

PERSPECTIVES ON APOLLO

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Biomedical Results of Apollo

****LEGACY OF APOLLO****

This is strictly from a medical point of view. The medical plan that was evolved at the time that I came into the Program had already had a plan before Mercury was completed. What did we have to do medically? One of the things that we had to do was to select some more astronauts. I had been involved in the first selection of astronauts. We had to have more astronauts for the Apollo and ~~we~~ even the Gemini missions at that time. The very first thing that I did was to set up the second selection program. We also remodeled all the ones after that.

We learned one thing from the first selection process; you couldn't anticipate the tremendous amount of fame and noteriety that was going to come to these people. It was already a huge problem for us in Mercury. We ~~we~~ realized that we needed to be a lot more ~~per~~ceptive about thinking about that in the selection process. We tried to consciously put into our thought process how somebody would react to this. It was actually brought up in conversation with these men. We also worried about how all this would affect families.

We also found that stress testing took a lot of time and didn't really tell us stress responses as a ~~sex~~ selection criterion. We used stress testing only to be sure that they could reasonably withstand stress and to use it as a familiarization process, e.g., centrifuge and altitude chamber runs, isolation rooms, partial pressure suit. There were six ~~sex~~ stress tests in the original run.

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We ended up with a group of astronauts and we tried to determine what kind of medical information we needed. What was necessary for us to do in order to achieve a flight of the duration and landing on the moon. You realize we weren't into Gemini yet.

At the end of the Mercury Program, one of the key meetings that was held in ~~Asking~~ Washington - there was a was a big move to sell what at that time was Mercury 10. There were only nine Mercury flights. Al~~x~~ Shepard wanted to fly ~~Mercury~~ Mercury 10. I wanted some additional information because we had only flown 34 hours at that time and the first Gemini mission was scheduled to be seven days long. I wasn't medically happy about that at all. We had long discussions about - as you well know, Al has never been medically oriented enough for that mission to go - he was willing to try because he wanted that mission. All he had was 50 minutes of suborbital flight. A lot of engineering considerations went into whether or not we could extend that time. We did decide we could extend a mission beyond 34 hours although 34 hours at that time seemed like an eternity.

We had to ~~do~~ ~~do~~ do some planning about a medical team and what kind of things that we needed to know. That meeting turned out very interestingly because Mr. is a very smart man and he decided another Mercury flight ~~would~~ would dilute the effort of getting on~~x~~ to Gemini if we all got tied up in that next mission. We decided to start an interim ~~program~~ program to do things that we thought~~x~~ needed to be proved for the Gemini mission.

That is why we included rendezvous and docking. Medically, the question was ~~xx~~ man in space was still a serious question.

Man has been a constant question. The engineers were confident ~~xx~~ that they were going to be able to get man off the surface of the earth and get him into orbit and they were just as confident that they were going to be able to get to the moon. As a group of people, the engineers had never been happy with the medical aspects. They could not understand man in the same kind of terms that they could the hardware. At the same time, we could not give them documented material to let them know ~~who~~ how man would react in the space environment.

Many people, medical professors, ~~physiologists~~ physiologists, and folks at the National Academy of Sciences, felt that there was not question--man could not withstand the stresses of launch. At that time, we had only very crude electrocardiography monitoring and no blood pressure monitoring. This gave some impetus to the medical program and some sort of power for the medical program small as it was during the Mercury flights. The Mercury program gave us very little information on questions which had to be answered. We did, however, in the medical program do some things which gave us much information. We learned about digestive systems in space, ~~xxx~~ urination, etc. So we obviously had some problems.

It was finally agreed that we could go through with the Mercury missions and we got through them with no serious medical

problems. The ~~xxxx~~ astronauts never felt that there would be any serious problems anyway. Most of the engineers felt the same way. Bob , as an example, while he had great faith, was also a smart manager realized ~~xxx~~ that man was a potential problem. Chris Craft realized that man was a potential problem. These people, while they did not understand why we couldn't do some of these things, they still understood that there was a problem.

The astronauts were always afraid that some of the medical input might keep them from flying. I had to prove that our ~~being~~ purpose in being there was to keep people flying. If you look at the record of the Space Program, you can see that we did pretty damn well. Mike Collins as an example - he was scheduled on a mission that he could not go on because he had a bony bridge that developed on the vertebra in the ~~xxxx~~ cervical area that had to be surgically removed. He would have been on Apollo 8 had that not happened. The surgery was done, he was requalified, and he ~~flw~~ flew. Al Bean had surgery, was requalified, and he flew. Also Shepard. My idea was to keep flying not to keep them from flying. The astronauts ~~never~~ ~~xxx~~ accepted this, they always had a fear that any of the tests might disqualify them from flying. This also happens with ~~xxxxx~~ civilian and military pilots. Some of the astronauts withheld information, some went to physicians on their own because they did not want something documented somewhere else. That attitude is important to understand.

In many cases, the astronauts with this attitude were aided and abetted by management to a great degree. We were hamstrung in many ~~wxxx~~ ways from carrying out our responsibility to get men to the moon and back safely.

The fire also made our task much more difficult. As a result of the fire, everything was changed.

Up until Gemini, the only thing that we ~~aw~~ saw was the evidence of hypotension but Gordon Cooper nearly fainted on the deck. He would have fainted but he didn't want to admit that. That was bad for the invincible ~~pxx~~ image. We had to prove to Congress who appropriate money for this venture that it was safe. The President had to worry about how safe this was so as not get any adverse reaction to his administration. The astronaut still felt invincible and did not want to undergo any medical experiments. We had to find a compromise position.

At that point in time, I suggested that we not go for seven days. I did~~x~~ not want to jump from 34 hours to seven days. I could accept a four-day mission. This was ~~g~~ agreed to. After that if things ~~wxxx~~ ~~wxx~~ went well, I was willing to go ~~kx~~ from 4 to 8. We really felt that the maximum time you could spend in that Gemini spacecraft was 14 days. We accepted three flight (4, 8, and 14 days) so we could get data from in particular and concentrate on this to learn what we need to know about these systems. There some medical experiments done on Gemini that were crude (the first mineral balance). We had a panel of experts

some of whom disagreed with us who went to the K Cape with us (Loren Carlson) and showed them how much we thought we could do. They ended up in some senses satisfied. Many reknowned physiologists called me right up to the launch time to say that we were going to have two dead astronauts if we flew for four days. I even had some men on my own staff who felt the same way.

Perspectives on Apollo would really be a better title for this than Legacy of Apollo.

We even ran some tests on ~~xxxxxx~~ pumping water in the bottom of the spacecraft to go into the suits so they would have positive pressure on the ~~guyxxxxxx~~ guys when they landed because of the drop in blood pressure. I have always been very optimistic about what man can do in space but I think I tempered that optimism with enough ~~xxxx~~ scientific concern about the need for data and still I was forced to temper it with some things that I probably would not have tempered it in the same way and temperit with a lack of data and do some things based upon projecting smaller amounts of data than alot of scientists would ~~xx~~ have done. Had we had a true physiologist/scientist try to run the program. If such a guy had been in my position at the time, I don't think we could have done some of the things we were able to do. I had to make some compromises with the engineers and had to create some kind of understanding with them. A true laboratory scientist would probably ~~x~~ have been unable to accept some of these things.

We added the EVA onto the 4-day mission since the Russians had done it so much. We worked very hard with the ~~my~~ guys on that mission and they ~~knew~~ knew what our concerns were. Ed, in particular, thoroughly understood what we were trying to do. Jim accepted this but he had more of the commander/pilot attitude. We discussed in detail what we thought might happen. We felt, because of what we'd seen with Mercury, that there might be a cardiovascular problem. We felt there would be orthostatic hypotension but not to the point where they couldn't stand up. I was apprehensive ~~about~~ about heart rates and things that could occur in EVA. Ed White had trained so hard for that mission that he truly had an athletic heart, his resting pulse rates would run down into the low 50s--that concerned us ~~because~~ because if got weightless, -we sent some medication in his suit but he never ~~had~~ had to use it. These guys wore these suits all the time. They could take their helmet off but not the suit they wouldn't have been able to stand up ~~or~~ or change their position. There was less ~~space~~ space per man in Gemini than there was in Mercury.

