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SKYLAB BRIEFING
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SKYLAB BRIEFING, 2-3-71, 1347 CST, 22A/1

PAO We'll get started now with the Skylab Briefing. I'll introduce the people from your left as you are facing them left to right. William C. Schneider, he is the Skylab Program Director, Dr. Charles A. Berry, Director of Medical Research and Operations at the Manned Spacecraft Center, Dr. Owen K. Garriott, Astronaut, and now coming up on the stage Anthony J. Calio, Director of Science and Applications at the Manned Spacecraft Center. We'll start off with Mr. Schneider.

SCHNEIDER Good afternoon, ladies and gentlemen. It's been some time since I spoke to you about Skylab and so I'm going to give you a fairly brief run down to remind you as to what the skylab program is, but the real important part of the discussion will come later when these other gentlemen here will talk about the experiments that we're going to do. I will start off with a brief over view, a brief summary of what the Skylab program is - looks like - so that when these other gentlemen talk about workshops and OWses and ATM, why, you can relate them to what I've talked to you before about. Could I have the first slide, please. This is a quick artist's conception of what Skylab is and I will not dwell on it. It, of course, is the orbiting workshop formally known as AAP which we've changed in the past year to be the Skylab program. Have the next slide, please. Briefly, there are 3 fundamental reasons for Skylab, three fundamental purposes, and the first of which is the conduct of scientific experiments. All - totaled on Skylab we have nearly 60 different experiments that will be conducted during the missions and they are broken down into a number of broad groupings. You will hear a great deal about some of the more important - I shouldn't say more important - I should say larger scientific experiments. Dr. Garriott will be talking about the, specifically about the astronomy portion it. In the area of applications we have a very comprehensive and complimentary set of experiments on Earth Resources being carried in Skylab. And then you'll hear from Tony Calio and then Dr. Berry will talk about the other aspect, a manned spaceflight aspect of Skylab, where we have an opportunity to examine man over long periods of time in a very carefully controlled environment with some very sophisticated instruments. These are three major objectives and we try not to give overemphasis to one over the other and we try to balance our - we're trying to balance our flight plan so that we adequately cover the conduct of all of these experiments. Have the next viewgraph, please. The fundamental concept of the Skylab hasn't changed since it was the Apollo Applications. First and foremost we have used all of the things that we've inherited from Apollo in an attempt to reduce our costs. And, you'll see a number of pieces of equipment that are used today in Apollo that are

SCHNEIDER needed for Skylab. Recently in the last budget review we did have a schedule slip, for example - or flight schedule readjustment, I should say - and that is specifically because we must wait until Apollo finishes using its equipment before we can get off the launch pads. We do have a policy of revisit. You'll hear us saying that we will revisit this vehicle three different times. We will resupply it somewhat, not to a great extent. We bring up most of our consumables on the first launch. We have a great deal of reuse equipment and a great deal of repair equipment. There are some 50 different items that are carried onboard the Skylab as in the store room in case parts go bad, wear out, or break down, the astronaut can manually take them out and replace them, just as you do, say, spark plugs in your automobile. We say we have an open ended mission philosophy. We have two link missions that we're planning on. The first manned mission will be 28 days long nominally and it will be followed then by two subsequent 56 day missions. Open ended means that we reserve the right to ourselves to come down if at anytime we find that we've completed our objectives and we haven't - we haven't completed the number of days. Using the same hardware I said and so forth, and so on. May I have the next slide, please. I'll try to get over my portion fast because these other fellows have the more interesting items coming up, not that the hardware isn't interesting. Next slide, please. I'd like to take a few moments to acquaint you with the different modules that we have in Skylab and remind you of them and what we call them and what they look like so that, as I said, to set the stage for what's coming on. The whole orbiting element we call the cluster and the cluster consists of the workshop or OWS, the instrument unit or IU, the airlock module, AAM, multiple docking adapter, the command and service module and the Apollo telescope mount the ATM. Now, briefly, the workshop which fits on the rib like that is in essence the living space and the space where a great many of the experiments will be conducted. It is the third stage of a saturn V vehicle which has been launched without any propellant on it and launched in a manner where it is fitted out for man's use. It's rather larger, about 11,000 cubic feet. It has the same dimensions as the S-IVB. These are solar panels. The whole orbiting cluster is powered by solar power and as we have no fuel cells we don't rely upon battery power for fuel cells. We rely upon solar power. There is a refrigeration system onboard and the radiator is located in the rear. The refrigeration system is not to keep the workshop cool, it's to keep the - some of the experiment equipment cool and to refrigerate the food. It has a meteor protection shield around the outside to reduce the probability of having damage to the flight - to the

SCHNEIDER equipment meteor heads. Have the next slide, please. Looking a little bit at some of the insides of it this is what the inside of the S-IVB will look like in the Skylab. Fundamentally, we have two floors, the first floor being where the crew lives, eats and sleeps and the second floor being primarily an area for doing experiments. What had been the liquid oxygen tank, the liquid oxygen tank in the S-IVB for Skylab has been converted to our flying trash dump, if you will, and we have a trash disposal system which permits us to put our trash in there and keep it stored in here for the mission. May I have the next slide, please. All of the consumables for the entire mission are carried onboard that vehicle at launch and we do not resupply it with the CSM for food. Looking at the crew quarters layout you can see the area here which is known as the ward room with a picture window. Primarily that window will be oriented towards the Earth and it is to - for observation of the Earth by the crew. There is a table here in the center with the ability to heat food, heat and prepare food. Along the outside are various racks containing many things...food...there is a refrigerator and a deep freeze and there are some entertainment equipment located around in that area. Right alongside of it is the waste compartment. This is the bathroom. It contains the usual things, washbasins, heads, and so forth, as well as equipment necessary for processing the waste so that we can conduct medical experiments. Along side of that is our three compartment bedroom. Each crewman has a separate compartment in which he sleeps. In this view it would appear as if the crewmen were standing up to sleep, but of course, in zero gravity there is no up so you could say he's on any orientation you want. This area in here is filled mostly with medical experiments and Dr. Berry will tell you much more about -

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SPEAKER I can't tell you much more about that, but, that is of course the trash air lock on top Next slide please. The second floor, as I said, is where a great many of the technological experiments are conducted, and here is a view of the mock-up of the second floor. Of primary interest here is what we call a scientific airlock. There are two of them on board the Skylab. One which is earth oriented and one which is sky oriented. And we have the ability to put scientific experiments out of those airlocks in order to get to the environment outside. As you can see it's a quite filled up space, there are a number of experiments located around there. Next slide please. Going a little bit forward, the instrument unit, I should say is exactly the same as the instrument unit on - on Apollo no change. Up forward is the multiple docking adapter and as its name implies, it's the place where we can dock the command and service module, which is the ferry in Skylab's case, to get the crew up to the workshop. It's being structurally made by the Manned - Marshall Space Flight Center and then it's shipped to - shipped to the Martin Company where they outfit the interior. It has two docking ports. A normal axial docking port here which will normally be used for docking the CSM. But we have also left the radial port in there, and this port is available for us in emergencies. Next slide please. The interior of this has changed somewhat in the last few months, and it is now in one of our very important experiment centers. You can see one of the experiments control panels. This happens to be in the Apollo telescope mount - control panels which is located in that multiple docking adapter. The earth resources control panel and a number of the earth resources experiments are also located now in this MDA. And the next slide please. The airlock is as its name implies, the manner - the way in which the flight crew can get in and out of the cluster in order to go extra-vehicular. We do use extrahicular activities to retrieve the film from the Apollo telescope mount. It has become the engine room of the workshop, it has all of the controls and all of the switches, circuit breakers and whatnot, the electrical power system, the thermal system and so forth. It also has stored around the outside all the oxygen and nitrogen that's necessary for crew survival. And the next slide please. The command and service module is almost - almost the same as the Apollo Command and Service Module except that we have provided redundant deorbit capability, since we are in earth orbit and not on a free return trajectory, we wanted at least two ways to independently come home and we've added extra fuel tanks to provide extra propellent for the RCS system

