Dick Gordon, interviewed by P. J. Vorzimmer, at noon, MSC, March 20, 1967.

Gordon: I guess to show this concern, you'd somewhat become excited. Its a lot like a night carrier landing or catipult shot. The adrenalin starts falling because of the excitement of the event taking place. But I don't think the apprenhension manifested itself until afterwards, if something did go wrong. Then that sort of thing would probably set in. When things are going along as you were trained and on a normal schedule, I don't think that it really manifests itself as an apprehension. Certainly it is exciting because it has never happened to you before. If you've been there, you still do a lot of things different, and you don't get there often enough that you become used to it, or climatized, so to speak.

Vorzimmer: Well, for instance, I know that there was a good deal of complaint, although I don't think they ever remedied it or ever wanted to, about, you know, there's -- I'm telling you-- at any rate, there's this builtin delay on the button when you push for the retrorocket, and a lot of people complained, apparently, at the beginning, some of the first pilots. Somehow that got to them, you know, to push the button and first there's that delay, and then they hear it go off.

Gordon: Yeah, and then there is a delay in between each one, too, the one that tails-off when it cuts in early. Its not supposed to be, it is supposed to be 5 seconds in between, or something, like 5.5 seconds retrorocket, or vice versa, I've kinda forgot the details, but there is a definite pause, a very definite tail-off, and then firing the other one. And a lot of times, it seems the timing sequence may be a little bit off on your own mental timing. A lot of times between your third and fourth retrorocket there will be a very noticable delay.

Vorzimmer: I see, this is an abnormal...

Gordon: Well, not so much abnormal, maybe its just their sensation is being that, because apparently all the records do not indicate that there is anything like, described that way. Our physical senses sometimes betray us, after...

Vorzimmer: Was there a delay on yours?

Gordon: Not that I recall. I don't think we made any, there was any kind at all, it was automatic retrofire. There was a transition between each one, but they came one right after the other.

Vorzimmer: Well, this is the kind of thing, in other words, you know its coming, and you know that its going to be a crucial point, and its also like your Agena PPS burn. Now when you shoot yourself out there...

Gordon: I was pretty excited.

Vorzimmer: ... a good long, a irretrievably long distance, and that was your first one. Why not go over just some of these missions, see, I've got my own summary which I've made from the mission report, and I'd just like to say this for a start, that almost everything that I've written down here is where something went wrong, well, not wrong but something was out of the normal. This is kind of unfortunate, because I know myself, that the press and the popular media who do these things, they always pick on that which, you know, and so therefore, something thats went beautiful, a beautiful, smooth sequence of events, which, (as a sort of an artist in your own field, you appreciate,) go sometimes completely unnoticed, and all you do is lose a lot of your meteorite package and, you know, they play that up like half the mission was circling around that thing. Of course, this is something that we intend to do in the history as far as the approach to writing the history is concerned, and also the purpose of these interviews is to ask you, for example, as the man who possibly knows best, what there was about your mission. In some cases they'll say these and never even get to the public eye, but you can appreciate in an objective sense, that it'll be some really good piece of work, something that really went off well, something that you feel could be explained properly in the right terminology to the lay public as something they should know, as opposed to what, for instance, was picked up and heightened by the press. I know Mike Collins, we didn't get to talk very long, and therefore, he is scheduled for next Friday again, because he said that you hit it right on the head, that if there is going to be an official, that this is our one big chance to get it in, as opposed to what other people pick out,

because, you know, something which is perhaps initiated because of public relations, In EVA on IV, there was a great bit of PR in NASA as far as getting it on IV, etc. And sometimes it covers up some of the things which are technically more beautiful, which you would like to, you know; well, anyway, if you can keep that in mind, if we have enough chance to cover it in this particular, that would be the kind of thing that I'd like to get and be able to put in the history. Well, let's see, oh, yeah, the thing that I was gradually coming to realize, as an example of this, was this bug-a-boo about EVA, and the mysterious X factor in outer space that brought about fatigue. It seems to me that, after talking with Mr. Machell and Mike Collins, that once you brush away this prep type fog around it, it very much comes down to the suit configuration, as being set up in a sitting position with a mesh net inside and with the pressurized interior, so that any motion outside of the sort of slightly, suit, you know, seating configuration represented work that had to be done against restraint. And you would say this was...

Gordon: Well, I think, probably the greatest thing that was learned from XI, see, these factors that you mention of the suit are all very true, and its a part of the work load that you have to perform on EVA. But, I think the biggest thing that was learned from the Gemini XI EVA, besides the things that were accomplished, were probably the necessities, or the actual requirements for a physical restraint system of some type that would allow you to retain body position without the use of your hands, so that you could use your hands to perform useful work. I think that's one big thing, with all the difficulty that we run into on XI, probably paved the way for a lot of the studies that have gone on in this area of restraint. I personally feel that the look-see we got in Gemini XII concerning various restraints in other systems went a long ways in providing information we need to develop this type of hardware so that we can work in an EVA type environment, whether its external to the spacecraft or inside the spacecraft, you will no longer have a restraint system. This is one of the things that we are vitally interested in in the Apollo, because the interior volume is such that your not confined as you were in Gemini, to a seat, and in a strain in Gemini all the time you are in flight. Apollo

has, call it innervehicular activity, if you will, this particular problem, of being unrestrained to some degree, and how we manage to work inside the spacecraft in this particular environment. I think all of us now have certainly recognized the need for a restraint system to keep your body in position while your using your hands to do useful work, to perform certain functions that are required. But I think XI in this regard sort of amplified the things that were suspected certainly in IX, the amount of trouble that Gene had with the adapter with the AMU. Mike's flight on X was somewhat different in that his EVA tests were different in nature where he had to go over and retrieve a package, but the lack of adequate handholds and restraint in this particular case caused him some amount of trouble. Although he was successful in getting the package, this kinda foreshadowed, or overshadowed the real requirement for restraint systems of the type. He had nothing to hold on to, and he was grabbing everything he could get his hands on, wires, and everything else, which was not very adequate, really, for that type of a maneuver.

Vorzimmer: Well, what about when you were in training for your XI, certainly you have a lot of Cernan's information fit into your training, and yet, this is a water egress practice. Did you, you didn't have too much of that.

Gordon: No, I didn't do any; the water was not available at the time for the training cycle for Gemini XI. It was being investigated at this time, and some things were being set up, and this was another area that we found to be in great variance to what we had thought about it, what we were able to do and reserve the air plant, and this limited exposure to zero gs and how we might be able to perform the tasks involved and it once again pointed out a requirement for more, a requirement for better facility in our simulations. It seems the water tanks provided for this for the Gemini XII training have a great deal more facility that we do require in all of our simulators, so that Buzz was allowed to actually work on a time line, and he found in flight experience that the time line he established in the tank was virtually duplicated in flight. So this was another area, the things that I was able to do in training with the zero g airplane with relative ease, became pretty damn difficult

in flight, the attachment of the tether is the example that I was thinking of. So without the restraint system, and without better crystal knowledge of the difficulties that would be encountered, its kind of an unknown area that we ventured into, and fortunately we were able to at least complete that particular part, but then the fatigue factor entered in and we had to cut the rest of it short.

Vorzimmer: I'm surprised that more didn't get fit in because of Collins' and Cernan's experience.

Gordon: Well, Mike's, once again, was slightly different than the rest of this, in regard to need for restraint, but it was at that time, during our training session that Gene himself was evaluating that underwater facility as a training device. Our judgement of what that would do for you in view of the training we had accomplished didn't seem to fit in at that particular time. We thought we'd made a mistake. But the things that I was able to do on the zero g airplane, the tasks that I was required to do in flight, was very easy to duplicate on the zero g airplane. So we never really put the two pieces together, and his recommendation that we have the underwater training duplicated his efforts in flight very well never really got tied in together in time to work on it on Gemini XI.

Vorzimmer: From the documents, looking at it from a purely documentary record, and because it was mentioned by, I think, who was it that was doing the underwater deep sea, was it Carpenter? or Shepard?

Gordon: No, Carpenter had been...

Vorzimmer: Doing underwater...all right, because from the documents I remember that he spoke about it somewhere, gave an address, and said it sounded like it might be a useful thing for Gemini training. And I remember somewhere in July, '66, some NASA Headquarters people entertained a presentation by some company to make a whatever is required to support underwater training. This was in July, now, and Machell records this in a four hundred page document on EVA, which you've probably seen yourself, which by the way is very misleading, because it led me to believe from reading that document, that the GT-11 crew had underwater training. It implied that underwater training practice had been utilized by XI and XII, and

that's why I suspected it. We still have this from July until your mission, which was in September, wasn't it? So it took quite a while before it actually got operational, didn't it?

