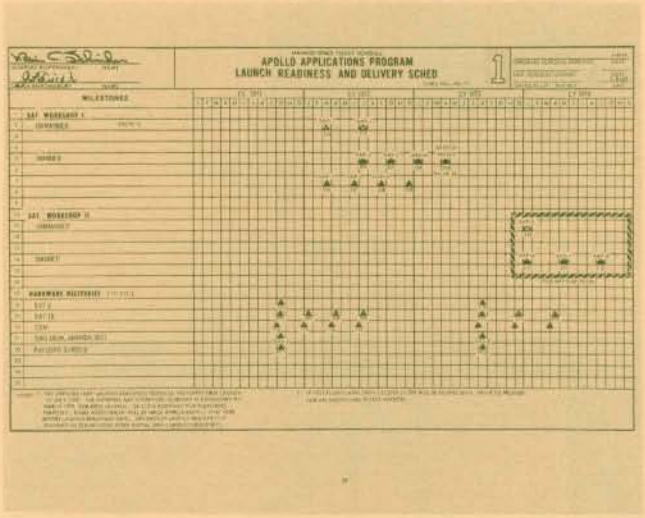


FIGURE 14

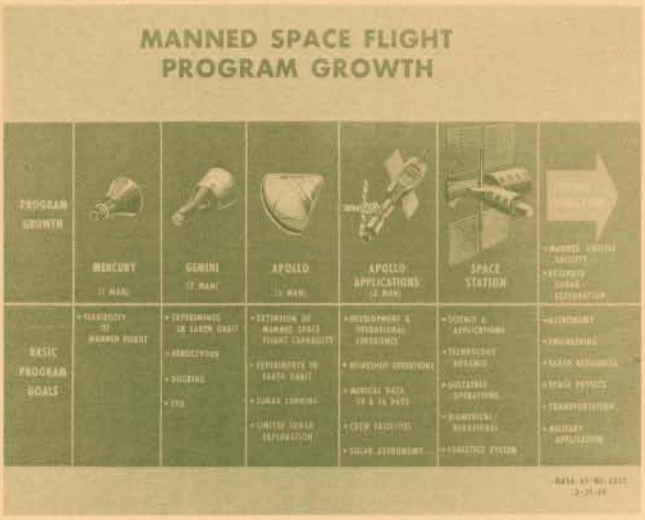


FIGURE 15

THE MANAGEMENT CHALLENGE

LEE JAMES

Director
Program Management
Marshall Space Flight Center

Good morning, ladies and gentlemen. It seems to be the order of the day to start off with a football story. I did not bring one. I have been trying to think of some analogy; one that might apply is that Rocco Petrone and I had the same coach, Earl Blaik. We still have the same coach, George Mueller; we are still on a winning team and although we made one goal, the season is not yet over.

What I plan to do in a few minutes this morning is to put into perspective where we are in the Apollo Program, particularly as it applies to management of the Saturn Launch Vehicle Program. It seems to me that if space can have a crossover point that we are now there. No matter how you describe it, the initial Saturn-Apollo Program is over. The Apollo job—to put man on the moon and safely return him to earth—has been done successfully. On just the other side of the crossover point are today's programs. These programs include further lunar exploration and Bill Schneider's Apollo Applications Program—two vastly different programs. Further downstream from this crossover point are some things that are quite glamorous. These are the future programs. They include many challenging things like space shuttles, large space stations, tugs, nuclear stages, Mars exploration, etc.

Today, I am not overly concerned with the success of the Apollo Program because it is over. I am not concerned about those glamorous programs down the line—the ones that Dr. Mueller described. Somehow the Government and industry have the ability to apply themselves most diligently to glamorous new programs, and we will probably do a good job on each of them. I am somewhat concerned, though, with today's programs. These programs, consisting of further lunar exploration and the Apollo Applications Program, are a real challenge to us. However, I am not sure that we are equipped for that challenge. Let us separate and briefly analyze these challenges.

First, the Apollo Program had a number of things going for it. It was a clearly established national objective. I do not think at the time the President made that objective for us that we realized how great a thing he had done. The setting of a goal gave the Apollo Program a big push. Next, the Apollo Program was supported by the general public. That may not mean much to us until the general public does not support a program, and then one certainly takes note of it. Third, the Apollo Program had a certain amount of international support. We may not realize what that means until our Government becomes concerned about lack of international support.

Internally, the Apollo Program was supported in a number of different ways. There was a vast industrial base solidly behind it and that really provided momentum. It has a very strong Government base behind it, and I do not mean NASA alone; it included the Bureau of the Budget, the Congress, and the Department of Defense. There were a lot of members on that team. Next, there was a very strong scientific interest. The scientific community was highly intrigued by the Apollo Program and gave it full support. I, personally, would like to submit that the Apollo Program had good leadership everywhere it needed it—in the Government, in industry, and in Congress. Lastly, to get down to the nitty-gritty, it had what it needed most: manpower, facilities, and sufficient dollars to get the job done. The combination makes for a successful program, and we have had a successful program.

We had our problems in Apollo. I think some of you are aware of that. We had technical problems. Exotic new materials were developed and we had to learn

how to use them. We had to learn to weld a different way and to use large hydrogen engines that nobody had used before. We had technical problems and many schedule perturbations. Above all, we had to learn to handle the sheer size of the program. There are some seven primes in the Saturn. It seems an astronomical feat to bring, time after time, and launch after launch, seven major entities to bear at exactly the same moment. So there were those of you and those of us who had to hurry up and wait. This caused problems.

We had some significant hardware losses during our tests and during our preflight activity. I want to talk more about that in a minute. We had a Viet Nam conflict that is real and is with us and that cannot be overlooked. It had its effect. As the program reached the peak, we immediately experienced serious manpower reductions. No matter how you cut it, even in the midst of a going program, even though it is planned and even though it is nothing new, it is always tenuous to come off the manpower curve. We had many—unfortunately maybe more than any of us realized—human errors in the program.

We had what one might term a major program catastrophe with the loss of 204. The accident was far more significant than any other problem or success. It was significant because it was at that moment that we learned what a tenuous razor's edge we all live on. We learned what a short distance it is from being known as a national success to being known as a national failure. We learned how quickly one can lose public support and following, naturally, Congressional support. While we lost a lot when this failure occurred, we learned a lot too. We had to learn, for at this point we faced a reality that said, "You cannot get there from here without absolutely total success from here on in." Fortunately, we had that.

We have had other adverse things, like natural catastrophies, such as Hurricane Camille. These things are part of the program. Many of the incidents I have described are what one would expect in the course of a large program. They happened, and fortunately, the program had enough going for it to overcome these adversities and capitalize upon most failures.

Now, I would like to talk briefly about where we are today. As has been mentioned in earlier speeches, we have 18 Saturns in the last stages of production, test, or checkout, and yet to be launched. They are not scheduled for flight right away. Some of these are built and stored, others will soon be completed and it is going to be a long period of time before we use all of them. This is a problem. These stages are going to be completed by teams that are being dismantled. These stages are going to be launched by teams that are somewhat dismantled. Believe me, this is a problem! And in the midst of taking what we might call old vehicles and finding out how to use them for our on-going programs, we are entering into a follow-on program for the production of additional Saturn V Launch Vehicles.

The Apollo Program was such that we could have an expensive launch vehicle and get by with it. But the public is not sympathetic with continuing the program at the high cost necessary to get the program started. And neither is the Bureau of Budget, Congress, or anybody else. We have to face up to that. After the Apollo success, we had to do something about lowering the cost. We met with your industrial leaders, some of you here today, and decided that a 50 percent reduction goal was in the ball park for the follow-on Saturns. We have reduced the cost 50 percent. We all agreed to this, and it is firm. The Bureau of the Budget has now adopted those figures and they are what we are going to live with. The reduction is no longer a possibility—it is a fact! Of course, I think everybody has been back to see me now to say, "You realize that 50 percent did not exactly apply to us." But it does apply across the board. This requires us to transfer now from an R&D concept which allows changes and tests, and static tests and other nice-to-have, but expensive, things to a production concept where we are not going to have static testing, frequent changes, and the other niceties. Deletion of static testing precludes pre-static checkout. When you do not have static testing, you do not have a post-static checkout. We will have post-manufacturing checkout, then go directly to launch. This means that some of the things—mistakes, accidents, human errors—that have been happening cannot be allowed to happen any more.

Now let us briefly consider the AAP Program that Bill Schneider described to you. As I see it, and in the perspective that I am trying to make, the AAP Program has many of the same features of the Apollo Program, and several drastically different features. In the first place, I think it has all the complexity Apollo had. We are trying to do in the AAP a program every bit as complex as landing man on the moon and returning him safety to earth. On the other hand, we are not building up a big hardware inventory. In Apollo, our plans said, "If you do not make it on AS-501, how about AS-505, AS-513, even AS-515?" In AAP, there will be two shots. It is a program that builds up and almost immediately cuts off. So it is different in that respect. Another big difference is that AAP is not a well-funded program. We are going to do this on, what I call, a shoe-string. This is a challenge. So what have we accumulated today? We have accumulated a program with funding less than its challenge. We have built some hardware that we have got to use over a period of time to make that work. And I say to you, that is a real challenge.

Now, I ask myself some questions. Can we continue to improve and maintain the quality of this hardware under these kinds of conditions? Can we make a transition from an R&D type of launch vehicle to a standard production type launch vehicle and make it work at this point in the program? Can we accomplish the task within our budget? (If we do not come within our budget, and that means 50 percent less than it has been, it has to come out of something. There will be no new funds for it. I think I have just de-

scribed that today's program, like Bill Schneider's, certainly is not going to provide for it.)

Can we keep the attention of those workers who have a slightly different perspective of this whole thing than maybe management does today? Can we motivate the people with the critical skills to transition from the diminishing program that we have today to the follow-on program that has to build up? Can we convert to a completely different program philosophy? Maybe you have not thought about it, but can we really succeed in a non-crash program atmosphere? The funding and the overall situation dictate a non-crash program atmosphere. We have a lot going for us. We have a tremendous team built up. We have a successful program. And goodness knows, we have a challenge.

Now, I want to address the situation one other way. What I have tried to do is talk about the Apollo Program and the transition to the follow-on program. Let us look at the Apollo Program with the eyes of the astronauts for just a second, and the transition just a little bit later. I looked through some papers that I had and came up with quotes from a couple of the astronauts. For the look into the past—the look into Apollo—I would like to read these.

The first one is from Mike Collins after the Apollo 11 flight. He said, "Any flight like this is an extremely long, fragile, daisy chain of events. The malfunction of any one of the thousands of pieces of hardware on the way could ruin the remainder of the mission. Despite the fact that I have great confidence in each individual item of equipment, I was a little pessimistic about our chances to carry the whole thing off. I figured that any chain as long and tenuous as this had to have a weak link. Believe me, I spent a lot of time before the flight worrying about that link. Could I be it? Could my training have neglected some vital bit of information? Or had I been properly exposed but simply forgetful? By launch day, I was convinced that I had taken all the steps within reason to prepare myself, and I hoped that the thousands of others responsible for the equipment preparation had done the same. Obviously, they had, because the performance of the whole stack was nothing short of perfection."

This is how one feels about a successful flight. Neil Armstrong, right here in town at the Rice Hotel on August 12 said, "It would seem that in such conditions we would be expected to be very lonely far away from home and alone. The facts are, I never felt less lonely in my life. In every piece of equipment, in every corner of the spacecraft, in every cabinet, and in every piece of scientific equipment we carried to the surface, I felt the hands and the spirit of those who were riding along on Apollo 11. Those pieces of equipment were superb. They brought to my mind the proof of the return (and I like that word) the return of 'American craftsmanship.' And as some of us, some of you, turn from this program to even more challenging adventures of tomorrow. you will take with you the knowledge that craftsmanship, in itself, is a worthwhile objective. So to all of you and those who you represent, I say thanks for riding along."

I would say that it is nice to ride along on a program like Apollo.

I have selected one launch vehicle, which I do not choose to identify, to illustrate the task we face in our continuing program. On this one vehicle, we traced some of the following errors to human beings. Fortunately, all of them were caught.

- Two of seven helium fill and dump valves, which had passed acceptance test and which had just been checked, leaked.
- A broken position switch pin and a short circuit valve in the LOX vent and release valve previously had passed a visual check.
- Tie-down straps used during furnace brazing of the thrust chamber were found wedged in the upstream side of an engine. The straps had not been removed during regular cleaning.
- An electrical harness showed heavy rust deposits.
- Water and a broken pin in one connector were caused by improper insulating by someone.
- Corrosion and a bent pin were found in the connector of the flight control transducer and an O-ring was left out of a mating cable connector; all due to human error during rework.
- Corrosion noted in the flight instruction harness connector was caused by a missing O-ring which allowed moisture to enter.
- An offset weld problem occurred during circumferential welding of the LH_2 tank forward bulkhead to cylinder six, primarily due to improper manufacturing and quality control of the diameter measurements.
- During post-manufacturing check, a screwdriver was dropped and penetrated the wall of an engine thrust chamber.
- LOX tank baffles were destroyed during too fast propellant loading.
- An LH_2 tank insulation problem indicated leaks and debonds caused by poor installation processes.
- Leakage at the main oxidizer valve idler shaft vent point check valve was caused by contamination from a change of lubricant. The vendor did not follow specs.
- An LH_2 and drain valve ruptured causing much damage to the skirt ducting.

All of these were on one vehicle. Fortunately, they were caught.

I pointed out earlier that we now have checks we were not going to have in the future, that is, pre-static, post-static, and static tests. I doubt if you would like to be riding along with Neil, Buzz, and Mike if some of these things had not been caught and corrected.

There are only two ways to stop these errors with the programs we have. One is not to let them happen, and the other is to catch them. It is probably going to take some of both.

Now I would like to carry that just a little further and show you some things that were not caught in time. We traced a number of things that were found on

various vehicles at one time or another that had a human link involved in them as opposed to something that may have been wrong by design. In Figure 1, the X's that are shown in the different stages represent such items. The shaded areas represent total losses that were caused by some kind of fault. I think it is interesting to note that we have only flown six Saturn V vehicles, but already we are finding a significant number of like things in AS-511 and AS-512. We must catch these things. The follow-on vehicles, AS-516 through AS-521, are now under purchase. In the follow-on, we are going to have a lot fewer places to catch all these things.

Turning now to some pieces of hardware (Figure 2), this used to be a tank dome. When this was shipped, it had two dust caps. One was located inside a piece of tubing; another was outside the tubing. Upon arrival for tests, the dust cap was taken off the outside, and a pressure indicator put on. However, the dust cap was left on the inside and the pressure indicator was showing zero when actually the pressure was about 25 psia. The bulkhead reversed, pulled away from the joints, and resulted in the damage you see. This stage (Figure 3) was lost due to a vendor employee seeing fit to change the weld filler to a pure titanium. This is the result of that one change

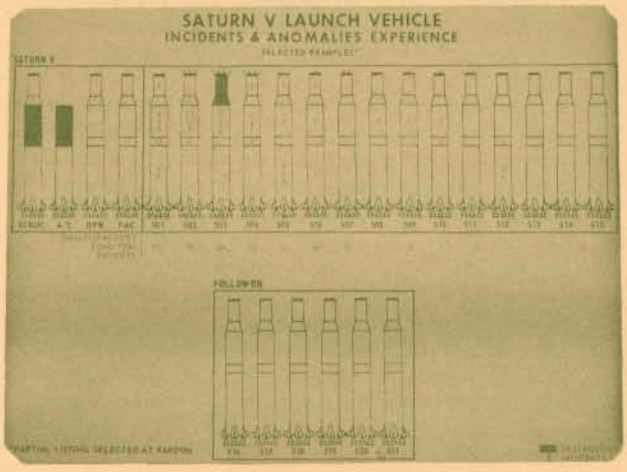


FIGURE 1

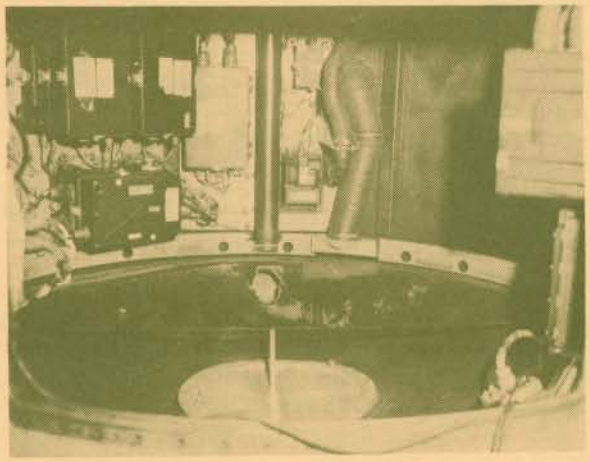


FIGURE 2

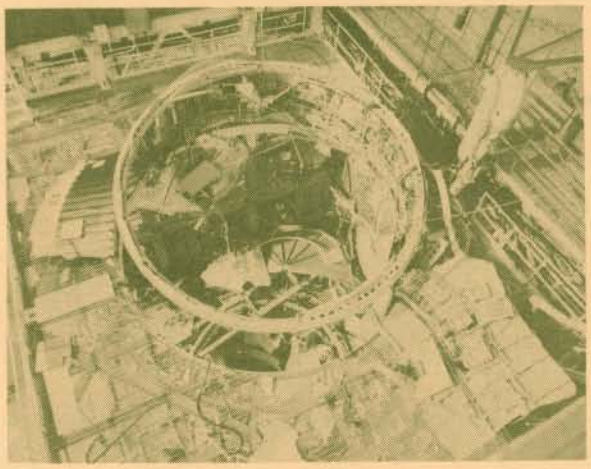


FIGURE 3

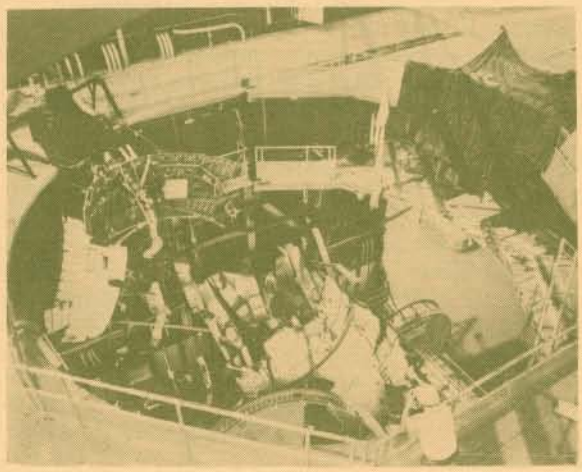


FIGURE 4

by a human. And we have humans in our system. Figure 4 represents an interesting case. A static test was about to start when the crew found a leak and shut down. After shutting down, they disconnected some pressure indicators to the tank. The next shift came on, decided to pressurize and look for the leak. Since the pressure indicators did not show a problem, they overpressurized and this is the result.

In Figure 5 perhaps we did not carry our procedures far enough. This was a structural test vehicle, and since we expect some failure in structural tests, we pressurized it with water to avoid a blast. As the hydrostatic test neared completion, a problem occurred. We needed to dump the water in a hurry, but we did not have a procedure to do it. Hence, a complete loss of the stage.

Figure 6 shows a very recent incident that happened on AS-511. Right where the man is pointing, there is a polyurethane shipping disc that is included with this unit for protection. It was left in during test preparations. The result was a major leakage during the static test and a major fire which possibly was not extinguished quickly enough. Hence, major damage to a very recent stage.

FIGURE 5

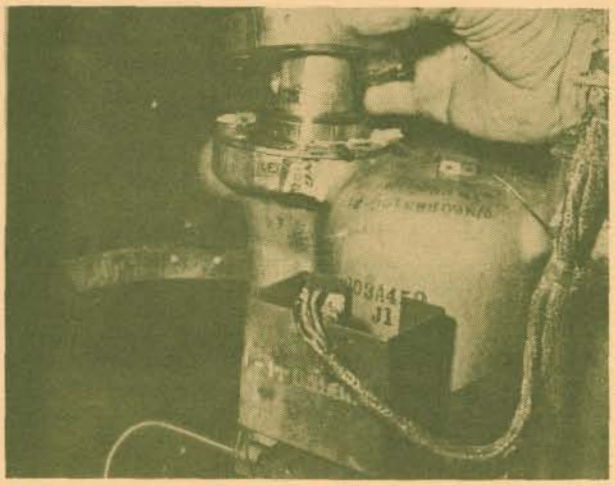


FIGURE 6

FIGURE 7

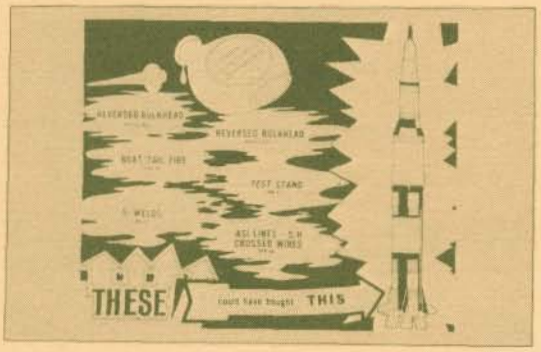


FIGURE 8

Figure 7 represents a different kind of a thing. On October 17, we were scheduled to have a static test at our Mississippi Test Facility. We postponed that test although the equipment was ready to go, as there was one contractor who did not feel mentally ready to go. Now that is easy to understand since this was a residential district where many of those contractor employees live, in Pass Christian right after Hurricane Camille.

I do not want to get personal in this. What I am trying to do is to paint a picture for you. That is, it does not take many of these failures (Figure 8) to take a national program that is going well, and cost it out of business. It does not take many of these failures to reverse a national trend. It does not take much to make a failure out of a successful space program. Therefore, we must address ourselves to such a possibility.

In retrospect, when Manned Flight Awareness first came to me, I was against it. This was something that would cost new money, and I am against anything that costs new money unless it is a problem that keeps coming back. The problems kept happening, MFA kept coming up, so we put some money into it. And I would like to say, again in retrospect, that this was money well spent.

The Manned Flight Awareness Program has put motivational material, from astronauts to posters, in the contractor plants. It has rewarded individuals. It has motivated the workers and the public to be aware of our space program. I think it has done a great job. Many of us represent the management aspect of the space program and I do not think that we have too much of a problem foreseeing somewhat into the future. George Mueller described a beautiful future for all of us that is probably going to carry on the rest of this century. I think all of us will manage somehow under this. But I submit to you this morning that there are human beings—some in your organization, some in mine—that we have to worry about. We are now completing stages with welders who know they are going to be laid off. We are completing stages with sheet metal manufacturers who have their termination notices. We are putting in engines built in plants that have virtually shut down their production line. I submit to you that this is a problem that cannot be solved by the Manned Flight Awareness Program, at least not as we know it today. An astronaut's visit to those plants will help. But I do not think an astronaut's visit to the plant can resolve the kind of problem that we have today.