SPEAKER so that it is a backup deorbit system. We've also added electrical power and all the other auxiliary things that will be necessary to provide that redundancy. Next slide please. The Apollo telescope mount, you'll hear a great deal more about that from Dr. Garriott, it's perhaps the most mis-named piece of equipment that we have, it has nothing to do with Apollo anymore. It's a telescope only in the sense that it's a solar observatory and it now provides a great many functions that are normally provided by other elements of spacecraft. It provides the attitude control system, it provides half of the electrical power and it provides - it has all the computer located on it. So in addition to being - to housing five very important solar instruments sections we'll hear about as the day goes on, it also provides a number of other very important things, that are necessary for Skylab. Next slide please. Briefly now, to talk about the missions and what we're doing, Skylab consists of four launches. Skylab One is the launch of the unmanned Saturn workshop which we currently expect to occur sometime in this period here, and it will be in orbit - active orbit for over eight months. Mission number two which takes place the next day, is of 28 day duration. And it will be the first manned mission and will take place with the launch of a Saturn 1B, sending 3 men up to dock, rendezvous and dock with the workshop and stay up there conducting these missions. In this mission we'll put the emphasis on the medical experiments, although we will do all of the experiments. The fundamental emphasis is on the medical experiments. The second mission - the second manned mission, takes place approximately 90 days after the launch of the first manned mission and it's for 56 days duration. During that period of time, we'll put an emphasis on the solar aspects of it, although I hasten to state very clearly that we will be doing all of the medical and earth resources experiments as well. 90 days later we'll conduct our third mission. Again, this is 56 days in duration, and the emphasis in this mission is again earth resources. And the next slide please. Now the first mission at launch looks something like this, the Saturn 5 is only a two stage vehicle, that is we use only the - the S1C and the S2 to place the entire cluster into orbit. That is we have no S4B as they do on the Apollo program that is converted into the workshop. It goes into orbit in this configuration. After it's in orbit and we intend to put it - put Skylab in a 235 nautical mile orbit with 50 degree inclination, 50 degree inclination means that we'll - we'll cover all of the Southern forty-nine states. After it's in orbit why the ATM falls over and

SCHNEIDER deploys and the solar arrays come out and then we - and we spin up our control motor gyros which orient to vehicle, the vehicle is then stationary in orbit - stationary solar orient that is, it faces the sun at all times, until the next day and the next slide, for the next day when we launch the Saturn 1B with its Apollo command service module on top. Then the next slide please, I think that I can make my point better on that one. The Saturn 1B we wont - this is the same vehicle that was used to put Wally Schirra in orbit on Apollo 7, but we've taken one very great liberty with it, we have deactivated pad 34 and we are planning on using the second pad at pad 39, 39B, and we have put a pedestal on the familiar Apollo - Apollo LUT in order to accomodate the shorter Saturn 1B. So you'll be seeing the configuration very much like that, when we come around to Skylab launching. And the next slide please. We do have as I said almost sixty experiments on board and the scientists are adding to them daily. This is a list of the experiments that are on board, I don't expect you to read them. And I'm not going to try to touch on all of them today. As I said, Dr. Berry will talk about the medical experiments, Dr. Calio will talk about the Earth Resources experiments and Owen Garrieott will talk about the solar experiments and one or two of these other astronomy experiments. I'd like to just highlight if you will permit me, two of the other experiments that I think are particularly important, are particularly interesting, and I've collected here a contamination measurement experiment and I've selected this because it's typical of the type of experiment that we will be putting out the scientific airlock. This is the scientific airlock here and this is the experiment fitted to that airlock. When the experiment is fitted to that airlock we put out this photometer head here out 18 feet from the edge of Skylab and we measure the contamination that is at that distance from the spacecraft. We also have other instruments that fit in the same cavity to do much the same thing. And the next slide please. One of the more interesting experiments in my mind that, and one that we're not quite sure what will come out of it yet is the one that we call the materials processing experiment. This experiment is being made in house by our Marshall space flight center, and it literally is a, a vacuum chamber with a high heat source. May I have the next slide please? In that vacuum chamber we have a number of different things that we will be doing.

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SCHNEIDER would be doing, two various materials. We have some exothermic heating experiments. We will be heating various metals to see what happens to them. We have some composite casting experiments where we'll be heating these metals and seeing what we can cast up in there. We'll try to form some spheres in the zero gravity, metals melting and some crystal growth. This crystal growth is probably one of the more interesting ones. The theory says we should get a crystal that has no internal stresses and we're quite interested in learning what the zero gravity will do to the growth of a rather large crystal in space. Slides off, if you will. Well that's a quick, I guess about a 15-minute summary of the Skylab Program and the important things are to come as the rest of the people talk about the experiments. I'd like to just say one word about where we stand as far as schedule is concerned. Skylab is moving along on schedule very nicely. There's flight hardware at all locations. We are delivering flight experiments to the module contractors right now, and they are being installed. We have major tests going on around the country. We will be delivering flight hardware to the Cape in preparation for launch this winter and early next spring. I'll take questions now.

PAO All right, if you have any questions, if you'll wait for the microphone.

QUERY Just one of those little hardware questions, Bill, do you have backups?

SCHNEIDER That's part of the Skylab Program. We have one flight workshop and one backup workshop and backup for all the equipment in there. We have three command and service modules and S-one B's; we have one backup command and service module and S-one B and I forgot to mention we have one Saturn-5 primary and one backup. So we have - we're not completely backed up in that we can't - we're not redundant in all the CSM's and one backup CSM. There are backup - all the experiments have a backup as well.

PAO Next question. Any more questions? Right here in the front row.

QUERY Have you decided if you are going to put women in this flight?

SCHNEIDER Will we put women in this flight? I'm afraid I think the flightcrew will come from the same population of astronauts that we currently have. Astronauts have already begun training for this mission. It's a rather involved mission. As you saw all those experiments, it will take a great deal of training to bring people up to where they're proficient in conducting all those things.

QUERY Could you go over for me the rationale for the positioning of the floors in the workshop? The modules for the space base that we saw yesterday were along the X-axis. Now, you've got them across. How was this arrived at? More room?

SCHNEIDER We put the floors in Skylab here because that was the way it started out as a fairly simple experiment, if you recall. The particular reason that we put them in the direct orientation they are, with up being up when they're sitting on the pad, is so that it's easy to work on at KSC. Otherwise you have to handle equipment from the ceiling.

QUERY Yesterday we had a briefing about a station - space station. What is the difference between that and what you have been showing now?

SCHNEIDER Well, the fundamental difference lies in the matter of resupply. Skylab does not have the ability to be resupplied. It has a finite lifetime in that you carry all the consumables up on the first launch. All of the oxygen, all of the water, all of the food, all of the clothing - indeed, a ton of consumables and containers for every man-month - as - on liftoff. The fundamental concept of space station is that it is up there for a long term usage, and that means resupply or some kind of regenerative system.

QUERY Will all the men aboard a Skylab crew get an all-purpose training so that, for example, the medical conductor onboard could also exercise or conduct the different businesses otherwise conducted by the pilot, or so on?

SCHNEIDER Well, all flight crewmen on every mission will be completely cross trained in all critical functions. That does not mean that all will be capable of doing each and every experiment. Anything that is critical and has a bearing on whether or not the entire mission will be successful, there will be cross training. But there'll be a primary crewman for each activity.

QUERY (garble)

SCHNEIDER Three men each time and we go up there three times. We use the Apollo command and service modules with the three couches.

QUERY I don't quite understand why you first put up the Skylab and then stations afterwards. What is the idea behind that? Why not the station right away before wasting all that money on a Skylab?

SCHNEIDER Well, fundamentally, because this started out as a very inexpensive program and it is an inexpensive program that will give us a great deal of information upon which to base the space station. If you saw the objective there of the medical experiments, Dr. Berry will be telling you how he needs the data from Skylab in order to provide the information to go ahead with the space station. Now, if you went ahead with space station first, you'd have to do a space station like Skylab in order to get that data.

PAO In the back row.