Gordon: Yeah, I think, yes, and there is probably a reason for it, too, and I think it was probably our own evaluation of the difficulty of the test and the zero g airplane. Our ability to collate actual flight-type experience with the value that you would get out of the underwater training, and this is where the time element comes on, because even though that report may have been put out, the facilities and the hardware availability to crank back in is a requirement, a necessity for this type of training. This was not fully realized until after we had all the trouble on XI, and then it wasn't until XII that we finally tied everything together and started looking at restraint systems and using the underwater facilities to actually provide the training on the actual time line.

Vorzimmer: And I suppose your schedule was none too...

Gordon: Well, about that time, it was just about a month before the flight, and its extremely tight and that's the type of training that had --- well, let me say this in all seriousness, had we known the kind of problems we were going to get into, or had we had a better understanding of the EVA tasks in flight, we probably would have damn well found time to go back and take that period of time necessary and get the underwater training. I think it probably would have showed us a lot, but we were just never able to tie the two together in that particular time plan.

Vorzimmer: Its interesting that nobody would have thought that the lack of sustain zero g, I mean, obviously you get in these parabolas, and you get 25 seconds, and then you've got to go through, I don't know how long it is, between passes.

Gordon: That's right, we were starting off from a fresh position, and, well, I think these were things that we found had to be more exactly duplicated from XI, because of the difficulties that were encountered. Had we approached these things a little bit different, too, the EVA flight plan was so filled with activity that when this task was completed, you went right on to the next task. It was so filled with activity that you were trying not to spend a lot of time on any one thing, because you knew that there were other things that had to be accomplished, as well.

And so we tried to arrange the EVA time line to be able to, or essentially to assign priority to each task. And the priority assignment is such that we wanted to do the most important things first, so that if we did have difficulty, the ones later on during the sequence would be the ones that you'd drop. So this is why we stuck with the tether and actually accomplished that particular phase before we went on to the other one, because of the following experiments requiring that tether, which were of a significant, scientific value.

Vorzimmer: Yeah, well, could you give me some idea of --- this is another thing you don't get in the Mission Reports , and often in the press, too --- of your training program. That is to say, I know of the fact that you've gone to the Planetariums, you get geology courses, and all this course work, but having shot down to two month launch centers, half way through the Gemini missions, I gather that, talking about let's say the last two months, was it really busy? I mean, were you really up first thing in the morning, and...

Gordon: Yes, it was like an 18-hour day, this type of thing. In our particular mission, we sequenced it, especially, so that our heavier activities were very early in the morning. During flight, we realized that we were going to have to get up on a different nocturnal schedule than we were on at the Cape, something like a 2:30 Cape time awake period, and then work until early evening, and then have the rest period following that. So we tried to duplicate this at the Cape, as well; we were getting up, not at 2:00 in the morning, but we kept moving back our reveille time.

Vorzimmer: Did this just sort of get to your mission, or have they made attempt at doing this on earlier missions?

Gordon: I think other missions had intended to do this, I know X worked on it. A lot of them tried to arrange the daily activities to the same manner which they were getting up at the Cape, in other words, 6 or 7 o'clock in the morning would be time to start the day. Now X had a late afternoon launch, so they went back a little bit the other way; they were staying up a little later at night and sleeping in a little later in the morning, so you try and attempt to phase in on the mission itself. Well, ours was

different, in that it was so damn early in the morning, and it was no use in getting up at 3:00 in the morning because nobody else was working, so we just backed it up as early as possible. We had some things we could do early in the morning, and even at that, we were still working into at least the early evening hours, or mid-evening hours, we were still doing something. But generally speaking, at that particular time it was really quite busy. There's a lot of little lose ends to tie together and...

Vorzimmer: Were there many aggravations? I know that mission planning, for instance, the people on duty early in the Gemini situation, they were experimenting this instance. They were very late, almost at the last minute. And then they were turning around and complaining that the astronauts had no festive interest in experiments, and really complaining that there was no astronaut involvement, since it required a lot of realtime decision making about pointing a camera, or about doing an experiment, you know. And they were counted by the fact that, gee, you guys, you barely had a flight ready article at X-170 minutes, and you were just stuffing it into the thing.

Gordon: Well, once again, I think our flight came late enough in the program that everybody finally got on board and realized the importance of providing all the training equipment, as well as flight equipment. Even then, there's still some perturbations on down the line with equipment that subtle changes have taken places that might have an effect, but by and large, we as a crew were somewhat hardened to the regard, in fact we established a basic flight plan very early in the training cycle, and we knew exactly what we had to do on a flight, and we planned all our training to take care of this pre-supposed flight plan. There were very few additions or deletions on it. One of the experiments was deleted because of phasing of the moon in relationship to our launch time that had to be dropped. But the thing the flight crew had added was the high altitude orbit; that was strictly a flight crew innovation to Gemini XI.

Vorzimmer: Yes, I remember they spoke very highly of Pete Conrad when straightaway he knew about this intended high orbit, and he went right to someplace and he said "Look, we are going to do this high orbit. Now, as far as we are concerned (I guess he meant you and he), we are test pilots and we look upon this as a new situation, a new chance to do these things, but I just thought I'd tell you in case you might have some experimental ideas." And apparently, they were amazed. They said,"Never

before have we had an astronaut come and ask us,, 'look, we're going to do this thing, would you like us to do something for you? '"

Gordon: Well, we needed justification, as well. I mean, there's no use going there when the scientific community would not take advantage of it, and there was a lot of reluctance to allow us to do this.

Vorzimmer: I see, so it wasn't just...

Gordon: Well, no, it wasn't really. I mean we needed the support from people in the other communities, as well as our own, to go ahead and do this, and this is one of the things we worked on very hard to try and establish this overall picture of the high altitude orbits and their scientific returns from it. I think it was one of the exercises that was very worthwhile doing.

Vorzimmer: Well, this brings to mind a point that strikes me, just on the basis of what percent you have done now---okay, now, you are launching the Agena into orbit, and if all you are going to do is rendezvous and dock with it, the ATDA would certainly suffice, but instead, all the way from the beginning of the program, it was NASA's plan to put in a rocket engine out there in space. So obviously, once you've docked with it, you are sitting there loaded with SPS and PPS fuel, and yet nowhere do I come into any discussion, maybe this is the cap in the documents we have about doing the Agena burns. Yeah, what are you going to do with it? When did this come into mission planning?

Gordon: Well, I think---I don't recall the actual plans on VI, but the backup crew on VIII, and there were a series, it was kind of a hurry, slow, methodical build up...

Vorzimmer: You were backup crew on VIII?

Gordon: Yeah. On VIII we had scheduled SPS burns.

Vorzimmer: I see.

Gordon: And then, undoubt...PPS burn was the Agena, or was the Gemini spacecraft along side of the Agena out where your dealing with somewhat of an unknown, and there were a lot of questions that we would like to have answered in a very methodical step by step process, but when we lost the Agena on VI, we essentially lost it on VIII in terms of the propulsion system. And

then IX lost his Agena. We reevaluated the situation and tried to do as much with the propulsion system as we possibly could. But when they first started out, Gemini VI had some, I think it was what they call vending moment tests that was scheduled using the Gemini thrusters to set up a vending moment between the spacecraft and the Agena itself, so that this particular vehicle dynamics could be evaluated before you fire the engines.

Vorzimmer: I see.

Gordon: And then the next step was to fire the SPS engine on VIII, and then IX was going to use it for some orbital changes, and they had started out essentially to go ahead and look at either the VI or the VIII Agena, then use that propulsion system to perform rendezvous. So there was actually a plan right in the beginning of using this. When we lost so many of them, we kind of pushed everything together in accordian scale and used the best knowledge we could to get this done as fast as possible. So therefore, it became a question of how much confidence do you have in the system; how much knowledge do you have right now; can you afford to go ahead and make some large primary propulsion systems burns with it? And the other thing to do, is even though you had it, what do you do with it? You'd like to do something more positive than just burning it out of plane just to make sure it was going to burn, and things of this nature.

Vorzimmer: Well, Jim Chamberlin wanted to go to the Moon with it on Gemini. He had all sorts of plans to...

Gordon: Project Leo?

Vorzimmer: I don't remember if that's what they called it, but I saw the one-man moon module and the whole thing. He said that he was absolutely sure that he'd get to the Moon on Gemini.

Gordon: Well, he wasn't alone. There was a lot of people who felt the same way, and I think still today feel the same way.

Vorzimmer: We've got a good chapter on that in the book, and it is very interesting reading about how all of NASA got shook up by Chamberlin's statistics, but I'll leave that for the time being.

Gordon: You've got a very sensitive subject there.

Vorzimmer: But we've got some beautiful copies, photostats of his original plans including the lander and his statistics about what he could do with the Titan. Let me see, I'll read my notes here. Right, that's right, okay. So the power tools couldn't be used, of course, because the EVA has been terminated, and also much to the lament of Mr. Johnson, HHMU couldn't be used, either. He was real sad about that, he thinks its still one of the most valuable tools but because of the way it was used in Gemini IV, it was used sort of as an extra type of, what word would you use, you know, something special and then to be put away. He still thinks to this day that the HHMU is a very useful device.