When these guys got back, there were able to get out of the spacecraft perfectly OK. They did have orthostatic ~~hyp~~ hypotension it wasn't severe. We couldn't find any other physiological severe problems. We were all ecstatic. We had certain medical tests to be done as they passed certain check points. ~~They~~ They did blood pressures, they did exercise ~~after exercise~~ and get blood pressure before and after exercise. It worked out very well but that was the last program that happened on (the 14-day Gemini).

At the end of the 8-day flight we saw more orthostatic hypotension, heart rates were higher and it took longer ~~for~~ for them to recover to their preflight normal. The higher rates were incremental and we could project what they would be for the 14-day flight. That didn't happen with exercise response - that looked to be OK but we saw a red cell mass loss. It also seemed to be increasing at the same rate. This again caused concern but not with the astronauts.

The reason for the 14-day mission was that it was projected that no Apollo missions would be longer than 14 days and this was to be the proof of the pudding. If we could fly men for 14 days with a reasonable amount of data, the way I had laid out the program at that time, then I felt we could go ahead with a lunar mission as far as man was concerned physiologically. I felt we had the tools in hand to do it. That is ~~ex~~ exactly what happened. We added some things-we did an EEG on Frank Borman. Man could go for the duration that was necessary to accomplish an Apollo mission. ~~x~~ That was a key thing that had to be done in the program.

We had also designed a series of experiments many of which later became Skylab experiments including uses of ergometry in flight. We had done that ~~on~~ pre-and postflight on the Gemini 14-day mission for the first time, and seen some decrement so we wanted inflight information if ~~x~~ we could get it.

We started with a series of experiments that would have allowed us to add some information in the very early flights

prior to the lunar mission itself ~~h~~ that would have given us in-flight data and we felt a tremendous ~~of~~ of inflight data because we had ^{only} those three flights that gave us the data - for the remainder of the Gemini Program, we stopped doing anything except monitoring. Crew were now convinced that man is invincible. They wanted no monitoring done whatsoever. After Apollo 8, we took no more blood pressures on Gemini or Apollo.

Our problem was ~~xxxxxxx~~ that we ~~s~~ were being asked to predict head~~s~~ what he was going to be able to do. I was concerned from a scientific point of view and strictly from a aerospace and medical point of view about longer duration. Every hour you spend in space is an hour that you should learn something from. We should use every bit of information that we can obtain in order to give you a bigger data base from which you can predict ahead for the safety of future flights. That is why our relationships with the Russians were so important. If they fly 20 days, that should be just ~~as~~ as valuable as us flying 20 days. This has not been true so far because the data are not comparable. We are getting closer to that.

When the fire happened, that caused alot of problems. We all knew that we had ~~been~~ been living with an oxygen environment that was a problem, we thought ~~that~~ that all the safety precautions had been taken to insure that you wouldn't have any problem with that. We got to a point where all the safety precautions weren't being taken. We lost one hell of a lot of things when it was decided to remodel. We lost some ~~an~~ monitoring capability.

We lost the medical experiments because they thought that they first had to deal with a spacecraft that is safe on a mission that is ~~fx~~ difficult and dangerous and we ought to put all of our effort onto that. Management felt that ~~owxying~~ worrying about medical experiments wasn't worth the effort and time at that point.

We had an ergometer that could be attached to the end of the couch, a bicycle ergometer-we were going to be able actually to do that inflight~~x~~ in the Command Module ~~wixx~~ which was a tremendous advance over what we had been able to do before. We had some blood pressure capability, we even talked at that time about lower body negative pressure. There was some vestibular testing.

We were still being asked to predict ahead on the basis of a very small amount of data. You know how much human variability there is. We only had data from two ~~gx~~ guys - it is very difficult to make accurate predictions on that. We finally got that across in the Skylab ~~program~~ program. IN Apollo there was a feeling that we didn't need any more data points. Fortunately, we had only good data points. The 14-day data looked ~~x~~ better, the 4- and the 8-day data the projection of the 14-day data looked terrible. But it turned out to be better. If it had turned out the other way, then I don't how they would have gotten out of that hot kettle of fish. I~~x~~ could not have set still for them saying let's go. But here I was saying let's go with two data points that ~~manxardixx~~

contradicted two others that looked like they were climbing and here is two down here that that went longer that ~~xxxx~~ says the longer you went the better off you are.

We ended up with really no medical experiments on Apollo. When we selected Jim Lovell (Gemini 14-day mission) we knew he had an abnormality that we were willing to live with. It is an abnormality of an enzyme in the liver which causes some peculiar blood findings and it causes peculiar findings ~~xxxxxxx~~ it gives him an elevated ~~xxxxxxx~~ finding that was the wrong kind of a guy to have when you are trying to look at red blood ~~xx~~ cell mass kind of stuff.

There was no question Apollo was going to fly.

The first thing that happened to us on Apollo that was different is that on the very first mission, we had gotten away from some of our medical organization during the remodeling, we had a crew that was really running the show totally. Nobody was telling that crew what to do. They were going to fly a spacecraft that had killed three other guys. The medical situation really got bad after that.

PART 2 DAY 1

Apollo 7

Respiratory Ailments

The illness was the first time we had had an illness inflight. Until that time no astronaut had an illness or physical difficulty during flight. Our first experience with a person who was ill that we had to ~~x~~ treat from a distance. It created a lot of difficulty for us in that ~~xxxwax~~ we weren't dealing directly with the crewman. We were dealing through a capsule communicator. I think we had some medical conversations on Apollo 8 and 9 that we called private conversations because we got so concerned about what was going on ~~xxxxxx~~ (this may also have happened on Apollo 7, I don't remember). On 7 we had some conversation about coming home without helmets on. They had a stuffed up nose, typical upper respiratory symptoms. We learned some things about common colds in weightlessness in that you get no drainage and even if you use decongestents, you ~~don't~~ don't get any results because the material does not drain out of the sinuses; it stays there, even if you shrink the membranes up. Wally Shira had the only illness that he had ever had - it was a sinusitis (an ~~a~~aerosinusitis) where he filled up the sinus with blood and he ruptured an ear drum. The only illness he had in his life. It played an important role because he didn't really understand illness and what it meant; this scared him (he had the aerosinusitis while flying not on Apollo). It became a very important factor because one of the other crewmen had blood from the ~~sinus~~ sinuses; the other crewmen had ~~p~~ plugged ears. Wally was convinced they would

rupture their ear drums during reentry so some great discussions went on and some absolute orders were given about wearing or not wearing helmets on reentry. The idea of a ~~xxx~~ crew reentering in the spacecraft without helmets on was absolutely unheard of; it was a very serious worry. We had fights, arguments over the closed-loop and some orders given over the open loop. We always communicated through a capcom. We had a crew with illness post-flight, influenza type illness. All that is documented very with Vita - pre, in- and postflight in the ~~Rxxxxxx~~ Russian chapter which will be some help to you.