I do not have answers to this problem. I do feel that from this meeting I should go back and worry about it, and figure out what to do. You should go back and worry about it and figure out what to do, too. I am not sure that we have the means of getting through the immediate years, if we do not innovate beyond where we are right now.

Thank you.

ASTRONAUT PARTICIPATION IN THE MANNED FLIGHT AWARENESS PROGRAM

MAJOR STUART A. ROOSA
Astronaut

Those of you that are sorry that Tom Stafford isn't here, well, I sympathize with you. I feel the same way, and I also realize that probably the best speech I could give is a short one.

But seriously, the MFA program in our office is a personal thing. It is probably the only direct link that we have to the people, the literally thousands of people, that are building the vehicles. Now, we spend quite a bit of time at some of the contractor facilities, climbing in and out of spacecraft, checking them out. You can sign a Snoopy doll, or give a Snoopy pin or something like this but in our normal duties we don't get to the majority of the facilities involved. I realize there are a lot of you here that have requested personal appearances, and have been turned down so many times that you think we are not interested. That is really not true, we do feel that it's very important. Rocco Petrone made the statement, and I will steal it from him, "One vehicle does not know what the other has done." The only continuum we have is the people. And so from our office, through the MFA program, we do have a link with these people. I know the personal appearance requirements are given every consideration within the Astronaut office. Lack of time is why more requests are not honored.

I know there are some people in this room who are quite familiar with our schedules, and not to belabor the point, I would just like to say that we stay quite busy, but we aren't unique in that respect either. I would be willing to bet that we could take 50 of you and have you do your job, and you couldn't meet all requests either.

We do feel that the people-to-people approach is a good one. When you go to a plant, the enthusiasm and the warmth that you feel from the people is real rewarding. And it is good for us to visit with these people. I assume it is also good for them to see the users of their product. Take the person that is bolting the heat shield on the command module, he can get pretty motivated, thinking of the consequences. But all the little things are so very important also. For example, a fountain pen that you are going to be using on a one-man contingency rendezvous. The data comes up on the computer quickly and you have got to copy it before it's gone, we can't afford a failure with that fountain pen either. And from my standpoint, as far as getting ready to fly on 14, and from the office as a whole, we are real concerned about the little things. We are real concerned right now during this transition period. We feel this direct link to the people is important. I wish we had more time to participate in those personal appearances. I guess if you spent all your time doing that, you wouldn't be training to fly, and then nobody would want to talk with you anyway. So it is sort of a vicious circle.

We are already well past lunch time. I would just like to say, from the crew office, "Thank you for the support that all of you have given the MFA program in your facility." I would also like to continue on with the theme that "We've got to keep up, and get out the good work, right now." You know that is really important to me between now and next July. And also to assure you that we are staying busy, and we don't turn down those personal appearance requests needlessly. We appreciate your support, and we ask that you continue. Thank you very much.

INDUSTRY'S VIEW OF THE FUTURE

WALTER F. BURKE

President
McDonnell Douglas
Astronautics Company

Gentlemen, I would like to say that I am very honored to be given an opportunity to talk at this seminar. I am really just filling in for Charlie Able. He was called away on a very urgent matter today, and I have been asked to step in and try to pass on the message. In looking at the Manned Flight Awareness that we're so anxious to be sure works, I'd like to go back a little bit and tell why I think the Government, and particularly NASA, is coming to the right group of people, namely the aerospace industry, and the aircraft industry as the managers of some of these extremely large tasks.

As you recall, back in the very early beginnings of any aeronautical endeavor, there was a very quick recognition of the fact that intense research of a very deep technological area was needed in order to make the rate of progress that was desired. This brought about, in the early days, the establishment of the NACA, where it was found that the depth of investigating the number of tests required and the caliber of the analysts was extremely important, and in fact, was the foundation stone of America's aircraft industry today, and I think we can look back there and see the very beginnings of this Manned Flight Awareness Program. Without telling you too accurately my age, I can assure you that I have taken part in many of these early activities far enough back to be very familiar with such things as terminal velocity dives and spin programs. You no longer even hear about them, but at that time they were the first and only ways we had to get into the structure of the airplane, and into the response of it those features that would give the astronaut, or as he was then called, the aviator, a chance to perform his duty and survive. Although we do a much more sophisticated job today, it certainly stemmed from the deep interest and the group of people that were generated at that time giving us their total lives in dedication to the aerospace industry, and it so happens that right now many of us who are just getting into it are luckily still involved. I say luckily and thankfully because to me I wouldn't have picked a different job if I could start all over again. I'm one fellow that was absolutely happy with what he chose as a profession from the first day, and I wouldn't get out of it except by force or age.

Now when you get close to the activity of the space end of the business, namely our spacecraft themselves, I would fortunately connect it with the company that was involved in both Mercury and Gemini, and when we started Mercury you can be sure that looking out for the astronaut was not only a very important thing, but it was a brand new idea of how to assure the astronaut's safety in a vehicle that we at that time could not plan to bring back and try over again, so it had to be a success on every shot. There was to be no averaging out, no statistical high score. It was decided it had to be a success 100 percent of the time. Now to get that, we spent many long weeks and months with everybody that we could collar, trying to find out the problems of environment, trying to whittle down the chances of thermodynamic or electronic failures, doubling up on any system that could possibly be a trouble maker, sending all kinds of animals, frankly both pigs and chimps through our test program, trying to find out what the effects of shock on the piglets which we dropped in specially designed cultures in the hangar in St. Louis were. In every case, trying to find out how to better make the vehicle give us a 100 percent chance that man would come back from the mission.

I recall receiving a letter from Dr. Wernher von Braun after he had walked through our shop in which he felt that we certainly could stand a much better

approach to the clean room. For this we have been forever thankful. We went after this particular phase of it, and we've done a great deal in developing the so called "white room" or "clean room" approach to the total manned space effort that we've been in. We also had concern about our test procedures. Did we know how to test without undue danger? Despite the years of flying and the thousands of flights with test pilots, we still had not reached that peak of mental acuity that tells you that you are doing the proper thing. As a matter of fact, in one of our early space chamber runs, we very nearly lost one of our own astronauts, Burt North, primarily for a lack of dry running tests in making sure that everybody not only understood what to do when the test was going well, but particularly, what to do quickly if the test started to deviate from the plan. This brought about a whole new approach in order of magnitude as to our preparation for tests when we had astronauts involved. The same thing happened when we built our larger space chambers. We had escape capabilities, we had fire possibilities and equipment in there for extinguishing any fires. Despite the fact we felt we wouldn't see a fire, we did have provisions for both extinguishing it and removal of the astronauts. We trained diligently, not only for the successful mission, but for all the possible deviations one might consider at all likely. This was our initiation, you might say, to be aware of the value of the man, and make our men aware of the value of the mission.

We then, at the very early stages of Mercury prior to even launching the first manned Mercury with Al Shephard, were scrutinized very closely over an extended period of time by a committee called the Weisner Committee. This Weisner Committee was set up by the Government to make an independent evaluation of just what we were doing, how we were doing it, did we know what we were doing, and could we safely agree to launch the man? This took us over every aspect of the design of the vehicle, every aspect of the test, a very close personal scrutiny, man by man for your motivation, for your internal thinking. You felt absolutely bare in front of them before they got through, and as we went through this we became convinced of one thing—that we had neither the time, nor the money, to have a convincing statistical record that we would have no failures. The only answer to that, then, had to be that every shot stands on its own, and every shot must work 100 percent by itself, and the only guarantee for that is the craftsmanship of the men, the management of the program, the skill of the designers, and the team work between the contractor and the customer. For one, I can say we have never worked with any group that rivaled the NASA personnel in giving us this team work. It's unmatchable with anything I've been connected with, and I believe I can speak with equal authority for the people with whom I've been in contact.

From now on as we keep going we have to look at a totally different climate. The size of the program is getting so large, and has been so large, that it undoubtedly is going to stay in one or more of the major aerospace hands. A small company by no means can have the diversity of skill, the facilities available, nor the financial structure to handle one of these major space programs. However, that one program such as we now have cannot by itself really support a total industry organization. There were many things on Gemini and Mercury, and in connection with our S-IVB that I believe could not have been available to improve the caliber of equipment to provide the capabilities, had there not been many other business activities going on in that organization. The manner in which we have a tremendous amount of engineering for a relatively small amount of hardware delivered, does mean that you have to call on facilities, particularly in the manufacturing area, that you would otherwise not be able to afford. And it's the simultaneous existence of other large programs within a company which provides the capital to give you this capability. We find that there are sometimes some concerns of interference between our program for you in one particular case, and for the Air Force in a competing case, and for commercial business in another. It's our determination and our conviction that it's the combination of these in a company that provides the real muscle and the heart, which is the cash, to go ahead and handle one of these big programs. But every problem, or every instance such as this obviously brings about some problems that are peculiar to itself. I would like to address myself to just a few of those.

How are we going to motivate the personnel? As I look around the room here, I notice very, very many faces that I've seen before at the same kind of meeting, and I recognize that the purpose of this meeting is really dual. It's first to remotivate we that are sitting here with the sole purpose of going back home and really motivating those that are not present at the meeting. As the space program continues, and as was well said before, the probability is that most of us here will stay in it, that we are the ones that have been in it before and are likely to control who stays in it, so we will, liking our own personal jobs, very well try to stay in it ourselves. But the hundreds and thousands of people whose craftsmanship we counted on may not be as fortunate as that. Some of the competition will come just in the very nature of our engineering personnel. Without creative engineering personnel, the space program could not have been as successful as it is. A creative person is very seldom a very patient person. He is anxious to progress personally, as well as being a part of a live team. He definitely has to be kept motivated when a tempo slows down a little, and it's in this area that we are going to find, I believe, the most critical problems. How to keep the creative engineering talent charged up if the program tempo slows down appreciably. We have ways in a large company of moving people from one large operation to another, from one activity to another. At the same time, if we want to be able to call on them instantly, we must find a way to keep them enough involved in the space activity that they really never lose their touch with it. We cannot afford to let them go for three or four years into the commercial business, or to the military business and suddenly just draft them and pull them back and

think they will be finely tuned for the space business. So we have a very definite program to watch where we put our people, if there is any contraction, and to arrange for frequent and high caliber renewal of this spirit in them, by re-energizing them back in our space group. We have the same thing, but to a far more difficult degree, in connection with the manufacturing people. Many of our manufacturing people have the skill which we have now developed in them, but as programs change, either within a company or due to bargaining unit decisions, we don't have exactly the same freedom of movement of one man from one job to another. There are seniority problems. There are new technology problems. We feel that we are going to have to find a way to minimize the impact of these problems on our manpower. Some of the approaches are that we set up continued training programs where the men are cycled back through the same type of activity they had engaged in formerly on periodic cycling so that they again do not lose this peculiar skill. By the same token, we have to be sure that facilities which these people need are not allowed to run down because of the lack of use, to that point that suddenly activating them becomes a problem. So a problem will exist for which we must find a solution. Namely, how to keep our facility up to date, and in fine running shape with the people constantly trained for the time when we may suddenly need them as we move from one phase of the program to another. In these areas we know we are going to be discussing with our labor unions, just how may we do this with a minimum impact on our bargaining capabilities.

In the manufacturing area, and I speak from about twelve years of factory manager operation in our company, I can tell you that nothing ever motivated the job as much as yourself when you walk out there and mix with the people. We can put out all the posters, you can have all the intermittent visits, you can have all the press releases within the company paper that you want, but my own opinion is that the top management, which represents those of us sitting right here, as we go through the shop, will have to get off the electric carts and go out where the hardware is, and talk with the people, and go out there so frequently that they get to sort of expecting you, and it's not a great big surprise or sort of a parade when you infrequently go through the shop. I have found that the craftsman particularly, is just absolutely in love with telling you his job. He'll tell you, he'll stop with you and speak to you about his job, how much he enjoys doing it, and what new he found out to do well if you give him one half a chance. And the only way you'll ever get that is by the top management circulating through the shop on a complete man-to-man basis, so that the shop people feel completely free to talk to you at all times.

As an example of what may happen if you don't continue this, during a four year period from '64 through '68 at McDonnell Douglas, we launched 125 SIV's and four Delta missiles without a failure. It's hard to believe after that that the design wasn't good. It's hard to believe that the statistical workmanship wasn't good, but since May of '68 we've had several failures. Each time we've looked into these failures we have found that they have been brought about by a multiple in-line person failure. Someone did something wrong, and the fellow that was supposed to find it, didn't find it, and this particularly is the thing that we have to watch. You have to get rid of any feeling that anything past just automatically guarantees the next shot. Statistically it's not good enough. You have to have each shot standing on its own. We have posters. How long does a man look at a poster before he walks by it and it no longer affects him? How many visits are there where the man is whisked through the plant rapidly because it's close to lunch, or it's about time for him to catch an airplane, so all the man in the shop sees is two eyes whisking through the shop, and probably if you were out there, you'd hear him say to the next one, "I wonder what that group's doing?" Now you've walked through, you've thought you've motivated them, and you probably didn't. You put more questions in their minds than you put answers. You have to spend the time in the shop, in the lab, on the drafting board—everywhere the people are individually working. All I can say is that having done things like that, this is the most rewarding part of the whole job. You get to know the people. Surprisingly enough occasionally they'll do exactly as you say, rather than what they had wanted to do and make you feel like you helped them, and these are the ones that build this company and in-plant morale.

We look over our total engineering design areas. "What were the things that we could do better?" But we then stopped to ask, "What are the things about the design we have right now that while they work, do have possibilities of not working?" And without having to define what it is, is going to make it work, assume certain failures, and then what is your recovery capability. So we have done this time after time, and on a continuous basis now have a group which reviews the design work done, with the specific charge that they deliberately insert mental failure into the design without regard to why they fail, but just assume they fail, and then determine what is the way you can overcome anything catastrophic happening after that. Sometimes it's redundancy, sometimes it is just a different approach to design rather than that. Where the lack of statistics hurts, is that even if we get by a flight, we very seldom really know how close we were to the edge with many things. Almost no flight is nominal from the point of view of the setup of physical conditions. You either don't have exactly the temperature you have designed it for, or you don't have exactly the wind shear, or you don't have exactly the glitch. Everything is just a little different on every individual flight, and therefore, you cannot be sure that many places on the vehicle weren't just about ready to have a problem. Of course, the more flights you get, the more you feel you can average these out, but we feel that the manned phase must have many flights in it in order to wipe out these areas where the facts of life are somewhat different from the facts that are put down on the engineering design, and it's with this particular thing that we feel we have to show the people in our country that we are really bearing down on how to do this job economically, so that we'll get their support for an on-going, more

rapid, and very substantial space program. Without this, without the help from the other people, and the real attention of the people on the ground, we just aren't going to be able to enjoy the luxury of a few flights per year. We're going to have to get a lot of repetition in order to have a truly valuable program.

My time is just about up, but I would like to make one other comment here. We have assigned our program manager for Apollo, Hal Bauer, who is sitting in the audience here this afternoon, and he has taken on the actual role of examining in detail every single piece of hardware that enters into our S-IVB again, with a review of the history every piece has had, the records of its problems in and out of acceptance, in and out of manufacture, so that we can see whether or not with each prolonged storage period, we have to do something more than we had thought about doing when we first designed these parts to again guarantee the absolute integrity of them in future service. So we are committed to applying our top personnel to this constancy of watching, this dedication of being in the program. We feel that we have many problems ahead of us in our motivation activity to look at. Primarily, not what we need to do it, but better ways of getting it done.

I would say in closing that their reward is going to be very great. In the Bible in 1st Corinthians, there's a very excellent little comment about what the reward is. It says "neither eyes have seen, nor ear hath heard, the great wonders that the Lord has to show to those that believe," and we believe in the space program at McDonnell-Douglas. Thank you.

WILLIAM B. BERGEN

President
North American Rockwell

Good afternoon, ladies and gentlemen. This is a particularly vital time for a meeting such as this.

We have all been complimenting ourselves during the past few months. And we all know that we did a wonderful job on getting those fellows to the moon and, particularly, getting them back. I am not sure that we fully understand why we were able to do it, because we tend to be engineers, and look at things from a technical point of view, and make a lot of other assumptions. The people who really put the men on the moon and got them back, happen to be the people of the United States who put up the money. And we really were tools in their hands. The most important thing I think we must remember for the future is that this is our role.

I don't think anybody ever had a better break than President Nixon, when he took off on his trip around the world immediately after Apollo 11. Because no matter where he went, the main thing in peoples' minds around the world was, this is not President Nixon of the United States. This is President Nixon of that country that put the fellows on the moon!

We are often asked what are the great fallouts of the space program? On this subject, I think we strain too hard to name some specific piece of hardware which is in being. In my opinion, the hardware fallouts in the space program are really not going to be known until many years from now. I know they are there. But I would be very much surprised that anything I wrote down today, turned out to be the important things in the future.

Probably, no single event in the history of the world has raised the prestige of any country such as the Apollo Program has. Well, this is a real fallout. And I don't know how you put a dollar value on it, but it is there. So where do we go from here? It is obvious that one of the nice things about the lunar program is that it can be easily understood. You can get it in your mind. You can easily define it, and it is what you might call a single point goal.

However, one of the things we are a little bit at fault for, is that we really didn't do as much homework as we should have before we got to the moon. Everybody says, "I'm going to get those men to the moon. Then I am going to get the hell out of this program." So this has caused a little blur, because he had to pick up some speed in determining what we are going to do next.

But here again, it is fortunate because just within the last week, the Space Task Group submitted a report to the President. I happened to be talking to Tom Paine last Friday, and I said, "Tom, is there going to be any specific announcement by the President on this thing?" He said, "There doesn't have to be. There it is—there's the Bible."

And what does the Bible say? You know as well as I do. It says that there is a continuing space program. There are several options available, as we all know. And, incidentally, I hope that we can get away from this distinction between manned and unmanned spaceflight, because I don't think it is really a meaningful division at all. But, we know we are going to have a very healthy program on earth resources. We know we are going to have a space station. And we know we're going to have a space shuttle. You fellows have been struggling with those things much more than myself. I know you have differences of opinion. I am not going to try and design the thing here this

afternoon. But very seldom do we fellows in industry get a chance to put our oar in, so I might make a couple of comments.

Let's take the space shuttle, as an example. (What I say can apply to the others just as well.) We have our goal. Let's make sure we all understand what that goal is. As I understand it, our goal is to make it possible to re-fly and reuse our space vehicles, as transportation vehicles, in a way that will give us good economic return on our efforts and our investment. In this respect then, as it fans out, we all have our ideas, and maybe some are pretty important on what it ought to be. So we tend to start designing by committee. And, I have heard much raving and rattling about what the cross range should be, and what the payload should be? I'll say this, "I don't know what they should be." I do say that if we try to make everybody happy, and set down requirements that just aren't do-able, we are going to end up with another bust. So, let's make sure we know what the requirements are. What the important ones are and then go ahead on that basis.

Here again we as engineers, don't fully appreciate the points of view of some very important people, like the taxpayers and Congress. And, I think we must face the fact that a very important item in the final specification, which we are going to end up with, has to be based upon the resources available. I am counting as resources the people, which, as you all know, we have plenty of. We don't have much time. We never will And, of course, we never have enough money. So I think the program should be phased on the realistic appraisal of the funding that is going to be made available. And if we shoot, if we put our sights too high, we will just never get there, or people will get tired of waiting for us to get there. The other thing to do, which is probably worse, is to set our requirements and our goals too low, in which case, technology will come roaring by us and we will have another program go down the drain, as we have had so many others in the past.

Getting back to this requirements business—I don't know whether or not space is going to turn out to be like some of our experience in aircraft, as Walter was talking about. I have been in very few airplanes that ever ended up by being used for the requirements that were drawn up to justify that airplane. Here we are at a situation today with a B52 being used for low-level bombing. I know that any airplane that started out with a low-level bombing requirement never got off the ground. And, as a matter of fact, we don't have one today. But that is the way these things turn out. I think this is the way we have to view these things we are talking about. They are good jobs. The technology is right. They are going to turn out to be a healthy program.

Walter touched on this business which is the whole theme of this meeting, motivation. Personally, I would like to say that I hear the word motivation and apathy kind of used crossway. I would like to make it real clear that in my opinion, I know of no apathy and I know of no people who have an apathetic attitude toward the space program contract. Quite the contrary. When you are laying off at the rate we are all laying off, there is terrific motivation and damn little apathy. But, really, this problem of motivation is a very interesting one. We are all aware of it. And I say the problem here is to avoid motherhood. There are some things I think that we can do that are real. I will touch on that a little later. But I couldn't agree with Walter more, that no matter what we do, if nothing else, we've got to know how to communicate with our people who are actually doing the work. There are several very fundamental things particularly, in this business. Number one, we have to have a continuous challenge. We have got to put up something that is really hard for people to meet. This could be a combination of technical things, scheduled things, and dollar things. And, incidentally, I think all too many times, we try to separate these three things into little independent compartments. We will have a meeting one day on schedule. And the next day we will have a meeting on cost. And the third day, we will have another meeting on pricing. And you would think there were three entirely different things we are talking about.

In addition, a challenge or a goal if you will, really doesn't do anything, or mean anything, unless we have specific ways of measuring that, and have a feedback. Then you have to let the fellow know exactly how he was doing; or the group on how it was doing. In that respect, too many times I see us trying to buckshot a whole area. We do it to ourselves. You, our customer, will do it to us. You will send a million people into the plant, and just kind of look the whole thing over. We come up with things like reports on subjects which were never a problem to begin with. I think the way we ought to handle these things is that you fellows ought to be sufficiently on top of us and when we do have a weak spot, come in and help us, whether we need it or not. But don't try and say, "Well, we've going to take a look at Company X today. We are going to get a hundred people and look at everything."

I think one of the biggest things that we do, and can do on a daily basis, is the sort of thing that is called for in this program and that we are kind of weak on. It is in the general area of what I call "discipline." I am not talking necessarily about military discipline. If you show me a dirty shop, I will show you dirty workmanship! If you show me an engineering office where people come running in and out all hours of the morning and day, I will show you a rather haphazard engineering job! There are so many of these things. I know I have arguments with my people on little things like an expense account. They will be six weeks in getting an expense account in. Now, you start climbing over their backs, and the attitude becomes, "Gee whiz. What difference does it make. I am a really important guy and I am really doing my job. And someday I will get it in. And don't worry about it." You will find out that the guy who is slack in his expense account, probably didn't get much out of that trip. So it is this type of discipline I'm talking about. You can get people used to doing things a certain way, so that doing them right becomes automatic.