Gordon: It might very well be. I think it is one of those things we really don't have the answer to yet. Unfortunately, we didn't get to look at it a great deal. Of course, X used the HHMU more than anybody used it.

Vorzimmer: Right, but then he said that Mike Collins---no, let's see, this is now this business about attempting to initiate a rotational rate to the tethered vehicles, mighty difficulties you would encounter because of the undamp behavior of the tether under tension, and because of attitude oscillations of the spacecraft. What do they mean by attitude oscillations of the spacecraft?

Gordon: Well, this is just merely the dynamics in the spacecraft being undamped when we establish a maneuver, when we fired the thrusters to ...this system rotating. We stop firing the thrusters and turn off the law control system, this dynamics between the two vehicles sets up an oscillation in attitude, about the tether attach point. And you get some very, initially some very wild ones, and nobody knew what the hell was really going to happen. I mean, they had a lot of very good guesses, and the best information that we had was just to leave it alone and let it oscillate and eventually it would damp out. Well, this is true, in fact it did, but it took an awful long time, and there was a lot of times when we actually lost sight of the Agena because of the dispersions in attitude. This is something we didn't like at all, so we had to transfer back to the tether and make sure that the tether...Well, if there is another vehicle out there gyrating around, you'd like to know where it is. In other words, it is proximity.

Vorzimmer: I see.

Gordon: So when we lost sight of it, we could go back to the tether and we could see that the tether remained taut. Well, we knew as long as the tether was taut, it wasn't about to come back and hit us. But the idea that you lose sight of the object is like flying formation with something you can't see, and then all of a sudden you are supposed to fly formation on it and you don't know where it is. But the tether itself, upon deployment, went into a very unusual, Pete coined it as a skip-rope effect. This is exactly what happened, but as we came out to the end the tension became applied to the tether, it came to the end and had a little bit of elasticity to it in a rebound effect that made it move back towards us. This put a slack in the tether itself, and then it started to rotate very much like a skip rope. When this started, and we don't really know how it started, as we back out away from it again trying to get the tether taut before we started the rotation maneuver, but as we backed out this loop got tighter, you know, kind of like a piece of string, if you wind it up and pull it tight, it gets faster, and it would rebound again and we'd come back in and start this skip rope effect.

Vorzimmer: They had built the elasticity into the tether... some of it?

Gordon: Well, it was very little that was supposed to have been in the tether itself, but there obviously was some, it did have some rebound, and we don't have any idea how it stopped, we just kept backing out and all of a sudden it became stabilized. We don't have any idea or any reason to know why this ever even took place to begin with, or what we did to get it stopped.

Vorzimmer: Who was making these particular maneuvers?

Gordon: Pete was doing the controlling of the spacecraft at this time, but there was enough time there that we were in this confusing situation, that we were talking back and forth to each other about which way it was going and what it was doing, and which way to apply the thrust. This became rather a kind of humorous incident, really, when we were asked to spin it up at a higher rotation rate after the first orbit, went through this day pass and the night pass and then came out in the day cycle again, it was all stabilized and spinning around at a very low rate, something like 40° per minute, and then we were asked to spin it up a little faster. Well, it was a very interesting discussion

because of the rotation of the two vehicles above the tether, and the way the system was rotating through the sky, which direction do you thrust in just to keep it going. So it became kind of a puzzle game, cause you've got an incident in the way you could thrust. You could actually thrust in the wrong direction and stop the whole system entirely, if we went the wrong way. But it was kind of interesting; we finally got it all sorted out. We used the horizon and the attitude reference system in the vehicle to sort this out and get our directions straight, so we'd know which way to thrust to increase the rotation...

Vorzimmer: And this was to achieve some sort of gravity gradient?

Gordon: Well, we started out this way, but we missed the point to start this, because the tether hangup in deploying, so once we missed that there was no way to get the Agena back in this particular mode, so we had this secondary maneuver to spinup the entire system. XII actually went back and got the gravity gradient.

Vorzimmer: Oh, yeah, this radar lockout loss, this has occurred in two or three missions, hasn't it? You get lockon, then as you...

Gordon: Radar problems...

Vorzimmer: Yeah, did they ever find out...

Gordon: Yeah, it was in the transponder on the Agena vehicle itself. They found the source of the problem, I don't recall exactly what it was.

Vorzimmer: Was it the same in both cases?

Gordon: Well, let's see, who else lost radar? I guess XII actually lost radar, too, and the only ones that really lost radar returns, I can't answer the question whether it was the same or not.

Vorzimmer: Yeah, because the transponder indicates the transmitter section of the transponder failed.

Gordon: But fortunately we had enough training with radar failure during the training cycle that it didn't really cause any particular problems. We knew what the problem was and we could immediately go to the backup procedure, and complete the...

Vorzimmer: Were these spacecraft backup procedures, or did they entail the ground?

Gordon: Nope, it was all onboard; we had our own onboard chart and procedure and we were able to complete the rendezvous. The ground couldn't give you any help in the rendezvous after TPI. The rest of it was entirely onboard the spacecraft; there is no way that they could...

Vorzimmer: Yeah, but you hadn't gotten that far at that point, had you?

Gordon: Yes, we'd gotten through TPI and made the first correction. It was at the time of the second correction and the break that we lost the radar.

Vorzimmer: I see. I know that was the case in Buzz Aldrin's flight. It was a sense in which, you know, although nobody wanted it to happen, a sense in which they said they appreciated it having happened because it gave them a wonderful chance to show what they knew, so he could put his doctoral thesis into action. But that's no way to do it, I suppose. Well, what about these, of course, your fuel cells failed---most of the problems in Gemini, in talking with Mr. Matthews, he said there is a sense in which they feel, there are two points: one is there is a sense in which if a system is made so that there is a backup, then a failure in the primary system, while still a failure, is not considered a total failure, obviously, as long as the mission goes through its nominal steps, etc. Then there's the second point was that if a failure occurs and it falls into that first category, and its not repeated in a later mission, that is, the matter has been set straight, rectified, etc., then again its not really a failure, and yet, that accounts for probably 90 percent of all the things that did go wrong in Gemini missions, except for two items, one is the fuel cells and the other is the thrusters. These seem to be chronic problems which never got off, solved in the Gemini program.

Gordon: The real problem in that is none of that equipment was ever retrieved...you know, retrieved for analysis, so all they can do is go back and look at records and try to figure out,from their best scientific knowledge, what happened if they possibly can.

Vorzimmer: Right. The fuel cell, that's something that is really off into the few monitoring items that you have that is more or less out of your hands, except for what remedial action you can take. On the other hand, the subsidy is something in which you are intimately involved with. This has come up, of course, on all the Gemini missions before yours, and degradation and thrusters was on your mission, as well.

Gordon: We never actually lost any of the thrusters, but we could tell just from flying the vehicle that they were sub-standard as far as performance was concerned.

Vorzimmer: Yeah, somebody referred to it as apparent softness.

Gordon: In other words, the normal crack that you get from a thruster, a normal impulse sort of a motion that you get, the whole reaction to these thruster firings was somewhat soft in nature; it wasn't the good hard pulse that you would normally get from them.

Vorzimmer: Well, how do you feel about that?

Gordon: Well, I'm not sure, exactly; there wasn't anything to feel about. We knew we were able to identify which thrusters they were, so that in case we needed full performance out of the thrusters, we could orient the spacecraft in a different manner to utilize some other thruster. These thrusters never gave us the amount of problems that we could not control the vehicle. We were always able to control the vehicle. It was just a matter of not having as much thrust out of the thrusters as you would anticipate, but it never gave us any particular problem, even to the very last day utilizing the thrusters for that re-rendezvous exercise that we had.

Vorzimmer: But if Gemini is looked upon like a group where everybody pools their information, and just because two of you in particular go on a particular flight, certainly there must be

among the core, the astronaut core, I don't know if you like to call yourselves that, we've been striking it out because nobody has ever given us an official name, anyway, there must be the feeling, you know, must be a feeling like you want to plan something, and say, "Goddamn it, there goes those damn thrusters again." Especially since you go all together after every mission, and you help each other in training, it must have been -- what sort of feeling was there about thrusters?

Gordon: Gee, I really don't know how to answer the question. I think the frustation resulted from our inability to identify the problems with the thrusters, was probably the greatest one that --- so the thrusters went out. Its a matter of being able to utilize what you have left after a thruster failure to actually complete the mission.

Vorzimmer: Well, something else, was they accepted? I mean, you've been busy slaving away during your training and Wally Schirra comes up and says "Ah, looks neat, doesn't it? Just wait until that thruster goes out." You know, so much so that ...

