Grimwood: This is Mr. William O. Armstrong, NASA Headquarters, January 24, 1967. Mr. Armstrong is Executive Secretary of the Manned Space Flight Experiments Board.

Armstrong: -- got involved in Mercury. I don't want to put a whole lot of stuff on tape, but basically my involvement started as a carry-over from the Mercury program. Flight Operations and Warren North's group had a flight experiments section which I headed up. This flight experiments section in Mercury did most of the effort of the implementation of the Mercury experiments, particularly the planning into the missions, crew briefing, and this sort of thing, and the development and making the equipment suitable and satisfactory for the crew to use, and I was still on this job while we made the transition. I started out in the Gemini program in this same function. At that stage - this was about a year to a year and a half before flight - we were just starting to define the experiments. We were doing little more than just trying to get a handle on the general requirements that were going to have to be satisfied. It was determined at the Center that there was a broader base required to sort of pull together the experiments efforts at the Center than just that located in Flight Crew Operations. So Faget and Slayton and - I don't remember whether Kraft had anyone immediately involved - but someone from the Program Office got together and talked about this and they decided---

Grimwood: Andy Meyer?

Armstrong: It might have been. And decided to get together and come up with a Coordinations Office. Eggleston, myself, and Kuehnel drafted an approach to this. Subsequently, with some modifications, it was bought off and I became head of this new office under Faget's organization. Our job---

Grimwood: Do you remember when this was?

[64]

Armstrong: It must have been in early '63. This office - and there's a management instruction still floating around the Center somewhere that can detail the responsibilities more than I can, but it was sort of the centerfold point to coordinate Center activities. It had no line responsibilities. It was supposed to see that the experimenters were informed of what they had to do to get on board the vehicle and make sure that the Program Office got all the information and the hardware and what not that they had to have to implement that the requirements, from an operational standpoint, were prepared and transmitted to the Flight Operations people, and that the crew support and crew training requirements, etc., were generated and transmitted to the crew, and to keep a general eye on the schedule and also to interface with Headquarters

on the experiment operation, because at the beginning of the Gemini program - let me go back. In Mercury, the experiments were selected by a Flight Selection Board in Houston. Mueller changed this before the Gemini program started and created the MSFEB. So the selection of experiments was no longer at Houston but at the Headquarters level and this board began to function sometime in early '64, I think. At that time, the board---

Grimwood: Who headed it up to begin with.

Armstrong: The board was chaired by Mueller and had Gilruth, von Braun, Gray, Newell, and Bisplinghoff, and who was that space medicine --

Grimwood: Lovelace.

Armstrong: Lovelace was on the board, and General Ritland at that time. And that was the board and Mueller was the chairman. I think Low was on it, too, eventually, and Walter Williams. They both dropped off as they moved out; as Low moved to the Center, he dropped out and when Williams left, he dropped out. But this board operated this way: each organization that had experiments they wanted to fly would bring these experiments to the board, and present them to the board, and the board would decide whether they thought they were the kind they were interested in or not. If they were, they assigned them to Houston for compatibility study; and this assignment was through my experiments coordination office, so I then fanned these out to the Center and let all Center elements review the experiments for compatibility to the vehicle, to the flight crew, to the mission, etc. Then we had what they called the experiments review panel, chaired by Faget, and representatives from each of the directorates sitting on this panel, and they reviewed this study effort and the minutes basically constituted the Center position on whether or not we could handle the experiments sent down by the board. This was prepared, then, in a written form, through Gilruth, back to the board and then was reported orally to the board at the meeting, identifying whether Houston thought they could or couldn't carry it. Then the board, based on this information, would recommend either approval or disapproval of the experiment to a specfic flight. At that time, they considered them for specific flights. Let's say that in May you got a bundle of experiments in from the various offices that were to be considered for Gemini V. They sent them to Houston. Then, in July, you'd report back on these experiments and if they were compatible, the board would say we recommend approval of umpty-ump experiments on Gemini V. Then, with Mueller's signature, it became a fact, and they were sent

down to the Gemini program office for implementation. And that was the general process of selection. That went on all the way through Gemini and the first two Apollo flights were selected in the same process. We got an awful lot of experiments on Gemini.