I am in the midst of this now and I think we all are. For example, with changing around our organization—I always get a sort of bang out of this—because the first thing everybody wants to do is come up with lines on a chart. And they argue whether the lines are to be solid lines or dotted lines. In the very best organizations I have seen, no one ever had to refer to an organization chart because the people were working so well together that they automatically knew where the responsibilities were, and who was responsible for what. And they got that way not because somebody drew an organization chart. They got that way because people had been practicing to make it work. Incidentally, I might say on the subject of organization charts I always look at them as sort of like a bikini. What they reveal is very interesting. What they hide is vital! You can spend a seminar on this one subject alone.

I think the key to the whole thing is this business of our communications with our people. When I first went to North American I was surprised, to put it mildly, to find that our so-called motivation program called PRIDE (and incidentally, it took me about two weeks before I could find somebody who could tell me what PRIDE meant) was under the aegis of our public relations people. The philosophy of the thing seemed to be that every time somebody made a mistake in the shop, you go to the PR people and tell them about it, and they put out a new poster on the thing. Those posters are effective for the first day they are up, maybe. But motivation takes a whole lot of different things. One of the biggest motivation factors I know of was when these fellows were building a spacecraft, and the astronauts would get to know them. These fellows knew that they were responsible for their lives. You couldn't get any better motivation than that. Recently, because the crews got busy in some simulator work, we noticed a fall off in the rate of the visits of the astronauts coming out there. And all over the place everybody asked, "Hey, how come we don't see Joe Blinks anymore?" Or, "Where've you been?" This is a peculiar tool, coming from this kind of a program, but it really works.

Another aside on this I might mention is our methods of written communications. I recognize that records are absolutely necessary. There is nothing better than a good configuration control and process spec, and all that sort of thing. But I'm referring now to the type of communications where we are attempting to get management direction. All too many times I see a guy who could probably walk across the corridor and talk to a fellow, but he doesn't. He sits down and writes him a memorandum. And you know, a memorandum is never read in the frame of mind in which it is written. It is probably one of the lousiest ways to communicate with people that I can possibly think of. My main impression of memos is that when you first go into a company as a young engineer, you write the rough draft on yellow paper for your boss. Finally when you get promoted, you get to the point where you can sign it. Then the great day comes when somebody else signs it and you approve it. You have really reached the peak when you have somebody sign it for you, and you didn't even have to read it! I say you can go on with these things all the time.

But the most important thing—Walter mentioned it, and I'm going to repeat it, because my own experience follows his exactly—is that you have got to go and see the people. They should not be shocked when they see you. Let them talk to you about their jobs. I remember we were running seven days, three shifts. The talk was that the third shift was always the most inefficient and, we ought to put better people on the third shift, because all the good people were on the first shift, and the mediums on the second shift. But it wasn't so. It wasn't so at all. The people on the third shift were fully as good as any on the first shift. But what happened is that all the bosses, and all the action was going on during the day time. And at night nobody was there. There was a kind of "Who cares?" attitude. For a while there I was just living in the plant. The first reaction was one of almost shock. The second reaction was "What the hell is he looking for?". Finally they got to know that I wasn't going to bite them and I was really interested in what they were doing. It was amazing. And then should something happen—I would take a trip and I would be gone for two or three days. As soon as I would get back everybody would want to know where I had been. It is just not the head man of the division being there, or anything like that. Everybody ought to do it. I found that supervision in general, spends too damn much time in their office. And that is why once I got real bold and took everybody's office away from them. But it didn't last long.

I'd like to conclude by saying that the most important specific examples in motivation that I know of are: (1) Let's have a good program. And I think we have the makings of a good program. But let's know what these goals are, and let's stick to them. Really, this is a job for us on the top. (2) Let's do a real good job this time in coordinating the performance which we want to try and get; the schedules which we want to try and meet; and the amount of funds we have to spend, so that they all tie together and form some semblance of a successful program. My own feeling is that as far as the people themselves are concerned, we have confidence to burn. Our job is to motivate these people to do it, by getting a good program. To tell the truth, I think that we have grown so much, that a little of this hard trimming might be pretty good medicine. I think we are going to end up by being a stronger and a more productive industry as a result of it. Thank you very much.

HAROLD J. McCLELLAN

General Manager
Southeast Division, Aerospace Division
The Boeing Company

Today I would like to give you my views on some of the positive actions that I think are being taken to provide the most meaningful assistance to NASA in the months and years ahead in the space program, with particular emphasis on the role that management, and management's use of the motivational programs have in helping both the Government and industry obtain the goals of the future.

We have had an unprecedented string of successes on the Apollo Program—Apollo 4 through 11. Our initial goal of landing men on the moon and returning them has been met. And all the systems on that flight functioned with near perfection. Now, the frequency of the launches has been rescheduled—stretched out—and additional people are being taken off the program at many of the locations throughout the country.

This gives rise to what some of us have discussed, a concern that has been expressed in various ways. I sum it up by saying that it's really an impediment to motivation.

The thing we are really probably dealing with here is fear of the unknown. Each of us—probably in industry more than Government—should remind ourselves that true security for the future really rests with doing the best possible, most perfect job on the task that each is assigned to do today. And certainly, the work must be accomplished in a timely and low-cost manner. The more challenging future assignments will result from the perfect performance and the effort that is put in on today's job.

Workmanship errors, naturally, will occur. That was ably pointed out this morning. I guess we could expect more of them to occur—and not be caught—when individuals, and organizations or groups of individuals, are spending some of their time worrying about future security while trying to do the job they have to do today.

But I think by paring down the employment numbers—which all of us are really doing today—in an orderly, selective fashion and in a decisive, straightforward, compassionate manner, much of this uncertainty can be eliminated. We can reduce the impact of this impediment to motivation. I think, perhaps, the most fundamental point is quick, straightforward, decisive action with a sincere attempt on the part of all of us to let each employee, who might be involved, know where he stands.

If we in industry let NASA down on any of the remaining Apollo missions—and I speak of failures of any consequence—we will have set back the agency's chance for future programs. And in the eyes of the public and our work force we will have started a whole new round of uncertainties and future insecurities.

I think there is something we can all do. I urge you to carry this message back to your respective organizations—and that is: take quick, straightforward, decisive action and provide good information to people with respect to their future in the space program.

Now, during this same transitory period, one of the fundamentals that we must carefully guard against is the lack of attention to certification of employees for each job. During times like these, companies and organizations within companies have to do a certain amount of reorganization and reassignment to fill the gaps where people have departed. I think it is incumbent upon each gentleman in this room, who has anything to do with it, to make sure he has an airtight,

ironclad system for insuring that the worker is certified, trained and put through the sort of scrimmage sessions that Lee James and Rocco Petrone were talking about this morning. That makes you darn sure that he is ready for the ball game.

A month before Apollo 11, I wrote a letter to all of our first line supervisors who are involved in our space activities, saying that the challenge we face for perfect performance—now that the Apollo Program is beginning the operational phase—is as great or greater than the challenge of designing and building the equipment in the first place. I still believe it today. At that time I called on each supervisor in our organization to satisfy himself that each of his employees knew his job, and knew it instinctively. I have insisted on a rigorous program of checking up on this to satisfy myself that it is done.

Two weeks ago, I took one of those factory walk-throughs that Bill Bergen was talking about, and I talked to many of the employees at Michoud working on the first stage. I can assure you that that experience was most rewarding to me personally. Each of the employees that talked to me had the urge to tell about what he was doing and how difficult it was to really train and get ready for his job. He was proud of his certification for being able to do it. He was even proud that there was an inspector making sure that he was doing his work right.

I know that we have isolated incidents, but I don't think we have a general letdown in morale within the sphere of workers that I talked to. But I think that we in all levels of management owe the employees frequent and proper communications about the right things. And I think if there is one message I would like the seminar on motivation to carry back—and perhaps to deal with more tomorrow—it is the question of applying our motivational techniques—and the extra dimension of communication that these programs give us—to the various levels of management.

It seems that when I hear about motivation, I usually hear about the fellow that's welding, or about the one that's inspecting, or doing this or that. I, for one, would like to make sure that we are using this tool to carry the message through all the ranks of management as well.

Now, I think there's another pitfall. Although I won't dwell on it, I would like to mention it in passing because of the title of this seminar and some of the discussion that has preceded. There is a pitfall into which industry must not fall in the days ahead. It is one of diluting our skills, or shifting too much of our management attention and emphasis on future NASA programs. I certainly believe that industry has the clear obligation of helping NASA, through studies and their own in-house work, to determine the proper steps for implementing the new programs we have heard about today. However, I think this support to the space agency must and should somehow be clearly separated from the ball team that we are putting through scrimmage every week to play that next ball game that is coming up Saturday. I recognize there's some level within a company where this all comes together, but I would certainly urge that we guard against dropping it too low.

There is an aspect about management and motivation that I call a "manager working his feedback loop." I would like to talk about it for a moment. First, let us recognize and take note again, that we have had eight straight successes on Apollo—six manned successes. Now, why? What has made this possible? Well, I happen to think it is because of the NASA/industry team of highly motivated people that have been working on the program, in addition to the other things that have been mentioned.

I think this team is typified by some of the people we have heard today—Lee James, Rocco Petrone, and George Lowe, if he were here. And I could name many, many more. You gentlemen have heard two of them speak. And this team is typified by men who pay great attention to detail. They really know the people and the hardware. They energetically investigate the symptoms of potential problems every bit as hard, if not harder, than they do the real problems until they are thoroughly understood and the answer is very clear and completely out of the nag list in their minds.

The paper work system, sure, follows up and tells us this is all cleaned out. But in the time we have ahead of us, that attention to detail is going to be even more important—if that can be true—than it was for the last few flights. I think you owe it to each manager, who is working in your spheres of activity, to point out to him that the really good manager is the one that has himself set up with a good feedback loop of information. It comes not just from paperwork or staff meetings, but from his people. Ensure he is energetically using this technique with a real short timeline and that he is taking the corrective action within his sphere of ability to do it. When done properly he will be able to sense problems which are developing before they become panics.

I think this is probably the most important part of our management challenge today. I would hope that somehow we can utilize the extra tools of our motivational programs to establish this in a more effective manner at all levels in the Apollo Program. If we have—and please don't misunderstand me, I think in the large part we do have, but I think there is also room for improvement—each manager on the Apollo Program in industry working in this mode, he will be so excited and challenged and motivated that he won't have five minutes to worry about being insecure about the future.

This brings me to the subject of motivation which I want to cover. I think when worked right, this attention to the feedback loop of information and the follow-up on it, can be one of our most powerful motivation tools. It should be used even more than it is today. The reason I believe it is because inherent in this mode of operation—this face-to-face communication, beginning at the lowest level and extending through all

successive levels of the organization—is the everlasting will to keep at it until that particular symptom or problem is clearly dealt with in a manner that everybody can understand.

I think our motivational programs, for which most companies have different names under the Manned Flight Awareness banner, are a very, very important part of this whole process. I will confess to feeling the way Lee James expressed it this morning—kind of hesitant at first. And I know many other managers throughout our organization were hesitant. They thought, "Well, what can these sorts of programs (of which they see outward signs in the way of posters) really do?" I think it has been proven to my satisfaction that what it really does is provide some extra avenues of communication on a subject that one individual, or one group of individuals, is trying to get across.

When we recognize that each human being really only hears that part which he wants to hear, and each will hear that same thing in different ways, and some human beings will respond to one method of presentation while others will be totally negative, then I think the motivational program will give us that added flexibility. If used by managers properly, it amplifies their ability to communicate with the people with whom they deal. I would like to suggest that we attempt to improve the utilization of our motivation program in just that manner.

One of the programs we have at Boeing that has been very successful is the Lunar Roll of Honor. We select deserving employees and have their name and contribution to the Apollo Program recorded in a book. This book, which contains paper designed to last 1000 years, will be maintained for posterity in the Smithsonian Institution and Library of Congress. Further, each honored employee receives an engraved doubloon as evidence that his name is being placed on the Lunar Roll of Honor.

This has reached some people in a very deep and fundamental way. We had one gentleman I happen to know of who felt so strongly about it that he has made provisions in his will for the line of succession of those credentials to his heirs. But I am sure—and I bring this up only to illustrate—that we have some employees that could probably care less about it. It just doesn't motivate them as much, or give them as much of a positive reaction as others.

There are other things that reach those employees. Direct contact with the astronauts, as was stated earlier, is certainly one of the most powerful motivational tools we have found. I think this clearly indicates the type of motivation that we are talking about is this human-being-to-human-being relationship, where the person can really identify with another individual.

Lastly, on the subject of motivation, I firmly believe that our motivational programs sometimes overlook the competitive nature of most individuals. I think this is true in the shops, as well as other places. I think each person, with very few exceptions—and these exceptions are usually weeded out pretty rapidly—really wants to do a good job. He wants his co-workers to know that he is doing a good job. Of course, he wants his boss to know it. I think taking advantage of this facet of human nature in a positive and proper way can be a most powerful tool.

I had a personal experience in the early days of welding on the S-IC bulkhead at Michoud. I found, much to my surprise, that the information I was looking for—which would tell us how bad things really were—was in our record system. But it was buried so deep that it took something like six to eight hours for somebody to dig it out, summarize it, and get it to me. It suddenly occurred to me that I really wasn't the one that needed it, because I hadn't done any welding since I was in high school. The individuals who really needed to see that data were the ones actually doing the welding.

Well, we had quite a psychological seance on the pros and cons of that one. We ended up having it introduced by the first level supervisor, explaining the purpose to his crews in a positive way. We also posted the data. After every shift the data was updated. And to the surprise of many, we found that here was the one most powerful drives for keeping the defect rate down on those welds. Once in a while a defect rate would start up. About all it took was the posting of the day's data and it would start back down again. Maybe we were lucky. But it is one example out of my experience that says that if you can, in a positive manner, appeal to the competitive nature of the people you might really have a powerful tool.

What is my message on motivation? First, I think it is different for every human being. But I think that it has something in common. I think basically it boils down to saying that I want to know somebody cares. You want to know somebody cares. A worker wants to know that someone cares. The ability of various people to show that they do care about his work and what he's doing can be brought to bear with good management plus the use of the motivational tools that have been developed. However, the communications process needs the advantage of feedback. I urge each of you to take back the message that management, on all levels, must be much more active in this area than I think we have been.

We should remember that the future starts now—this minute. What was said a minute ago is in the past. And every day the future starts anew. The next big event in the future for most of us in the room—and the people you are going to talk to when you leave this room—is Apollo 12. Pete Conrad, Dick Gordon, Allen Bean, and all of the flight crews on subsequent flights must be made to feel that the team represented by us today, as well as the people who work with us, view their missions with the same single-minded purposefulness for perfection that has typified the Apollo mission successes to date. Let us make sure that we carry this message, and other messages from this seminar, back to each member of our respective work forces, both managers and employees alike.

PANEL DISCUSSION

QUESTION:

Will the various centers continue to provide posters and motivational materials to the contractor?

MR. SCHNEIDER:

I will field that one myself. The answer to that is yes.

QUESTION:

We have a question here for me. Are any funds available for maintenance of facilities and training for contractors who are essentially all done?

MR. SCHNEIDER:

In the AAP funded area, if you mean someone like Chrysler, for example, where we have the launch vehicles in storage, we are maintaining a capability at those contractors so that we can reactivate the launch vehicles. With respect to supporting subcontractors and suppliers after all of their equipment is delivered, that decision will be made on a piece-by-piece basis. We will examine whether or not it is required, and take the appropriate action.

QUESTION:

Next question is for Lee James. It is from Mr. Trainer of DCASR. How do you maintain top management active support?

MR. JAMES:

I really think Bill Bergen, Burke, and some of those people answered that question for me. Certainly a lot of this is direct communication, and communications is one of the toughest problems we have. I feel we in NASA are working a whole new chain now. And that chain is getting educated; is getting around a great deal. For instance, I have changed jobs, and I have a new deputy. The Saturn boss is now Roy Guthrey, who is here. And they are now going through a cycle of getting ready for the next launch, 507. My deputy (who is new to the program) has been on the West Coast with Roy all week. And Roy himself with his new deputy, Dick Smith, have been on the West Coast all week going through the flight readiness review cycle to make sure that all of the things we have been talking about today are not going to happen on this next launch. The newness of them in these jobs, and the attention to detail that they are having to give to get themselves all on board is a very good thing for the system right now. And certainly we are maintaining management contact by getting everybody reoriented to something on the new team, even though they have all been a part of it, one place or another before.

QUESTION:

Now the next question is addressed to Walter Burke, and I think it is a particularly good one. It says, "How do you motivate the people building commercial jets?"

MR. BURKE:

I guess it is the very same way that we do on this particular program. To me the thing that gets the best work out of the people is to discuss with them my problem, and ask them how do they think they can help. The hardest part for me is to keep my mouth shut, while I let them tell me. If you can do those two, you get the people that are going to be on the job so interested in contributing that the word motivation just tells what they are doing, rather than anything you instill into them. And commercial jets are one of the greatest pieces of engineering that has come down the road for a long while. Nothing is more beautiful than a DC-8 (and I hope a lot of DC-10s). They'll motivate anybody.

QUESTION:

The next is a motivation question, and it is addressed to Dave Lang. It says, "Can we use visits to the Mission Control Center as an incentive award in the same way as we would use visits to the Cape?"

MR. LANG:

Bill, I am sure that such a motivation device could be arranged. There are regular tours out here at the center that are fairly public in which some of the facilities are available, like the simulation facilities in the mission control center. But I am sure you mean during an actual mission, and I think with a little preplanning that could be arranged.

QUESTION:

Next question is addressed to Hal McClellan and it says, "Remembering the old adage 'Once burned, twice shy', do you think the new employees expected in the space program in 1971 and 1972 will be as motivatible as the old team?"

MR. McCLELLAN:

Well, my answer to that is an unqualified yes. I think that the existing employees and the new employees that will come into the space program are fundamentally joining that program for a desire to participate in mankind's greatest adventure. Now I think that when they are subjected to the pressures imposed upon them by their working environment, and their management, that can put some bias into that. But, I except that there is this fundamental capability to motivate that underlies any person that is a part of the space program.

QUESTION:

Now here is one for Bill Bergen that, gee, I could have written myself. But I guarantee I didn't. It says, "I notice you said, 'We didn't have enough—we won't have enough money.' Apollo cost was high. Can the NASA/Aerospace team really do a program differently so it costs less?"

MR. BERGEN:

I didn't mean to say we didn't have enough money. I said, no matter what that amount of money was the program should be tailored so it is compatible with the funding. In other words, we shouldn't plan on doing something way beyond our means. The other part of that question is, "Can we build things for less money?" The answer is obviously, "Yes, we can." But now you ask yourself, "Will it be the same?" And this is the question that we really can't answer. Are we going to stick with the philosophy that has so far been a very good one, a philosophy of 100 percent success? I think we're going to have to maintain very strict standards in such areas as certification, testing, vibration testing, and you name it. And this in my definition is going to cost a lot of money. It is debatable, for example, static testing, is one we always talk about eliminating, and you can save a lot of money. But my best guess is, though, we are not going to let the reliability factors take a secondary priority over the cost factor.

QUESTION:

The next one is for me, and it says, "Would you prefer to have a reactivated Pad 34 or 37 at your disposal as opposed to sharing Complex 39 with Apollo ?"

MR. SCHNEIDER:

Well first, I am going to be using Complex 34 or 37 (we haven't made that decision yet) for the launch of the manned vehicles using the Saturn IB. As far as Complex 39 goes, we are doing our best to decouple AAP from Apollo. In that we will have a dedicated lot and a dedicated bay in the VAB, and we are structuring our system such that we can do almost all of our Cape testing inside of the VAB. We are only planning on 21 days out of the pad. This is made possible because we no longer have cryogenic or hypergolics that we have to load onboard. So we are trying to decouple the two systems. Fortunately there is enough capability on Pad 39, such that it shouldn't become any constraint. (The answer to the question is I'm happy the way I am.)

QUESTION:

"Why not move the Manned Flight Awareness Program to a NASA organizational level to include all of NASA, unmanned as well as manned?" This is addressed to anyone.

MR. SCHNEIDER

I will take the liberty of answering it myself. I think it is a very good question, and I understand there have been some thoughts along those lines. It is quite possible that it will become Space Flight Awareness, rather than Manned Space Flight Awareness sometime in the future.

QUESTION:

The next one is addressed to George Meuller, who likewise isn't here, and it says, "In the minds of the people of the United States, the Apollo Program was to put a man on the moon. Do you have a catch phrase or brief description of the next goal?"

MR. SCHNEIDER:

I will field that one, too, and say, of course. I consider the next goal as Apollo 12, and that is still to land a man on the moon and come back. But if you mean for the long range, the way we are steering the program hopefully, is to a program that is less spectacular and more understandable to people. We are looking for things like the space station and the space shuttle. You may have heard Dr. von Braun (I understand from reading the newspaper) said, "Well, maybe in 1976 the President of the United States will be able to have a fireside chat." But to have a talk with the nation from space. I think 1976 would be an awfully ambitious goal. But we are trying to make it such that space flight isn't nearly as specialized as it is today. That is why as I said before, I think I am in a transitory kind of program trying to lead into that area. Certainly AAP will still be specialized, but we are hoping to get some of the specialty out of our systems and components.

QUESTION:

For anyone and I will pick Lee James for this one. "Where will the polar space station be launched?"

MR. JAMES:

I guess that means West Coast or East Coast as a launching site? Well, there's enough extra energy required for the weight you put in orbit to require, I think, a vehicle something on the order of the Saturn V. That would be the starting point. And I guess the question lends itself to the fact that if you are doing the polar launch, you either utilize an exorbitant amount of energy getting into it, or else you fly over some South American countries. It would appear to me that instead of moving this entire complex to the West Coast, the only choice is to negotiate such a launch, if we are ever going to have a polar space station. I don't know that that is a firm program item right now, so I presume they don't have these negotiations with us right now. But I think the answer to that has to be the East Coast. There is the alternative, of course, of a northerly launch, where our negotiations are closer to home, but so is the first land that you go over.

QUESTION:

Will Manned Flight Awareness Saturn/Apollo launch honors activity be continued at KSC?

MR. SCHNEIDER:

The answer to that is an unqualified yes.

QUESTION:

Question for Bill Bergen: You mentioned aircraft design. Do you think that a 100 percent reusable booster and spacecraft is feasible on the present time scale? Or would a tradeoff, i.e., some expendables, seem to be the most practical approach, referring of course, to the space shuttle?

MR. BERGEN:

You are very restrictive when you say 100 percent recoverable. In my opinion, the reflying of these things is very definitely feasible. As you probably know, each one is checked out after it returns, and in none of the flown spacecraft have we found any anomalies after flight. There are a few things, for example, that are very sensitive, like perhaps batteries and hand controllers which would have to be changed. But I think reflight and reuse of the present spacecraft is very definitely feasible.