Gordon: Well, we trained in this regard. We failed thrusters in the mission simulators, the instructor failed thrusters all the time on us, so that we could be able to identify the problems, isolate the problems and continue on, so that even though we were faced with a possible thruster failure, we always felt that we could, in fact, complete the mission. Now the exception to this case is probably Gemini VIII, where that mission, hindsight, of course, once again, but concievably could have gone on had that particular failure been identified early enough where the reentry control system would not have been actuated. That was the reason that that particular mission had to be terminated, once the thruster itself was isolated, to regain the control of the spacecraft, they actuated the reentry control system, and once that was done, there was no choice. But I think it had great --- there once again, a failure, but a great deal was learned concerning the design of the system. We always were under the assumption that once you had the power switch turned off that there was no way the thrusters could possibly fire. Well, this essentially was not true, cause all we were doing was supplying the ground with that and if it picked up a ground somewhere else, it could, in fact, fire. About the only thing that would have stopped that would be if somebody had turned off the motor valves in our propulsion system, and that's something we never want to do because if the motor valves ever got closed, your hold system was lost to you then. There was no way for you to reactivate it, so we were always reluctant , in fact, it was our rules that once those motor valves were turned on, unless there was identifiably a problem, in the fuel system itself, that we were always going to leave those

things alone...

Vorzimmer: Oh, I can imagine, you don't want to tear it down. Its the same, that once you activate the RCS, you don't want to monkey around and try to turn it off and on again.

Gordon: Gee, your question kind of hit me unawares, but it was, I think, thruster failure as such, was something that we never really understood, but we never gave it that much concern about our ability to complete the mission or control the vehicle. I think they've probably since identified the more probable cause of the thruster failure.

Vorzimmer: How do you think my reaction would be, let's say, as a Gemini, you know, going into Gemini XI and saying "okay, there are about 6 people behind me that's got 2 mission experience, they always keep telling me, you know, 'just wait until the thruster gives out, you'll have a ball up there'," One of my tendencies would be "well, why in the hell do we have to live with this existing possibility, after all," you know.

Gordon: Well, I don't think it was ever presented in that manner--wait until the thruster fails, you're going to have a ball, because none of the identifiable ones we came up were really that much of a problem. I think the thing that probably...

Vorzimmer: Yeah, but VIII must have given them a big scare.

Gordon: Well, they did something about VIII; they refixed the ...so this particular failure would not recur, I mean, if the failure occurred, you could salvage the situation.

Vorzimmer: Well, that brings to mind an interesting point, which is not on the technical side, but might go into the history, and that is this business, like I said, that despite the fact that only two go up on a mission, you really sort of pool everything amongst yourselves, and you said that nobody ever said this, but obviously you do pool them, and you do BS around about missions and...

Gordon: ...crew debriefings and everything...

Vorzimmer: What about the informal stuff, I mean, once you've been officially debriefed, you get back and you trade stories, like all pilots do, and sometimes out of this comes a few points that may be worked in as to real technical suggestions. Was there a lot of this? I mean, you said nobody said wait until the thrusters stuck, but if you guys are like I think you must be, then you must get a lot of razzing about stuff on missions, and the old veterans from Mercury must, you know, when a young guy, you know, meaning one of the strictly Gemini astronauts thinking about, you know, "Man, we are going to go up to 850 miles", and they sit there with tongue in cheek and say "Yeah, but what about this". I mean, what sort of espritdecorps do you have? This might become book material.

Gordon: I don't know, it's kind of a difficult question to answer. There is some of it, but I don't think we allow too much of it to happen;because of the professional pride in each and every one of us, we can always rationalize ourself out of any particular situation. We have a tendency to do this, anyway. But, I think, generally speaking, the flight crews, when they get down to the very alternate stages of training, are generally left pretty much to themselves. They are not isolated, but they are more or less isolated from the people before. They are all working in other areas. Now, like on XI, everybody was interested in Apollo at that particular time; we were at the tail end of the Gemini program, we weren't too bothered by other people with ideas or reactions to certain problems, we were pretty much, with the exception of people in the immediate Gemini program and the flight crews, themselves, the XI crews, were pretty much left to their own devices. It was about that time that the Apollo program was giving people more problems, and Gemini was more or less established, and we were just allowed to carry on with what had already been learned. I think that the help that comes from the other flight crews has gone before you, in the BS sessions, its talking about their own particular experiences that they had and how that particular experience might allow you to recognize various malfunctions and failures, and apply certain techniques in each case so that once it does happen to you, its not a complete surprise, and you can always recall and say, "yeah, I remember Frank telling me about that during his flight", or like on the rendezvous, I remember Tom Stafford mentioning this particular thing.

Vorzimmer: Well, can you recollect any input specifically from another crew for you mission?

Gordon: Well, I talked to Gene a lot as far as the EVA is concerned. He and I sat down and had fairly lengthy discussions concerning what would likely take place, and we were concerned about the hatches and our ability to go from A to B, and his work in the adapters. I talked to him a great deal about the things that had happened to him, and how we thought we probably had these things covered; was new things put in like his inability to keep his feet on the bar while he was working on the adapters, and they came up with this overshoe.

Vorzimmer: But you weren't going to have any of that on XI, were you?

Gordon: Yeah, it was back in the adapter.

Vorzimmer: Oh, that's right, but you didn't have any MU. That's right, you had Apollo sump tank...

Gordon: Yeah, and held maneuvering units, too. So during that time, this was part of the evaluation you get back and take a look at those shoes and see what they did. So there was this natural feeling. During the rendezvous, we talked to all the crews that had made rendezvous before, what it looked like and what they expected us tosee, certainly during the terminal phase because the rendezvous on XI was unlike any other one that's ever been done before, the M equal one rendezvous. This was a complete new departure from anything that had ever been done, and we did all the maneuvers completely on-board. We were without ground tracking capability for most of the rendezvous itself. Although the thrusting and maneuvering was done at insertion was all done on board. Our out of plane correction was no help from the ground. The ground did provide a backup TPI that was a very good one, but we had the close loop solution and our own backup solution on board that were very close together and very nominal. The whole thing was a complete departure from any of the rendezvous that had been done with a lot of ground assist.

Vorzimmer: Now we are getting down to what sounds like probably most impressed you about the mission, although it made it difficult even speaking objectively, as just another Gemini astronaut, in evaluating the significant things of GT-11. You want to say something about, you know, those particular things that struck you as having been a well-done piece of work?

Gordon: Well, I think the M equal one rendezvous was a pretty dynamic task, it was very well trained for. We established our training early, we probably put more time in the GMS in our suits going through realtime that whole launch phase through rendezvous, with the actual stowing we had in the spacecraft we went through the exact timeline; this was one of the things that probably made that rendezvous work out very well, because you were busy from the moment of insertion until your actually rendezvoused with the rendezvous proper. There wasn't a lot of time to look around and acclimate yourself to that particular area, or environment in which you are operating. So these things were very important. I remember, recall a statement that Gordon Cooper made after his MA-9 flight in which the first orbit should be left completely free so that the pilot can become acclimated to his own environment. Well, shoot, here we are in the first orbit and we'd accomplished a complete rendezvous, and actually docked with the Agena before the completion of that first orbit. So its kind of a departure from this regard, but I think it is based on the experience of a lot of other people.

Vorzimmer: Some people said it couldn't even be done.

Gordon: Well, whoever they might be, I really don't think they were very knowledgeable to make that sort of a statement. Obviously, it could be done, because it was done with not a great deal of difficulty. The fuel required was obviously much higher because you had so much larger maneuvers to make, in a big hurry. You're combining several maneuvers, and this in itself...

Vorzimmer: Well, did this make the loss of lock-on more aggravating? I mean, there you were, you know, rush-rush, push-pull, quick-quick, and then all of a sudden you lose it.

Gordon: No, I don't think so. I think that any particular time once you go from TPI, in any rendezvous, on in, they all essentially follow somewhat the same pattern, so that any of the crews obviously could handle these particular failures because of the training that they have gone through. But it is aggravating, because you would like to have that added help. If we had missed the rendezvous, it sure as hell would have been aggravating. But I think we base our training on this requirement, that if it does fail, we'd damn well better be able to complete it. I think the significant things -- one of the significant things about the Gemini XI flight was that we were

able to stay on our flight plan all the through our flight. You go back and look at the flight plan update, and they were virtually non-existent. Now, the only thing that wasn't in our flight plan,that we had worked on was that last rendezvous, and that was just predigated if we had the fuel we were going to do it, and we wanted to do it very badly, so we were a little stingy a lot of times with the amount of fuel we burned. But our ability to keep up with the flight plan and not have any in-flight changes, we went through our flight plan from cover to cover and accomplished all those things that were required in there on time. This was very meaningful to us and very significant. Our ability to work and have the knowledge about what we were doing without requiring a lot of help or aid from the ground. Our ability to control and work the Agena was very satisfying to me, without any particular assistance from the ground. Don't get me wrong, it was there in case we ever needed it; they were watching everything we did; and if we had had to use, we sure would have been glad to have it, but the fact that we had trained that well to be able to carry out that complete flight plan, to me it was a very significant thing, Of course, one of the most exciting things, personally, was the EVA, itself. The other one was using the primary propulsion system within 150 miles. That was extremely exciting, it was a lot of fun, it was very interesting.