In Apollo 8, we had illness occurring in flight. It is my personal opinion that we had the first incident of vestibular illness in flight (that was in the first trip to the moon) orbital flight. ~~They~~ When they got out of the couches, they had one orbit to get ready, as soon as they started to move around the spacecraft, all three developed vertigo. It is my personal opinion, not only did all of them develop vertigo, one, Bill Anders has absolutely admitted without any doubt that he had a vestibular problem for about 2½ days where he had nausea, he stayed pretty close to the couches. Frank Borman vomited, had diarrhea, but swears that that had nothing whatsoever to do with the ~~xxxxxx~~ vestibular thing. Now, I don't believe that. I think that was the beginning of the problem. That was a first, we had never had any problem in the vestibular area. We also have a paper about that. The ~~Rxxxxxx~~ Russian's had accused us,

(Russian name) had accused me of lying many times because he just couldn't believe that we really had not had anything happen but we never had. This was the first time we moved around very rapidly early in a space flight in a large volume, I think it got us into trouble and we had some susceptible guys. All ³⁻⁴ these guys developed it. The one who got over it the easiest was Jim Lovell, his lasted only a few hours, the next guy was Bill Anders, and the guy who had the most trouble was Frank Borman who tried to blame it on everthing from seconol to having viral diarrhea.

Apollo ~~10~~ 9- again we had some severe inflight illness. That was the first LEM flight. Rusty Sweiker had severe inflight illness. Rusty was in the LEM - both he and Dave Scott developed vestibular illness, we canceled part of an EVA because of Rusty and the Commander, Jim , was absolutely convinced as an individual, that vestibular problems was going to be a very severe problem with space flight and we better do something about them. He made that very, very clear to some people, I don't think he ever made it clear to the astronauts. Other than my self he ~~said~~ said it to George Low. Low and I had some very serious talks about that because Jim was deeply concerned, he was very frightened by the whole episode and what that could mean to the loss of the mission and possibly the loss of some people. It really pointed the vestibular problem. That showed that we had to start putting some limitations on what they did preflight and postflight. They were getting run off on these fantastic tours, paraded around, etc.

They were'nt even recovered from the flight and PAO people had them in a press conference and running them around the country exposing them to everything, they were tired still and not adjusted at all so we ~~xxxx~~ had a problem postflight. We had a ~~xxxxxx~~ hell of a preflight problem because we couldn't isolate these guys preflight. That became an open battle and with Apollo 11 coming up, the lunar mission, we need to talk about the whole lunar quarantine thing, I'd like to give my views about that because I think ~~xxx~~ it's important to understand that. We ~~xxx~~ need to come back to that some time along the way.

The important about this particular preflight isolation program that was then finalized alot better - we got it put in even better form by the time of Skylab. It was one terrible flight. The closest I ever came to leaving NASA was that episode about were we or were we not ~~x~~ going to be able to have control of crews. Here we were, responsible for their helath with no ability to control them in a preflight situation and then they are going to get on a flight and they are ill and who's responsibility is it? It's your responsibility. You have all of the blame and no way to carry out the responsibility that you have. We stopped the flight of Apollo 9 for three days when all three crewmembers developed upper respiratory infections. That really brought things into focus about preflight illness. That was public knowledge. ~~Rxx~~ People kept saying we~~x~~ were wasting the tax payers money, they had to ~~defxxx~~ defuel - ~~xxx~~ talk about being under pressure - those guys could have killed me every hour

of the day. That was the first that anything medical (Apollo 9) had ever really had any forcible impact on the flight. Every body understood very well that there had been problems in Apollo 7 and 8 (medical) which had never been encountered. It began to make people think that maybe astronauts were'nt so invincible after all. We began to think we were jinxed. That was belying all the evidence we had from Gemini. We found ourselves in a spot where we wanted some answers.

~~xxxxxx~~ Preflight isolation got to be a ^{functional} real thing between management found itself in a very difficult role and we almost got ~~xx~~ to the impass where it was a decision point where there was no room for them to go without being really in trouble. In short, they were going to have to make the decision exactly the way that I said. The facts made it so. A very difficult time - many conversations with Chris Craft and Bob Gilbert about this and even had Bob come over to my house. He was so concerned about the ~~xxxxx~~ decision because the astronauts were fighting this so hard. They did not want that kind of control.

A plan was finally worked out, however, and it was put into effect. It was vital that it ~~a~~ be put into effect because not only was the mission at stake because of an illness developing, but when Apollo 11 came along, ~~xxxxxxx~~ we had to have a postflight quarantine that was going to be 21 days and that was an imposed ~~thinkx~~ thing on us and I had fought as hard as anyone else against ~~xxx~~ that whole idea. I did not believe we were going to encounter an organism on the moon but we had some people who were raising

holy hell (Congress, outside scientific community) right up until the day that mission flew. They were ready to stop it because there were compromises made in that lunar quarantine that should not have been ~~a~~ made and did not need to be made. One of these compromises was that we were absolutely told and were sworn to we could not lift the Apollo spacecraft onto the deck of the carrier and thus connect a tunnel to it and have the people going as we had planned into the mobile quarantine thing. That was the original quarantine plan and was a total quarantine. What we ended up doing - landing the spacecraft, opening, throwing these ~~gar~~ garments inside and then swabbing everybody down with _____dine, you opened it up and it was not a total quarantine. We knew it and the engineers forced that issue and they did it. It was an absolute lie because you know damn well that we have lifted the Apollo spacecraft since that time, we did it in every single Skylab mission. All of a sudden we could do it.

I think there ~~were~~ were some bad decisions made at the beginning of the Apollo Program when we got into the whole quarantine issue. Who is responsible if you bring an organism from the moon or not? NASA could have maintained that responsibility. It so happened that a man who is dead now, Hugh Dryden, made the decision and he elected to not take that responsibility, not have NASA take that responsibility. As a result, we ended up with the Public Health Service taking that responsibility and then we got involved also with the Department of the Interior and Agriculture. We had to set up a big committee and we went to one long

lot of hell. I was then put in a position, very difficult, about lunar quarantine. Once we lost the battle, the National Academy of Sciences took a position and said you are going to quarantine and we do not care ~~xxx~~ whether there is a chance evidence to the contrary is not significant. There was no way to collect evidence ~~xxxxxx~~ unless you went there and brought it back and even once was not enough. We did it three times before

.Once you decide that you really have to quarantine, you have to make a plan that was going to be a true plan. We were trying to conduct a true quarantine with management who didn't believe it, the guys who were going to conduct it didn't believe it--you either do it or you don't do it. It was said by the head of the Committee that if the astronauts were not quarantined, they would not be allowed back in the United States. We had NASA management people who said well, we have to do it but don't pay too much attention ~~xx~~ to it, do what you have to get by. Dr. Berry was the NASA representative to these meetings and having to make commitments about what they were going to to from a quarantine point of view but NASA management said well you go through the motions at all these meetings, but don't worry too much about it.

I finally called together the top management at JSC and I told them I wanted them to understand the position I was in. They were ~~payx~~ paying only lip service to the commitments that I had to make--they didn't plan to adhere to them. I felt that ~~ixx~~ since the decision had been made to quarantine, then by God we are going to quarantine. I wanted a clear commitment from the

senior NASA staff that they would back or I will no longer go out and make these commitments. I needed to know if I was going to be backed on these commitments. They said OK. There was still all kinds of foot dragging. They never wholly accepted this. We still believed there was no basis for the quarantine but we lost the argument with the Academy of Sciences so at that point we had no choice but to go along with the quarantine.

If there had been an organism on the moon, I think that the quarantine, as it was conducted, had a 90% chance of containing it. They were also isolated preflight so that if they did contract an illness, we could prove that it did not come from the moon. They never understood this. The astronauts were not worried about this, they wanted to put on their white scarfs and jock straps and go flying. So this was the kind of pressure we were under.

Up until this time, there had been no real assessment of what might be experienced on the moon.

Apollo 15 was the anomaly.

We had people ~~wax~~ who were convinced that ~~xxx~~ once an astronaut stepped onto the surface of the moon, his vestibular system would go haywire - he would be so disoriented that he could not be effective in the 1/6 g environment or inside the spacecraft. We had other people who thought that because of the atmosphere, the astronauts would not be able to see the LEM. Everybody had a different idea about the problems that would be encountered on the moon.