QUERY You're giving a lifetime of 8 months for Skylab. Is that an orbital lifetime or the lifetime the consumables will -

SCHNEIDER That's the useful lifetime. The orbital lifetime will be many, many years. It's up at 235 miles and I think the 3 sigma number on that is 5 or 6 years, for orbital decay.

QUERY Well, what is inexpensive?

SCHNEIDER I'm sorry, I didn't hear the question.

QUERY What is inexpensive?

SCHNEIDER Well, inexpensive as we expect...we're in for the budget this year for 500 million dollars. Total program run-out costs depends upon when we launch. It appears now to be in the order of 2 billion dollars.

PAO Any other questions? If not we'll go to Dr. Berry, now.

BERRY I'd like to start by taking mild issue with Mr. Schneider about the way we have to do things on this particular flight series. It's quite obvious that I'm going to be prejudiced on what I say and what I think the priorities are. I'm sure each of the other gentlemen on our panel here would feel somewhat the same in their areas. But I think it's important for us to realize that we have real questions about the limitations of man. I personally, don't adhere to most of the feelings that have been expressed by numerous committees and individuals around the country and the world about man's limited capability in space. We need to prove that, though. We do have some serious questions and we need data to prove it. And we can't have just opinions about it. And therefore, it's vital that we get this data - that we get the data for a period of 28 days and that when we extend it we get the same kind of data and so I think that while we say that we are going to emphasize something, I think the primary reason in my mind for flying sky lab is to find out about man, because it isn't going to do you any good whether you have telescopes or earth resources or anything else involving man if you can't prove that he can do that job. And that's the roll that we're about with this particular series of experiments. May we have that first slide, please? Now the thing that we're trying to do, then, is to look at what the effects of this environment are and you'll see from the experiments that we have that, number 1, we do not cover all - -

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BERRY We do not cover all the systems of the body, and certainly any good physiologist could tell us well there are some systems your not really examining in detail, and that's correct. You can not do everything and we have very carefully selected the expirements that we are doing, to give us information concerning those systems, that we have see change in to date. In short, we have seen some evidence that there might be something happening in this particular body system and therefore we want to get that information with this series of experiments. So you will see when we talk individually about these expirements, that you can find some areas that you might think were not covered, but certainly we do have a very valid reason for looking particularly at those things. Now you must realize that the things that we have been able to do thus far have been done pre and post flight principally. In the GEMINI series we were able to make some inflight measurements that were very vital to us at that point in time as we were extending our duration to 14 days. At the present time, we are not making any sort of detailed inflight measurements. Most of our information is gained from what we can observe on the crew by comparing post flight with their findings with their pre-flight base line. We have observed change and the thing that we need to do now is to determine what happens to that change really in the weightless environment, and is there a way to draw the time curve, to determine what is the onset and what is the time history of that particular effect in flight and then to look of course at what happens to us in the recovery phase when you get back into earth and have to readapt to 1 g. I'm sure your all familiar with the fact now that we really haven't seen anything that really concerns us in flight with the change, the changes that we are concern with are readapting to 1 g here on the ground. And how much happens to you in flight so that you find that that adaptation process here on earth is going to be more difficult for you. Now we would like to be able to see what those mechanisms were. What made those effects happen, and for the first time we hope to be able, with this series of experiments, to do something about that. Obviously we are trying here to gain information to be predicted. Every time we fly, we have to be able to predict ahead as to what man is going to be able to do and when you end up doing that on a daily basis actually as you're flying even as we are in Apollo 14. But as we extend our time in flight and go past the 14 days that we have flown and the 18 days that the Russians have flown its important for us to have information to say we feel that on the basis of what we've been able to see, man is going to be able to go that next step, which in this case, is the 56 day time period. We need to determine then whether we

BERRY do have to have any corrected measures. Is there anything we need to do to protect man before he does re-enter the 1 g environment down here on earth, and that's the kind of thing that we would like to have as an out come. At the moment we have not seen anything that we feel that we absolutely have to do and as these durations get longer its important for us to know that. The Russians experiment with Soyoz 9 would lead us to believe that they certainlly feel that that is the case, that there would need to be some kinds of protective measures, and we need to asure ourselves whether that is indeed true. Now in the Skylab area then of course we have committed to a 28 day mission and as Bill said its sort of middle opened at least, open ended is the term use that means that you could come down before then if it were necessary. If we saw something that were necessary. We need to then predict to that 56 day and then now look at the 56 day mission itself and say that yes we really feel that things went well on the 56 day and thus you can predict ahead still further from that kind of experience. So what's really happening with stability in this sort of, the data that we are able to determine is going to be very important to us in these long range predictions. Now I'm going to leave this one up because some of the hardware that you see in here we can talk about as we look at indiviual experiments. Next please. Now, I told you that we do have these experiments picked on the basis of things that we have seen thus far, and so you'll note that as we go through, and the first of these here is an overall area that we're concerned about called nutritional and musculiskeletal function. We have seen changes in this area and so have the Russians. Now, this is a very complicated thing to do. We made a first attempt at it in the Gemini series on the long 14 day mission where we tried to do a very detailed calcium and nitrogen balance study. This is expanded actually, in this series, and what we intend to do is a detailed mineral balance study, all of the minerals. And we intend to add to that, bone densitometry studies by a new technique that we plan to use rather than the one you see here. And actually, this principle investigator has been changed. We have also, as part of this experiment, looking at the body fluids, a bioassay of the body fluids for the constituents, particularly the electrolites and the hormones are what we're concerned with here. And of course, along with that entire area, we have to be concerned about body weight and so we have both a body mass measurement device and then there is a specimen mass measurement device because in this experiment, we are concerned with bits of food that are left and with the weight of solid waste material, the feces that is obtained on any given day. Now, most of the -

BERRY aspects of this experiment then occur in this area with the food system that you see here where we have to have very detailed analyses of the food, preflight, know exactly what's in every bit of that food, and this becomes a costly item in our experiment development for us. We also, then have to have methods of preparing that food and know exactly what was eaten and measure what was not eaten. And in here you have the waste management area as Mr. Schneider said, and in this area we have the capability then to try and obtain urine samples so that we know in these areas what has - we have to know what goes in, we also have to measure what goes out. And so in output measurement, we are deeply concerned with obtaining 24 hour urine samples. This means each man has to have a 24 hour urine saved and chilled during that 24 hour period. We then have to able to take a representative sample of that urine and freeze it for return and analysis, postflight, because we do not have the analysis capability onboard. Now, that is an area that has posed a great deal of difficulty for us and it's one of the problem areas still in the program that we're working with to make sure that we do have a good system that will allow us to obtain these urine samples. It's not a simple thing to do. We need to know the volume aboard the spacecraft of the urine that was obtained in each instance and then have a representative volume taken out of that. And this is an area that we are still working on, and trying to assure that we do not end up with problems in flight. It's a very important experiment because we thing that some of the things that we have observed thusfar in flight are directly related to this. You're all aware that we have lost some calcium from the bones. There has been nothing, certainly alarming about that in the flight durations that we've flown at all, but it is something that is happening and we need to know whether it's going to plateau or if it's going to continue to decrease. And we need to know, also, what is happening to body fluids here because the indications in our pre and postflight measurements thusfar are that there are shifts in body fluids and that this may indeed be the basis of some of our other findings involving a cardiovascular system and other exercise capacity. Next please. Now, the cardiovascular area is another one that we're looking at. I am not going over these co-ordinating scientists. I think you can read these slides as well as I can. We have a system where we have a principle coordinating scientist who is here on my staff at the center. In addition to that we have principle investigators, then, who have a given experiment under this overall protocol area governing protocol as we call it. And so you will see several things listed under these large areas. These are looking at cardiovascular functions. You know we have been using lower body negative pressure, pre and postflight here, in the Apollo series. We will continue to do it here.