Vorzimmer: It must have been a bit apprehensive, wasn't it, I mean, in the sense that about the time you push the button, you shoot yourself way...

Gordon: Any time you light that primary propulsion system in the Agena when its accelerating, you know, you're looking right at the rocket; that's the closest anybody has ever been to a burning rocket, and your looking right at it.

Vorzimmer: Oh, that's right, your ... the wrong way, aren't you?

Gordon: That's right, so your up against the straps rather than back in the seat, and that's a pretty big thrill.

Vorzimmer: There is a real g on that?

Gordon: Oh, yes, over one. It's more heading in the wrong direction because ... but it's more acceleration that we are even going to get from the service propulsion system on the Apollo; its a little over 1 to 1 ratio, we've actually got about 1.1 negative g on it, or ...but our ability to perform those maneuvers and control the Agena and use the Agena as a work horse as well as we did, was, I think, very significant.

Vorzimmer: Especially after XII and the troubles they had. You can easily put yourself, I imagine, in the position of those fellows, not knowing whether to fire that thing up and take a chance.

Gordon: Well, I don't think they had that particular decision, it was not really theirs to make. I think that was made on the ground for them, because they don't have the information available to make those decisions, and as it turned out they wouldn't have been able to fire anyway.

Vorzimmer: No, right. Or could he, no one knows---there was a big time difference between the time they did get around to firing it again. No one knows what would have happened when they did it.

Gordon: That's true.

Vorzimmer: And knowing test pilots, sometimes its up to their decision, and sometimes they say, well, we will blow it clear, or something...

Gordon: You don't do that with that thing, that's for sure. They just simply didn't have the information available for them to make the decision, so it was properly made on the ground, and I think it was a good decision. But we trained for that high orbit, we trained considerably to make damn sure that we could do all that ourselves; we knew exactly what was going on with the Agena, how we were going to control it, and what way to do those things to make it work. I think we were very pleased that we were able to go up to high altitude and fire that retrograde maneuver, and end up back essentially in the same orbit that we departed.

Vorzimmer: Right, but this seems kind of daring to me, you know. Your out there --- if you got stuck out there, could you retrofire back.

Gordon: Yeah.

Vorzimmer: I see, well, that's nice to know.

Gordon: We never would get rid of the Agena if we couldn't fire the second time and we would have to fire the retrorockets at apogee. And I think we could have gotten back.

Vorzimmer: I see, well, that's nice to know. It makes even eerier if your going out to where you can't come back. That's a long way to wait to degrade back into reentry. Well, let's see you said you have ...

Gordon: I have a 2:00 appointment.

Vorzimmer: A 2:00 appointment...

Gordon: Do you have a couple of quick ones?

Vorzimmer: Well, I don't think they are going to be terribly quick.

Gordon: Why don't we try to get this done some other time, then.

Vorzimmer: Yeah, some other time.

Vorzimmer: This is Dick Gordon again, on the following day, March 21, 1967. All right, where did we leave off. Oh, yeah, the difficulty that you had in deciding the small excursions in the roll horizon censor output channel, it says here.

Gordon: That was on the Agena.

Vorzimmer: Was that it?

Gordon: Yeah, that had nothing to do with the spacecraft. That was on the Agena afterwards, and it had no effect on our particular portion of the mission with the Agena at all.

Vorzimmer: Well, it says in...oh, yeah, this is GATV revolution 43, I see. This is where they postponed the first SPS burn. I see. Okay, that's good. I didn't even notice that, and that does say in the GATV revolution 43. Oh, yeah, and then there was that problem that you seemed to have with the visor. I think it was Machell that explained to me that this particular hand configuration where you are reaching for the visor is one of the very ones where you really do go against the suit configuration.

Gordon: Not only that, it was the visor itself was actually tight in the fitting, it was actually a variation of the fit and it was very, even sitting with the helmet in my lap even after flight, was very difficult to get on and I actually cracked the thing trying to put it on. It's very flexible, so in trying to put it on up here and it had to be lined up very precisely and it was extremely difficult task to perform.

Vorzimmer: But that's what the---that was supposed to be one of the factors which led to a certain amount of fatigue before EVA got underway.

Gordon: Yeah, because I must have worked on that for a good 15 or 20 minutes, trying to put that visor on.

Vorzimmer: But was that on your head or in the lap?

Gordon: No, the helmet was on, and I was pressurized at the time. You see, I can't put the visor on unless the face plate is down and closed, the billbar gets in the way. So it had to be down and closed, and once your on the ELSS, and you close the visor, that pressurizes the suit. So that was part of the difficulty afterwards. And we never had any difficulty with it in training; I'd always been able to put that on without a gread deal of difficulty. After we got back and thought about that, it could have been done the other way around, it could have been done completely unpressurized. All we'd have to do is we'd have to go back and change our procedures we'd been working on for a long time and had the figures down very well, so we'd have to turn off the emergency oxygen and the ELSS, and also turn off the oxygen at the repress valve. And then it would depressurize the suit and it would have been easier to do. But that did get --- I was actually perspiring and hot during this period, and it essentially put me behind the power curve on recovery, so I started out hot and perspiring and a little tired, not really tired or anywhere near that, but the amount of workload coming up, didn't add anything to the...

Vorzimmer: Well, one of the things that was mentioned several times, I don't know if---you mentioned that your timeline throughout the mission, as far as the mission plan was concerned, was tremendously improved in XI over previous missions. Does this include preparation for EVA, as well? This was also a big argument, they said it had to be over a station, you know, and by the time they got around to doing it, and they were very unrealistic timelines.

Gordon: No, it wasn't that so much. I don't think the requirement was to be sure that everything was, the spacecraft and everything was all set for EVA. Of course, they like to have the station pass before they give you the go ahead to depressurize the spacecraft, but this does not have to be done necessarily over a station. Now what they like to do, of course, they like to save the best Stateside passes for EVA while

you're out, because they get a lot more track and its continuous all the way across, and they can stay with you a little longer and watch things that are going on. But the timeline there, we had more time than we knew what to do with. In fact this is one of the things that kind of got us---well, put us in a waiting period where we had four hours set aside in the flight plan for the EVA operation. This was once we started to the hatch opening, this was all what we considered the preparation for EVA. But Pete and I had done this so much and so often in the trainer down at KSC; we'd go over there almost every day and go through this complete exercise, that we were actually ready to go for about 2 to 2-1/2 hours, so we essentially had another rev to set there and wait, and I was on the ELSS, which has the water boiler for cooling, and while the spacecraft is pressurized, of course, this water boiler doesn't work because its not evaporating or boiling off any water. There was no cooling in this, so we broke all these connections, went back on the spacecraft hoses just like you'd use the spacecraft ECS system for cooling, then we just sat there and waited, and then picked up. This was everything except the EVA ladder, all the gloves were on,the helmet was on, and the whole thing, but this way I could raise the visor. So we waited and in about a half hour before time for hatch opening, took off the ECS hoses again and put the ELSS back on, and then put the visor on, and then we opened the hatch and went out. That was kind of a minor incident.

Vorzimmer: That's pretty good about the water boiler. I didn't realize ...

Gordon: Your not getting any cooling at all until that water boiler, that ELSS, is exposed to at least 150,000 feet, or essentially a vacuum so that it does evaporate water and this is what you are using for cooling in the ELSS.

Vorzimmer: Yeah, that's something that, I guess, they hadn't --- had they thought about that problem?

Gordon: Oh, we all knew it, that it wouldn't get, be cooling until it was in a vacuum, but the normal procedures were you were on it for a very short period of time before you open the hatch, where in this case we were sitting there for an hour and a half, or we could have, but we started getting too hot and went back to the spacecraft ECS system.

Vorzimmer: Uh-huh, yeah, that's right, I see. There was no cooling for the ELSS, but it doesn't say why. The pilot became overheated and perspired and experienced elevated heartbeats. I notice that by that time they had attached a lot more Velcro® around the spacecraft interior for the purposes of fastening stuff.

Gordon: Yeah, we had all kinds of Velcro, it was almost wall-papered with Velcro, even on the instrument panel there was a small space with little cut-outs of Velcro we put little cards, and things of this nature.

Vorzimmer: I see. Yeah, they went wild with that, well, one reason was because they did have those complaints about storage and things lifting up.