QUESTION:

A question for Rocco Petrone. It says, "Space rescue has not been discussed for future missions. Are there any plans concerning space rescue in the future?"

MR. SCHNEIDER:

I will field that for Rocco, and say that in the sense of space rescue in the classic Sunday Supplement sense, no, there is not. However, as you recognize, space rescue has many, many aspects. Of course, the Apollo Program will continue as the Apollo Program had. In the AAP Program we do not have a rescue capability per se, except for the fact that we have retreat mechanism where the crew can obviously go back into the command and service module and come back at any time. If the command and service module is the source of the problem, we have the option, at least up until the time when our food and water begins to run out (and incidentally we are putting a year's worth of supply on there hopefully) of just staying there until the new command and service module is sent up. And I do have one command and service module. Obviously that isn't rescue in the classic sense, but it says, "Alright, there are retrieval capabilities." When you get into the era of the shuttle, then you begin talking about a vehicle that will be reusable and will have quick turn-around times. And then, of course, the idea of rescuing stranded people becomes practical and something that can be real, including its use on the planetary missions.

QUESTION:

Question for Walter Burke: What should the criteria be in determining what types of jobs should be considered in giving people the FMA Snoopy award?

MR. BURKE:

I think if you distinguish, at any time, the value of the contribution of an individual as compared to another, you will in a sense really invalidate the whole program. Individuals are selected to do a necessary job. And each job that is so necessary requires such perfection that you should reward all on an equal basis, rather than distinguish between shop personnel, engineering personnel or flight operations personnel. The shop man, from my years of working with them, is one of the most valuable tools that the American economy has, and nothing should be done to make him feel that he gets a second grade award.

QUESTION:

Dave Lang, could you field this one, please? When do you think the NASA program options proposed to the President will be decided upon and NASA given a firm go-ahead? Do you anticipate significant Congressional opposition?

MR. LANG:

The answer to that is we have been given no firm date. However, there are plans, and we are moving out on them. As far as Congressional opposition is con-

cerned (as in every Congressional action) there will be opposition, and the question is just how strong that opposition will be and to what level. We have no indication as to which one of the options will be selected, or how fast it will be selected. Lee, could you add anything to that?

MR. JAMES:

There is one thing, Bill, that seems like it is worth saying. I find the emotional support that I am aware of in the Congress, and with the public, etc., to be high for the options given to the President. I think that the real problem, which all of us might as well understand, is that the year end budget is taken up by present day programs. This really doesn't give us the option of exercising one of these new follow-on programs in the time scale that I believe the emotions of the public and the Congress and the President would allow.

QUESTION:

A question for me. Is AAP funding sufficient to allow continuation of the R&QA system that keyed the Apollo Program success? Is the same R&QA approach necessary?

MR. SCHNEIDER:

We have been funded in AAP in a satisfactory manner. We are not hurting for money this year. I hope the same is true next year. We are in reasonably good shape, but we have not elected to continue all of the previous Apollo R&QA practices. Where we are interfacing with Apollo, things like the CSM where we wouldn't separate them, we are continuing R&QA effort and the Apollo and AAP will be built on the same standards. In areas such as experiments, we are making some rather wide deviations from the traditional NASA, Apollo, R&QA requirements. We are trying to tailor the R&QA requirements to fit the needs. You know we usually have Category 1, Crew Safety; Category 2, Mission Success; Category 3, Secondary Objective; and Category 4 seems to have the title All Other. I have a new category in AAP called Category Experiment. And that just says we are treating experiments on an individual basis and giving them the R&QA treatment that is commensurate with the experiment. On some of them, we are telling the principal investigator, "Deliver a satisfactory piece of equipment to these specifications on such and such a date." If it doesn't work, we aren't going to fly it. And it is his responsibility to be sure that it works. On other experiments, obviously the more complex ones, and certainly the ones that interface with the spacecraft or the workshop, we don't have that attitude. We have to tailor the requirements to fit the need.

QUESTION:

Question for Bill Bergen. It says, "You, as a prime contractor, have cited the problems of communications between NASA and yourself as well as certain of your organizations. How can the second and third team of contractors be stimulated to do the job?

MR. BERGEN:

That is a pretty good question. Basically, I don't think he has a problem any different than the prime has. It depends upon the severity of it. In some cases, we have had a subcontractor who has had a little difficulty here and there, we have been very, very helpful to him, whether he likes it or not, and communicate very intimately with them. So here again it is a matter of degree. I think communications is a very fascinating subject. I could talk about it forever, and we will never solve it. But it is something that you have got to keep working on, all the time.

QUESTION:

Question for Mr. McClellan. Slowdown in launches at the Cape must give a disturbing feast or famine condition for the launch crews! What are you doing to level the workload?

MR. McCLELLAN

The Cape Kennedy area, for our part of the action there, is a testing operation. We conduct launches of Minute Man, and help NASA with the Saturn launches. The nature of that type of activity is one of peaks and valleys. We recognize that, as do, I am certain, most of the work force that's involved in that activity. This does add a complication, in that particular instance, that when you go into a valley period, we have to call upon people to provide them other opportunities within the company. To make family moves, as other companies have, we have move policy. It creates an additional hardship on the people. But so far it has turned out to be a workable situation. I think I can best illustrate that it does work by my own experience. I have moved every two years ever since I have been on the Apollo Program, the last seven years. Each one a little bit traumatic. But looking back and summing all of them up, it is quite an experience.

QUESTION:

Question for Bill Bergen. Will you please amplify on your statement concerning industry participation in NASA studies and other preliminaries?

MR. BERGEN:

Well, as I recall, I was trying to make the point that at this stage of the game is where planning, and good

planning really pays off. Take these new programs of which I think I cited the shuttle. The thing to do is to sit down and establish and have an agreement on what are the primary goals. And then let us not clobber up those primary goals by putting in a lot of other things that would be nice to have, or that somebody would like us to have, such that we lose track of what we are really trying to do and what we are actually doing.

QUESTION:

Lee James, I guess you are the best qualified to field this one for Rocco. It says Dr. Petrone stated the qualification of hardware and a thorough failure analysis as being essential for the success of the Saturn missions. KSC provides correct evaluations for failures at the launch site. But does KSC also consider the possibility of the recurrence of these failures during flight?

MR. JAMES:

Well, the first part of that isn't entirely accurate. I think Rocco would say "KSC is an engineering on-the-spot activity, and for some failure down there, they do get into it first." If the program management chain, which I used to be a part of, gets into this right away and finds a deeper analysis of this is required and comes out of the KSC laboratories, of course, we wait for that analysis. And Rocco's happy to wait for it. What really is done at the Cape is to provide a quick, on-the-spot analysis, and as we feed this back through our channels to our prime contractors, if that makes sense, then we go with it. If a deeper analysis is required, then we have to take the time to do it. I think simultaneously, though, we ought to realize that the paper work through the UCR system, etc., is feeding every one of these back through the entire system. It goes all the way to the primes or the vendors (as the case may be) to make sure that the action that we took wasn't just a lucky one. So I think we are real careful not to let any superficial answer that might come up on spot be the final answer, in case that answer might be wrong.

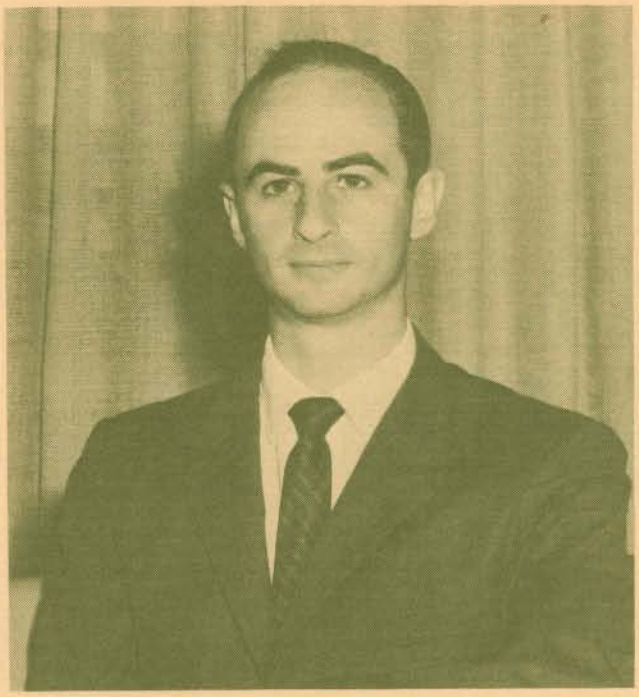
QUESTION:

It looks as if we have time for one more question. Is there one more from the floor. The question is "Is there a formal method for seeing who the critical people are, as there is for finding the critical components? I'm going to ask Lee James if he would like to answer that.

MR. JAMES:

Well, I don't know how formal this can be. I guess we will probably have to answer this by example. If Veto Peco here at Chrysler, who I saw here today, will excuse me, we might use him. Probably, the place in our whole system, where the critical skills dropped the lowest in the exercise, is in the manufacture of the development designs for the S-IB stage of the Saturn IB, which is done by Chrysler. Since that activity was started first, it quite naturally ends before some of the Saturn V activity. And yet these vehicles have to be launched with the necessary backup of an engineering team to the minimum depth possible. And backup in manufacturing is absolutely required and certainly the right checkout people. Now, I guess our Governmental process, as Veto would probably be happy to tell you, counts for doing this rather thoroughly. Every time you get scrubbed down a little bit more in money, he has to examine those critical skills just a little bit more closely. He has probably gone through the reiteration now with us of examining the critical skills that he really has to have to do this job of coming back up, probably ten or twenty times by now. And each time we have to decide if the budgetary process is such, that, OK—we will really make a judgement here, that we are not going to have a welding problem come back up that has to be redone, and take a chance on not keeping the welders. The next time it might be something else. There are certainly some prevowed experts, and things like this that we identify that we have just got to keep. So the real problem now is to profitably utilize these. I think it was Bill Bergen or somebody here earlier that said that you can't get a concept person motivated and then just put him on the shelf and say your time comes up two years from now. He has got to be creative during that time. So once you identify them, the proper utilization of them during this drought, is really a problem. But I think it is an iterative process that we have gone through now with each of the contractors—Douglas, North American, Boeing, and Chrysler—enough times to really ferret out what critical skills we just can't do away with, even though they may not be fully utilized during the low period.

MFA CONCEPT AT WORK



JOHN W. SMALL

Assistant Field Director
Space Station Task Group
Manned Spaceflight Center

Frank Borman asked me to express his apologies to you for not being able to attend this morning's session. As Dr. Farish said, he was pre-empted suddenly by the White House. As many of you know, Frank discontinued his active flying status in January of this year to devote his energy to formulating what our next major space activity will be. He asked that I pass on some thoughts to you, and briefly describe the program that we are now working on.

A key element in the plan you heard Dr. Mueller describe yesterday is a space station module. Recall that he mentioned modules will be playing quite a role in the next space program! This module will be capable of a wide range of scientific activity and technological applications. The space station itself will last for ten years, with some resupply by reusable shuttles, that you heard about yesterday. It will accommodate a twelve-man crew, and will be launched into earth orbit by the Saturn V. This particular configuration (Figure 1) utilizes a nuclear energy source for primary power of 25 kilowatts. It also has a solar cell power system as a backup capability.

One of the first things we will be doing after we launch a space station in 1975 will be performing an artificial gravity experiment. This particular concept utilizes a spent Saturn II stage. By connecting it with a cable arrangement to the space station module (Figure 2) and by rotating this whole affair at approximately four revolutions per minute, we can obtain up to 7/10 of the earth's gravity at the space station module point.

The space station modules will be orbited on separate launches and will be joined together at various stages of a space base buildup which you heard about yesterday. The space base in this particular configuration (Figure 3) utilizes an artificial gravity capability by a rotating hub arrangement. Those compartments

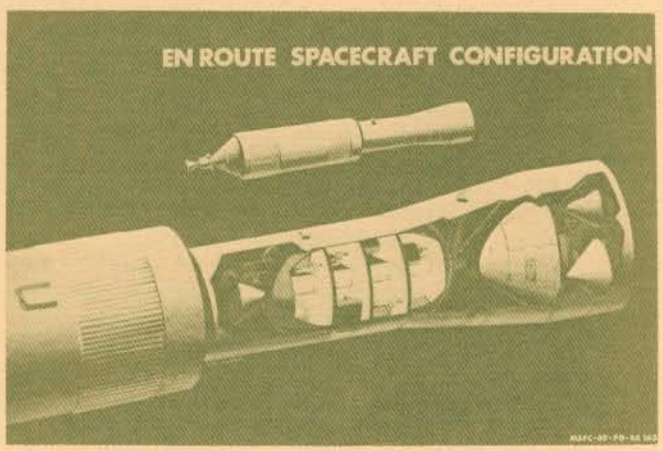


FIGURE 1

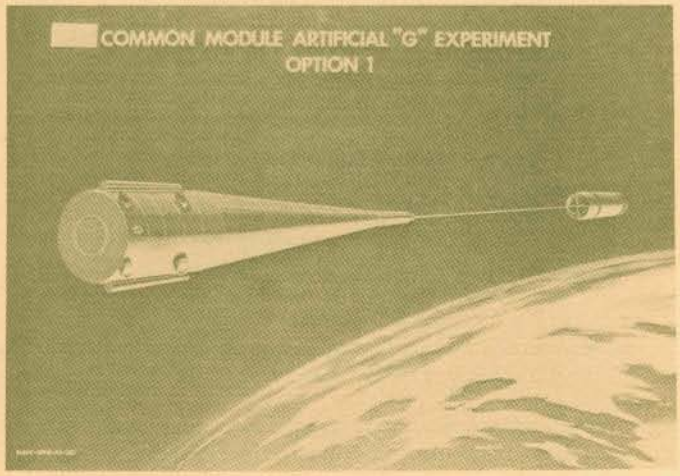


FIGURE 2

are shown at either end that would provide the artificial gravity to the men. Over here, on the fairly dark side of the figure, I believe you can make out our space shuttle that is docked to the space base. Obviously this is another key to the next program—a low-cost, reusable space shuttle that would be able to sustain the space base activities through refueling and through cargo replacement.

The compartment as shown in Figure 4 along the hub axis is a zero gravity area and the rotating areas will be the gravity field compartments. We have free flying compartments that are checked out on the space base and can perform various experiments in orbit around the space base. Although we haven't detected any adverse biological effect on our astronauts to date in the zero G environment, when we are talking about the longer duration missions, say, of a planetary nature of upwards of two to three years, we haven't yet studied the biological processes enough to establish what these longer term effects will be. The lab, as you see in the conceptual form in Figure 4, is actually a facility that could check out not only the man and his conditioning (unlike other experiments that we found in Gemini and Apollo which were discrete) but many aspects of the man. It could also check other kinds of organisms to study effects that gravity actually induces in our make-up—to better understand our living organisms. I might mention that a frog egg, for example, likes to be oriented a particular way. If you disorient that frog egg, it will try to reorient itself. But, if you push it over, and keep it over, you will get a bunch of deformed frogs from those eggs. Some will be born without any legs, and there will be creatures of various sorts. So there is a mechanism in life that is gravity-dependent. I might also mention that earlier this year in March, Dr. Christian Bernard had a few interesting comments to make to a subcommittee of the House of Representatives that related to the heart rejection problem that we are experiencing in heart transplants. Effectively, he mentioned that the cells of all of us are the same, but the actual structure, the DNA that binds the cells together, is different. And it appears to be very gravity-oriented. Dr. Barnard has suggested experiments in space to learn more of this phenomenon. I am not suggesting that this space base facility could solve all medical problems, but I am saying that this is a unique facility that could be utilized to look at varying effects of gravity to better understand our human mechanism.

Figure 5 shows an alternate configuration of a space base, again consisting of various modules of the space station joined together. The artificial gravity effect is created by a "y" with a rotating hub. At the end of each of these we have a nuclear reactor. These are flying in this direction, and again we have the zero G operating area, and the gravity areas. Over here you see another free flying astronomical module which I'd like to show on the next figure.

Figure 6 shows the free flying module docked to the space base prior to flying out away from the influence of the space base to obtain good astronautical readings. It has a 120-inch telescope. The module itself is

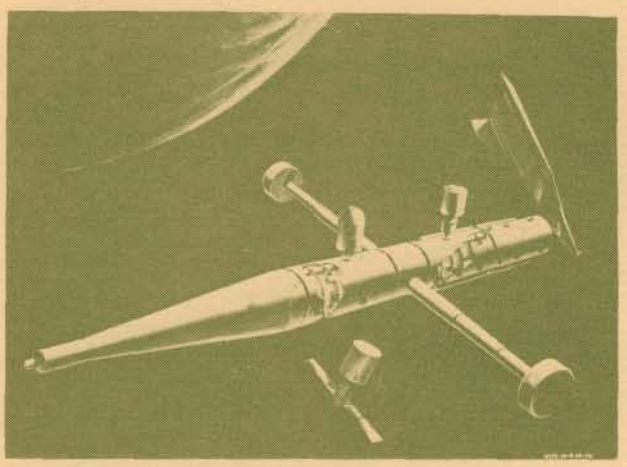


FIGURE 3

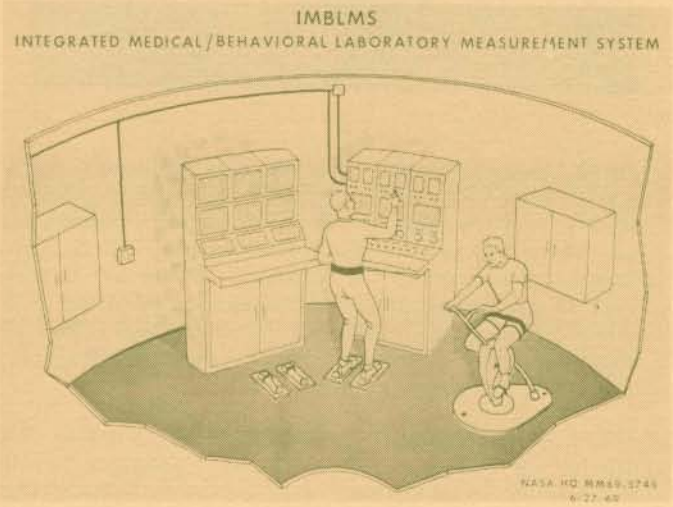


FIGURE 4

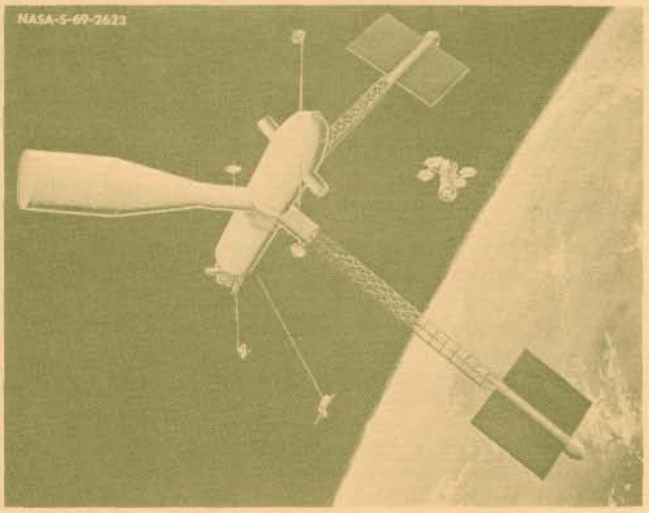


FIGURE 5

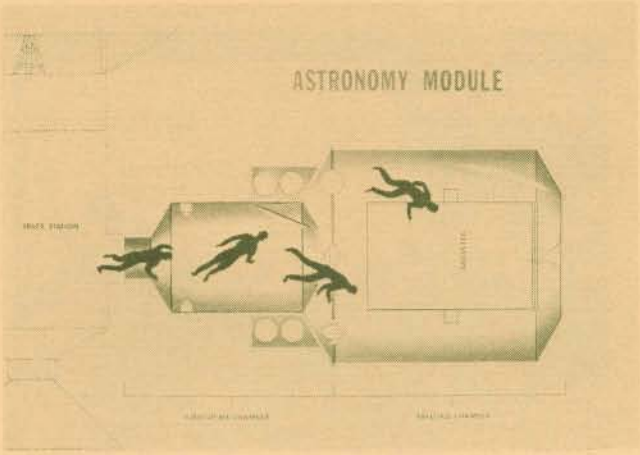


FIGURE 6

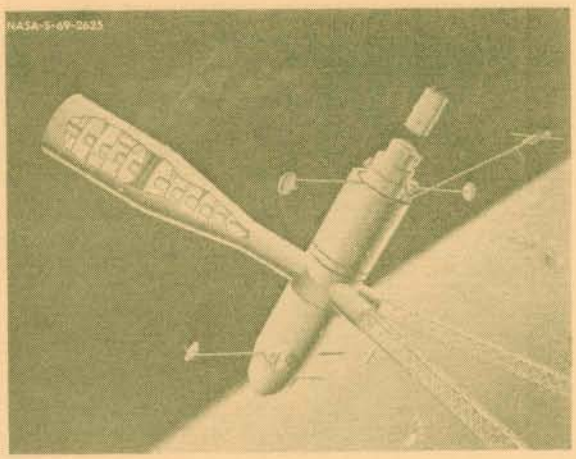


FIGURE 7

pushed off by reaction control jets. These solar panels are shown in the stowed configuration. After check-out the men enter the compartment. This door comes open, and studies can be made of the universe, without the atmosphere getting in the way.

I'd like to, with the next series of figures, mention a few things that could be done in space. Figure 7 is an artist's conception of certain earth resources remote sensing type of equipment. Now some of these figures that I'll be showing will represent or typify things that we can do in space. It doesn't necessarily mean we'll be doing all of these things in the space base, but we do intend to complement automated satellites. Where it makes sense, we will send trained observers up into the space base, because the goal of this integrated program is not to require the very rigorous training that astronauts normally get. There will be a limited crew number, but a large capability for transporting scientists of the general variety.

Figure 8 is a picture of the Dallas area and I am going to try to pinpoint areas for you, if you can make them out. There are several reservoirs around that are used for drinking water to service the populace. As you can see, there is some silt filtering into the reservoir, there. Now that's a very interesting process, and the hydrologists can learn a lot about sedimentation flow from a synoptic view from the air.

Figure 9 is a Gemini VII film, an infrared picture that Frank Borman took. This is the Imperial Valley, which is very well irrigated and a very lush area—very cultivated. This is the Rio Grande River and this is Mexico. Now the infrared film is sensitive to the chlorophyl content of the crops; in fact, the redder the red, the greener the crops, and the more healthy they are. You can see over here on the Mexican side of the border, it is not very well cultivated yet. The other bluer areas show uncultivated lands. So we can get an idea of the health content of the crops.