BERRY And it's really in combination with this inflight lower body negative pressure experiment which will be done for the first time. Because if we could then validate that the inflight measurements were meaningful to us and meant the same thing that they appear to mean in flight, if we could confirm that on the return to earth then this would be a very good tool for us to determine inflight, the status of the man

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BERRY for us to determine inflight, the status of the man and predict from that exactly what his status was going to be when he did arrive back on the earth. As a tool to get information from that experiment you know we monitor the electrocardiogram and we monitor blood pressure and here we will use a vector cardiogram for the first time and Dr. Allebach is a principal investigator along with Ray Smith here and they have - we will use this system as our primary means of obtaining the electrocardiogram, we'll use spectrocardiography all the time. And so it will be as a integral of a part of this. It is a separate experiment of its own in order to just look at just spectrocardiographic changes should they occur. This is a low body negative pressure device as it will be placed in the workshop and you can see here that the lower half of the body ends up encased in this device and then we go to 30, 40 and 50 millimeters of mercury negative pressure and observe the changes in a heart rate and blood pressures that occur. All right, next please. Now this is a hematology immunology program and you realize there's been a fair amount done in that area particularly in the Apollo series. There are a number of investigators most of whom have been involved in someway in our studies thus far. You know that even back in Gemini we did some blood volume and red cell life span observations and most of these areas as a matter of fact we looked at in some way. This is not anything to do with worms. It's not nematodes - it's a misspelling and it's suppose to be special hematologic affects and the investigator here is Dr. Kimzey in our Lab is replacing Dr. Fisher as the principal coordinating scientist of this area. And what we're trying to do here is to look at the at the formed elements in the blood and also then of course at the - at what happens with the total blood volume, the plasma volume - red cell mass and we are particularly interested in trying to relate these to the other things that we're seeing involving the cardiovascular system and exercise capacity - metabolic response. Now the immunity and sort of immune status that we have been looking at is another part of this experiment as you can see here and we have the capability to look at these things. These are done ordinarily - all of these things are done pre and postflight. I'd like to be clear that we are not here proposing that we draw blood samples inflight on Skylab. We are not intending to draw blood samples inflight during the Skylabs series and so I think that we should be clear on that and this shouldn't get confused. Next please. And the neurophysiology area you realize that we did an EEG experiment one time in the Gemini series, for a very

BERRY short period of time, it ended up about two nights and Dr. Delucchi is the reporting scientist here and then Dr. Frost has this suit monitoring experiment and I'd like to show you - we just happened to get some of that hardware in today and I'd like to show you a piece of that hardware and what we intend to do with that experiment. We also are interested in (garble) function as you can imagine. We have had as you know as had the Russians some motion sickness in flight resulting from exposure to the weightless environment and this is the piece of equipment that will be used - at least one of the pieces that will be used with that particular experiment. There are a couple of other things that are involved with that too. And you can see a storage container here for some of these other pieces of equipment, some eye goggles and things that will be used too. And the idea here is to get a baseline on the indiviual and then determine how that changes in the weightless environment. To know for instance, how many head movements he can make at a given rotation of speed on the ground and then compare that with what he can do before he develops stomach awareness and then compare that with what he can do in a flight. And so this is one of the things that will be done as a portion of that experiment. Next please. On the behavioral affects, again most of the observations that have been made have not been - really experiments, they have been things that have just been observed and reported. And here again we feel that to do specific psychological tests of any sort has not been a very fruitful thing. It's difficult to get any one to be really oriented toward that type of activity in flight, punching holes in paper, things of that sort that were done back in the early Mercury Program for instance and so what we have here is a time and - is called a time and motion study but its certainly far more than that in that it's a use of photography to analyze the way individuals do tasks in this environment. And we're going to utilize tasks that are already being done. We're not making up tasks to have them do and so this turns out to be a very valuable tool and is very helpful even in the analysis of what happens in some of these other experiments. Next please. Next. Now the pulmonary function in energy metabolism is in the area which you know we've been concerned with since early Gemini where we found out that the metabolic costs of working in zero g environment appeared to be unduly high. You know that we learned something about that up through Gemini 12 where we programed that activity carefully - we've been looking at it in the 1/6g environment on the lunar surface and we have an experiment here for the first time where we're going to be able to try and

BERRY do some measurements aboard the spacecraft in the weightless state where we can actually look at the exercise capacity determination and measure very carefully by a direct method which we have not been able to do inflight thus far. You know everything we're doing on the lunar surface is indirect. We have a bicycle ergometer that has been made to use in this workshop and we have a capability here with some very advanced metabolic equipment and metabolic analyzer which has certainly pushed the state of the art to determine then oxygen uptake in CO 2 output and thus get some very definite measure of the metabolic requirements in this zero g state for a given work load. And this should be a very important experiment for us as far as planning for activities of this sort on longer duration missions. Next please. Now we have a number of operational things that we will be doing. For operational monitoring you can see that we things that are not very different from what we're doing now with the exception that there is a body temperature measurement system that is connected with that - it's an ear probe. We have a cardiotachometer which will give us heart rate routine which we don't normally get now. We take that off the electrocardiogram at the present time and that will come down separately this time. We have to provide some equipment aboard that is greater in amount and capability than what we've had with the medical kit thus far on flights like Apollo or Gemini. And we have some diagnostic equipment which will be aboard which will be available for use. Now if there is a physician aboard certainly - this equipment certain pieces of this equipment will be very valuable. If there is not a physician aboard, some of it can be utilized by non physicians and you can then get information back to the physician whose monitoring on earth. And for instance, one of the things that could be utilized in this area is the use of TV to look at certain things and observe them back on earth. There is some laboratory capability here where we have a microscope and we'll have some capability to obtain a blood smear if we should determine that to be necessary with a capability to do some microbiology and we feel that that will be necessary. And then we have treatment capability, a far greater treatment capability than anything that we've had in flight thus far because of the duration of the flights and the possibilities for getting into difficulties. Next please. Now there are some vital science and biotechnology experiments that are on here that are not strictly medical experiments aimed at man although they have some man implications. And there's a zero g single human cell which is being done by Dr. Montgomery up at Dallas and he's particularly interested here in what happens

BERRY to the growth of a single cell and maturation of the cell in the zero g environment. We have too the pocket mice and the vinegar gnat experiment which are aimed at determining some information about the circadian rhythm question in a zero g environment. And then there is an inflight aerosol analysis and radiation determination which obviously have some implications as far as man is concerned although they are not basically experiments that are medical - -

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BERRY That are medical experiments per se. Next please. Now we do plan to run, and I say it's going to be somewhere, we don't know that it's going to be 56 days, we're going to have it set to run that long, but again it's sort of open end, and then the fact that if all of our data plateaued we wouldn't run it to that end. This is a chamber and we, here at the manned spacecraft center, and we plan to have it set up in this way, and we plan to run those experiments in, in a chamber run here, prior to the skylab mission, and try and obtain some information then, that we can use for comparison in flight, with, we would know then with everything we produced as nearly as possible with the exception of the zero g environment on those experiments, and we could then compare that data, and so, this is going to be a fairly large operation that has to be conducted and a great deal of work is going into the preparation for that sort of a run at the present time and it will be done here at Houston, about a year from now. Next please. Now we do have some concerns here. These were some that were listed earlier, I'd mentioned some as we went along. I mentioned our concern about the cap - our capability to get the urine in the state that we need it. That has been, and continues to be a concern from a medical point of view. The activation period, I think we have that, you know we have a 24 hour activation period here of the workshop, and of course the best thing from our point of view is that you can get data as soon as you can get there, and the other thing, is on the other end of the thing, to get data up to the last minute too, and there's some things that have to be worked out here because, depending on what the data show, and what trends show, particularly the lower body negative pressure, you may, while you have to deactivate the workshop if you're going to bring a crew down and then send another one up, we may get into some problems about how far up toward the end we want to get that data, and that's something that we're still thinking about. Now carbon dioxide humidity levels have concerned us in this workshop. The system is such that we are not going to be able to maintain with the equipment in the life support system, it's a molecular sieve in contrast to lithium hydroxide canisters we used previously for the longer durations involved here, and with that hardware it is impossible to get the concentration of carbon dioxide down below somewhere between the 4 and 5 milimeters of mercury level that is what is at the moment thought to be, and we also, it appears that we are going to have some problem in maintaining adequate humidity levels, although both of these problems we think we have a way to get at and solve and the chamber study is going to help us in getting some base line information certainly in this area, and also in this one. Thermo fluctuations are another concern with the experiments of course because some of these can be affected by thermo variations and we're just going to have to watch that, there's