Gordon: Well, there has to be some place you can put it, and that stuff works, actually it works very well in zero g. You can put a little strip of Velcro on a camera or any piece of equipment you've got.

Vorzimmer: Right, it works very good in g conditions, I imagine.

Gordon: Yeah, you put it on the wall or up over-head, use the whole hatch area for equipment up there that you need to get, you know, you don't want to re-stow all the time, equipment that you are going to be using periodically throughout the mission, so you just leave it out.

Vorzimmer: Well, tell me, Velcro didn't come out very good on this Apollo fire, have they just made another type of Velcro, I mean...

Gordon: There are other types of Velcro.

Vorzimmer: So they just substitute a less combustible, or non-combustible one?

Gordon: I'm sure this is what will happen, but you're right, some Velcro in the other fire did have a...

Vorzimmer: It would be a pity to lose this, because it's been proven so handy; it's even proven for the outside as a---except I think at certain moments, certain directions, it wasn't good on EVA.

Gordon: Well, its extremely good in the chair, I mean it will really hold. You can't pull it off, but you also have to apply it with a certain amount of force to get it to stick to each other, too. So this is one of the problems in using it for a handhold, or something like this. You would have to be able to push down to get the hooks engaged ...

Vorzimmer: And you tend to... roll motion and certain hand movements which pull it off, yeah, that was another thing, too, wasn't it? The adhesive with which they put on the Velcro, I forget which mission it was, one of the later ones, but it seems that some things that had been attached with Velcro, I think it was on the Agena, that the Velcro had seperated, whatever it was out in the vacuum, the elastic material to hold the Velcro onto the article...

Gordon: That could be, I guess there is, in effect, a sort of vacuum on the material itself, and I think it takes quite a period of time, however. It is susceptible to heat, it will melt, and launch heating loads, if it is exposed to it, will deteriorate it to some degree, depends on how much heat it gets.

Vorzimmer: Tell me, have they cleared up the window problem by your mission, or has that cleared up at all?

Gordon: I think they got more information on it. My window on the right hand side, I just read the report this morning, was the cleanest one that they've had to date, but they were able to identify the material, where they were getting the silicon seal that they used around was actually object, and this was leaving a residue on the window. On XII they were able to, by some process and I don't know what it was, they were able to clean that up fairly well, and I am quite sure XII had the best windows of any spacecraft that has flown. But my right hand window was fairly reasonable, it had been the best one they had and we had the window covers on it, too.

Vorzimmer: Oh, you had the window covers on XI?

Gordon: As a matter of fact, I think that IX on up had the window covers.

Vorzimmer: I see. That was a point, but obviously the booster separation did add something to the...

Gordon: I don't know if that's been identified as such or not. I can't answer that question...

Vorzimmer: ... simply because when somebody was EVA on --- and wiped out the window with a towel, there had been no window covers and the pilot reported improvement...

Gordon: I'm not sure what it is. You would have to go back and look at something in analysis from the flight. That could very well be the case, and where it came from, I don't know. There had been speculation, and it could have been some staging or spacecraft separation or something of that nature. I think by and large, most of the material they found, even on the outside, was from this silicon seal that they had been using.

Vorzimmer: Okay, let's see. Oh, yeah, on the ELSS, this is not strictly out of ignorance, but why isn't it possible if you, after all, have an umbilical from the spacecraft to the EVA astronaut, why isn't it possible to eliminate the chest pack? Why can't you use a small one just for emergency purposes? Why does he have to have a rather cumbersome chest pack?

Gordon: Well, you have to look at the thing that it does provide. There is a limitation on the temperature and flow that comes out of the spacecraft, because it's cryogenic in nature and it has to have heaters and it has to go from a liquid stage to a gaseous stage before you can use it.

Vorzimmer: Okay, but why not have the pack proximate to the spacecraft instead of proximate to the astronaut? In other words, still have the pack but have it sitting on the seat when he leaves.

Gordon: This had been considered, had been thought about we could do it this way, but then this is, in the time element, changes the design and characteristics of the chest pack itself. But what you are saying could actually be done. You could have a line going from the chest pack and you leave it in the spacecraft, and then you'd have to have two big long umbilicals from the spacecraft to the EVA astronaut. Now there's probably a limitation there, how long you want to make it, but it only has to be as long as the task required for you to make it. That could be done and it has been considered, but this is more testing because of the pressure loss, or line loss, between the chest pack and the astronaut himself. Where there is considerable length, there is a limitation on how much flow and how much pressure you can provide through that line. These would have been problems, but that is a feasible approach to it.

Vorzimmer: Because one of the things that you reported after the mission was that the PLS test was distinctly cumbersome, I think you reported that the fact that where you could see from your visor to look at the instrumentation on it.

Gordon: There's no doubt about it, it's in your way. Any time you strap something in front of you, and you are trying to use your hands to do work, its obviously going to cut out some of your ability to get close to something if you had to, or move your arms directly in front of you. You have to reach around it all the time. This is very true, its probably the worst place you can hang something.

Vorzimmer: It would have been better on the back, wouldn't it?

Gordon: It would have been, but then you don't have access to the controls if it is on your back. You've got flow rate to select, you've got light dimming switch, you've got a test switch, and the gauges there that let you know how much oxygen you have remaining in the emergency bottle, are all there on the chest pack, so you have to have something you can monitor somewhere. Somebody has to be able to look at these things and determine what is going on.

Vorzimmer: Now, in your EVA you were back in the adapter section?

Gordon: No, I never got back there, I got back to the handrail on the adapter, but I never did get back to the adapter. We terminated the EVA before that particular...

Vorzimmer: I see, you went forward first?

Gordon: That's right.

Vorzimmer: I see. Uh-huh, and that's when you were riding it, so to speak. There were definitely, there was a difference in this driftup tendency.

Gordon: It seemed to be. I don't have any real explanation of what it was, whether it was small forces from the ELSS or whether I was putting these forces in myself or not. Just in the physical...

Vorzimmer: There's an unconcious counter to some other...

Gordon: Well, just the physical activity of trying to stay in place with my legs or feet, so my hands would be free may very well imparted some forces that had a tendency to make me appear to go up. Now by up, that's strictly in relation to the spacecraft as we were in a inertial hold attitude, and some of the pictures, if we had gone further, we would have been completely upside down in relationship to the Earth. So it was merely a reference to the Agena and the spacecraft. Now I don't know what this tendency is or was, or where it came from. Obviously, there has to be some force to make me go in any given direction.

Vorzimmer: Well, it wouldn't be the suit to pull you back into the sort of sitting position?

Gordon: No, that seated configuration is not that much. The legs are slightly bent, but you are really not in a seated condition. And I was using my legs to wedge in between the docking collar and the nose of the spacecraft, and that in itself may have been part of the problem.

Vorzimmer: And you had a great deal of difficulty putting that tether bar onto the collar.

Gordon: No, the tether was simple enough to put on, and the locking device was relatively easy to put over the docking bar, but I had a lot of trouble clamping it down.

Vorzimmer: Using that bar?

Gordon: Yeah, it was a lot of, well, it took a lot of motions, and without hanging onto it, with the other hand I'd hang onto the handrail and try to tighten it with one hand, and each time I went back to get another purchase on it, if I bumped it or anything, it would just spin right around the docking bar, then I'd have to reposition it. It had to be repositioned precisely in a manner so that both pilots in the spacecraft looking through the windows, could view the status display panel on the Agena. Therefore, it had to be placed down very low on the docking bar and had to be oriented in a certain direction so that the line of view is almost in a line of sight to the status display panel, so we came up with an exact location for it. And if it could have been put on any place on the docking bar it would have made a lot of difference, too, but there was this attempt to try and precisely place it on the docking bar.

Vorzimmer: And yet, this would have been known on the ground, though, wouldn't it, ahead of time, this difficulty in line of sight obstruction, because...

Gordon: We knew this on the ground, that's why we planned it this way. We'd gone through this exercise several times and we both would sit in the spacecraft and determine which was the best locations for both of us to see the status display panel on the Agena, and we came up with the actual location for it in flight.

Vorzimmer: Was handrail deployment all right on that?

Gordon: Yes.

Vorzimmer: I see. Well, I think that's all I've got on my sheet. Now, you were talking about yesterday, you know, some of the things that you yourself said in an objective sense, appreciated about the mission and all, Now, if you would like to add anything that you think that I should have for the flight.