FIGURE 8

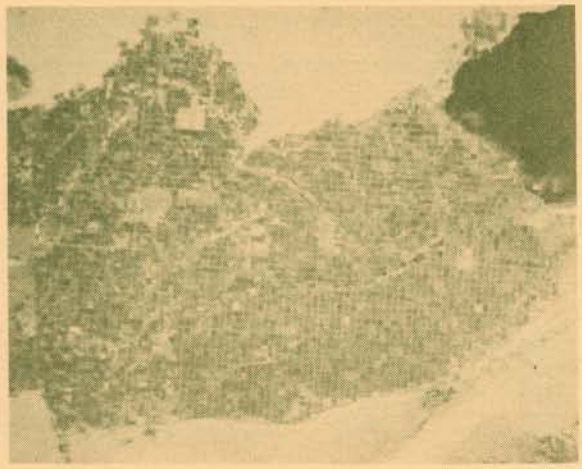


FIGURE 9

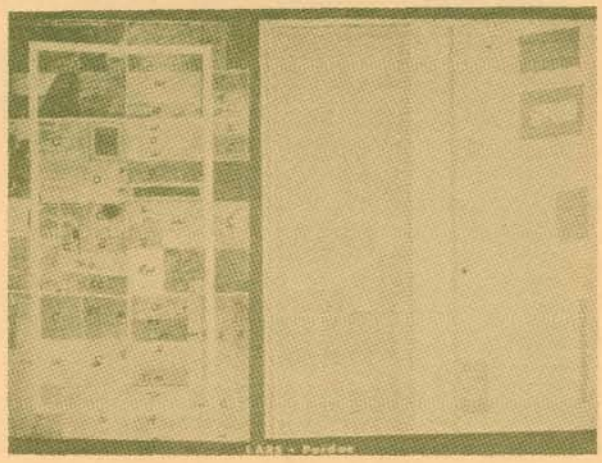


FIGURE 10

FIGURE 11

Purdue is helping us obtain reflectance signature properties in various crops (Figure 10). The "w" stands for wheat, and the "o" stands for oats. Over to the right you can see a format that's been established that singles out the wheat from the oats and relates it to what the total resource in wheat would be. Now all this can be geared to a central processing station within the space base complex, and other data need not be transmitted to the earth to get our total wheat resources.

Figure 11 is another space picture taken in Apollo. We have a contour of cloud heights. Where it makes sense, we will send some of the trained weather observers up there to get a better handle on our long range weather forecasting by these contour plots of altitude, leading toward our ultimate dream of actually controlling the weather.

Figure 12 shows a program that we're pursuing. Yesterday you heard various elements of the Apollo Applications Program, the first three portions of the chart, and today a bit about the space station, which we plan to fly in 1976, and a space shuttle to the right which will also be operational at that time. All this leads to a space base capability, a facility capability that NASA would provide and the country would have.

What this will do is lead toward a general capability of planetary flight. Figure 13, for example, could be a space module, that you see to the right of the picture, that is being used in a Mars mission. A little bit further to the right you see a conceptual drawing of the Mars landing, and two vehicles further to the right represent landers that could be deployed from an orbiting Mars vehicle down to the surface to bring various samples back to the orbiting Mars station.

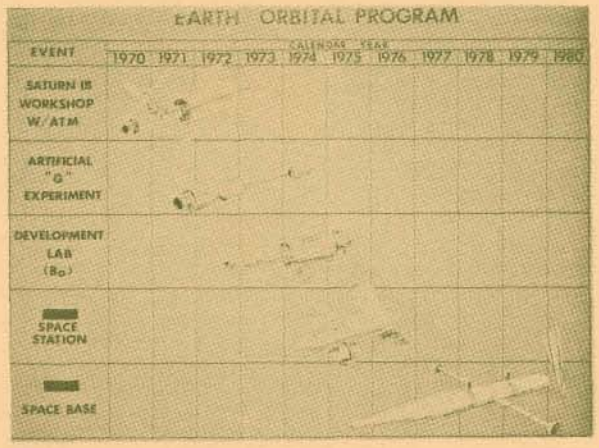


FIGURE 12

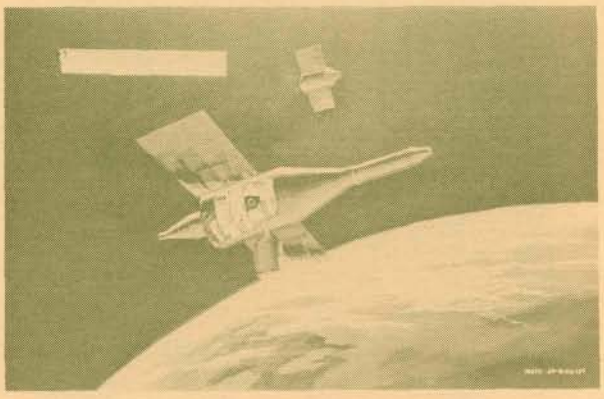


FIGURE 13

So very briefly, I hope I have given you some insight into the activity NASA is presently engaged in, with fairly substantial industrial support. I assure you it is a very, very vigorous effort to provide the nation with a broad base technological capability in space. I would like to emphasize that right now we are in the program definition phase. This is in anticipation of program approval for national commitment in space. As Dr. Mueller said yesterday, we are quite optimistic that we will get this approval. The Vice President has endorsed it, and we feel optimistic that the President will give his approval.

But the optimism that we have is based on the confidence that the country has in the space team that actually made the Apollo 11 a success. The American public now has been trained to look for success, following success. They believe that success will follow success in the space program and they continually expect us to demonstrate success and rightly so. We can't afford a failure. We want that program up there. Whether we get it or not, really depends on you and your team. Your assemblers, inspectors, the whole team. Sure there's a phychological slump that we recognize right now. We talked about it yesterday. And I suppose we'll be talking about it today. But slump talk really breeds slump talk. All the bad effects, and the insecurity that results in below par workmanship, that we can't afford. But we have to think positively now. How do we convince the assembler, and the inspector that he owns that part of the spacecraft he is putting together, that he will inherit that program up there? And how do we create an atmosphere of his recognizing his personal contribution toward that program up there? Now we cannot inspire people to do specific jobs, on nebulous terms like building a national capability for the exploration of the solar system. We have to translate this to what he is doing toward that capability, and make him a part of it. He won't be doing a better job on the next Apollo flight on a nebulous term. So we have to get smarter in our translation. In 1954 Roger Bannister broke the four minute mile, and that was a pretty big milestone. Before that people didn't think it was possible. But racers didn't stop trying to repeat his performance. On the contrary, many people now have demonstrated that capability. In fact, in a good meet, as many as four starters have finished in less than four minutes. But it really depends on the pacer in the race, how fast the race is going to be. And the excellence of the race depends on the pacer. Now the product of this symposium is to develop a methodology of offering individual challenges. And we've got to be the pacers, because we want that program up there. And tomorrow really depends on today. Thank you for your attention.

DR. JOHN CONDON

Director
Reliability and Quality
Assurance Office
NASA Headquarters

Good morning, ladies and gentlemen. I would like to talk to you this morning about the relationship between the Manned Flight Awareness Program and NASA's Quality Program. Our Quality Program, as you might surmise, is aimed at ensuring that our aeronautical and space hardware perform its intended mission. However, the realization of this aim is not the sole responsibility of Quality Assurance personnel within NASA, or within our Department of Defense support group, or within the contractor organization. This in no way is to belittle the Quality Assurance people, but rather to emphasize that mission success depends on everyone doing his or her job effectively and conscientiously. And certainly it is in this context that the Manned Flight Awareness Program has provided vital support to our Quality Program.

The efficient attainment of quality hardware is dependent upon many factors. However, there are two which I would like to talk about this morning. These are somewhat intangible factors, but nevertheless very important; specifically they are: the management environment relative to quality; and the motivation of individual workers. Now, motivating the individual worker to eliminate errors from his work, and to constantly guard against carelessness, is one of the very fundamental objectives of the Manned Flight Awareness Program. I think it has done a great job in accomplishing that objective. And certainly those of us in the reliability and quality business in the agency feel that it has provided a vital complement to our function.

Motivation, and the factors which influence it, is really a subject for the behavioral scientists, if it is pursued in depth. I won't attempt to pursue it to any degree of depth. However, I think most of us have observed the contrast between the presence and absence of motivation, as reflected in the behavior of individuals. Let me cite a few examples which, at least in my view, indicate the presence of motivation in an individual.

- The person who has an open, creative, and responsive attitude toward his job and his co-workers.
- The person who enthusiastically searches for better ways to accomplish things and is not satisfied with the status quo.
- The person who recognizes the capability and experiences of others and is eager to learn from them.
- The person who finds a way to get the job done efficiently and effectively, in spite of the constraints and obstacles which may seem insurmountable.
- The person who unselfishly does more than the minimum required.

These, I believe, are characteristics of motivated people—the type of people who are so vital to the attainment of quality hardware for the success of our space missions. The type of people that we have fortunately had in great numbers on the Apollo Program. The Manned Flight Awareness Program has played a vital role, and will continue to play a vital role, in the areas of communications and recognition. These are two key areas in the field of motivation. We must inform the individual of the importance of his job, and of how his job contributes to some total objectives. And we must recognize the individual who has performed superior or outstanding work. I think recognition in particular is very important to the individual who has done a fine job. Again, the Manned Flight Awareness Program has provided us very valuable assistance in these areas of communication and recognition. I am sure that those of you in industry who have participated in this program have found this to be a significant adjunct to your motivational efforts.

Of equal importance to the efficient attainment of quality hardware is the management environment regarding quality. Management must establish and actively support an environment of quality consciousness or awareness. In particular, this environment must be manifested through the decision making process. Management decisions, indeed, are influenced by many factors, in addition to quality. For example, cost, schedule, and personnel consideration. In some cases, management decisions may give the impression that quality was not given appropriate consideration in the decision process. Management thus has a responsibility to inform the personnel involved, of the reasons for such key decisions, if an environment conducive to the attainment of quality hardware is to be sustained. How many of us have heard the complaint that management "is only interested in meeting a schedule," or "are only interested in reducing costs?" "They have no interest in quality, therefore, why should I be interested in the quality of the hardware?" "Why should I care whether this particular discrepancy, or this particular deficiency is properly recorded, appropriate corrective action taken, and properly closed out?" "If management doesn't care, why should I care?" Now, I happen to be enough of an optimist to believe that management does care. And to firmly believe that. At least I have never talked to a member of the management team who has given me cause to reach any conclusion to the contrary. I think the fundamental problem is that management often does not take the time to get the word down the line, so that people understand why a decision was made which may seem to conflict with appropriate consideration of the quality of the product.

Every day we are faced with misinterpretations and misunderstanding. Things don't always come out the way we think they will, or the way one might logically expect them to. I feel that every member of management, from first line supervision on up, has a very, very significant responsibility to establish and sustain an environment of quality consciousness and awareness within the organization, and to communicate when appropriate the reasons behind key decisions that affect that product, and the quality of that product. In this way, you keep that team on your side and we keep it on the side of good quality.

The Manned Flight Awareness Program has significantly helped you in management create this type of environment. The program not only elicits management support, but stimulates active management participation, thereby enhancing a positive management environment for quality. As we move into this second decade of space exploration—and the speakers yesterday and this morning have given you some excellent insights into what we can do, what we expect to do—it's obvious that our missions will be more complex, of longer duration. And it is also obvious, or should be, that our quality requirements for hardware will be more stringent. Thus the need for highly motivated personnel, coupled with a sustained management environment for quality, will continue into this second decade. Certainly the Manned Flight Awareness Program will continue to be a vital support to those of us in the quality business. Thank you very much.

DR. CHARLES HUGHES

Director
Industrial Relations and
Compensation Service
Texas Instruments, Incorporated

After spending a number of years being concerned with motivation and participating in some research, and looking at all the work that's been done in achievement motivation, I sometimes get the feeling that this entire space program was set up just to prove out the theories. It is an amazing example, even down to the kind of language, terminology, and concepts that have been developed, of the kind of motivation program that can turn on the commitment of people to achieve clearly identified goals. I am not particularly concerned about the research and the concepts, only with the engineering of a mass application of these ideas within the business organization.

When we look around, we come very quickly to the conclusion that motivation comes from having a job in which the goals are excruciatingly clear. So that at any point in time we know what it is we are expected to accomplish. This has got to exist from the top, right down to the bottom of the organization. From the chief honcho, right to the little girl or guy who is assembling the unit. So the guy's boss turns out to be the number-one factor that affects this motivation. Although, interestingly enough, we have found that supervisors themselves do not motivate! It is the content of the job. But the supervisor can arrange conditions in which the job content has enough motivating factors in it so that we can get the kind of commitment that we need to have.

So some of these conditions of motivation that supervisors affect can be illustrated by Figure 1. If you look first at the bottom box, it says, "What we really want to get is human effectiveness." There are some criteria that the organization needs to meet. These are some suggestions. For example, in a business, profitable growth, because under the free enterprise system, that is your index of how much contribution you are making to that society. Institutions that act responsibly within that society do not have to suffer from excessive third party intervention, which typically follows irresponsible behavior both for corporations and individuals. And one in which the organization itself is renewing, so that when it accomplishes a goal, it can continue to be vital and be alive and continue to grow. Because, if it is not going to grow, it will go out of business, or it should! There are some human criteria that are not particularly different: the entrepreneurial concepts, the idea that commitment to the goals of the organization is necessary for that organization to grow and survive; so too, the individual has commitment to the goals for himself and whatever kind of work career that he expects to get; and an environment within the organization of mutual trust, not trust based upon blind faith

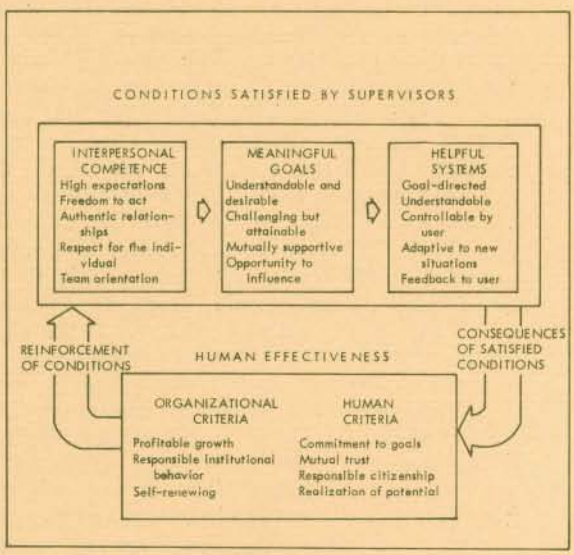


FIGURE 1

but the kind of trust that comes from dialogue, knowing that we know what we are expected to accomplish. Now, these kinds of conditions would be criteria to determine whether or not the organization is effective.

In the research that has been done within our organization and in a number of other places, we have tried to isolate some of the factors that can be influenced by management in order to get this commitment to the success of the organization, to this achievement of the goal. One of them that I usually mention is interpersonal confidence. I am not talking about the old 1930 type of human relations programs that continue to exist in some organizations. The basic theory of these I consider obsolete human relations programs. The idea behind these is that you can love people into productivity. All you have to do is figure out how to love them enough, and in the right way. I am talking about interpersonal confidence, which is based upon a different set of assumptions about people, of which the most important one is high expectations. We will expect excellence, and we will communicate that! We will not accept anything less than excellence in the work of the members of the organization, whoever they are! We will grant a freedom to act in pursuit of the goal, once we have a clear understanding of what those goals are! We will develop authentic relationships, best expressed by candor, and very clear, direct, blunt communication about what is occurring. We will show a respect for the individual, (1) because he is a people, and (2) because he can contribute to the success of the enterprise! We will encourage a team orientation in the best sense of that concept—a group of people with a common goal, who must all pull together and make the oars bend or we will not get there! There must also be a clear understanding of these conditions, a kind of interpersonal confidence. It says nothing about motherhood. It says nothing about pledge cards. It says this is the job that we must accomplish.

Another condition, and probably the most singly important one, is goals which are meaningful to the individual who is expected to accomplish them. To do that, they are going to have to be understandable to him. He has to see them as desirable. They are going to have to be challenging. But, they will have to be seen as attainable. Goals that are too remote, too long a term, too distant, and with too little probability of success will not motivate. But conversely, goals which are too easy, too close, too simple, do not do it either. The evidence on that seems to be quite clear. Goals that are set high enough to have a challenge, with about an 80 percent probability of success for the individual, will get the most motivation. Those goals must be mutually supported so that in execution of his job, he is not in conflict with another goal of the organization. A conflict that has already been mentioned at least twice this morning is time schedule versus quality. That kind of goal-conflict is going to lead to confusion, and possibly disaster. So goals must be mutually supportive, so that by doing well on one job, the goals of another job are enhanced. And another goal which seems to be critically important (if we can engineer it; it is very difficult) is the idea of an opportunity for all members of the organization to influence what those goals are. It does not mean that the assembly man on the line is going to tell the program director what the goals of the program are. But it does mean that any person, at any level, to the degree that he or she has an opportunity to really understand, can make some inputs to the plan before the plan is locked in. This will get a much higher level of commitment to execute those goals.

Another thing that seems to have been demonstrated over and over again is the idea that systems should help rather than restrict the achievement of the goal. Now people, such as myself and accountants, are pointed out as people who restrict goal achievement through the systems they develop. These systems are often seen by project people as elaborate Mickey Mouse ideas designed to keep the computers full of data. Systems must help achieve the goal—must give the kind of data and feedback in time to keep the program on its track. They must be directed specifically to the goals that have been cited, and must aid all of the staff organizations. Therefore, systems goals are subordinate to the project goals. Systems should be understandable to the guy who has to use them (which is not the programmer; it is the guy operating the business). They should be controllable by the user, so that he can have the information and the resources necessary to do his work. Systems should be adaptable to the situation, rather than elegant solutions to questions that have not been addressed. Now that very brief sketch of the conditions for motivation seems to be able to apply at any level of the organization! And those are things that could be under the influence and control of the supervisor.

But the climate of the organization can make this either real or can make it a facade—just a big game in which no one admits that they really do not agree. Now in the authority-oriented organization (an organization that runs on the authority of somebody to tell somebody else what to do), this will work. It has been quite successful. Many businesses have been built upon this. Many nations have been built upon this. The question is whether it is efficient, as effective as some other modes. Let me point out a couple of things that give the character of an authority-oriented organization. It is based upon a theory of social organization and business organization designed to handle the industrial revolution, over a hundred years ago, by a sociologist by the name of Weber. He called it bureaucracy, at which time it was a good word. Now it is a four letter word. The basic idea behind bureaucracy is functional specialization. See Figure 2. They will put function A under one management team, and function B under another management team, and C and D and so on. And we will build elaborate long pyramids of people. The only problem with this is that you have to have a very well defined hierarchy of authority in order to operate that way, because the functions do not have a common objective. They do not have a common goal. And so in the authority of an organization, you will find evidence of this as usually expressed by some kind of a tree-shaped organization chart that is extremely valuable because it tells you

who can do what to whom. And whether they have to like it or not! It is based upon the same concept of, "You will play volley ball, and you will enjoy it!"

Now because of functional specialization, planning and control will have to be kept at a very high level. Responsibilities are, for example, separated throughout the organization in which quality is the responsibility of the quality department and everybody understands it that way. And the authority for it rests entirely with them, because it is their goal and is not the goal of the rest of the people. And we see that planning and control is what managers do. Now if we say that is the exclusive right of managers—they will plan and they will control—then there is the third function, doing. Executing the plan, is a function of the people well down in the organization. They will find a common phenomenon, that the managers are turned on. They are motivated because they have a fun job. They have a job with motivating content. But, they cannot understand why the hell the rest of the people are not. So motivation as seen in this concept is the right of someone to tell someone else what to do, the relationship between an individual and a figure of authority. Going along with it will be typically a system of rights and duties of the employees, sometimes expressed as a union contract, work rules, and other kinds of things.

AUTHORITY ORIENTED ORGANIZATION

- A DIVISION OF LABOR BASED ON FUNCTIONAL SPECIALIZATION
- A WELL-DEFINED HIERARCHY OF AUTHORITY
- PLANNING AND CONTROL KEPT AT HIGH LEVEL
- MOTIVATION SEEN ONLY IN RELATION OF INDIVIDUAL TO AUTHORITY
- A SYSTEM OF RULES COVERING THE RIGHTS AND DUTIES OF EMPLOYEES
- A SYSTEM OF PROCEDURES FOR DEALING WITH WORK SITUATIONS
- IMPERSONALITY OF INTERPERSONAL RELATIONS
- PROMOTION AND SELECTION BASED ON TECHNICAL COMPETENCE
- PEOPLE DIFFERENTIATED VERTICALLY IN ORGANIZATIONAL PYRAMID ACCORDING TO RANK

Adapted from
Bennis, Changing Organizations

FIGURE 2

This kind of operation will run, if the management accepts the assumption that it has all of the brains, and what it wants is hired hands. But as Drucker pointed out, you cannot hire hands. The whole man comes with it, and you get this kind of problem (Figure 3). It is a statement of a problem, one that is known in industry quite widely, particularly in the typical manufacturing organization in which up at the top there is planning and control, organizing, the fun things, the motivating things. And management says, "That's my job, and I do that." We come down lower in the organization and we get a bunch of people called supervisors. We say, "Here is the plan, now go lead and control those people against that plan." Then somewhere far below that is a group of people (typically called labor, wage roll, and other obscenities) in which the job is to "do." But don't plan. Don't think. Don't control. Don't evaluate. And because they don't have that in their job content, it is much tougher for them to become motivated. And we get a gap. And that gap is a problem. It is a problem that needs to be solved, in industry, if we are going to get the kind of human effectiveness that we have the right to expect. The question comes down, "Now how can we design jobs so they can be more meaningful? How can we get more people involved in a process of being concerned about the goals of the organization; being committed to the objective; and having those kinds of goals which any person can relate their job to?" During the space program, up to this point, that was very, very clear. Anybody could understand the name of the game, and what that one ultimate goal was, and possibly could relate themselves to it. Unless the space program develops something that is just as clear as put someone on the moon and bring him back safely within a decade—a very clear goal, anyone can relate to that—unless a new one is developed that is as simple and as clear as that (it is in your brain, you don't have to write it down, you don't have to hang it on the wall for people to know it), we will suffer a loss of motivation due to the lack of a clear, meaningful goal.