BERRY been very careful analyses made of what will happen with this entire workshop from a thermal point of view and we're going to have just continue to work with that. No one, I guess is going to really know until we get there, with the exception of the analyses that have been made, and those have worked out pretty well in the past, and they probably will in this particular instance. Launch intervals, we've looked at carefully, in short, how fast can you turn your data around so that you can get an answer to go ahead, and we think we're pretty well set in that area and it's not a real problem for us. The one that we have not completely firmed up, and we have had some experience with crew held stabilization, and not only prelaunch, but for the entire time here, in flight, and postflight as well, and that is going to be even more concern to us on the Skylab program where we have microbial floral changes in the long duration flight period here, and we're going to have to protect the crew in a postflight period. You're going to have to protect them in a preflight period and so we're going to have to look at that, and then crew time, and the competition for crew time that is going to occur as a result of what happens with these demands of various experiments. Okay, next please. This just sort of sums up how these experiments fit together. We will have, from a flight like this, we will have information certainly on chloric intake and metabolic energy expenditure and from each of these experiments and don't worry about the numbers and things here, we will have a fair amount of information on fluid and electrolite balance and that should be very valuable data to us. The cardiovascular system, we will have a fair amount of information in that area, that should become predictive also. We'll have some information on crew capabilities in the zero g environment that will be verified by actual photographic means too. We will have some information on the neurophysiology and really an accessment of that system and this whole sleep question, which has been one that has bugged us a great deal, and then we'll have some postflight data in the areas involving cardiovascular blood, bone density and muscular skeletal adjustment, and this post flight period of course we think is the key area that we're concerned with. We'll also know something about habitability and something about the maintenance of circadian rhythms if you can apply the things that you see from the pocket mice and vinegar GNAT to the manned situation. Next please. I'd just like to mention, we're going to be on a daily basis. We're going to be having to evaluate things in three basic areas here, and this is sort of the way we're looking at mission operations now. We will have to be concerned about medical experiment protocols, we'll have to be concerned about medical systems operations, and there are a lot of medical systems involved here, and then about over all

BERRY crew health, and we plan to have what amounts to a grand rounds every day, where you're going to have to get all these specialists together and we're going to have to sit down and determine where we are with the operations of all these systems and where we are with the data that we're obtaining. Okay, may I have the lights please. This is a piece of hardware that has, and I don't know how well you can see it from there, but you're welcome to come and look at it. You know that we have been trying to develop a better system for getting EEG temperatures from experience with Gemini, and this is a very simple cap that has been developed and works very very well. It has some electrodes which already have some liquid in them inside the cap. You can just clip this little tip off here and then the wet material is available. You don't have to shave the head or prepare the head in any way. You just put this cap on like this and you could get a very excellent EEG that way. Now there is a amplifier here on the top, and this is the device that will be placed, this is just a, this great huge thing here on the top is to fit into the grill work that you saw. It was going into the wall. You can clip it into the wall area and it will hold it in place, and this will save a tremendous amount of money by some of the things that we've done here in the development of this system, with these particular caps, which can be used clinically here on the ground too, and we're doing some of this now. This is a sleep analyzer and that's the purpose of this experiment. We're not - in flight we'll get information which will tell us the depth of sleep. Whether it's in stage 1, 2, 3, or 4 or rim sleep and the amount of time each individual has spent in that particular period of sleep, and we'll have that real time on the ground. The actual EEG tracing will be obtained on these recorders which are really Gemini recorders which have been modified and placed with this device, and here you can see the 2 recorders on the back, and these tapes will then be returned and can be run off and analyzed post flight, where you can look in detail then at the EEG, what we're interested in inflight at the present time is just the determination of the amount of sleep at the various level. Thank you.

MCLEASH If you have any questions wait for the mike please.

QUERY I hope you will allow a general question after all of this very detailed information. Why was the period of 28 days and 56 days picked? Is there any interesting reason behind that?

BERRY Well we used, in our early program, we just selected what we thought to be an apparent biological, biologically acceptable doubling proceedure and we have flown, you know we went 4 days, and then we went 8 days and then we went on to 14 days which was the maximum period, you should have said, you should have gone to 16, but 14 days was

BERRY The maximum that we thought we could do with the Gemini system. Now from that we have just doubled that and said okay, it's 28 -

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BERRY - from that we have just doubled that and said okay it's 28 and you double that and it's 56. Now, there isn't anything magic about that certainly. You know, there's no magic about any one of those time periods and I think it's something that we have to look at and this is exactly what Mr. Schneider was saying that it does depend - you know it is sort of open in that regard.

QUERY Is one of you doctors there going up in that skylab?

SPEAKER The crews have not been selected. Do you care to comment any more about this.

SPEAKER I was going to say the same thing. The flight crews have not yet been selected.

QUERY - it occurred to me, looking at all that, that the - that the astronaut as an objective for scientific research is something completely different from the astronaut who pilots the ship on the moon. But I think psychologically, the situation is completely different. Are there any problems and do you - do you deal with these problems that man doesn't feel like a rabbit? I mean, everything you say and everything - every way your body reacts, everything is analyzed and observed - to me I think - that I would feel very odd at least. I think - what's the psychological situation of somebody who's life and everything is tracked down to an extent as you do.

BERRY Well, I think that that has to be one of the things that comes into consideration for a mission like this. The objective of the mission is certainly something that has to be carefully understood by the crewman and he has to except that as an objective. And I think that there is a certain amount of that that is unfortunately goes with the process of just being an astronaut at the present time and there is little that - you only exposing so many men to an environment and you're trying to obtain information to allow you to expose more people for longer periods of time. And this means that whether you want to admitt it or not you have to realize that in a sense you are a subject in that regard and you have to - you have to be analyzed and your bodily reactions have to be looked at and reported for the good of people who are going to fly in the future. This - in some people this is more of a problem than in others, certainly. Everybody has some individual feelings about that and I think it has to be considered in crew selection problem.

QUERY What will be your basic cabin atmosphere and will you vary it.

BERRY Well, we hope we're not going to vary it here. But the atmosphere - this is not - it's about - it's 70 30. We're not going to fly anymore hundred percent oxygens as you know, Paul, and so we're going to - it will be 70 30 here. And we don't intend to try and vary it. When we try - intend to try and maintain it at that.

QUERY Before the Skylab it will be some experiments in animals?

BERRY You mean will we fly animal flights specifically before skylab? No, we do not intend to do that.

QUERY In order to have a better evaluation of the scientific experiments, do you plan to send doctors or just to train the astronauts to evaluate these experiments and besides that to recognize some symptoms of the unexpected problems?

BERRY Well, there are as you know at the present time four doctors, four M.D.'s who are in the astronaut corps and are in various stages of training. Now, it's certainly likely, the crews have not been selected as has been stated, but it's certainly likely that there would be a physician on one of these flights. Whether we're going to end up having a physician on all of these flights or not is certainly an open question and has not been decided, but we think it's likely certainly that we would have a physician on one of these flights if view of the number of medical experiments involved.

REIM In the back there, please?

QUERY You say it's likely, but is there a guarantee that there will be a physician. It seems totally unlikely that you would want to conduct them without a physican onboard.

SPEAKER Well, if you're asking me if there's a guarantee, Larry, I can't guarantee that. It's my feeling that there certainly should be, but I cannot guarantee that. Maybe Mr. Schneider can.

SCHNEIDER We have number of criteria that have to be fullfilled in these test and we'll have fully trained astronauts onboard and I have confidence that we'll conduct all of these experiments and conduct them safely. They have not been selected yet. They will be selected from a current cadre of astronauts, which includes physicans, includes astronomers, includes a whole variety of people including some test pilots and we're liable to have all kinds onboard during the three flights.