Gordon: Well, I really don't know. It's one of the first missions where, with the exception of the early termination of the EVA, it was one of the first missions where all the objectives were actually accomplished. In fact, we added one that wasn't even in the flight plan, and that was that second rendezvous. That was not an objective of the flight, it was just an exercise that we were able to do simply because we had the fuel to do it, and we were in the proper position to do so. If it looked like we weren't going to have the fuel, it would not even have been attempted. So I think in that essence, I think both Pete and I take a little bit of pride, mainly in the fact that we were able to accomplish all the objectives and to actually stay on the flight plan without any major perturbations. Now we were very lucky in this regard, one of the reasons we were able to do this, probably one of the biggest reasons we were able to do it was the spacecraft was a pretty decent spacecraft and it never gave us any problems. If we had had system malfunctions or system problems with the spacecraft in any portion of this flight, our attention would obviously have been diverted. But a very deligent attention to the details of the flight plan allowed us to do this. We would, even during the sleep period, when our work was through during the day, we would completely restow the spacecraft and get it in the exact configuration for the next day's activities. We'd haul everything out and tack it in the stowage in the reverse order from which it was going to be used, so that all the equipment, as it came out, fell right in sequentially with the next day's activities. You are working

all the time up there, in this regard, trying to think what you are going to be doing next, and when somebody is performing a given task, the other guy is looking at the flight plan and making sure that he has things ready to go for the next experiment. Because just the assembling of the equipment and the gathering of the, oh, camera as an example, with the various lens and so forth, for the experiment, and the assembling of these things takes a considerable amount of time. So we'd attempt to do this all the way through. I think the major portions, of course, that were accomplished, the M equal one rendezvous, certainly; and this was the first time that we got all four dockings in that were planned in any flight; the first time that a pilot had been able to dock and undock; our ability to use the Agena effectively and efficiently was a plus, I think.

Vorzimmer: I notice on this thing about docking, I was just reading the GT-12 Mission Report. This is the one where in docking, they gave an impulse to the Agena. And everybody seems to be quite surprised. Is this...

Gordon: That's why Jim has the nickname of "Shakey".

Vorzimmer: Oh, really, that's pretty good.

Gordon: No, we give him a bad time about that. He's not supposed to hit the Agena that hard.

Vorzimmer: You mean, it'll tilt the Agena...

Gordon: ...sure it'll spring weight on that rim...there's little tiny thrusters, 5 pound thrusters trying to control this great mass of material, and if you perturb it, it's going to move around. It'll come back, it just takes a little while to settle down. And when your talking about dead bends, we did our dockings in flight along those lines, which is the sloppiest. It has a 5°, plus or minus 5° in any attitude, it has a dead bend which it can oscillate around it, and the thrusters won't fire until it gets to the end of the dead bend. And even when they do, it takes a very long time for it to get back. Well, shoot, you disturb it in this manner and it's just going to take a long time. It will eventually come back if you have the patience to sit there and wait for it. But we never had any problems with the Agena in this regard at all. In fact, our only problem with the Agena was in being able to talk to it, we had some problems because of the transponder difficulty. But after we were---even when we were docking the heart line, there were several times that we had to send commands twice before we got a MAP, which is a message

acceptance pulse back from it. But in all cases when the ground was monitoring, they got MAPs back from the Agena on every occasion. So we knew there was probably an inability for the two vehicles to talk to each other.

Vorzimmer: What about experiments, now? This is one part we haven't covered, but I don't remember exactly the ones that were on your mission. Was there anything in particular?

Gordon: I'll almost have to go back and look at that list, as well. We accomplished all those.

Vorzimmer: I mean, if anything stood out with regard to experiments because the record is in the mission report, but I just...

Gordon: No, I don't know. I think the one that was most interesting to do, from my standpoint, of course, they were all interesting and had a great value in everyone of them, but I think the one that was most interesting to us probably was the S-13, which was the standup EVA, where we did the open hatch photography and the ultra-violet spectrum of the so-called "hot stars" on two nights there.

Vorzimmer: Uh-huh, you each worked on it?

Gordon: Yeah, and we had a lot of fun doing that and that was a very enjoyable thing to do, just standing outside the spacecraft and being able to see as much as you are able to see. And then the fun we had lining up on the proper star because Pete's window was really quite bad, and he was having a great amount of difficulty aligning the irradical, or aligning the star field of the constellation pattern in the radical in a certain manner, so the spectrum lines from the stars wouldn't overlap or fall upon one another. I was trying to direct him to some of these places, but I'm just standing out there with no sight or anything and I can only get a very general direction of where to point. We had a lot of fun doing that. That was an extremely interesting experiment for us to do, or attempt to do. We used the Agena once again to a very great advantage. I don't think we could have done the experiment without it, because your pressurized and the spacecraft control is very precise. So Pete would fly the vehicle to the right attitude and I'd reach down and turn the Agena back on, so that we'd use the Agena's control system to stabilize us inertially at this position, and then we'd take pictures, the camera mounted bracket on the outside of the spacecraft held the camera, so it was a matter of taking a sequence time-exposure. To me that was one of the most interesting experi ments that we had.

Vorzimmer: I'm curious about personal questions about EVA, and stuff like that, because I remember from my own flying days that, you know, without a parachute in these old Tiger Moth's, the only thing that held us in was four straps and each had metal . . . with a cotter pin, one pin that went through the center and the cotter pin went through that. And I remember many times just as I'm going to do a stall spin or something like that, just for the hell of it, I always looked down there and checked it. So I'm sure that you must go over it pretty thoroughly, that suit integrity checks before they pop the hatch. . .

Gordon: Yep, I think this is probably one of the most dangerous things we do, really, is EVA. I mean, its dangerous from several standpoints. There isn't anybody that can help you, you are sort of on your own, even with two people there, you can hardly help each other. If one got in trouble there is nothing the other guy could really do; your gambling, its a calculated risk. Your gambling on the equipment your wearing and your gambling very highly on suit integrity. There's not much between you and oblivion other than that suit and the visor, just the one piece of visor that has the seam around the face, all of these things have to work. But I think your not concerned about them working, you make sure that you do every thing you possibly can to make sure that the equipment is in the best possible, and that you have the knowledge of how to use it, how to assemble it and how to make it work. I think by working with the people and working on the procedures, and doing this over and over again, you gain the confidence that is essential to the accomplishment of these tests. It would be really foolish to even attempt something like that if your main concern was your equipment. So you go as far as you can and that's the best you can do, so you accept it. I don't know what you have to do, either rationalize this or you just have a thorough knowledge that this thing is going to work, and don't worry about it. Now I'd venture to say that you look at the pressure and make sure that it is being sustained quite frequently. Every time you bump something, I know I came back one time and hit the corner of the hatch, and you want to make darn sure that you didn't rip or tear anything, or a small puncture or hole. So you are conscious of the pressure being maintained in the suit.

Vorzimmer: And, of course, being the 4th man helps a little. The first guy out who didn't even know about what micro-meteorites might be pinging into his suit, he must have had an even greater. . .

Gordon: Well, there's a lot to be said about that, but then you've got to look back and there's been a lot of spacecrafts up there, and they've had very few micrometeorite impacts that could be identified as such, and the EVA suit is an entirely different suit than the other one, and it is constructed to withstand the micrometeorite impacts. Shoot, there wasn't a mark on mine, and I don't know of anybody's suit that has had a mark on it.

Vorzimmer: It's a pretty small parcel when you think of outer space.

Gordon: Yeah, the chances are extremely remote.

Vorzimmer: But what about this case where somebody's some sort of suit outlet valve was leaking during the entire time of the mission?

Gordon: Well, that can be tolerated, too, as long as the supply is greater or at least equal to the demand.

Vorzimmer: What's the sort of feeling, I mean, you must get irritated as hell at the - since that was - by the evidence on the way they have of piecing this thing together, it was found to be that way when that guy got into the spacecraft, something that came from the vent, and it must be, you know, you figure we got enough problem with the normal risks, we can't be bothered...

Gordon: Well, I don't know, to err is human, I guess, and everything mechanical, more appropriately, everything electronical, our electronic devices we feel is more susceptible to failure. Shoot, if you could drive your car all the time without ever getting a flat tire or having something happen to it, it would be great, but you know, this can't happen.

Vorzimmer: Except you figure the guy makes only 40 suits, and its quite different from General Motors who makes 40 million cars, and the number of lemons to the number of overall cars seems to make---you should be able to get by with 40 suits...

Gordon: Well, I don't know, the precision with which these devices are made, the tolerances that are so-called acceptable, the specification values are extremely tight. It takes a great deal of craft and workmanship to make these things function. Hopefully, you catch these things, your quality assurance program and the many

inspection processes and testing processes that take place are going to find them when they are at fault. But I don't care how many nines you attach to your liability, that doesn't impress me. The thing that impresses us is that .0004, those failures and what happens if this failure did occur. Now we don't care how remote it is, if it is a possibility, it is liable to occur. And we want to know what that failure itself will do to us within the mission or the spacecraft or whatever. So if we have the capability to work around this failure, well, this is what we want. We have to be able to survive this failure, and more appropriately, to continue the mission. So I think this is the way we look at these things more than --- the reliability numbers don't mean a hell of a lot to us, as per se. We are much more concerned with the failure numbers, and what do we do if it does fail, and what backup systems or what assurance do we have that we can continue to function properly.