The Apollo 15 episode, the episode, the 18-day Russian flight, and then the Soyuz 11 mission - only by continual argument did we get the 28-day mission. There was no question that by that time we should not have had men flying for 28 days. The whole future of space flight was at stake from a medical point of view. I was told that I had to go to Washington because we had to be able to prove ~~xxxx~~ what man could do or we were dead. It was vital that I deal with Congress and our relationship on the Washington scene.

100 A
Question of Medical Data and Its Privacy and the Role of Attitudes
Toward This Subject and Decisions Made in the Apollo Program

Astronauts, as a group, were never clearly directed or clearly made to understand that they indeed were public figures who lost a great ~~deal~~ deal of privacy by ~~xxxxxx~~ virtue of their position as an astronaut. This privacy obviously involved areas other than medical ones but it was particularly irksome to them from the medical point of view and thus created a medical problem. The whole privacy issue is one that has psychological overtones particularly relating to the Apollo 11 crew, two of whom were very private individuals and who became world figures over night and, interestingly enough, have accepted or handled this in entirely different manners.

The entire issue of medical ~~px~~ privacy is a very difficult one and has always been so for any physician ~~xxxx~~ involved with any person of noteriety of any sort. Typical examples are daily reports of number of bowel movements, type of pain, how much sleep, etc. any President of the United States might have during an illness. The difficulty that we faced in our particular ~~sxxx~~ situation was one where the astronauts had not accepted the idea that they had to give up a certain amount of privacy due to the fact that they were world figures just the same as a singer or a performer, or a foreign political figure. Some resented ~~xxxx~~ the fact that launch heart rates were requested by the press and were given to the press. The numbers of people involved ~~xxxxxx~~ in the program made it impossible to maintain any sort of absolute

anonymity of the individual involved because, starting with Mercury, we flew one individual and finally two and eventually three at the very most. And, in any case, if any individual had vomited, for instance, the press was unable or unwilling to accept merely a statement that a crewman had vomited, but demanded to know which crewman.

Certainly, we were, as physicians, were concerned with maintaining as much medical privacy as was possible if it involved areas of medical importance to the crewmen which were not related to space flight per se. A typical example of this, I'm sure unknown to many, that occurred at the time of the hearings concerning the Apollo fire. As we had three dead crewmen and autopsies were performed, obviously the medical records and all of the autopsy data become important information in the investigation of this incident. Congressional committees in both the House and Senate spent weeks of time with various members of the NASA staff trying to chase down information relating to this incident and trying to determine any factors that might underly the cause that obviously should be corrected before we attempted anything as complex as a lunar landing.

At one point during this investigation, a fire occurred in an altitude chamber at Brooks Air Force Base and an airman was killed. Again, an oxygen fire incident and the House Armed Services Committee thus became involved in a situation not totally dissimilar ~~xxxx~~ than that faced by the Senate and House Space

Committees. The House Armed Services Committee demanded that the medical records of our crewmen be made available for ^a ~~their~~ perusal by ~~xxxx~~ a group of the Committee. I refused to make these records available on the basis that any pertinent facts relating ~~the~~ to the accident, cause of death, etc. would be gladly given but that the medical records were privileged information and would not be given out to any Committee. I was backed in this decision morally and by telephone from the American Medical Association but the individual who finally settled this situation was Tiger Tige, the Chairman of the House Committee investigating the Apollo fire who also happened to have a strong position ~~of~~ on the Veteran's Committee, and he individually made a personal agreement of the Chairman of the House Armed Services Committee to assure that the medical data would be handled in the way I have stated. ~~The~~ This agreement was upheld and my only ~~xxxxxxx~~ requirement was to convince a medical advisor to the President at the time of the exact cause of death and the basis on which I based that cause of death from the autopsy data and this was done both privately and finally publically in a House and a Senate Hearing. I cite this incident because I think it demonstrates the lengths to which we have gone to try and maintain the privacy of medical data when it does not bear on the future of manned space flight.

What our crewmen never understood, and I'm afraid many still do not, is the fact ~~xxx~~ that every ~~ofx~~ hour of time that they spend in space flight and their responses to that peculiar ~~xxx~~ environment were important not only in our monitoring their own

~~xxxxxxxx~~ reactions and thus their safety but were equally important in our determination of the future safety of crews who would fly for longer ~~xxxx~~ periods of time because every bit of such data has to be assessed due to the small numbers of people involved and predictions of great importance made based on very little bits of data from varying ~~xxxx~~ individuals. I ~~dox~~ not think that invasions of medical privacy occurred as a result of the open policy which ~~a~~ NASA ~~xxxxx~~ established for the conduct of its ~~a~~ space program. I frankly had great concern about the openness of this policy but I think the wisdom ~~xx~~ of it has shown itself in the conduct of the program ^{to date} and in great contrast of the program ~~xx~~ of our Russian at least up to the present.

The press conferences which were held preflight, during the flight, and postflight centered many times about items of medical interest because people can identify with human beings and their responses to such an environment whether these responses be adverse or not. IN all honesty, I feel that the crews and in some cases NASA management had valid concerns that medical incidents particularly if they could be considered adverse, as an adverse response to that environment, would be utilized and exploited by the press to thwart the advancement of manned space flight. I think this conditioned many of the responses although the primary factor I am also convinced with the crews is the age old flight surgeon-flyer argument of whether you were really trying to keep the individual flying or whether you were trying to find something that will keep him from flying. We had always tried to keep our

people flying and I think that the record speaks well in that regard ~~in~~ and ~~cases~~ after case can be cited to bolster this argument.

I personally feel that any crewman who has volunteered himself as an astronaut in our nation's space program pays a certain price and owes a certain debt for that privilege of that flight. Part of that debt is the fact that he must give up a certain amount of that privacy and he certainly should be much more concerned about the safety of future astronauts on even longer duration flights than he is about some minor adverse reaction which ~~may~~ might be commented on during his own particular space flight. Again, part of this is an astronaut image problem which I'm sure will ~~never~~ never be faced in the space program in the ~~same~~ same way again because I doubt we will ever have a time when astronauts will assume the same importance psychologically to the public and to the program that they have had in the past.

Apollo 10 was flown without any medical illness occurring and was the first such ~~an~~ Apollo mission flown. It did give us a feeling that perhaps we were turning the corner where illness was concerned. Apollo 11 allowed us to actually view for the first time reactions of man in a 1/6g environment. Again, an area about which almost as many conjectures had been made as had been made about that of the weightless or zero g environment. We have already commented upon the necessary preflight isolation and then the particular problems involved with lunar quarantine.

Aside from the myriad problems in trying to conduct ^{THIS} very important isolation period, there were obvious emotional responses to this activity which caused some highly colored and very tense moments in the pre- and postflight periods of this particular mission. I'm sure the one incident that has had the most public discussion was the incident in which it was ~~xxxxxxx~~ necessary to request that the President of the United States not have dinner with the Apollo 11 crew on the evening prior to launch. Many storeis have been related concerning this incident. I think it is important that we understand it in its true perspective. It is a very important incident, not because the President did not go to dinner and should not have gone to dinner, but it~~x~~ is an important incident because it impressed upon everyone's mind the limits of our concern about preventive medicine and its importance in such a ~~xxxxxxx~~ situation. There is no question that, had proper plans been made, such a dinner could have been carried out and the crew could have been adequately protected. We had completely redone the astronaut's converence room to make it a laminar flow room in which you could have assured that all of the air flow would be away from the crew and any air coming to the crew would have gone ~~throught~~ through biofilters. This room was in existence at that time but it was a conference room, not a dining room. Medically, I was never consulted nor was a member of my staff concerning the desire or plan of the President to have dinner with the ~~xxxx~~ crew prior to launch. The first word I ~~xxxxxx~~ received of this incident came from the press and not only was seen in writing