MANAGEMENT/LABOR DICHOTOMY

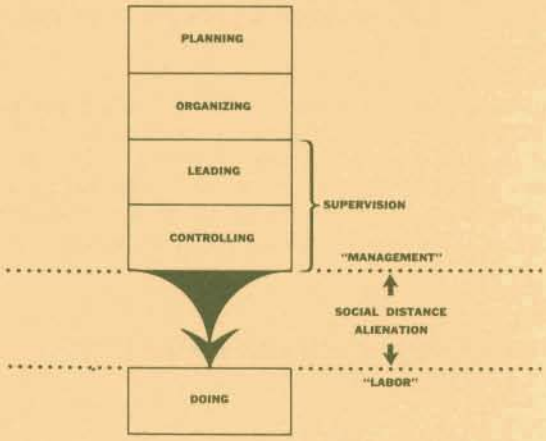


FIGURE 3

In doing research and motivation, there has been material developed over the last ten years that has helped to clarify things about industrial motivation. Up to that point, it was generally done with people in mental institutions or with rats in the laboratory, none of which necessarily predict what people do at work. This research has become, I think, a set of guidelines that can be used to tell management what to do in a number of cases. We can test our plans and assumptions against these, with some confidence. This is based on the work originally done by Frederick Herzberg at Western Reserve, which is now having world wide attention as an industrial motivation con-

cept. What it does is separate this phenomenon into two distinct factors. One set of factors relate to the environment in which the work is done. And they do not motivate at all. If they are bad, you are unhappy and dissatisfied, and you have low morale. If they are good, you are just not dissatified. There is another set of factors which, if present, are the motivators. And if they are not present, you may not be unhappy, but you are not motivated either. You are just there, sitting around in a warm bath, looking at each other's navel. And management tells you that they love you, and your work is important, while you put on left hand door handles, day after day in the automobile plant!

Figure 4 is a concept of what kind of organization we could have. Let me just pick out a couple of things, so we can see how we might be able to engineer a way, on a mass scale with thousands of people, to get some advantages. Let us divide the organization based upon goals, otherwise known as project management. Let us organize the entire organization, if we can possibly figure out how to, on either a matrix organization, or on a concept of projects, multiple projects, and tasks. Because within the tasks force—project management concept, the goals get a lot closer to home. And then the organization chart looks like a PERT chart, and we burned the rest of the ones that looked like little trees because they do not represent what happens. In fact this flow chart type of organization tells us how the work moves through it, tells us what the goals are at each point, and the time, and the other criteria. If we do that, the planning and control aspects of work get closer to the individual who is going to execute the job.

This big wheel shown in Figure 5 (with a shaft through the middle of it) is an artist's representation of how you might look at this motivation theory. It says in the outer circle, "There are some needs that people have, and if we do not maintain them they are going to be so unhappy you will not be able to operate." And

GOAL ORIENTED ORGANIZATION

- A DIVISION OF LABOR BASED ON GOALS
- A NETWORK OF TASK FORCE GROUPS WITH INTERDEPENDENT PLANS
- PLANNING AND CONTROL DELEGATED AS PART OF ANY JOB
- WORK MANAGEMENT SYSTEMS ADAPTIVE TO USER
- PEOPLE DIFFERENTIATED ACCORDING TO FLEXIBLE, CHANGING ROLES
- HIGH TRUST IN INTERPERSONAL RELATIONS
- KEY LEADER ROLES ASSIGNED ON GOAL ACHIEVEMENT ABILITIES
- MOTIVATION SEEN AS RELATION OF INDIVIDUAL TO WORK, GOALS AND GROUP

FIGURE 4

FIGURE 5

they have to do with physical needs, social needs, status, orientations, security, and some form of economic need. So we have physical working conditions. If the cafeteria is bad, people are unhappy. So we spend money on the cafeteria. They are not now motivated—they are just no longer unhappy with the cafeteria. So then it's the parking lot. So you improve the parking lot. Now people are not unhappy with the parking lot. They are still not motivated. Companies can evolve elaborate schemes of air conditioning, the esthetics of the buildings. If they don't, they will have dissatisfaction. But they somehow say look how much I love you! Look what I give you! How come you are not motivated? The answer to that is, "Look at what you have asked me to do! That is what turns me on or turns me off." People have social needs. It is nice to have a Christmas party. If you are going to have a Christmas party for the plant, have a good Christmas party. But don't expect any motivation from it! Matter of fact, you might as well not do it. It does not lead to work performance. However, if people expect to have a Christmas party, they would be unhappy if you don't do it. And if you give a good enough one, they will temporarily not be dissatisfied.

Status? Status can cause us problems. Status helps us get that gap. Status is always there. Some jobs are more important than other jobs. That is a fact of life. It is not necessary to create executive dining rooms, however, to reinforce the fact that we are management. It is not necessary to measure your office to see whether it is one foot wider or narrower than the guy's next door, or to make sure you have the ultimate status symbol, a secretary that looks good from the front and the back! These things inhibit communication. They cause problems. They also waste assets that could be spent in more meaningful ways.

Orientation is necessary. If people don't know what is going on, they will invent what is going on. So we tell them what is going on. We put our brochures and company newspapers and tell them how great and

wonderful and important their work and the company's business is to this space program. But that does not motivate them to do their work. There is no evidence that it does. But if they do not know those things, they will be confused, disoriented, and possibly dissatisfied. So we can remove dissatisfaction through this. We should do it! We should do a good job of it! But we are not getting motivation yet.

Security? If we are insecure in our work, we are going to be unhappy. So we get absolute security! It does not lead to happiness, as many wives will tell you.

Now economics is an interesting one. If we don't get paid enough for what we do (or we think we don't) we are going to be unhappy. But, when we are paid enough for what we do (we have a nice base rate) we are temporarily not unhappy. But I assure you, we shall be unhappy again about our pay. We may have had breakfast this morning, but we will need to eat again. And regardless of how good the breakfast was, we don't want another one right after it. And as Herzberg says there is no food which will keep you from eating. So the stuff in that outer circle is environmental. The environment in which the work is done. Let us make the environment good.

If we want to get the things that really make it go, it is in the job. And they are the needs for growth, achievement, responsibility, and recognition. Those are the things which motivate. And they come, not from existing, not from being within the plant! They come from the job we have asked people to do. Growth means that we can continue to improve our skills. We can learn. We can grow. Responsibility means we know, clearly, that we are responsible for making certain kinds of things happen. When we know quite clearly that we have that responsibility to get results, this can motivate. Recognition for doing well can motivate.

And achievement turns out to be the strongest motivator of all, in any work group studied, whether it is salesmen, engineers, accountants, or ladies on the assembly line. Achievement, as all the research that has been done over the last several years says, is the strongest motivator of all. And achievement comes from long-term involvement. It comes from a career concern in the way of advancing yourself through the organization, through what you do. And it comes primarily from having goals in the work—and in the organization—which are visible to everyone. Which are clearly understood! And which are seen as desirable! And when we achieve those goals it almost becomes its own reward. Figure 5 shows examples of things that can take care of these conditions. For instance, under economic, we give insurance, we give holidays. If we don't do that, we don't keep up with the industry. I think we are going to have dissatisfaction. But having nine holidays, and getting a tenth one, never produced any motivation, only an incredible expense and disruption. And automatic increases (which gives everyone the same raise regardless of their level of performance) takes pay out of the motivator category. If you want to put the economic factors into the motivator category, what we would do is tie it to achievement. And the better the achievement, the better the pay; the poorer the achievement, the poorer the pay. And for no achievement, there shall be no pay!

The thing to do with both the authoritarian managers and the non-performers is to place them with your competition, because they are a drag on the organization and they will create dissatisfaction. We have learned this in our organization the hard way. We continue to recreate these studies and to our amazement find that it holds up most of the time. We give free coffee in the morning and afternoon. It does not have anything to do with motivation, but if the coffee isn't any good people are going to holler. Once upon a time somebody started giving free doughnuts in the morning. Some companies may think that that motivates! I assure you when the doughnut machine would break and you got a broken Oreo instead, you cannot believe the kind of dissatisfaction that occurred. So we stopped all of that, and interestingly enough, there has yet to be the first comment about discontinuing that practice. And every company has little peripheral practices which are tradition—posters and signs, slogans, company songs. Maybe it sells insurance, but I don't think it'll get a guy on the moon and back. These things, if they are tradition and they don't disrupt things too much, and they amuse the management, they perhaps should go ahead and do them. But let us not confuse, however, the maintenance of the environment, with the content of the work. That is all. Motivation is in the work itself.

Let me just tell you one quick example, from a company that I once worked for. I went to work and they said, "Okay, you're a hydraulic test inspector." Now that sounded like a good quality-assurance type job. They gave me a little bottle of purple dye and a stamp and, hot damn, I'm a hydraulic test inspector. I went to work with a guy. I said, "Hi, I'm supposed to work with you, but I didn't bring any tools." He said, "That's all right. You can use mine." (Because he didn't.) For four months he did nothing. And I said, "What do I do?" He said, "Pick up this casting. Bolt it down to that jig there, and put the air hose on it. Drop it in the sink of water. If it doesn't bubble in 15 minutes it's good. Hit it with your stamp, put it in that box. If it bubbles, it's bad. Put it in that box." I said, "Is that it?" He said, "That's it." And I kid you not that I made 800 percent of standard the first day. And truly, it was explained to me in the parking lot about that. So the next day I worked very slow the first half of the shift. Did nothing at all the second half of the shift, made 200 percent of standard! I put half on my work sheet. The other guy who did nothing, whose tools I used, got the other half! And the department was full of about 60 people who did the same thing. And we never saw the supervisor, except when the shop steward would call him and explain the benefits of behaving himself. Where's the motivation? I'll tell you where it was. It was those ten minutes in the morning and afternoon when the bell would ring and they would play Hillbilly music, and we would toss washers in a hole in a board! That was motivating. Why? Because it was under my control. I planned it. I organized it. I evaluated it. I might even win

60 cents at it. It was growth, achievement! Responsibility and recognition were all present. But 20 minutes a day? No, something was wrong. Something was really wrong with an organization that operates like that. And I assure you that in any organization we can find the same kind of thing. It is a severe problem that needs to be attacked, when people are given routine, Mickey Mouse, stupid jobs to do.

There is a tape recording at AT&T made by Bob Ford who has worked quite a bit on this. They asked a girl, "What's the best thing about your job?" She says, "The money." Okay. He says, "All right, what's the worst thing about your job?" "The money." He said, "Aren't you contradicting yourself?" She says, "No, it's the best thing, and the worst thing, because it ties me to this stupid job." She understands the motivation theory.

What we need to do is to find some way of making work meaningful. That is the only way we are going to get motivation. Fred Herzberg, who originated this research tells a very great story. He said a company called him up and says, "We have a motivation problem and want you to come down and see if you can enrich these jobs and make them more motivating." He went down and looked and says, "Well, you have got to change the job." They said, "There is no way we can change that job." He says, "Well, then, you have these alternatives: 1. Automate it because it's unfit for human consumption; 2. Live with it, and go right ahead kidding people that their work is important. Or have a morale problem." They said, "I thought you were an expert in motivation." He said, "You got an expert's answer."

There is no way to motivate with impoverished, trivial kinds of tasks. There must be meaning in the work. It is a problem, particularly in manufacturing, to do this. It is not easy. We have built these kinds of jobs. The unions have assisted us. And many organizations are reducing the content of the job to a very narrow band of short cycle, highly repeatable processes. And as Harry Levinson says, "When a man asks you for a job, he's asking you to tell him who he is." So you give him something stupid to do. I guarantee he will behave in a stupid manner. We have got to get out of this kind of problem.

Figure 6 puts these two things together. That gap that shows in between labor. You could put that gap between the top management and the middle management just as well. For exactly the same kinds of reasons. All management jobs, just because they carry that title, are not meaningful. It depends on whether or not they involve in a top down, cascaded, iterated process of defining the program, plan, and objectives. Involvement in the planning process, not just knowing what the plan is, but having helped create the plan can be very powerful and can get a high degree of commitment to achieve. And achievement motivation comes from goals, and knowing what the goals are. Comes from involvement and planning! And that seems to be the answer.

The engineering of this process, on a mass organizational scale, will be quite difficult to achieve in itself. Goal setting says that any job ought to have planning in it, doing in it, and controlling or evaluating. And whatever happened to leadership? Leadership of the chairman type is becoming less acceptable. Leadership in the new concept means what the guy above does is involve the people below him in planning. That's an operational definition of leadership. It seems to have nothing to do with personality characteristics. It simply has to do with high expectations of people. We should think well enough of what they can do for the organization that we are going to involve them as much as we can. Then you would have a series of circles going down through the organization, just as far as we can engineer it. So that every job has some motivating element. Otherwise, we will just have to tolerate the morale problem, or an incredibly large cost.

Figure 7 contains some ideas taken out of a book by John Gardner called Self Renewal, that I think do relate to this business of staying alive and keeping the organization growing. Particularly with the kinds of experiences that many people have been involved in the space program and surely must be experiencing at this time. The first is an effective program for the recruitment and development of talent. That goes without saying.

We should not accept less than excellence in the people we bring in, if we have any way of doing it. Secondly, provide a hospitable environment. That says, "Take good care of the maintenance factors and then shut up about it." Third, provide an adequate system of internal communication, not in one direction through a dielectric layer of management, but one that goes both ways, with the same degree of speed and accuracy. A tough problem. It flows down so easily, and it does not come back. Fluid internal structure which says organizational structure is a dependent variable. Do not fit projects into the current bureaucratic organization. Change the organization any time the goals change.

Watch out for becoming a prisoner of your own procedures. That has happened to all of us. Once upon a time I heard of a man who sent in an expense account. It had rubber boots on it—eight dollars. They sent it back to him saying the company doesn't buy rubber boots, that's your expense. The thing came right back. Same total, and a note, "The boots are in there. Try and find them." I also heard of an engineering manager one time who faced an edict which said, "Thou shalt not buy any more microscopes." He says, "I got to have that particular microscope. I cannot reach my project goals." Management said, "You can't have the microscope." So he filled out a purchase requisition, listed all of the parts, and the last line said, "Please assemble before delivery." Now, that is one way to use your creativity. It might be better that it went into the project.

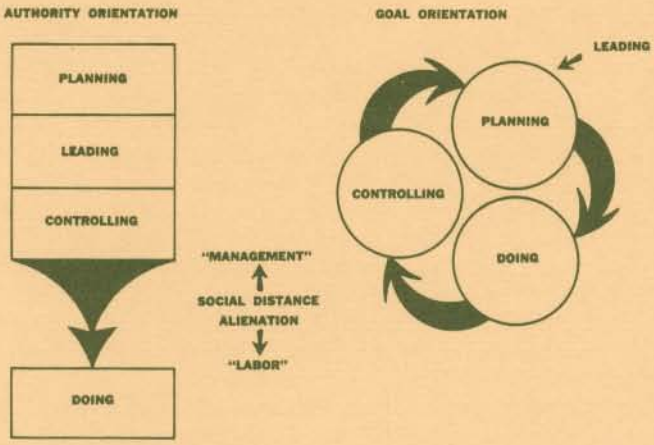


FIGURE 6

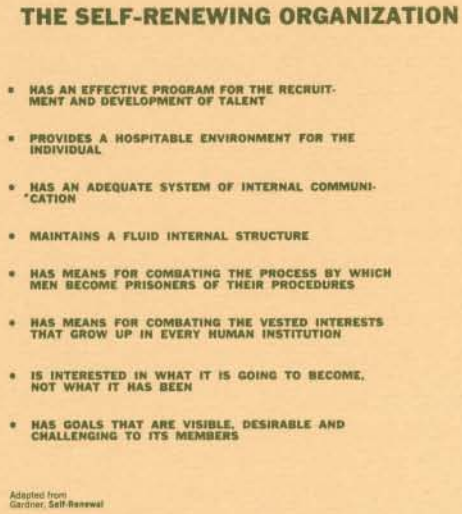


FIGURE 7

Vested interests do get created, and they get very protective. And they are very wasteful of resources. Particularly, human resources.

The organization should be interested in what it is going to become—not what it has been. Never mind what your goal was last year. History is fine, but you cannot do planning based on extrapolation from the past. With strategic planning (planning with goals) the question is, where do you want to be? Now, let us work backwards, through our planning cycle, to see whether we can really get there or not. That is the way you find out whether the goals are meaningful. Not because we can lay a straight line across the chart and make it go to a point. But, where do we really need and want to be? Then the challenge is to engineer a way of getting there. Does the organization have goals that are visible, desirable, and challenging to its members?

In summary we are not going to motivate anybody by loving them with fringe benefits, programs of faked superficial involvement, pledge cards, and other obsolete manipulations. We have got to have good working conditions. Have a good environment for people to work in and do their job. But these are not going to motivate. The only thing that is going to motivate is things that we ask them to do. Whenever we have a motivation problem, we should <u>not</u> say, "I wonder what the hell is wrong with that guy?" A better question is, "I wonder what is wrong with that guy's job?" Because, I assure you, when he is out playing golf or bowling, he is probably so motivated you wouldn't recognize him. But, under those conditions, he has significant opportunities for motivation. If we would engineer that kind of process at work, then we could achieve our organizational goals. But we must take the time and care to have the goals well understood, clear, constantly visible, with real-time feedback through <u>true involvement in the goal setting process</u>.

INNOVATIONS IN MOTIVATION

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Gene Horton

This is the "Innovations in Motivation" panel assembled here on the stage. My name is Gene Horton. I serve as the chief of Manned Flight Awareness for the Manned Spacecraft Center. These are my counterparts in industry or their representatives.

I'd like to very quickly summarize, before we get into the panel discussion, some of the points that the speakers left with us. First of all, in Dr. Mueller's opening remarks yesterday, the stage was set for this conference in his remark that cost reduction is certainly the essence of manned spaceflight, now and in the future. Following this Dr. Petrone pointed out that we must hold the team together. His industry counterparts, Mr. Bergen, Mr. Able, and Mr. McClellan, pointed out that one of the most difficult problems we face is keeping the creative individual engaged in meaningful work during this period. Today, we heard about some of the mechanics of putting together a motivational program that is meaningful, and we heard a very good talk by Dr. Hughes from Texas Instruments, and Dr. Condon. I think they were concerned, as we should be, with how to create an environment of quality consciousness and how to find ways to show the employees in industry, in NASA, and in the Department of Defense that excellence is, in fact, expected. Then we were reminded in the last presentation that there are maintenance needs, and there are motivational needs. I think that the four that were mentioned bear repeating. We should be reminded of this as we try to take a second look at our motivational programs back home. These needs are growth, achievement, recognition, and responsibility. We learned a good bit about the long-range plans of NASA to explore space. I think that we all found that there is an orderly, broadbased, continuing, step-by-step program of space activity.

There is no need for any of us to turn-tail and head for the weeds. There is plenty of work to be done. We have been reminded that we are the tools in the hands of the taxpayer, and I think that this is something that we should often remind ourselves of. It is necessary that we continue to show that there is a payoff from the space activities that we are engaged in, if we are to compete satisfactorily with other national programs. I was reading recently in the newspaper that over the course of the last twelve months, this nation committed some 19 billion dollars of its national resources to what may be described as welfare programs, and to the space program, over the short period of its life, it has devoted something on the order of 2-1/4 billion dollars annually. I think that we have to point out that not only is the space program portion a relatively small amount of the total national resource, but there is a great deal of new technology and dividends that are being derived and they have to be reported, not only by our technology office, but by each of us. I think as communicators—and that's how we regard ourselves—it is our responsibility to translate the meaning of the new technologies and new developments into words that the working man can understand, both in our plants and for the man on the street. And so, the name of this panel is "Innovations in Motivations." We are looking for new ideas! We have a creative group of men, not only on the stage here, but in those that I recognized in the audience whom I've worked with over the last several years. What I think we should do is to begin this discussion and try to get some answers to two questions. The first is, "What can we take back to our own plants, offices, and organizations from this seminar that can be useful; that can be put into effect immediately, with some payoff?" And, secondly, "How can we improve our own internal communications?" I mean by this communications from NASA and the Department of Defense and from industry, and horizontally and vertically within the individual organizations.

It was pointed out by Stu Roosa yesterday, and several of our management, that face-to-face communication is probably the best tool that we will ever come up with. So, with that background, I would like to start by introducing our panel: From my right, John Willmott of IBM: Tom Scott representing Boeing Company, Dwayne Gray of North American-Rockwell; Tony Tocco, TRW System, Redondo Beach; Harold Durfee, Grumman Aerospace Corporation; and, finally, Gordon Macke of McDonnell-Douglas Astronautics Company. Would any of you like to start things off?

Tom Scott

Since the panel is discussing innovations, I have found innovations to be very effective in some programs for which I have had responsibility. Effective both from the viewpoint of getting the employee participation; and effective from the viewpoint of getting the interest of management. It may be more meaningful, though, if I start out with some of the results we have achieved through innovations of well-established programs. First, in a 1400 man organization, well run, the best record of employee participation of any organization was in Boeing. They came in with some innovations at the direction of the Vice President. And we raised the total cost savings from $1,500,000 to $3,500,000 in a period of one year. Or rather, we changed in ten weeks to that rate, and it was actually accomplished in a year. In another 16,000 man organization, we came up with a very simple innovation that you may want to use. And last year we had a total cost savings of 32 million dollars, 74 percent over our goal. I attribute the whole thing to one bit of innovation.

I have followed 10 precepts, 10 ideas in motivation. One of them is innovation itself. But I'd like to recite the ten principles for you.

First, anybody connected with the program from management on down, must distinguish the difference between pep talks, inspiration, and true motivation. Pep talks can create enthusiasm. Inspiration can create determination. But motivation affects an attitude change. And that is the thing we must get.

Second, motivation results in the employee's feeling a proprietary interest in the company. A responsibility as a member of the team, and dedication to ultimate mission success.

Third, motivation results in a permanent and sustaining effort towards the attainment of management goals by the employee. Inspiration and pep talk? The results last as long as you apply the pressure, and then they drop off.

Fourth, motivation can be measured to the extent the employees contribute ideas to management. Many people don't know how to measure (especially management people) and don't understand that motivation can be measured. It is measured to the extent that employees contribute ideas.

Fifth, the extent of the contributions are ultimately measured in dollars of cost savings or cost avoidance. They are inseparable.

Sixth, cost savings achievement reflect the degree of concern management shows for motivational programs. If you show management that they are saving money, they get concerned with motivation. And it makes your life easier.

Seventh, a motivation program yielding a million dollar cost savings or cost avoidance, should have the same level of management support and interest as a $20 million contract in which they are anticipating a million dollar profit. I have come up with a theorem of my own on motivation. I say that the motivational results vary directly as the level of management support, times the square of the talented insight of the motivation manager, divided by the physical results of the motivation effort. And by the physical results I mean that you divide by the number of charts, posters, and everything else. There is an old German proverb that states that the better the carpenter the fewer the chips!