Vorzimmer: Okay, but, now, just to be quite human, now, maybe I'm trying to say something that isn't true; I'm not really fishing for anything, but, just knowing, having an impression of what you guys are like, and when a suit comes down, and its been leaking on the fellow all the time he's been up there, I mean, its all nice to say, I mean, you sit back and say now that its all over, and you say "well, to err is human", but I'm sure that something is slammed half way across the room when somebody gets down and says, you know, you'd think ...could make 40 suits without making a...

Gordon: He probably never even knew it.

Vorzimmer: Yeah, he found out when he got down, I'm sure.

Gordon: Well, if he did, he probably shrugged his shoulders and said "well...

Vorzimmer: Well, that's true, but don't you guys really get ticked off at vendors, I mean, you know, like the tape recorder failures, for four missions in a row the tape recorder failed...

Gordon: All right, the repeated ones, the ones that happened over and over again continually are the irritating ones. The tape recorder was an extremely good example. A tremendous amount of mission

data has been lost because of tape recorder failure, whether anybody admits this or not. The voice communications recorded between, just between the pilots themselves, contain an awful lot of this data that you would rather put on a tape recorder than to take the time to write it down somewhere, and a lot of things have been missed just because of this. But I think you probably hit the crux of the problem with that last statement. It's the ones that continually happen over and over again that kind of irritate you, and they irritate everybody. That on-board tape recorder was not an inexpensive piece of equipment, for all the value we got out of it.

Vorzimmer: Right. And there again, how many Ampexes are sold in homes and how many are lemons, do you think, when a man is geared, especially, these are the ones that come back and could be used again. Let's say a vendor makes four tape recorders in this age where transistors have proven themselves, they can miniaturize and do this stuff. And that biomedical tape recorder, that really small one was doing such a damn good job, and here he's got this other machine...

Gordon: That bio-med tape recorder is not a very small one. That's a pretty healthy piece of equipment, its got enough tape there for the entire mission, because none of that is dumped, that's all on-board.

Vorzimmer: Yeah, I was very impressed by that, but not quite...

Gordon: Well, I can't argue with you on that, in fact, I won't argue with you. I can't agree with you, there are certain elements that you can identify that can change and give you problems, and you wonder why it didn't work. And they always found something wrong with it. Now we had tapes that apparently nothing was wrong with them, but they just never ran through the tape recorder. You take out the cartridge and look at it, and the tape hasn't moved and its been running for an hour.

Vorzimmer: Well, what do you do when you come down, then, is this stuff you feed through Slaton and...

Gordon: No, we grabbed the whole debriefing process, taking care of these problems. You have various debriefings; the systems debriefing, the total mission debriefing, experiments debriefing, we debrief the other flight crews and have a session with them. All of these are, every phase of the mission is covered by the crews debriefing with those people that are more vitally concerned with any particular

system or sets of systems, if you will, like the Agena spacecraft.

Vorzimmer: Okay, so someone handles your gripes are automatically...

Gordon: Yeah, there is no doubt about it. Everything that we come back and report is thoroughly looked into, and I'm sure if you can find somebody that's still around that spent a lot of time on the Gemini tape recorder, somebody like Scott Simpkinson, who's...

Vorzimmer: Yeah, he's been taken off, though.

Gordon: pet peeve, he could probably give you a complete rundown on what happened...

Vorzimmer: I didn't ask him about the tape recorder, but I got some beautiful stories on the angry alligator landing systems. The guy in Seattle whose wife was having a baby, but I was interested because there is---I would get this feeling...

Gordon: Well, we don't get that upset over the actualated type things that fail. Now take that valve that leaked, so the valve leaked, that's no big deal. If the valve failed it would be a different story, but as long as the leak is small enough so that the amount of oxygen you have flowing in...

Vorzimmer: ...if some additional thing had come, I mean, you know, like...

Gordon: You mean to compound your problem...

Vorzimmer: That's what I said, if I were the astronaut, I'd say, "Look, there are enough problems like that contention possibility to worry about, not to have my suit leaking all the time, shifting out the back, so to speak".

Gordon: I'm sure he wasn't even aware of it.

Vorzimmer: That's true. But sometimes it would even irritate...

Gordon: Even if it leaked and was passing his suit integrity checks that you provide on the suit before you go on EVA, if it passes this inspection. There is some leak break, there is a certain amount, anyway. So if its within the reasonable number that somebody has arbitrarily established, maybe, at least its been established and everything has been going through all the checkout procedures, meeting this justification, it shouldn't bother you too much.

Vorzimmer: You know, what we were just talking about reminded me of somethings else. First of all, most of you are assigned, I believe, to some specific area of specialization, not just relative to your mission, but all the time.

Gordon: No, not necessarily, anymore. There used to be that --- people that are on the flight crews do not have this particular assignment. Once somebody is on the flight crew he has been relieved of any technical responsibilities.

Vorzimmer: Well, when you first came on to the Gemini Program, they handed you a list and said pick an area of specialization, EVA, rendezvous, suits, or ejection.

Gordon: That's right.

Vorzimmer: What was your particular one?

Gordon: I had the cockpit controls and displays, for a while, and then when most of the people in the second group moved up and were on flight status in the Gemini program, I had the Apollo branch at that time.

Vorzimmer: I see.

Gordon: Then shortly thereafter, about a year, I guess, I was assigned to one of the Apollo crews, I mean the Gemini crews. Once you are assigned to a crew, then you primary responsibility or duty is training and getting ready for the flight. So you don't really have what you would term an area of specialization.

Vorzimmer: Well, what I meant was, for instance, one of the people that stands out in the Gemini program as having made a lot of very valuable inputs was Rusty Schweickart, because he sat on a lot of committees. This is just what I get from the documentation, because his name is carried sometimes. He got up or I hear about some other people at these meetings say Schweickart got up and said, "My god, you can't expect an astronaut to do that. I suggest you..." So there is somebody at these various panel meetings who represents the astronaut's view. I can remember a case, I can't recall who the

astronaut was, but in one case when the Air Force first presented the AMU, or the MMU that came out, there was no tether involved. They saw the tether as being, presenting hazards, infact, and so the guy was going to stand at the edge of the hatch like bailing out of a plane and just jump off. All I had was the flight crew support committee meeting as they entertained this idea, see, I only had their half of the minutes. I didn't have the Air Force presentation, but it was interesting about what you could imply on the Air Force presentation on the basis of what flight crew support, what strength they wanted to put on it. They listed the restraints and you wonder, if your in my position, you wonder what the hell it was like without the restraints. And the restraints was to use the tether, no, it was first check it out before pushing off in the spacecraft, which was, I thought, a pretty reasonable one. And then they wanted a tether, then they wanted the EVA pilot to be in view of the manned pilot the entire time, never be out of his sight. And also, this is again what was on it, be untethered or even tethered, that there be enough OAMS to rescue them. I automatically wondered what the blazes the Air Force proposal could have been without those restraints, because it was presented without them. Well, here was an example, those restraints were inputs, I think it was either Warren North himself, or one of the astronauts on the panel, so I was curious to know if you know of any situations, like yourself on the panel of displays, where you sat on comittees reviewing things which would later be used in missions.

Gordon: No, my big concern was to actually make sure that the astronauts in the spacecraft had the ability to monitor and control adequately all of the systems that were involved in the operation of the spacecraft. And then, of course, we get into the problem of arranging on the panel and the proper and logical order of the sequence, which a lot of times you can't do because of space limitation. But the primary concern was to provide enough information to the pilot so that they would know how the system was performing, how it was functioning, and then provide the controls for him to be able to do something about it if it wasn't properly functioning, or to control it.

Vorzimmer: Well, were you responsible for any of the changes that were made in the configurations?

Gordon: Oh, yeah, shoot, we used to change that thing daily, until we finally came around to a reasonable configuration, and it still is probably far from optimum, but...

Vorzimmer: Was this before GT-3? Or are you talking about changes after GT-3?

Gordon: This was in Apollo.

Vorzimmer: Oh, this was in Apollo. I see. What about the Gemini?

Gordon: On Gemini, I guess, they assigned to another flight crew member. I never did anything in Gemini. That particular area was more or less concrete.

Vorzimmer: But on the other hand, you weren't assigned to a crew until March, '66.

Gordon: No, that's when it flew, was in March, '66. I was on a crew in, was it October, '65?

Vorzimmer: No, you flew in September.

Gordon: Yeah, but I was backup on VIII.

Vorzimmer: Oh, I see, I see. That's right, cause that accounts for the flight crew, as well. I get it. March 26 was when you were appointed to the XI mission.

Gordon: And then its just a matter of,the Gemini spacecraft had come along so far in its development, or in the evolution of the spacecraft, that there wasn't really anything left to do in that particular area.