QUERY One other question. Is it a logistic problem that you cannot draw blood samples during the skylab program?

BERRY Yes, basically, it's a logistics problem. We are concerned because you've got to have some very good methods of - in order - to just draw the blood doesn't do you any good, if you can't preserve it properly and get it back for analysis. So we do intend to draw blood samples during our chamber run that I mentioned so that we will have some comparisons with the blood values with some of our urinary values during the chamber run during our ground base studies and that will be very good baseline information for use in the actual flight situation. But we -

BERRY logistically it's difficult. It's going to be extremely difficult even with the urine and feces problem at the present time and blood would pose another one that would be very difficult right now.

QUERY Dr. Berry. Are you more concerned with manned operation in zero g than you were before the Soya's 9 flight or are you just waiting for the results we're going to obtain on skylab?

BERRY I think I'd say I was more concerned following Soya's 9. I - it's hard to just say - to ignore the - what was seen on Soya's 9 certainly. I think that - I still am very optimistic. I think that the worst thing that could happen to us is that we would have to provide some sort of reconditioning regime which would be used prior to reentry. That's my feeling at the present time. I think that we're going to have a lot more information on which to base our decissions and that we're going to have to do on virtually a daily basis here than what the Russians had. For instance, if we're able to look at a metabolic determination which we'll be able to do and at response to lower body negative pressure in flight on a daily - on interval basis whether it be daily or every other day or whatever we ended up doing it. That sort of information gives you a lot better chance to predict what that man is going to be like when he actually comes back to the 1g environment. Much more than what they - what they had available to them.

SCHNEIDER I can understand Dr. Berry being more concerned, but I - he hasn't added any more experiments since then -

BERRY That's right.

SCHNEIDER So he had pretty good foresight.

REIM Any more questions for Dr. Berry? If not we'll go on to Dr. Owen Garriott who will present the next portion.

GARRIOTT Well, in the next few minutes I would like to describe at least some of the principal astronomy experiments involved on the skylab, both in the solar and in the stellar area. One of the first things to keep in mind about the - particularly the solar instruments is that they are really very large. They do come mounted in that large cylindrical cannister behind the crossed solar array. They are contained in this cylinder some 11 feet long, something more than half the length of this table and 7 feet in diameter. And this large size is quite significant. It does, first of all, provide you with good spacial resolution when you look at features on the sun. It will also provide you with enough light gathering power that you can see some of the fine details down in the X-ray and ultraviolet region that you are interested in. I'll be talking more about this in just a little bit. But things

GARRIOTT that cannot be seen at all from the ground. So it is a very large instrument complex that we're talking about. It is solar powered. That large crossed array provides some 3600 watts for the experiments and the supporting equipment for it. I did mention also the high spacial resolution that we will be able to obtain with these solar instruments. Most of them are rated as having a spacial resolution of about 2 arc seconds and to get some idea of what this really means, a resolution of 2 arc seconds would provide you with the ability to distinguish an object a half an inch in size at a distance of 1 mile. Another way to look at it for example since our fingers are something of that dimension, a man who held his hand up could be seen at a distance of 1 mile and you could actually count the number - -

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GARRIOTT at a distance of 1 mile, and you could actually count the number of fingers on his hand. This is the sort of spacial resolution that these solar telescopes will enable us to provide and we'd actually be able to point it and hold it on any one of these fingers at a distance of 1 mile. And so it is a very large telescope, far larger then we have ever been able to put into orbit about the earth before. Now, they will also cover a wavelength range all the way from visible light which we can see with our eyes clear down through the ultraviolet and X-ray ranges which are entirely obscured by the earths atmosphere. And the only way that we can ever see the sun at these wavelengths is to put our instruments above the obscuring atmosphere of the earth and that's of course, the principle reason for mounting these experiments in a spacecraft or being at this high altitude of 235 nautical miles. Let me talk just a little bit more then about these individual experiments that are going to be a part of the solar astronomy complements. I do have a viewgraph here. If I could have that first, it will just list these and then I'll tell you more about them in detail, in just a moment. But the first principle instrument is a white coronograph whose purpose is to monitor to the brightness of the corona and see how it changes with time during the course of the 8 months that the spacecraft is going to be in orbit. Dr. McQueen at the High Altitude Observatory is the principle investigator for this experiment. And the next principle instruments are led by Dr. Tousey at the Naval Research Laboratory. He has 2 instruments onboard. One is a device to make entire images of the sun at different wavelengths, called a spectra-heliometer, and another one is a spectrograph to record the emission from various lines in the wavelength range of about 1000 to 4000 angstroms in the ultraviolet region. Then there is a X-ray instrument by Dr. Giacconi, who is one of the pioneers in the development in the study of X-ray emissions from stars and the sun. They have 1 telescope onboard. Another telescope, I'll skip down to the last line, by Mr. Milligan, who is the only representative from inhouse NASA, as you may note, who has an X-ray telescope onboard. And then another ultra-violet experiment by Harvard College Observatory, which will provide a different kind of display, which I will describe in a few minutes. So these are the basic set of 6 instruments, which are mounted in the ATM and the group of people who will be conducting those experiments. Now, I do have 2 slides at the back of the room. If I could have that first one, which will provide you with a picture of what the data to be returned from the spacecraft, will be like. Now, we already have mentioned the fact that we will be going up and visiting 3 different times. And at the end of each of these 3 visits, largely photographic

GARRIOTT information will be returned from these solar telescopes. Now, the corona is shown up here at the top, and this is the sort of image that will be returned on the film. Now, this image was actually obtained from the earth. The only difficulty is, we have a few minutes every couple of years to obtain an image like this during the time of a complete solar eclipse, when the moon passes directly in front of the sun. And so then we can obtain those photographs but those are the only times that we can do it. And through all the course of history, when we had the opportunity to take these photographs, there have just been a few hours accumulated. There has been no opportunity to study the evolution of the corona, the way it varies, both on a short time scale and over the 28 day period that it takes the sun to make 1 complete rotation. So it will be very important for us to see how this solar corona varies during the course of the 8 months that the Skylab will be in orbit. Now, we've mentioned several ultraviolet experiments that are going to be on board. These 2 display the sort of information that will come back from the Naval Research Laboratory Experiments. This is the spectra-heliograph, which shows images of the sun in a single wavelength range. And so at every point in the ultraviolet range where the suns emission is particularly strong, there will be a darkened image, such as you see over here and then at the next point where there is a strong emission line, you'll see another image, and in this way they can reconstruct what the emissions from the sun, this ultra-violet range are, across the whole scale. Now, you may also be more interested in looking at fine details of the emission from the sun, because there are various atoms in the solar atmosphere, which radiate light at specific wave-lengths. And by studying those emissions, you can determine the relative abundances of different elements in the solar atmosphere. And you can determine their variation of temper-ature with altitude. And for that purpose, you need a slightly different instrument, called a spectrograph, and this the sort of information that will come back from that instrument. Each of these little lines that we see here corresponds to the emission of a particular atom in the solar atmosphere. By measuring its width and by measuring its intensity, you can determine these things about temperature, about abundance, and about its distribution with altitude throughout the corona. Now, X-rays are even more energetic photons then are the ultra violet - then is the ultraviolet radiation. And at X-ray wave-lengths, we find that the sun looks something like this. It does not look uniformly bright, the way it does to us at visible wavelengths. Instead, we find that there are little pinpoints of light, coming out at various spots. And these are the active regions on the solar surface, and we'll want to be looking at these regions with our solar telescopes. And there are 2 instru ments for this purpose. One will provide images, such as we see