Eighth, the same is true with employee motivational programs. The fewer evidences of motivation effort that the employee discovers, the better your motivation effort. The best program in the world would be one that is not a program—the type of feeling you get in your family. Now comes the key to the whole thing that attracts the interest of management.

Ninth, the program results, measured in dollar cost savings, can be permanently increased at least 100 percent, 10 weeks after you energetically integrate the individual motivation of employee participation in cost improvement programs. When you eliminate the competition between programs, get them working together, in a period of 10 weeks you can increase your results 100 percent. It is just as easy to increase them 100 percent as it is 10 percent or 5 percent. And you can go beyond 100 percent, if you want.

Tenth, motivation appeals must be on the level of interest, and level of comprehension of the employee group to whom it is addressed. Too many programs are real fancy programs intended to get the aesthetic approval of management, rather than being a Lawrence Welk type of program that appeals to the employee. Now I think that if you integrate your efforts, and post your results to management in terms of dollar savings, you will get their support, and with the integrated effort accomplish an increased employee participation at the same time.

Mr. Horton:

Thank you, Tom. Dwayne, do you have any comments from North American?

Mr. Gray

Well, Gene, I guess I have a little different philosophy in regards to this thing called motivation than a lot of people have. I don't think that it is the tools of the trade that we use. Admittedly, when they are used discreetly, I think they can help an awful lot. But I think that there is one thing that must be in any effort, whether or not we are speaking of a formal motivation program or any type of goal to be obtained, and that is the proper attitude. And I think that this attitude, too many times aims at the employee, at the working level. I think that if we would change our philosophy

here a little, and we would start setting these standards at the highest level of management, and a program aimed at the personal standards of the members of management, down through the chain of command, I don't think we would have to worry about our people too much, other than giving them the guidance. Because they will work to the performance standards that we set. I think whether we use the other tools or not, if we continue to maintain and keep these standards in front of our people, and then recognize them very meaningfully and sincerely for their accomplishments, whatever they obtain toward the standards, I think that will give us more motivation than all the posters and newspaper clippings that we can hang up. And that is precisely what we are basing our motivation effort on at the present time in the Space Division. Our standards have been set by the President of Space Division, and all the people are aware of this. It is carried down through the chain of command, and we are plotting courses toward achieving these goals. And we don't have to just speak in terms of error-free performance. However, we have, as Mr. Bergen and several of the other speakers pointed out yesterday, cost and schedules. But when we start aiming our different programs at these different goals, when we get to a certain level, we have to specify exactly what we mean and what we want from our people in order to obtain these goals. Too many times we speak of motivation in generalities. And too many times we frustrate not only the people, but supervision. If you are talking about preventing defects, then you have to tell them that is what you want them to strive for. If you are talking about saving dollars, you aim your program at that, but you have to be specific. I see too many motivation programs where people think they can just hang up the word motivation, and that is going to take care of all the problems. Well, it's not. And I think that the way the standards are set by management, at the highest levels, and communicated down through the ranks is what is going to determine the success of the program.

Mr. Macke:

Could I get back to the original statement of what we are going to take back with us, if I might? I think this seminar is the finest seminar I have ever attended, and I have been to all of them, as you know, Gene. And I have found this one to be the most enlightening and the most productive. What I will take back from this seminar is something I had never been able to take back before. And that is fine messages from our great white father who sat up here yesterday, and the NASA great white fathers who sat up here yesterday. I am going to take all those messages back to our people. They were to the point. They were objective. I think I could sit here and talk about what we have done with VIP at McDonnell-Douglas. But I see very many familiar faces out there. I think you all know we have a successful program. If any of you are not familiar with it, you can write to me at Huntington Beach and we will send you all the brochure material necessary.

I think what is important today is to talk about what we are going to do with today's climate—with cutbacks, critical skill loss, and so forth. I think the message from both industry and NASA yesterday gave us some of the answers. I think probably the most important thing is for fellows like ourselves, on the stand here, and our counterparts throughout the rest of industry to keep our thinking positive—go around and generate a good climate. I have been exposed to some of my counterparts across the nation, and some of my own people back home that have a defeatist attitude. How in the hell are we going to motivate people, thousands of them, if we go around with a long face. So I think the first objective—to meet the demanding conditions of the present climate—is for us to start thinking positive and to show that we are thinking positive. I also think that I would like at this time to thank you, Gene, and all your counterparts, for these excellent presentations, and for the type and caliber of personnel who were on this stand. And I would like to ask for a round of applause to show appreciation to our Manned Flight Awareness counterparts and thank them for the excellent panel they designed yesterday.

I have before me reams of paper that say what we are going to do, and I am not going to dwell on the details, just some of the highlights. We have had a program. We are looking at our programs at McDonnell-Douglas and that is quite a bit of looking. I'll just pick out a couple of the highlights. We are going to reactivate, with more emphasis, our vendor awareness program, both the mainline and workshop. We have already developed an internal awareness program which will get the message and communication down to the grassroots level, from the top down, on the responsibilities of the people, their part of the job. This has been going on constantly. But we are going to do it in a classroom manner until all, everybody on Saturn and Apollo mainline and workshop, has gone through this. We are going to train their supervisors, because when they hear it from their supervisor, this is more important to them. It's long lasting, that's one thing. The other thing, of course, is the community—the wives at home. I don't think anybody touched on that yet. They are going through these pangs of insecurity. More so than the husbands who are still working. So we have devised a program to get the message of motivation, morale, and the future of the space industry, through radio station communication—free time incidentally. And our first attempt—and it's only phase one, subject to be changed each time—was about three weeks ago. We negotiated with radio station KPOL, the real quality standard AM/FM in Orange County, that has about a 200 mile transmitting range. Within that 200 miles is of course McDonnell-Douglas, and many of our competitors and many of our team components. So we intend with this program, which will go on for the rest of the year, to get the message out to the community and the housewives. I would like to play the taped message just to show them what is happening. Before the tape, one grand and glorious thing that happened yesterday is that Mr. Wallerburg, our president, said that he felt the greatest tool of motivation was getting out there in the shop. And believe me, starting Monday morning he had better get himself a new pair

of shoes, because he is committed now; but, he is right. And many other fellows said this yesterday. And that's another fine thing. I think all of us here should be damn grateful that our great white fathers were here yesterday, because they are committed now. It might help with the budget situation, gentlemen. So if we could have the tape now.

(Announcer)

Apollo astronauts had barely returned from the moon when Americans began to ask, "If we can reach the moon, why can't we settle some of our lesser problems here on earth?" Columnists and commentators pointed to the callbacks in the automobile industry of defective cars, short lived appliances, and poor quality control in general, suggested that perhaps other industries might learn from the aerospace industry, how to do it right the first time. The Pentagon, NASA, the Congress, and even the President had ganged up on contractors in the space program, and demanded that they do something about quality control—that was in 1964. In 1969 we reached the moon. The McDonnell-Douglas Corporation received last year's award from the Pentagon for outstanding results in the program designed to cut costs and defects. I toured the Santa Monica plant and talked to the people involved in the program, and must admit that I was not only impressed but overwhelmed. McDonnell-Douglas calls its effort the VIP program. The vice president and general manager of the western division of McDonnell-Douglas' astronautics division, Jack Logan, explained to me how it works.

Jack Logan:

The basic program that was designed and developed by Charlie Able, who is the chief executive officer of McDonnell-Douglas Astronautics, was really designed on a rather simple philosophy. Number one, the people are important to the total management objectives and that you had to convince them that they are important; and that you have to show very sincere appreciation for them; and show them that it does result in benefits to them, to the company and to the country. People tend to forget in the routine of day-to-day effort, that every job that they do is very important. We in the middle management, in the upper management levels have designed a program that continuously reminds them through posters, through meetings, through awards that they truly are important. And this thing sort of works from the grassroots on up.

Strangely enough it doesn't include money.

(Announcer)

But most of us think of money as being the ultimate reward. It's more or less recognition. Is it true that recognition works better than money in this particular instance?

Mr. Logan:

Well, I would say this, recognition works generally as well as money. Now of course we have our standard employee suggestion system, in which any employee is eligible to make suggestions towards improvement of the product or reduction of the cost of the product. And we do hand out, regularly, substantial sums of money as a result of these suggestions. However, the real grassroots solution to the problem, Ray, in our opinion, is that 98 percent of the people, or maybe 99.9 percent of the people want to do the right job, as long as you convince them that top management is truly appreciative of the individual efforts. And the awards of various kinds, a simple plaque in some cases. Rewards below intrinsic value, such as pen and pencil sets, cigarette lighters, these kinds of things, are just a symbol of the appreciation of management. It is amazing how people react to them. It is really not the thing that you hand out that is valuable. It is the fact that top management has taken the time to say thanks for a job well done.

(Announcer)

Would you go so far out on the limb to say that this approach would work in most any industry?

Mr. Logan:

Oh, I don't doubt it. I think it's inherent in human nature that we all like to be appreciated, and that we all will do a better job if the boss will come around and pat us on the back once in a while.

(Announcer)

Well, that's the magic ingredient, according to Jack Logan. But it takes a lot of effort. The VIP program is everywhere in evidence at McDonnell-Douglas plants—goal charts, progress charts, awards to the group which won last week, and a photograph of the group with that individual. One group of VIP winners was flown to Cape Kennedy to watch the Apollo 11 launch while another group went to Houston to help welcome the astronauts back. The company wants its employees to keep constantly alert to opportunities to improve efficiency in the product. And the company in turn keeps constantly alert to ways to reward these alert employees. The real payoff, of course, is in more Government contracts, which means more profit for the company, and more work and more pay for the employees. The Government demanded quality control on the space program. If the general public were half as fussy about the things we buy, we might be able to encourage the same practice in other industry.

Mr. Horton:

What kind of response have you gotten to that...

Mr. Macke:

Tremendous. Of course, I did a little PR work in letting everybody know indiscreetly this was going to be on at 7:30 on a Sunday night, two weeks ago. So I imagine we had a tremendous audience, and I bet that a day doesn't go by that somebody doesn't come by and say, "That's a nice thing. My wife and I listened to it," and that sort of thing. So we are going on with that type of program, especially during the conditions of today. Not always the same radio station. We have contacted a few others, and these fellows are middle of the roaders. We sort of get the background on these fellows. We can't have a leftist or a rightist doing this sort of thing. We've got to have a middle of the road commentator sort of thing. So it is working for us. The results are fine. In these times, I think it is good to get this idea to the housewife, and the general public. I think we are going to accomplish a hell of a lot here.

Mr. Horton:

Before we take questions from the audience, I would like to swing the discussion, just for a moment, to subcontractor and vendor supplier relations. I think this is a fairly representative group of some of our major contractors. Stu Roosa, in speaking to us yesterday, pointed out that it is very easy for someone who is working on a heat shield, and bolting it into place, to be motivated. But it is another kind of problem when you have a man who is making a fountain pen for which he cannot see the space application, particularly if it is an off the shelf item. I would like to direct this question to you, John, and also to Tony. "What do you think can be done to improve the relations that you have in your plants with your subcontractors and vendors, to make them more aware of the efforts and the objectives of the Manned Flight Awareness Program?" I think in answering this, you might describe to us some of the communication links or techniques that are employed in your company at this time.

Mr. Willmott:

We have for the last several years at IBM been engaged in a very active supplier awareness effort. At one time we called them vendors, and somewhere along the line it began to stick in my craw. Because when I think of the word vendor, I think of someone coming along with a push cart of hot-dogs or something of this sort. We decided that we would dignify it somewhat and call them suppliers. So far, all our suppliers seem to appreciate this.

The IBM Corporation works in a number of different ways, and because we do work in different ways, and are subject to some different restrictions, we have to attack our problems in our own fashion in dealing with our suppliers and in trying to get the message across to them that we are playing with human lives. You can't settle for anything less than the very best. We have yet to really twist an arm. We have always gone in as the guest of the supplier. None of this sending a TWX, "I'll be there on so and so, and please try to have so many bodies." And this method of going in as a guest has worked wonders for us, even when there are some serious problems. It has enabled us to establish a rapport with them. And I think the answer to dealing with your supplier is simply what was said at the very beginning, "Communicate with them."

I go back to an incident that I came across right after I came onboard this program, right after the fire. I went into a supplier's plant, and I came across a grandmotherly type on the assembly line making little boggons, smarts, and gizmos. When I came around and looked over her shoulder, she said, "You know, I've been working on this program for 5 years, and this is the first time anyone has bothered to tell me where this thing is going." I have never forgotten that. And I think that has sort of shaped all of our efforts. The people who are working on the subcomponents that go into the black boxes that we take and put in our segment of the Saturn—that the rest of you assemble into the various other stages—have a right to know what the heck is going on. So we have geared our program to bringing them up-to-date information, as accurate as possible, as soon as possible. In fact, I put together what Mitch Sharp has come to call a Dog and Pony Show. We have been back and forth across the country, in hundreds of presentations at all of our major suppliers. And it has paid off for us. It is very difficult to measure. But the feedback we get from the suppliers management indicates that the message is getting across. I had a very interesting bit of feedback the other day. I was talking to one of the executives of one of our suppliers. And he said, "You know you really scored with us." He said, "It got so bad, that we had to stop the non-Saturn people from coming to your sessions." He said, "We build things to NASA specifications and we build things to other spec. The people working on the non-NASA hardware would come into one of our sessions and go back to the floor and raise all manner of hell with the management. How come we are not building it this way? How come we are doing it this lousy way?" That is the first real concrete evidence that we had down on the floor, that the message was getting across in a lasting manner. Now, we like to gage the effectiveness of our supplier visits on what we hear from the floor, not what management tells you. Because management is all too prone—particularly if they have a contract with you—to pat you on the back. "Great job. Come back any time you want to." But it is the little comments you get from the people on the floor that make the difference.

Now, we have a program of visiting all of our criticality 1 suppliers every 6 months, and our criticality 2 suppliers and selected criticality 3 suppliers once a year. And we have managed to adhere to this rather rigorous schedule, and there's only one person in the program. And this has worked very very well. But

now we are facing the inevitable cutbacks that are coming, as the result of having reached the moon. And so, many of our suppliers are shutting down their Saturn efforts. And this becomes a problem. I have been to several phase-out banquets, some of those tearful goodbye sessions, and people come up to you and ask you, "Why is it ending?" This is a very tough thing to answer. You don't want to talk about it, but you have to. What we are planning to do is, in some instances, go back to our major suppliers, the suppliers that we know we will be using if follow-on business does come—go back to them on a reduced schedule—to keep them informed as to what is going on in the space program. We can't go out and promise them business. Our procurement people would climb all over us for that. But, we can keep open the lines of communication. We are also planning to make available increasing quantities of the awareness mateerial dealing with the follow-on Apollo missions, available to our suppliers for distribution in-house. I think the important thing that we have found at IBM is that you can open up a good channel of communication with your suppliers. Then if you do get a problem, you can talk about it in a mature, gentlemanly fashion without beating each other over the head. We want to keep those channels of communications open.

Mr. Horton:

Tony, would you like to comment on this, or speak to another point.

Mr. Tocco:

Well, let me comment on this one first. We have had limited experience with the program as it affects our suppliers. However, this experience has included factoring in our quality data system into the overall supplier program for zero defects and Manned Flight Awareness. I think that the point to be made here is that we have to look at all of these things that we do, in the way of motivation, quality, and reliability, as interdependent activities, rather than monolithic efforts in our company. Because, if they work together as a kind of research network, the results seem to have a much larger payoff.

Now, another thing we have been doing for some time is develop a Vendor Rating System. Based on this Vendor Rating System we will shortly have recognition of certain selected suppliers. We went through the gambit of calling them vendors, and then suppliers. And that worked so well that we now call them speciality suppliers. That works even better. But, we do have a kind of network of things that we do that are aimed at our subcontractors to intensify their awareness of their role in helping us produce a quality product, but not only a quality product, but a product on schedule, and at the lowest overall cost. And again, this means it has to be sort of a consortium of activities. Because you can't get at this total goal without doing other things besides motivating by posters, or by occasional visits. The element of communication is very important. I have the feeling that Dr. Hughes said it all. There were so many things that I had in my mind, I said, "That is what I would like to say." And he said them. But I would like to make one other point, and that is, "It is important to tell the man he has a job with goals." That today, here and now, there is a more important concern and that is about having a job with goals.

I think we are living in somewhat a state of euphoria after the success of Apollo 11. And I also think that maybe we are whistling in the dark about how things are and how we can easily make this transition from Apollo 11 to Apollo 12, and beyond. I think that it is human to put vested personel interest, the basic emotions, the basic drives before national interest. And, I think this a fact of life. This is something we are going to have to face. Now, I would agree that this has been very enlightening for us. Certainly, it has been enlightening for me to hear some of the things that have been reported here today, and yesterday, about the on-going program plans. But, I think we have to ask ourselves the same question that the drunk would ask leaning up against the lamp post, "Are we here for enlightenment or support?"

Mr. Durfee:

I certainly can't add much if anything to all the preceding comments this morning. I think that the profundity that might tie a few things together is a thought of mine—when you have a dozen people, you have a dozen different personal reactions to a different situation. I think that one of the main things to keep in mind in motivating our people is the fact that Joe likes his silver Snoopy. He is extremely proud of it. All of the people are. Joe may be a little more proud of it. Maybe express a little more personel appreciation than the next guy.

We, in Grumman, try to diversify the motivation of our people. We do try to assist our management in carrying out the precepts that Dr. Hughes mentioned this morning, and the other speakers talked about earlier. At the same time, our contract with the members of the NASA team, that deal in motivation provides us with a gimmickery the importance of which must not be minimized. But, at the same time, we must be careful that we don't concentrate on it to the exclusion of recognizing what lies in the motivation coming from adult, mature, intelligent treatment by our management. We hold our Snoopy presentations regularly. Our management gets on the floor regularly. Our management pats the men on the back regularly. We think that ours is a balanced program. It does incorporate, to a reasonable degree, all of the elements that have been discussed here. I'm proud of this. We think that in this way, our people who appreciate the gimmickery, feel that they are recognized. I feel that, with the other approaches, the serious engineer feels that his work is recognized, because his boss and the bosses over him express this recognition.

Mr. Gray:

I would like to elaborate on one point that Tony brought up. I think this is a good time, and a good environment for us all to kind of step back and take a look at what we are doing in our motivation program. I think for the past few years we have all been more or less driving forward pretty forcefully and awfully hard with a lot of new ideas and new concepts and new approaches. And, I think that sometimes if we look deep enough, we will find certain things that can be just as demotivating to our people, as they are motivating. I think this is a good time to reevaluate what we're doing in this field, to make sure that we weed these things out and keep it on the positive side.

Mr. Horton:

Before we go into questions from the audience, I would like to see a show of hands of those of you who represent organizations that, at this time, have something or someone that you could identify as the Manned Flight Awareness element within your organization.

That is rather impressive to me. I don't know how many of you are representing the Department of Defense, industry or other centers, but if we can double this number by the next meeting of this sort, I think we should have a very meaningful awareness effort. Well, at this time, I would like to have the mikes move to those who have questions.

I would like to ask a question. With respect to this meeting again, I think that a meeting has to have a product to be successful. I would like to raise a question, "What is the product of this meeting?" Is it a one-event kind of thing where we have met, we have discussed, and we will go away, and take nothing except some information with us, that may or may not be worthwhile in an implementing standpoint? Or, can we go away from this meeting with an action planned? Something that we can work on, so that this will be the first step of a continuing process to make the Manned Flight Awareness Program a living program in all of our organizations. And if we can agree on the latter being the better approach, then how do we do about doing that? This has been my first opportunity to interface with my counterparts. And that is regretable, because in this kind of situation, I have not been able to take advantage of the lessons learned in other areas, and some of the innovations that have come about in other companies and other organizations. So we need to talk to each other more. But, there has to be a mechanism that provides the opportunity to do this. It can't be a random thing. Maybe we need to set up some task forces or some study groups, but at least some planned approach to make this first step meaningful in improving the overall performance on Manned Flight Awareness, so that the end objectives of the customer and ourselves can be met, and, as I say, in a very difficult environment.

One of the captains of industry who spoke yesterday, is laying off people at the rate of about 1000 a month. In this environment, it is difficult to convince the employees of the objective of Zero Defects or Manned Flight Awareness. The individual is not as much concerned, if you will, with Apollo 12 as he is with October 12. Will he have a job on that day, when he sees the stream that is going out the gate and handing in their badges every day? Now, this is a nervous environment we are in. And I think it is a shame to gloss over the realities of it. I don't think that we can appeal to the American worker by saying, "Well, the American worker is dedicated to craftsmenship." This is not true in many, many instances. Our consumer products I think abundantly attest to the fact that pride in workmenship has in many areas disappeared.

So perhaps I am asking a psychotic question here. Where do we go from here in a very difficult environment where funding has been cut. In the letter of invitation I received from Dr. Gilruth, it was stated that there is concern about a degradation of quality, and the personal zeal to excel in this program on individual jobs. It is not going to be easy to get that answer. But I think we have to design a blueprint for some action, other than just a discourse of the problem and an illumination of the future plan of NASA. What I am asking for here is some effort toward that objective of admitting a team that will make this a going program in the months and years ahead—recognizing the tremendous problems that we face.

MANNED FLIGHT AWARENESS THEMES AND PROGRAM CONTINUITY

CENTRAL THEMES AND AWARDS

AL CHOP

Headquarters West Coast Representative
Manned Flight Awareness Office

You know, I've been sitting here listening to top management representatives, and the more successful motivation directors, and the one thing that strikes me and runs as a thread all the way through this area of motivation of individuals is the fact that we need to communicate. That is not a new problem. Go back about 50,000 years, when man first crawled out upon the land, and began to talk to his fellow man. But he had no written language. He could not put down a lasting thought. Instead of the ability to write, he did come up with the ability to draw. And even today our archaeologists exploring caves will find drawings on the cavern walls—man desperately attempting to put down something that will last, and give the benefit of his thoughts.