but was passed on again verbally by a large press corps who were present during interviews with the many people involved with the preparations~~x~~ for the Apollo 11 mission at Houston. It was obvious to them as laymen, which is even more interesting as one looks back in retrospect, that it would be impossible to conduct a preventive medicine program as I had outlined and to have this event occur. Therefore, a great interest was evidenced by the press corps, that I was indeed going to let this occur. On a particular Saturday, I was busily working at the Center and was contacted by a ~~newxxx~~ newsman as I left one of the laboratories and he specifically asked me the question. I told him that I had not been personally made aware of the fact that the President was going to have such a dinner; that obviously there were going to be difficulties if this were indeed true. Unfortunately, by the time I reached home that afternoon, my wife had been called by a representative of the Associated Press who asked these questions in a much more direct manner. While we had tried to avoid as much press contact as possible, this turned out to be one of those times when through mistaking who was ~~xxx~~ calling, I found myself talking to the Associated Press representative. It was impossible to say no comment to the questions that were asked and I was directly asked as to whether such a dinner would be in violation of the plans that ~~wxxx~~ we were trying to conduct for preflight isolation. Any ~~idiot~~ could certainly tell that they were and I tried to phrase the answer in such a way ~~xxxx~~ that it would be understood that certainly the President or any *

individual could not be put in that ~~possi~~ position ~~xxxx~~ unless it was absolutely necessary and proper precautions were taken and there were certain precautions that could be taken to make absolutely necessary conferences possible. But again, I assured ~~them~~ them that I had not been contacted ~~a~~ concerning this incident and I had not been asked to establish such precautions or to consider such a dinner¹. This~~xxxxxxx~~ article appeared within the worldwide press within a matter of hours and immediately the President found himself in a very embarrassing position - placed there by his staff and in particular by one of our astronauts who serving as ^{PRESIDENTIAL} advisor for the lunar mission, one Frank Borman and by the NASA Administrator at the time. Immediately it was clear that there was no course that the ~~Rxxxx~~ President could take at that point in time where he could be a winner because it obviously looked as if he was willing to risk the entire mission for the purpose of what could be determined by some as a publicity stunt in having dinner with the President and he was already being assailed on some fronts for taking a great deal of personal interest in the Apollo mission when, in fact, the entire program had been designed and come to its present state with virtually no input on his part and entirely ~~xxx~~ prior to his administration. I'm sure that this irritated his ~~sxx~~ staff, I can understand the irritation based on the fact that they had been given information. I can also understand the irritation expressed by Frank Borman publically and on television when ~~he~~ his advice was countermanded by the President cancelling any plans for such a dinner. There

was no direct confrontation between myself and the President in the sense that I said, Mr. President, you cannot attend this dinner. There was a great deal of concern within NASA and hours (difficult) in phone calls with John Paine the NASA administrator, Bob Gilruth, ~~and~~ George Lowe, others at NASA management, as well as others of the White House staff. In the end, the President while obviously irritated, understood this well and following the mission, did carry out in a supervised manner a meeting with the crew who were in the Lunar Quarantine facility aboard the carrier. This was seen on national TV and at a White House dinner celebrating the Apollo mission. It was made clear to me that the event was understood, forgiven, but probably never ~~for~~ forgotten.

The next very important medical event that occurred ~~xxxxxxxx~~ with Apollo 11 involved the demonstration that man could indeed fly the Lunar Module after having flown only a training device which was certainly no exact duplicate and that he could in fact not only fly it near the lunar surface and conduct a landing but he could change that landing ~~a~~ based upon terrain characteristics which made such a change imperative. This was the case with the initial Apollo 11 lunar landing and Astronaut Armstrong did an masterful job in conducting such a landing and demonstrating man's capability to do so under very adverse circumstances.

There had been much conjecture concerning man's response upon being in the 1/6g environment. Would it provide a sea level sufficient to correct many of the things that had ~~been~~ been noted

as physiological effects of zero g exposure. Certainly, the x crew had been immediately aware that they were in 1/6g. There was suddenly an up and a down and they could stand on the floor of the vehicle and move in an entirely manner than they did in a zero g ~~xxxx~~ atmosphere of the Command Module. From a physiological standpoint, they noted little in the way of significant physiological change except that they ~~did not~~ were not aware of the same fullness of the head that was experienced in the zero g situation.

~~xxx~~ Vestibularly, many discussions had been held and warnings had been sent to us ~~xxxxxxx~~ by vestibular physiologists from several sources ~~xxxxxx~~ stating that it would be ~~xxx~~ absolutely impossible for an astronaut to maintain his orientation on the lunar surface, in a 1/6g situation and as soon as he started to navigate on his legs on the lunar surface, he would not only be motion sick but have vertigo and be unable to move in any proper direction by means of walking. This was another one of these ~~xxxx~~ bugaboos raised, considered, and immediately shown to be false by first initial steps upon the lunar surface. ~~xxx~~

Lunar dust had been raised as a serious problem~~x~~ and it did become a problem inside the spacecraft where the crew breathed it, ate it, had it rubbed into their skin and under their fingernails and were thoroughly exposed to the lunar material. It was impossible to do otherwise and our worst fears in this regard certainly were realized. However, we saw no adverse ~~x~~ effects from the lunar material except that it was difficult to remove.

Two of our astronauts on Apollo 12 were aware, as all of our astronauts were, of the peculiar smell of lunar material, a somewhat acrid, powder-like smell and still, two did show some sort of sensitivity to this material.

Questions had also been raised about lunar material being exposed to 100 percent oxygen and the possibility that it might ignite as soon as there was such exposure. Many tests were conducted on the ground and in vacuum chambers to try and rule out this possibility and there was still doubt in the minds of some as to whether this would indeed be a problem we would have to face. Luckily, this was also shown immediately to not be a true problem.

We had had some serious concern about the capability of man to work effectively in a 1/6g environment in a pressure suit. We had tried to take measurements of the capability to do so conducting the lunar surface activities in simulated 1/6g conditions on the ground by using harnesses connected to the centrifuge and following him around as he conducted supposed lunar traverse activity. We also had measured his response under water and tried to determine what the metabolic loads were of varying forms of activity in the simulated zero g condition under water. The first true information was, of course, obtained as our crewmen landed in Apollo 11 and this was added to greatly by studies on the remaining Apollo lunar missions where we were able to determine that the metabolic cost was certainly an acceptable one

-one which man could handle. It averaged somewhere around 1000 Btus per hour and some particularly strenuous activities were conducted by varying crews and probably have been discussed in some of the previous detailed physiological data presented in this volume.

Of particular note was the activity of the Apollo 14 crew in pulling a rickshaw type device to the top of a mountain and the severe activity ^{which} with the Apollo 15 crew, in particular the Commander, had to engage and try to conduct a drilling operation on the lunar ~~surf~~ surface. This was not without incident, however, which we will detail when we discuss the Apollo 15 mission.

As we reviewed all of the data obtained on people having been exposed to 1/6g then returned to zero g and then returned finally back to 1 g, we found it virtually impossible to show that there was any ~~ak~~ salutary effect of the ~~perks~~ the brief periods spent at 1/6g because these effects I'm sure were virtually wiped out by the ~~excessive~~ additional 2½ to five days spent in zero g on the way home after the lunar activity.

One particular vestibular incident was of ~~a~~ interest in that astronaut Erwin ~~in~~ on Apollo 15 had some stomach awareness and ~~vertigo~~ vertigo on movement of his head for the 2½ to three days ~~per~~ prior to the time ~~at~~ that he ~~descended~~ descended to the lunar surface. ON entering the 1/6g environment, this disappeared and returned in the zero g environment of the Command Module, it ~~did~~ did not ~~recur~~ recur. This is an interesting data point and it should not be lost ~~x~~ as we evaluate the responses of the vestibular system in this unique environment. It is particularly important

in view of the fact that he also had postflight vestibular difficulty lasting for some five days and is the only astronaut prior to those flying the Skylab Program who ever had postflight vestibular postflight sensations which were documented.