SPEAKER here in the lower right, and the other one involves a grading, which disperses the light so that we can see how it is split into various components at various wavelengths. And so - this is the complement of photographic equipment that will be provided onboard. There is 1 other ultraviolet experiment that I mentioned, which has a very fine pencil beam. It's only 5 arc seconds in dimension, which corresponds to something like 1/200 of a solar diameter, and so you see if this is a solar image, 1/200 of that is a very fine pencil point indeed, and with it you can scan across the sun and pick up the radiation emanating from that very small point, and you can then see what its intensity is at various wavelengths and study the evolutions of the active regions on the sun, and various other interesting features on the solar disk. And so this is the sort of information that we intend to be able to bring back both - on telemetry, I should have mentioned the fact that this last pencil beam scaning instrument sends its data down on telemetry rather then photographically. And so the people here on earth will have the opportunity to see it at the same time the crewmen onboard the spacecraft do. And the rest of the stuff is brought back on photography - on film for analysis at the end of the mission. And there will be opportunities then between each of these 3 missions to see what has been brought back, to modify the observing program, and to provide advice on how the next set of data should be taken. Well, 1 more slide is all I have. It shows the controls and displays panel in which these instruments are monitored. We saw this somewhat earlier in a smaller view that Mr. Schneider had, but that set of solar instruments are controlled from this center of the controls and displays panel. And the displays that we have down here, and over in this region provide the crewmen with the picture of what is happening on the sun so that they are able to first of all point the instrument accurately with this very fine spacial resolution that I was describing a little earlier, and also will tell you when it is time to take your photographs at best advantage, because there is only a limited amount of film onboard, and you are interested in taking some of the more interesting phenomenas such as solar flares. A solar flare will occur relatively frequently say, once per day. And when those events do occur, we will want to take our pictures very rapidly and in very special modes. And so these display instruments will help the crew decide when it is time to take the pictures and at what rate and in what mode. So these are the things that are going to be onboard to allow the crew to make maximum use of these fine solar instruments, and make the most efficient operation possible. Now, the operating modes themselves, are rather interesting. The most obvious one is with the crewmen, and at this display console, directly controlling the pointing of the instruments. But he is going to have to do this in close

SPEAKER cooperation with the ground investigators, the people who designed the instruments, who have been building it, who have been working right along with the crewmen in the preparations and the plans for the flight. They'll be there on the ground to communicate with the crew, to give him advice or the benefit of any ground information that he might not have. And so when the crewman is not at this panel, there is also a way, we call it an unattended mode for certain switches to be thrown to allow the ground to control the operation of several of these instruments. They can only do this at times when the accurate pointing is not required or when the quick response to transients are not required, but it will allow them to perform some of the more routine monitoring programs when the crewman is perhaps sleeping and the crewman is then available to come back and check if any malfunction or question should arise. And the third mode is one of completely unmanned operation during the interval between manned visits. And during this time, again, switches can be placed

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GARRIOTT Return visits, and during this time again switches can be placed in the appropriate position, so that the ground can continue, for example to look at the solar carona during the several months of time that there are no people on board the spacecraft, and then when the men go back the film is retrieved and brought back to ground so that we have a complete picture of the evolution of the solar carona for the full 8 month interval that the skylab is in orbit. Let me just take a couple of minutes in addition then to tell you about several of the stellar astronomy instruments. If we could have the slide off now please. There was a very unfortunate failure of the orbiting astronomical observatory just a few months ago, as some of you may know, and it of course has very important and significant stellar instruments on board. They were intending particularly to look at the spectroscopy of ultra violet stars. They wanted to measure many of the things that we're doing here on the sun. Well, we do have some smaller instruments on board skylab intended for much the same purposes. The instruments are smaller than they would be on OAO, but with the failure of OAOB at least it will provide part of the information that it would have been desirable to have had this satellite been in orbit. And 2 of the experiments, the first one is called stellar ultra violet spectra, and the principal investigator is Dr. Carl Henhize, who does happen to be a member of our office. He is, as the investigator has been responsible for the design of this experiment and it will be inserted through this scientific air lock that Mr. Schnieder described in his earlier presentation. They will be looking at a variety of fields, when the spacecraft is on the back side of the earth. You see he'll be looking at the sun, on the sunny side, and on the back side will provide an opportunity to be taking photographs of stars of up to 100, 150 star fields in the ultra violet region of the sky with very good wave length resolution, approximately 2 angstrom resolution is expected to be provided by the experiment that Dr. Henhize is the principal investigator for, and another rather similar experiment is authored, or directed by Dr. Cortez, who is the director of the laboratory of space astronomy in Marseille, so this is a joint experiment between the French and NASA and it is also intended to measure the relative brightness in 2 colors in the ultraviolet range. It'll measure it at about 18,000, and about 31,000 angstrom. Compare the relative brightness of these young hot stars and from these 2 experiments it is hoped that they will be able to understand more about the genesis, about the birth of stars in their very early period, and understand better the evolutionary process that the stars we see, in this and other galaxies appear to be going through

GARRIOTT and so these 2 experiments in the area of steller astronomy, I think do have added significance since we are not going to have the benefit of the OAO until OAO C comes along in another couple of years. So I think I should stop at this point in the interest of time and we'll perhaps entertain any questions you might have in the area of these astronomy experiments.

MCLEAISH Do we have any questions. Right here.

QUERY In the UV stellar spectroscopic apparent magnitude do you expect to come down, and at what exposure time?

GARRIOTT Yes, for the FO19, Doctor Henhize experiment, the magnitude is at least 6 magnitude and perhaps down to 8 magnitude stars and the exposure times would be from the order of seconds up to 10 or 20 minutes. For the S183, the French experiment, they are not getting the spectral resolution of 2 angstroms, they trade that instead for a wide wavelength coverage in just 2 bands and should be able to go down to about 9th magnitude stars, and the exposure times are also comperable, 20 minutes or so.

QUERY Are you limiting your stellar observation only to the ultraviolet field?

GARRIOTT Why. Would you suggest perhaps that we should extend it to the x-ray region, is that the point? Well as far as I know there are no small x-ray telescopes available and you, the energy arriving in the x-ray region is so much smaller than even the ultraviolet, which is maybe only a millionth of what it is in the visible that we need a very large aperture to see these x-ray stars, and there has simply been no instrument constructed as yet to look at, or image the x-ray stars.

QUERY (inaudable).

GARRIOTT Oh, it was not just by an advantage. It would be very nice to do that, and I'm convinced that later spacecraft will indeed be able to when we can go to even larger telescopes.

MCLEAISH Do we have anymore questions. Alright we will go to Mr. Calio, Director of Science and Applications.

CALIO I plan to talk about the theory area of emphasis that Mr. Schneider talked about in the introduction, that is the area of applications. Before I get into that though, I want to give you some idea of how this applications area is put in context with respect to skylab. Those of you who are familiar with the space applications program in NASA, it involves not only an area called earth resources, but also communications and navigation. Today, I'm going to specifically talk about the earth observations part of that. Now earth observations in NASA has its primary objective, the desire and ability to develop predictive systems to be able to measure the result of change in man's environment

CALIO Now what do we mean by change here? We mean both natural events, natural change and also man induced change, by what we do with our environment. Now in an effort to measure this change, and to develop predictive models we have to essentially get a data base for an understanding of the earth environment in which we live. Now this is done in essentially 3 areas. It is done by our basic understanding of the physical characteristics of the earth and its environment, secondly, by measuring these characteristics and describing these characteristics, with what we call contact sensors, people actually making an object and describing that object by its physical characteristics, and thirdly with what we call remote sensors. By measuring the physical characteristics at some distance away from the object of interest. Now as we go on then, and look into the area of remote sensors, here is where we have the application to skylab. We essentially have a set of remote sensors in the skylab spacecraft. Now let me have the first slide please. There are several ways in using remote sensors to our advantage. Some of them, 1 way that certainly you all have knowledge about is the use of what is called the visual part of the spectrum. If we look at a spectral display here it's in this area of the spectrum we have interest in, and we use an instrument commonly called a camera, which gives us some idea of the physical characteristics of the target scene we're looking at. I'd like to bring out this point then. There are several ways we can describe the physical characteristics of a scene or a target. One is through, what we call spectral resolution, or spectral characteristic, understanding what we're seeing through the spectral variation of that scene. Secondly, there is an area called spacial variation, where we can actually describe the physical characteristics of the scene by its dimensions. A third way to describe the characteristics of a scene or a target is by what we call polarization, and then finally in a 4th area there's looking at these 3 changes in a scene or a target by temporal variations or changes with time. Now what we are attempting to do here is to understand or obtain this data base by the use of these remote sensors to give us these physical characteristics. Here's another example in the infrared region of the spectrum, a spectral variation of measuring targets on the earths surface and then the third area of interest from a spectral stand point, the microwave area what we commonly call radar in 2 modes of operation. One where we're looking at the emitted radiation coming from the surface or the target scene, what we call a passive mode, or secondly what is called an active mode, where we actually send a pulse out, a microwave pulse and see the reflected, or the change in the reflectance as it is returned back to the receiver.