Now today we have a written language, and through the space program we have communications that are worldwide. You would think we wouldn't have any problem talking to each other. But obviously we do. I think at least three of our top management people with industry said, "What we need to do is communicate a little bit better with the worker." They recognize the problems. We too in NASA have a problem of communication. We have to communicate with many thousands of contractors. We have to try to get our message down to your workers—and there are several hundred thousand of them. And when the Manned Flight Awareness program tried to build a little fire under our efforts in this area, about two and a half years ago, one of the things we recognized as lacking was a central theme. We knew that everybody had good motivational programs in the field. But they weren't really talking NASA's message. They weren't talking about our astronauts and our mission needs. So we tried to put together a little central theme, and I am sure you are all familiar with our "Snoopy the Astronaut" program. I don't want to go into it too deeply because we don't have much time. But there are a few little things I would like to mention about Snoopy the Astronaut. Snoopy is not a motivation program, and there have been several remarks in that direction today. I hope no one looks upon Snoopy the Astronaut, as a motivation program. Snoopy serves two purposes. He is a visual symbol of communication, and he serves as an award, or recognition program, for use of the astronauts themselves. Those are his only two roles. He has absolutely nothing to do with your motivation program. A good motivation program has been spelled out here pretty distinctly today. But, Snoopy is an assist. He is a tool for you, if you care to use him. A good motivation tool. He has been extremely effective. I think most everyone relates to Snoopy, in one way or another. But people do relate to cartoons, ever since that dim day in the geological past. People do "turn-on" to a good cartoon. We have been carrying Snoopy as a communications symbol for approximately two years now. When we first made our contact with United Features, which owns this copyright, and with Mr. Charles Schulz, we made some agreements with them. I would like to spell these out so that if you have any doubt in your mind you know exactly what you can, and what you cannot do, with this symbol.

Number one: Mr. Schulz and United Features both agreed that they do not want company personnel artists in the art department drawing Snoopy, and using that image that they draw on posters, decals, cards or anything else. The reason for this, no two artists will draw Snoopy exactly alike. Pretty soon, when a million different Snoopys appear, he looses his identity. If you want to use Snoopy in a particular way, or if you need a particular drawing, all you have to do is ask for it. And I'll tell you how to do that.

Second, if we use Snoopy in any form on posters, cards, etc., we will carry the United Features copyright. Just a small "c" in a circle followed by United

Features Syndicate, 1969 (and that will change to 1970). The reason for that is a very good one. If a producer of materials that are sold to the public can prove in court that a character like Snoopy has appeared thousands of times without a copyright, then it becomes public property. This is a very valuable piece of property we are allowed to use at no cost to us. I think the least we can do is be absolutely sure that when we use it in our company papers that there is a copyright underneath the picture. But first, we should assure that the picture itself has been furnished to us by Mr. Schulz. Our agreement covers posters, decals, and silver Snoopy pins. Even the silver Snoopy pin has a copyright on the back. If we have ideas in which we wish to use Snoopy on other items, we must, under our agreement, submit these to Mr. James Hennessey at United Features. My experience with him has been that he has approved 100 percent of everything we have asked him for. So this is no problem either. He does want to know what we are doing with his property. Those are the basic ground rules for using Snoopy. My office on the West Coast is available to you. All you need to do is submit your idea as to how you wish to use this little character, give me a rough sketch, and I will have Mr. Schulz draw it for you. We also do use everything he has drawn before. For example, the cartoons that appeared in the comic strips. We can take these and use them, with different backgrounds, because they are authentic drawings by Mr. Schulz, provided of course that we use the copyright. So that should be no problem. We have Snoopy doing many things. Our agreement, again, only covers Snoopy as an astronaut. That's important.

We have found that the use of cartoons is very effective. I think a lot of you do like the Snoopy cartoons and do use them. However, some of the companies do not care to be associated with Snoopy. One I know of, because Snoopy was used in a car advertisement on television. I think it was the Ford Company that used the little Peanuts Gang. This particular supplier makes another brand of car. So we have, thank goodness, just recently been offered some additional help in the cartoon area. I would like to show you a cartoon that has been drawn by this world famous cartoonist, as Schulz would term him (Figure 1).

I think you will all recognize some of the little characters from the very popular strip "BC," drawn by Johnny Hart. I guess the reference to the jackass is to Thor who rides the wheel. I am very intrigued with Johnny's launch pad here. Johnny has offered to let us use his material. He will draw them for us. We can use them in posters, on decals, or in any other way in which he would approve. We will again have to submit them for approval, except for the posters. Mr. Hart would like the opportunity to draw the characters also. He does not want the company artist doing this. Again they will lose their authenticity and their character (Figure 2).

This is going to be a little 3-panel in our newsletter this coming month. I think Johnny's trying to give us a message here. And it's true. It's true. People will relate to good humor. It's a peculiar thing about

FIGURE 1

the American people. They have all got a real good sense of humor, and they get the message real fast. Cartooning as a basic form of communication is extremely effective. This is all we're trying to do with these characters, and we don't use them 100 percent. As you all know, we put out a great many posters. They are not all cartoons. We use our astronaut pictures. We use many things that have no trace of humor in them. But we like to intersperse a little bit of humor, because we think it gets a hold on people. We get our message across just a little bit better. I believe we have Mr. Hart in the audience with us, and I would like to introduce Johnny. I wish you would come up and say hello, Johnny. I'd like to have you all meet him, and then we will go over the ground rules of our agreement with Johnny.

FIGURE 2

Mr. Hart:

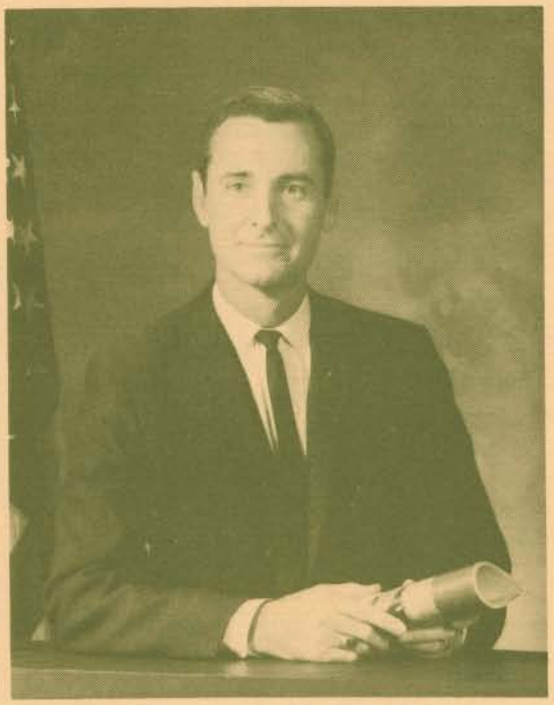
I'll be very brief. When you are as short as I am, you are pretty brief in the first place. But I am just proud and happy to be given the opportunity to work on this very noble program. Thank you very much.

Mr. Chop:

Let me tell you a little more about this guy. So you will know the type of guy you are working with. When I talked to him about coming down here to visit with you all, I offered to attempt to get invitational travel orders so that NASA would pick up his travel cost. He said, "No, that is too much trouble, I will just pay my own way." And he did, all the way from Endicott, New York, and back. That will give you an idea of the sincerity that he brings to this program. The ground rules again, I explained to Johnny how we operate with the United Features and with Mr. Schulz, Mr. Hart has Prentiss Hall. Is that right, Johnny? He likes our existing arrangement. A single source of contact, which will be my office. Otherwise he would get a flood of letters and he would have to pick and choose himself to decide which are most important and that would take up all his time. One of the things his agency is insisting on, is that we do not overwork him. He has a job to do. He makes his money cartooning for the Syndicate. You make nothing cartooning for NASA. The ground rule then is use the single point of contact for your request, and that will be my office. The second is that the company artists will not draw the little characters. Johnny will do that for us. And third, if we have anything outside of posters and decals we want to produce, we will have to submit it for approval.

Now you know we have created Snoopy, the Astronaut and we use him as the symbol for flight safety. The astronaut's personal mascot representing good work in the areas of flight safety, and mission success—which is quality hardware. We are going to try to expand the Manned Flight Awareness Program to incorporate some other areas. One of the big ones, of course, is cost reduction. You have heard a lot about cost reduction in the last two days. We hope that some of you will come up with some good ideas for cost reduction, using Johnny's characters. You can also look at new technology, or dress up otherwise very dull engineering standards reports. Johnny's working on a bunch of them for us now. He will work in any area that is approved by NASA. So we hope to put Johnny to work on everything the agency will let us have. I think, so far as the cartoon characters are concerned, that's the end of that.

I want to digress just a minute. With Mr. Bolger in Tom Stafford's office the other day we had a little discussion about astronaut plant visits. As you may know, Tom has just been assigned to the job of Chief Astronaut. That was previously held by Alan Shepard. Tom kind of threw up his hands while we sat there and said, "You know, I get letters from everybody asking for an astronaut to visit a plant. I get phone calls, notes that are scribbled, messages from the chief's secretaries." He said, "You know, we've got to put this thing on the right road." He said, "I want everything in writing, and I want it from one single source." And, he said, "I want a 30-day lead time, minimum. And I want an alternate date." Mr. Bolger thought that was reasonable. He turned to me and said, "Alright, you do that." And, so, I have that one too. If you want an astronaut to visit your plant, drop your NASA MFA guy a letter. He will acknowledge and forward the letter to me at North American-Rockwell Space Division, Downey, California. My address is 12214 Lakewood Boulevard. Attention: Al Chop/RESPO Office. We must have about a 30-day lead time, and an alternate date. Tom said he would honor everything he can. You must keep in mind the words that Stu Roosa had for us yesterday. He pointed out that they are working many, many long hours. It's a long week. They like to do these things and they feel they are important. But don't be disappointed if the answer is no. Tom had just about the same words for us. He promised he would do everything he can, within reason and within his training schedule. If anyone has any questions on our Snoopy the Astronaut Communications Program or award program, I will try to answer them. If not, thank you very much. I appreciate your attention.



MANNED FLIGHT AWARENESS WORKING TOOLS

EUGENE E. HORTON

Chief, Manned Flight Awareness Office
Manned Spacecraft Center

In the hierarchy of hounds, there is one who stands scarf and goggles above the rest (Figure 1).

He is the only beagle to reach the moon, and he even got there before that stupid cat next door. He is a pilot, philospher, raconteur, the quintessence of quixotic quadrupeds. He is the master stroke of cartoonist Charles "Sparky" Schulz. His name, of course, is Snoopy. There is a magic about this mutt that has endeared him to millions. Snoopy appears in newspapers around the globe, in dozens of languages. He grins at us from sweatshirts, flight bags, pennants, stuffed toys, decals, coloring books. And even, thanks to Colonel Tom Stafford, from space. He is a household word. Perhaps we love him because we relate to him. We all lead a dog's life. Whatever his magic, he is one of the most powerful communicators of our age. This is why he has become a part of our Manned Flight Awareness Program. And, like Smoky the Bear, who served to protect our forests for some 25 years, he is an important symbol. Snoopy, in his astronaut's garb, is the astronauts' mascot. He has become the accepted symbol of quality and of excellence and worth and craftsmanship in everything associated with the Manned Spaceflight program.

Now, the value of symbols should not be minimized. In July, there was a flag placed on the surface of the moon. It was not just a flag, however, it was an American flag! It symbolized. It was the standard of a free people. It was left on that naked, far-away rock to say something. It has a message about imagination, courage, and technological prowess. And, as our President soon found, this message had been heard in every land he visited. The flight of Apollo 11 is etched forever in history. Yet, the one event that will burn most vividly in the minds of men, is the raising of Old Glory on the lunar surface. A symbol. A lot of people attach importance to symbols. And we attach a lot of importance to Snoopy. He is our standardbearer for quality and for professionalism. His work is important. His job is really our job, to hold the team together. And one way to hold the team together is to create meaningful work. This is the job for management. But it takes more than this. It also takes close communication, up and down and across the organization. And it has to take many forms, because people are different and are motivated in different ways. One motivator that has universal appeal (and we have discussed this these two days) is dissemination of understandable information, from the top—straight talk. Evidence from the boss that the work we do each day is important; that someone cares that the job is done right, and done right the first time! (Figure 2.)

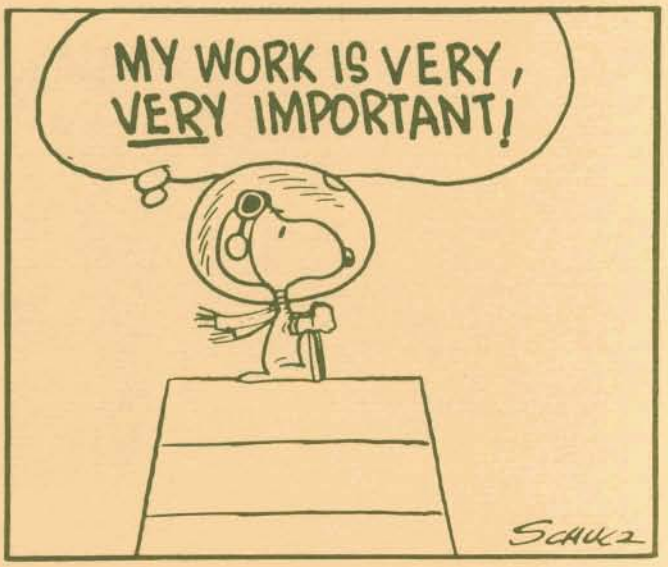


FIGURE 1

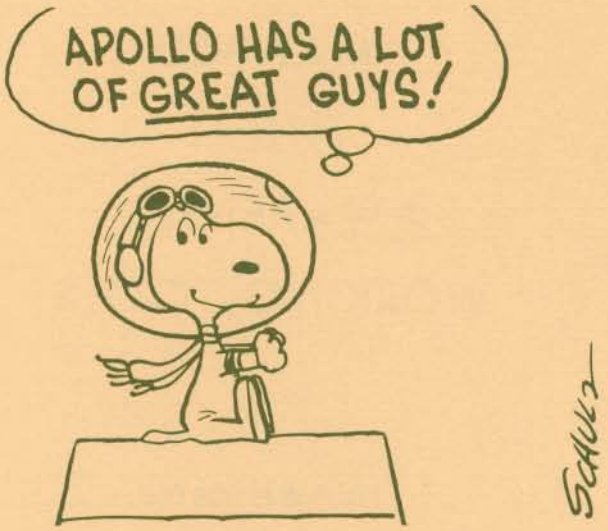


FIGURE 2

FIGURE 3

There are many ways to communicate. When Snoopy joined our program, we introduced him to a few. Did you know that Snoopy, assisting our Manned Flight Awareness Program, reaches the Department of Defense, the airlines that carry our cargo, and some 200 contractors? Did you know that in three years MFA has distributed 90,000 posters, a quarter of a million photographs, 900 individual awards, 40,000 safety decals? Also, produced a monthly newsletter to all contractors, DCAS and NASA centers, and seven films on Manned Flight Awareness and quality; shown exhibits to 155,000; films to 100,000; sent astronauts to 53 plants; hosted some 600 honorees at Cape Kennedy? I think it appropriate our Snoopy's reply, "Good grief!" (Figure 3.)

This is a picture typifying activities of the astronauts in support of the Manned Flight Awareness Program.

Figure 4 shows astronaut Rusty Schweikart at Grumman, Bethpage appearing before the workers who assembled the hardware for his flight. And, we are hoping that during the months ahead, these visits will continue and will be conducted on a selective basis in order to equitably serve the interests of all contractors, with the astronauts appearing in plants throughout the nation where critical hardware is produced.

As mentioned a moment ago, we have a poster program. It is unique perhaps in the sense that only through NASA, it is possible to obtain the Snoopy

FIGURE 4

FIGURE 5

theme on posters which are produced through our exclusive arrangement with United Features. I think that we should recognize the NASA Manned Flight Awareness Offices as "tool rooms" for industry. We realize that you have on-going programs; that you produce your own films and pictures and the like, but there are some subjects which are unique to the NASA-Apollo Manned Flight Program which you might not be familiar with. In using our symbolic Snoopy, we are able to provide these to you in quantity. So, I wish that you would regard the three MFA offices, here in Houston, KSC and MSFC, as "tool rooms" for your exclusive use. (Figure 5.)

We have also actively worked with the airlines across the nation; the commercial carriers that transport sensitive, high cost, delicate equipment from your manufacturing and test areas down to Cape Kennedy. And, if you have visited any of the areas of the airlines where cargo is handled, you may have seen examples of the ZDOD posters that have been produced by Manned Flight Awareness. And, while this is only in black and white, the image at the bottom of the figure is the ZDOD label in red, white and blue. It is placed on all critical flight cargo. Write us for these if they are useful to you. (Figure 6.)

FIGURE 6

Figure 7 shows our MFA exhibit van. I hope those of you who have not visited this van will do so before returning to your homes. The van is parked outside this building. It is a 40-foot walk through exhibit van which has been in use throughout this nation for a number of years. It contains examples of craftsmanship, as well as a story of the progress of manned space flight.

I think that Snoopy has a point here that we would all agree with (Figure 8). The awards program at NASA is really a two pronged effort, one of which is directed on an official internal basis. It is the NASA incentives and awards program; to be distinguished from Manned Flight Awareness. In our program—MFA—we have tried to create the most direct paths available for recognizing, in a very prompt manner, outstanding performance on the part of individuals within DOD, industry, and our own Government work force. Those people who have excelled in their work as it relates to manned space flight. In order to make this an effective and timely program, we have developed an agreement with the Astronaut Office here in Houston that those individuals who are cited for excellence—and brought to our attention through a letter of commendation—will promptly receive a personalized letter from one of the Apollo astronauts, which cites specifically the accomplishments of that individual. It is signed, and wherever possible, delivered in person by one member of the astronaut team. And with this goes the silver Snoopy award, which I am sure many of you have heard of. It is a small silver pin which is a replica of "Snoopy the Astronaut" as created by Charles Schulz. The only manner by which this award can be received is through the Manned Flight Awareness Awards mechanisms in each of the NASA centers. It is a highly coveted award. It is not an official NASA award per se, but rather is an award from the astronauts themselves. In that sense it takes on greater meaning to those who wear the pin.

Here is Astronaut Gene Cernan, I believe, at the Grumman offices in Houston, presenting the silver Snoopy awards. Neil Armstrong was featured on the front page of the morning's paper making awards at TRW Systems. (Figure 9.)

Here in Figure 10 is General Exon and some of the people from the Defense Supply Agency that so ably supported the program with inspection services receiving awards.

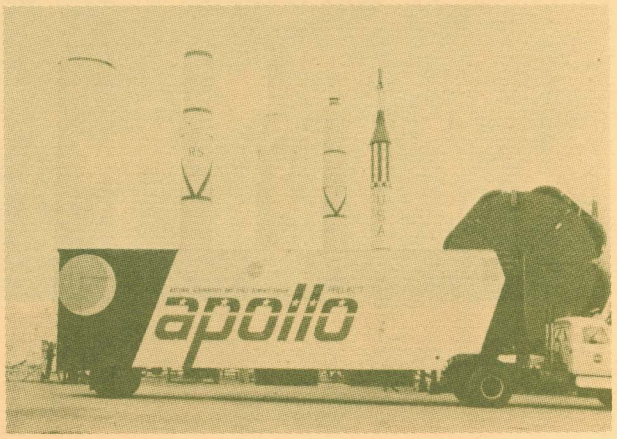


FIGURE 7

So, a final point made yesterday. This is not the end, it's the beginning. There is an orderly, balanced program ahead of us, with work that will carry us for generations to come. The benefits are just emerging.

New technology will be created, and new jobs. With the space station, and shuttle, and missions to Mars, the challenge to the creative individual is just now opening up. Happiness is knowing there is a future. This is fundamental to our motivational effort. We know much better as a result of this conference, and the programs that we have seen over the past two days, what the challenge is. Now, let us go home and spread a little happiness.

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 11

CLOSING REMARKS

I will just take a minute of your time in closing before concluding our meeting. We have been on the phone here for several hours trying to reach Frank Borman in New York. He was scheduled to be with us, and wanted to be here, but unfortunately because of some problems in New York he is behind schedule, and won't be with us. We will miss the opportunity to hear from him. This is unfortunate since he is as vitally interested in this work as we are and one of our strongest supporters and advocates.

I just wanted to say a few words about the purpose of our meeting. It was to bring you here, introduce you to our NASA plans for the future, and to reemphasize the concept of a team effort we have had from the beginning of the space program. Every man in the aerospace force that works on these space programs is a member of that team. That of course is what we have been trying to emphasize with our Manned Flight Awareness Program all along. And finally, we wanted to reiterate the requirement for quality workmanship. We have done this because we are experiencing an inevitable slump, or letdown, after the major effort to get to the moon with Apollo 11. And it concerns us all. You have heard of the concern of NASA and contract and management yesterday. We want to combat this letdown and the lowered morale that we see in a lot of our plants, because of the cutbacks, by assuring that the people who are motivating and talking to the workers in their plants understand what our planning is and know that we are going ahead with a program for the future. To do this we have brought to you what we think is a fairly good cast of characters to speak—top NASA and industry management. And these people have come because they are concerned. They have spoken of their concern about this letdown and the fact that this breeds human error and indifference to detail. And of course with that we are afraid of experiencing a failure of some kind which could kill some of our programs.

I just want to take one moment to read a statement by Jerry Lederer, whom most of you know. He spent 35 or 40 years as Mr. Flight Safety for the United States, and he is known around the world. He unfortunately had an operation recently and then a minor heart attack, so he couldn't come down here. Luckily he is back on his feet and well on his way to recovery. But Jerry says, in a short statement,

> Dr. George Mueller, in a classic statement on the successful splashdown on Apollo 11 said, 'In this moment of man's greatest achievement, it is timely for us to dedicate ourselves to the unfinished work so nobly begotten by three of us, to resolve that this nation, under God, will join with all men in the pursuit of the destiny of mankind that will lead the way to the planets.' These words propose a powerful beacon to guide the future of manned space flight. But to reach this goal, a vast succession of intermediate problems must be solved. Not the least of these is the motivation of craftsmen toward perfection. The Achilles heel of spacecraft can be the man at the bench. Success thus far is attributed to human integrity, the basis of product integrity. The natural inclination of most men to conduct themselves with integrity has been superbly supported by the MFA programs which you individually, and collectively, have conceived and implemented. However, the psychological environment has changed. Apollo 11 was a tremendous success. Complacency feeds on success. Thousands of craftsmen are being laid off—creating a problem of morale. The future is uncertain—creating a problem of discipline. Dr. von Braun addressed himself to these problems at the Honorees Reception on the evening of July 15. He affirmed his confidence in the success of Apollo 11. What worried him, he said, was not Apollo 11, but Apollo 12, 15, 16, and on down the line. It is for this reason you have gathered here. The exceptional originality of your previous programs may need additional creativity to maintain the momentum of the past. I am confident that this will happen. I regret that I am not present to hear the lively discussions and unique ideas that will be presented.
>
> Jerry Lederer.

I want to thank you all for coming, for giving us your time, and for participating. I know it is a sacrifice to you coming from your work. We felt that the fairly overwhelming agreement in the need for this reunion and participation was very gratifying. We have over 400 people that participated. And finally we want to thank the MSC, Dr. Gilruth, and the rest of his staff for being hosts to us here today. That's it, gentlemen, that concludes the meeting and thank you very much for coming.

PHILIP H. BOLGER