Apollo 12 gave us further confidence concerning man's capability in the 1/6 g atmosphere and added further validation to our ~~xxxxxx~~ feeling ~~xxxxxxxxxx~~ concerning the ^{metabolic} cost of work in this environment. ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~

Apollo 13 was an interesting mission because it not only turned ~~xxx~~ out to be one of the most difficult and danger ridden missions ~~xxxxxxxxxxxx~~ of the Apollo program due to a later incident involving ~~xxxx~~ explosion of an oxygen tank but prior to the mission was threatened by many medical difficulties.

The incident was a peculiar one and in many ways related to the previous comments which I have made concerning isolation. Charley Duke who was a backup crewmember, his wife, and two children had spent a weekend just prior to the ^{onset of the} 21-day isolation period. It turned out that two of the children ~~xx~~ in the family with which they had stayed had rubella. During the preflight isolation period on a ~~S~~ Sunday morning while I was at the Cape, I received a call that Charley had entered the medical clinic at Houston complaining of a rash. There was concern about the diagnosis of this rash but it certainly appeared to be measles of some sort. Other viral diseases were also considered, and proper blood samples were immediately taken.

One of the immediate things learned from this episode was the tremendous importance of having detailed immunological data ~~xxx~~ available on every potential crewman. IN short, immune

for each of the potential viral illnesses should be a part of the baseline medical record of individuals involved in such activities. It is difficult for many individuals to recall from a historical point of view whether he has had rubella because it is frequently misdiagnosed. Particularly was this true prior to modern day immunologic~~xx~~ technique. ~~xxx~~ The history of exposure was obtained from astronaut Duke and immediately an epidemiological investigation was set in motion whereby I had one Flight Surgeon ~~ix~~ visit the family, obtain all the information possible and even blood samples from members of the family with whom the Dukes had stayed. The next step, of course, was to do complete examinations and immunologic ^aevaluations not only of the Duke family but of the prime and ~~xxxxxx~~ backup crewmen.

The illness that Astronaut Duke had was shown by immunologic to be rubella ~~xxx~~ over the period of the next few days and he even developed a rather common complication of the illness, a rubella arthritis, involving both ~~xxxxx~~ wrists. The difficult problem that we faced was that ~~xxxxxxxx~~ the prime crewman whom he ~~xx~~ backed up had spent the day before the development of the rash inside the Command Module trainer with Astronaut Duke. Therefore, guaranteeing an absolute and complete exposure to whatever illness Astronaut Duke had. Another unfortunate event occurred when.

when the immune were all obtained when it became evident that the prime crewman was the only individual on the prime crew ~~x~~ Ken Manningly who had no immune antibodies and therefore had not had the illness. The question was would he get the illness or not in view of the exposure and here we were faced with a short period of time prior to launch. This became a real epidemiological and medical nightmare with daily and nightly flights back and forth between our laboratory ~~x~~ in Houston and the Cape, ~~x~~ as we obtained blood samples on the prime crew at the Cape keeping the backup crew at Houston and doing all of the ~~sax~~ samples ~~x~~ in our laboratory. Specialist help from the National Institute of Infectious Diseases and still it came~~x~~ down to a question of what were the odds of the development of this disease in this crewman during the mission and if he did develop the disease, the potential complications of an adult having rubella and therefore, ~~waxkxkx~~ what was the risk to the mission. These were all studied in great detail and I'm~~x~~ sure that I learned more about the disease, Rubella, during a period of some five days t han had ever ~~y~~ been learned by any one individual in the same period previously. Each day, the NASA Administrator, Tom Paine, ~~axdxkx~~ at the time was being queried by the White House ~~ax~~ as to the status of this condition ~~axkx~~ and what our decision was going to be because it ~~kx~~ had become known to the press. Each morning I had to brief him and then he ~~ax~~ had to brief the White House. We reached a point where a decision was going to have to be made if we were indeed to do anything in changing this crew. A fact

which had never previously ~~exam~~ occurred in the history of manned space flight. No crewman had ever reached this point in time and not been flown. So true was this fact that a maxim in our planning that we had made an agreement with the astronaut office that from a medical standpoint, once we reached the 21-day examination, that we would do ~~not~~ further exams on backup crewmen. There was no ~~any~~ way that we could fly the backup crew without recycling the mission which would give us ample time to ~~xxxx~~ do the ~~xx~~ examinations necessary on the backup crewmen to ensure their medical safety for the mission.

A long and detailed ~~xxxxx~~ discussion meeting was held at the Cape Chaired by Dr. Paine as the Administrator in which I tried to explain what I felt the odds were based on the data that we had from the Immunologic studies and what I had been able to learn from the experts concerning the complications of rubella. These complications ranged from arthritis which astronaut Duke already had to encephalitis and therefore the decision was certainly not an easy one. After ~~a~~ several hours discussion, it was my recommendation that we not allow astronaut Manningly to fly the mission. We would substitute his backup crewman who at this time was Astronaut Jack Sweigert. This proved to be a very ~~xxx~~ difficult psychological problem also because the mission commander, Jim Lovell, had no desire whatsoever to have his crew tampered with and was virtually at the point of declaring that he would not fly with a substitute crewman on his crew. ~~xxxx~~ This was also a difficult position to place astronaut Sweigert who was being inserted into a

crew with which he had not intimately ~~xxx~~ trained being only backup and where it was obvious he was not wanted.

The painful decision was made based on the medical advice given. Dr. Paine elected to swap out the crew this being the first time it was done in history and we spent the first night following this decision ~~xx~~ vying for time with the training people trying to swipe Sweigert long enough to get the proper ~~x~~ X-rays, electrocardiograms, etc. in order to have him medically cleared for flight. I am personally convinced that Astronaut Manningly never really forgave me or the medical department for this decision for, as fate would have it, in spite of his massive exposure and his susceptibility as shown by the data, he did not develop Rubella. He was immunized later but here ~~xxx~~ again was another incident where a difficult decision had to be made and did not help our medical image in the astronaut corps.

Later advantage of this episode was taken by the national ~~program~~ program to create ~~adequate~~ adequate Rubella immunizations and TV clips were made which were shown throughout the country using Astronaut Manningly and myself emphasizing the importance of Rubella immunization because here was an astronaut who missed a space flight because he was not immune to childhood disease. We had no sooner launched this mission and begun to settle back and try and come to some sense of peace of mind following a very difficult two-week period preflight when~~xxx~~ the explosion occurred and the remainder of the Apollo 13 mission is well known history during which ~~xxx~~ our portions of the decisions

involved helping to assure that we had adequate oxygen, water, and means of removing carbon dioxide and adequate means of keeping the crew ~~warm~~ warm and providing them food. As a matter of fact, there was not adequate water supply available. The crew continually were concerned and correctly so the future of the mission and whether our calculations were correct from the ground. A fantastic team effort was developed and information was relayed to the ~~new~~ crew in a manner that supported them both psychologically and in every other way technologically so that the mission could be successfully completed. Due to the reduced water ~~intake~~ intake, however, the fact that the spacecraft was extremely cold and that in order to have to keep from removing any clothing to urinate the crewmen wore the in-suit urinary devices for the duration of the flight. Irritation of the external urinary tract ~~developed~~ occurred and one crewman developed a urinary tract infection which resulted in chills and fever and an obvious severe acute illness.

side B

While this urinary infection occurred inflight, it was not diagnosed by the crewmen due to the chills that were encountered by all as a result of the coldness of the spacecraft itself.