CALIO May I have the next slide please. Now in carrying out these measurements, describing the environment in which we live it is done in several ways. First we try to develop a theoretical analysis of what we expect to see and what we understand in the way of the earth's environment. Secondly, we carryout a series of experiments in the laboratory, trying to understand the physical characteristics of the environment and then we go out into the field -

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CALIO of the environment and then we go out into the field with the contact sensors measuring the physical characteristics of a scene. We then take it to higher and higher altitudes by the use of aircraft trying to understand the effects of the degradation or the change of the characteristic or measuring due to atmosphere and finally to spacecraft. When I focus my attention today to an array of instruments that will then fly in spacecraft namely the earth resources experiment package. May I have the next slide, please? The package itself is made up of six instruments and are classified in five experiments. These experiments then or instruments are then are mounted in the mulpible docking adapter which is the second piece of spacecraft module that you saw - see up in the model. The photographic experiment is a multispectral facility. I'll get into each of these experiments a little bit later. We have an infrared spectrometer, a multispectral scanner and a microwave system, with the L band and the X band. Now Skylab EREP package provides us for the first time the capability to fly this array of instruments in a spacecraft application. And then provides us then with data points taken from space which will fit into our predicted model. Have the next slide, please. Okay, here is essentially what we'd expect to see on a typical pass using the earth resources experiment package sensors operating them at one particular time. As you can see from here, the particular photographic coverage is described by the orange, the radiometer - and that radiometer by the yellow dot and then the microwave equipment by light green and then the dark green describing the multispectral scanning device which covers both the infrared and the visible region of the spectrum. Have the next slide, please. I'd like to give you some example of - have the slide on the left slide, please. Of the equipment involved and then some typical examples of the kind of data we expect to see or information we expect to gain from this particular data. These particular instruments. This is the first instrument they talked about which is the multispectral camera. It operates over six bandwidths of the visible region of the spectrum. A predecessor to this experiment was one which flew on Apollo 9 which was called the SO-65 multispectral camera. As a matter of fact, this is a photograph taken from that flight of a salton sea area using color RI ektachrome. Have the next slide, please. A typical application here for this kind of photography can be showned in this photograph taken from an airplane flight where infrared photography was obtained of an area and as you can see in this particular forest, this region which shows a soft brown

CALIO scale infestation of the trees in this particular region. The next slide, please. If we look at the second instrument going down into the spectrum towards the IR we have the infrared spectrometer. Now one of the typical things we're interested in here is obtaining what we call signatures and eventually we hope to have a sufficient library of signatures which are characteristic of in this particular case, of typical rock types. From the geological mapping application, here is a type of a scan that was made on our aircraft flight and you shall see in the next slide, one obtains - may I have the next slide, please - by the use of this instrument a characteristic - looks like we're out of order - a characteristic curve which enables us then to identify a specific target by its peculiar and unique signature, similar to the kinds of signature one has when they take a fingerprint of an individual. Okay. This is the infrared spectra then that one does obtain or type of spectra that one can obtain from the use of this kind of information. Now as you can well imagine, there are a tremendous number of such signatures that can be obtained for different rock types and so there's a rather extensive experimental program that must go on to be able to identify all these unique signatures. Have the next slide, please. The third area, in the spectrum where we're investigating is the combination of the infrared and the visible region. Here we have a ten channel multispectral scanner. Now the purpose of this scanner is to provide us in ten discrete regions of the spectrum essentially electronic imagery that will enable us to put together the imagery in such a way as we can obtain a composite picture of the scene we're looking at. The picture on the right, is actually a panchromatic photograph taken from an airplane at an altitude around 2000 feet. Now I want to show you what can be done then with the electronic imagery that's obtained from this particular instrument to enable us to reconstitute a picture of this type. I'll briefly go through a series of slides here. Have the next slide, please. Okay. We've taken this panchromatic photograph now and have identified by ground truth measurements what are the various scenes on this particular photograph. The inmature rice, mature rice, safflour and then bare soil. Now the next slide, please. If we now vary and look at the variation of output we have obtained from this multispectral scanner from an electronic digital data, we can reconstitute this data in the various regions of the spectrum. You see these are various wavelength regions of the spectrum to give us a different type picture or different sensitivity depending upon the wavelength region of the spectrum we're looking at - the scan.

CALIO Next slide please. If we desire to get some sort of pattern recognition from this kind of photograph we can then ask the computer by various programing techniques to collect like-type information. And you see we've gone through and color coded the areas then that are normally the safflower or the mature rice or inmature rice or bare soil. Have the next slide, please. Another way of using this electronic information then is to actually construct a simulated color film of the scene that was seen without the use then of bringing back film or onboard processing we can actually create from digital telemeter data a simulated color photograph. You can extend this a little further in the next slide. Let's see, again a simulated photograph in the infrared region indicating that we can get some of the thermal information out of the scene of interest. Have the next slide, please. Another way to handle this information is to obliterate or obscure all of the area not of interest and to look at the areas of interests. For example, in this first one, we have - are only looking at the matured green rice, and the second one the inmature rice and so on, the safflower and the bare soil. Have the next slide. And then finally we can collect the information that's available from such types of data to be able to give us a total amount of acreage in the scene representing bare soil, safflower, inmature rice, mature rice or anything else that's in the scene. Have the next slide, please. The fourth area, from a spectral standpoint that we're looking at with the earth resources experiment package instruments is that of the microwave area and this is what is called a radiometer, scatterometer experiment where we are actually looking at transmitting a radar pulse and looking at how that pulse is scattered back to us on the spacecraft. Here's a slide which shows how we see these variations as a result of a rough sea surface on an airplane. And the next slide, will show on this - -

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CALIO On this curve here, here we have the reflected beam or back scattered beam as a function of wave height, so we can actually see that there is a correlation of return beam signals as a function then of C state. This of course has a potential application than to, to the shipping industry, in addition to world wide weather forecasting. So it will provide us with the capability then eventually to establish a model which will enable us to determine these states without having to have ships in the ocean at that particular time and that particular location. Next slide please. Another advantage of the microwave area, and this is the passive part of the microwave devices, is that the microwave radiation primarily penetrates cloud cover, so we're at a limited photography by the presence of clouds here with using microwave devices we're able to penetrate the majority of the clouds and see the scenes on the surface of the earth. May I have the next slide please. Another example of the use of these microwave devices is the ability to be able to, have the next slide please - to measure the selenity of river basins and essentially the ocean. Here is a typical example of a flight, of a series of flights that were made, where we used these microwave devices to measure the characteristics of fresh verses salt water and the variation of that selenity as we went out of the river mouth into the ocean, and as you can see if we plot the selenity variation as a function of distance out of the mouth of the river, we can see that the amount of salt in the water changes in this particular way. May I have the next slide please. Another advantage the skylab provides in the earth observations area is the amount of coverage that we expect to get over the world because of its increased inclination. The area shown here in yellow is what we have previously experienced with the 33 degrees associated with the Apollo program. Now the skylab will fly at an inclination of approximately 50 degrees, and thus we will get an extended coverage over the world. May I have the next slide please. And here we see it from Europe, and then the last slide, here's a typical ground coverage that one might see using the earth resources experiment package duty cycle with the various instruments on at different periods of time. Have the lights please. Any questions.

REIM Alright do you have any questions? Okay, if there are no questions that's the end of this briefing, thank you.

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