Apollo 13 thus, while not achieving a lunar landing~~x~~ and providing any further information concerning lunar conditions, certainly did provide us with information concerning a childhood disease and the disastrous effect it could have on a flight crew. And finally, of the effects of what amounted to a survival mission of the flight crew as they had to continue the mission, circle the moon, and return on the bare essentials ~~xxx~~ which could be scrounged and put together from the LEM which was certainly not designed for that purpose.

Apollo 15 will probably always remain an anomaly in our flight program. Historically, it occurred after our Russian counterparts had flown the 18-day mission and had the very prolonged recovery period both cardiovascularly, vestibularly, and from the musculoskeletal standpoint. This has been difficult for us and for them to explain in the light of our experience on a 14-day Gemini mission. Apollo 15 went ~~xxx~~ along very well as far as ~~px~~ preflight and inflight activity was concerned including the lunar surface activities where much heavy work was done. The crewmen, in fact, worked to the point of near exhaustion on several occasions and the Commander, David Scott, pulled a shoulder muscle in working with the lunar ~~xxx~~ surface drill. The pain of this shoulder

muscle injury persisted for several weeks and even bothered his sleep on the lunar surface and on the return flight. There was interference with rest on the lunar surface and a very tired lunar surface crew of Scott and Erwin departed in the LEM and rendezvoused with the Command Module.

This mission had been difficult on the lunar surface even though this was the first mission involving the use of a vehicle, a cheap-link(?) vehicle, called a lunar rover, which they had used for very ~~xxx~~ long traverses on the lunar surface. Shortly after rendezvousing with the Command Module, ~~xxxxxxx~~ they were still orbiting the moon and there was a scientific package in the Service Module which was being used to obtain data from the lunar surface by the Command Module Pilot, Astronaut Warden. He was still busy obtaining this data and while preflight plans had called for him to be one of the prime movers in transferring the equipment from the Lunar Module into the Command Module, he was tied up with experimental activity and really did little of this leaving most of the transfer operations to be conducted by Astronauts Scott and Erwin who already were extremely fatigued.

Once the ~~xxxxx~~ transfer operation was complete, they attempted to seal the tunnel between the Command Module and the LEM but were confronted with the fact that they could not get evidence of a good seal between the hatch of the LEM and hatch of the Command Module. There appeared to be a leak ^{BETWEEN THESE TWO} into the tunnel. _^ This was a particularly worrisome event in view of the fact that

also prior to this flight, just prior to this flight, the Russians lost three crewmen due to a hatch seal failure and explosive decompression ~~xxxx~~ of the spacecraft. Several fixes were tried and ~~none~~ none seemed to work and finally, we directed the crew to do at least two more lunar orbits to reenter the tunnel, take the hatches apart, reenter the tunnel, ~~x~~ and check all of the seals and try resealing the tunnel again. This was done and at this time the tunnel was successfully sealed and the crew then were lying quietly in their couches prepared to jettison the LEM. At approximately this moment, I suddenly noticed on the scope ~~wxx~~ where monitoring the electrocardiograms of ~~xxx~~ all three crewmen that a ~~xxx~~ bigeminal rhythm appeared in Astronaut Erwin. This was so unusual and rather shockings and at the moment I was convinced that it must have been an artifact of some sort and asked for hard paper copies so that we could study them more carefully. This lasted for some ten to ~~2~~ 20 beats and then was followed by a series of premature ventricular and auricular beats interspersed with normal beats. We ~~xxx~~ received no word from the crew and this was a critical time, of course, and no messages were passed to them concerning this event ~~xx~~ and there was no evidence from them that any difficulty was noted by the crew at all. As a ~~matter of~~ matter of fact, after the mission, the crewman reported that he did indeed have a period where he lost contact ~~wxxx~~ which ~~donk~~ could best be described in retrospect as a loss of consciousness at probably this precise time. We were further bothered by the fact that we did not have continuous monitoring of every crewman

and we wanted to make it clear that we ~~wx~~ wanted this crewman monitored that night when he was not scheduled to be ~~x~~ monitored for that night. We therefore asked that all three crewmen monitored so that we ~~x~~ would not have to single out the one. This started ~~kxx~~ a series of what amounted to coverup activities in our public conversations with the crew because we wanted to ~~xxxxx~~ tinue to monitor this crewman as often as possible and this incident was not discussed at any time with the press during the mission and did not become publically known until the mission was complete at which time there was a huge press furor and we were accused of having covered up a potentially dangerous event for some dire purpose of our own. In actuality, this againa is all part of the subject that we discussed previously about the confidentiality of medical information the conduct of space flights in the open and whether you should indeed have~~x~~ the capability to ^{medically} evaluate someone and make those decisions without having to have that information become publically known. This was discussed at length in a recorded press conference which was probably one of the most difficult I ever went through and which became a shouting match between the press and myself.

There was little doubt, that if the crew had their way, this would never have been known and the only reason that it was made public at all was because ~~postflight~~ postflight they were taking an undue amount of time to return to their preflight normals. IN fact, it took them some 21 to 28 days to return to ~~x~~ preflight normal as far as exercise capacity and cardiovascular capacity

were concerned and this had never previously been seen in our program and was uncomfortably reminiscent of the findings of the Russian 18-day mission. When it was obvious that we were going to have to continue ^{POST FLIGHT} evaluations, a decision was made by management and myself that we would have to face the ~~xxxx~~ press with the fact that we were going to have to continue these evaluations and obviously the discussion of the arrhythmia was going to come up. A clean breast of all this activity was made and I was immediately visited by the Commander of the ~~xx~~ crew who felt that he had been ruined for life because he now in the public press had been branded as having had some sort of a cardiac irregularity which would certainly mean that he would never again be able to fly. Hours of talking did little to dampen ~~xxx~~ his anger and it ~~was~~ ^{was} in fact ^{WEEKS} before he really understood what had happened. Interestingly enough, Astronaut Erwin who had the more severe arrhythmia and who was also having postflight vestibular system difficulties understood this very well, discussed it fully, and expressed no such hostility concerning what had occurred as far as the press was concerned.

I made an omission in ~~xxx~~ discussing the Apollo 15 ~~xxxx~~ arrhythmias because I should have noted that two days ~~xxx~~ after the rendezvous and transfer from the LEM to the Command Module and the development of the bigeminal rhythm by Erwin, Astronaut Scott was sleeping and as we monitored his sleep by electrocardiogram, we noted he was running a heart rate of 28. At this extremely slow rate, he suddenly awoke, the rate increased slightly

to about 40 and he developed an arrhythmia consisting of ^{PAIRED} premature ventricular and premature auricular contractions which lasted for a period of roughly an hour and one-half. We never saw any arrhythmias on any of these individuals postflight interestingly enough.

One of the frequently asked questions concerning manned space flight has always been what about the psychological aspects. Are men really afraid, what happens during launch, what happens when they are landing on the lunar surface, do they get along when they are in the spacecraft. The amazing thing to me from the psychological viewpoint has been the tremendous lack of difficulty in this area among very highly competitive, driving, and forceful individuals. Some of this certainly I'm sure was helped by the fact that there were 11 hours of original selection activity devoted to ~~psyche~~ psychological and psychiatric testing. This was added to ~~ex~~ of course by numerous observations by those of us involved in medical and other types of training and monitoring activities in the preflight period. Certainly, there were times when tempers flared, when there were individual differences of ~~ex~~ opinion and arguments occurred. But at no time did we ever see any psychological response before, during, or after flight, ~~immediately~~ immediately after flight, that ~~wxxx~~ could be considered really abnormal. I think the reason for this is related to the fact that we had individuals who were very highly motivated. Each of these individuals would have gladly done most anything to get the flight rather than have someone else take the mission. I have

alluded to ~~x~~ this in the fact that certainly they would go to lengths to cover up medical and I'm sure they would have done the ~~same~~ same in training areas and other such areas to cover up deficiencies in order to maintain their position in the flight crew. This I think is evidence of ~~extremely~~ extremely high motivation to do ~~an extremely~~ difficult mission. This high motivation allowed them to overcome many difficulties which would have been bothersome irritants to them individually and between the crewmen had they not been so motivated.

A second factor~~x~~ that was extremely helpful was the high workload that was assumed on ~~x~~ all of these missions. The timeline was constantly active, in fact, we were ~~xxx~~ always fighting for additional time in which to do the things that were necessary and therefore there was little time for introspection on the part of any individual's part. Had he had long periods of time for introspection, I'm sure that we ~~xxx~~ would have seen much more difficulty (or some difficulty develop) because we really did see ~~none~~ none develop. ~~There were~~

There have been some incidents happen postflight to individuals who have gone to the moon which I think are difficult to explain and are important psychologically~~x~~ and bear further study. The episode involving Astronaut Aldrin is well known because it ~~has~~ has been covered widely in the public press, in television, and in a book which he co-authored. It was obvious to him and to us in the postflight period although not the immediate postflight ~~ix~~

period but several weeks postflight that he was having ~~and~~ difficulties which could best be described as a depression. I have alluded to the ~~x~~ fact that both Astronauts Aldrin and Armstrong are private persons. Several events in Astronaut Aldrin's development involving his family , in particular his father, have been discussed by him in his book and some of the difficulties concerning who was to perform ~~what~~ what role in the mission and who was to step on the moon first, etc. have also been discussed in detail. The two things that bothered him most and led I believe to the depression postflight, however, were his marked difficulty with public appearances which was not a result of having gone to the moon at all except in the fact that he was suddenly thrust in the position of being a world figure for which he ~~x~~ was ill prepared. He was a world figure, he was required to make public appearances, and he paid a high psychological price for each of these public appearances. He ~~xxx~~ further became convinced ^{as} ~~that~~ he made public appearances and saw more people ^{in our own country and} around the world that the tremendous ^{CHANGES} ~~that~~ he had expected to occur in the world as a ~~xx~~ result of Apollo 11 were not occurring and this was extremely disturbing to him. He somehow felt ~~xxx~~ that in a way he was being cheated for ~~somethingxxxxxxxthoughtxxxx~~ having done something he thought of as having great value to the world , the world did not appreciate and was not going to change as a result of this tremendous achievement. He found himself unable to accept this ~~xx~~ psychologically. I am sure many other factors could be cited and I'm not trying to do a psychological ~~xxx~~ analysis but merely to cite

the fact that he did have a depression. There were factors involved is not the result of peculiarly response to having been on the ~~man~~ moon but could be called the results of a response of an individual of his makeup being exposed to the results of having become a world figure as the result of such an event.

In addition to this, two other individuals are frequently referred to as being psychological dropouts of some sort following lunar missions. Astronaut Erwin ~~wxxxxxxx~~ went into a religious program called high flight(?); he is still involved in that program and the important to know here is that Astronaut Erwin was indeed a very religious individual prior to the flight; he was made more so by the flight as were many of our astronauts; seeing the world as they did in an entirely different perspective. In fact, this new perspective of the world and the fact that it is a space ship may do much to change our views of ourselves, our world, and our future. He became convinced that while he had some noteriety and his name was known publically because of what he had done, should use that to the best advantage possible to ~~try~~ try to convince others of the value of his religious faith. Therefore, he convened a group of people who ~~thex~~ formed the high fi organization(?) with which he is still associated. I do not consider this an abnormal psychological reaction. Indeed I consider it normal and an intelligent psychological evlauation of a situation existing and of which he might take adequate advantage.

One other astronaut frequently referred to is Ed Mitchell. He is an extremely intelligent ~~xxx~~ individual who had a deep personal interest in psychology, psychiatry, and in parapsychology prior to the time of his flight. While we were aware of some of this interest, we were not aware of the depth of it to the point that he was willing to conduct an experiment in flight which he told no one about until after the mission. He has since left the program, as you are aware, and is involved in a unit in California that is investigating the phenomenon of parapsychology and is frequently described by some of his cohorts as being spaced out. I am personally unable to evaluate Ed's true condition but again I find it difficult to blame the fact that he walked on the surface of the moon for any of this other than it gave him a launching platform from which he could pursue interests which he already had.

I do feel that because of what has happened in lunar missions that it is imperative that we pay more attention to psychological responses of crewmen pre-, in-, and postflight and that retrospective studies ~~xxxx~~ particularly involving crewmen who have been involved in lunar missions be begun at an early date.

CONCLUSIONS

I think we can conclude that we found no ~~physi~~ physiological phenomena during the Apollo missions that had not been at least identified as ~~xxxxxxx~~ potential happenings from our Gemini experience which showed that at least that planning and preparation was of great value. We do have the Apollo 15 episode standing as a anomaly in our Program, not totally explained perhaps due to , in a major way, a lack of adequate ~~pot~~ potassium intake as has been discussed in ~~xxxx~~ previous papers. These arrhythmias have not been seen in other missions and were not seen following increases of potassium intake but it is difficult to be assured that this is the cause.

I think we learned a ~~gx~~ great deal about man's ability to perform in a 1/6 g environment and it appears that 1/6 g is sufficient to give him a feeling of near normality to performing functions with the same ~~w~~ ease as he does on the earth. He learned rapidly to adapt ~~xxxxx~~ to movement in this environment on the lunar ~~surf~~ surface and to traverse the surface in a rapid fashion by many modes. He also demonstrated that the metabolic costs of activity in the 1/6 g ~~xxxxx~~ environment was certainly acceptable and that in my view, a lunar surface laboratory in the future is not only feasible but highly desirable and I sincerely hope that one day we have an international laboratory which can be established for study of our solar system and indeed the universe.

We learned ~~a~~ the tremendous value and importance of adequate preflight isolation of crewmen if we are to assure that they are

to be in a position to conduct a mission without illness ~~exisng~~ ^{vening} in flight or even preflight. We also learned the importance of closely ~~fk~~ following the immunologic status of our crewmen and of adequately immunizing them against any deficiencies in this immunologic pattern. We certainly learned that there are no organisms on the lunar surface. This was a massive program to prove that there were no ill effects on any living thing on the surface of the earth, ~~xxxxxxx~~ human, plant, or animal.

I do feel that we have not properly gotten the story across either to the crewmen involved or to the public of the tremendous medical concerns that existed and made the proper medical evaluation on these missions so ~~xxxxxxx~~ important. I think this is particularly important as we look at missions in the future and plans for these missions because ~~x~~ crewmen must be made a part of some of the medical considerations at a very early ~~xxxxx~~ date in their assignment to a career. It was ~~xxxxx~~ always difficult if not impossible to secure time with the crew ~~for~~ ~~for~~ ~~medical~~ medical purposes and indeed every hour ~~x~~ spent in ~~anx~~ medical evaluation or of medical training of any sort appeared to be resented because it took time away from valuable mission simulators, etc. I think that future missions should plan very carefully ahead of time to start ~~x~~ adequate crew briefing about effects that have been observed fully believe the mechanisms of these effects are, and know symptoms are and every attempt should be made to design training mechanisms whereby these effects can be demonstrated to the crews wherever possible. Certainly,

vestibular effects have been ~~wh~~o~~se~~ shown to be important by these missions and these were further confirmed by the Skylab experience. This first experience with ~~ve~~s~~ixx~~ vestibular difficulty is an important lesson which must be built upon and considered carefully in both our research, selection, and training programs.

The most~~ix~~~~ix~~ important thing of all accomplished by the medical efforts associated ~~wx~~ with ~~ax~~ allowing man to reach the lunar surface would have to be the fact that we were able to ~~sux~~ support him in a difficult operational environment with little data and difficulty in obtaining that still in a way that made it possible to explore numerous areas of the lunar surface and lay the ground work for a ~~bx~~ better understanding of the moon and its relationship to our earth and universe and also for the building of a future lunar laboratory.