Ertel: From your point of view, what---

Armstrong: There was a couple of things that - there were a couple of drawbacks. First of all, you always had trouble getting people to submit adequate documentation to really do an evaluation, and so you could only really come to a tentative position, and you got into a lot of trouble downstream that we worked our way out of, but it created, I'm sure, a lot of headaches for Mathews. I don't believe that they had to take over one or two, of the some hundred or so experiments that were flown, off the spacecraft because they couldn't handle it after they'd agreed to fly. But it caused a lot of strain.

Putnam: This is largely like how much time it was going to take, or---

Armstrong: Generally the problem was - a few of them were operational, but a few of them were also hardware. They just couldn't make some of the changes, or we ran into a weight problem or something like this. There were a variety of reasons. As I say, it was a very small percentage that didn't make it once they were approved by the board. One of the problems,though, was that you didn't get good enough documentation of the experiment to start with. Secondly, you didn't have too much time, and we didn't have money to go to McDonnell and study it prior to board review; so you've got more or less a tentative approval from the board instead of a firm commitment. Again, they met all of them and they- let's see if there's any real serious - I guess the other problem was that the Center didn't have the kind of latitude that most of us felt that they should have had, and this was later corrected. Mainly, the board selected the experiment to a flight without any latitude in the program office. It might be that the mix was improper. They might not have picked enough experiments for Gemini V and put too damn many on VII. So later, and the way they do now, they're approved to a program instead of to a specific mission, and leave the assignment of a specific mission to your implementation.

Grimwood: When was "later" in the Gemini program?

Armstrong: Well, this never did occur on Gemini. You always assigned by flight in Gemini, but in the Apollo program, since about

205, and certainly now in AAP, we select by program office, only. The board recommends approval to the program board and then these programs make their flight assignments.

Grimwood: A Gemini experience lesson then.

Armstrong: That's one of the experiences that came of out Gemini, I think. I think that another one was that you have to have a sort of focal point at the Center to handle experiment activities, if they were going to be run properly. That's how ECA came into being, that was later expanded into the EPO that Piland took over.

Grimwood: It's now Science and Applications Directorate.

Armstrong: And now they've gone back four years, I think. And, believe me - off the record - I'd better not say this; you're taping it.

Grimwood: Go ahead.

Armstrong: They went back four years, in my opinion. They're right back where they were with Mercury, with no real central point of location. There is indication that they may straighten this out. I think that Piland will still - in talking to Low, anyway, I think the idea ia that Piland is going to be Science and Applications, but sort of a focal point for definition, overall, and that, once you go through the board and start development of experiments, then the experiments will become the responsibility of the flight ops. And even though Piland's group will develop science experiments and Berry will develop medical and Faget engineering, the focal point, the guy responsible for schedules, basic requirements, money, and that sort of thing, will be Thompson, SAA. He'll let these guys do the detail work, and this probably will work all right. I don't know. I was a little disappointed at first when they killed the EPO, and I think Mueller was a little bit unsure about this, initially. I know Gray was, but I think most people are satisfied that this proposed scheme will work all right; if they ever figure out what they're going to do, and they haven't yet. That's sort of the history of what went on in Houston.

Grimwood: How did the priorities on the program come up?

Armstrong: That's been a sore point, and I guess there is some reason for complaints about this. Legitimately, the MSFEB was responsible for assigning experiment priorities, providing for priorities. That

function has never really effectively been exercised. They sort of worked at it, but I don't think they have ever, not even today, come to grips with a good system by which you assign priorities. What you have done so far is gotten these offices, these sponsoring offices, to establish the priorities of their respective experiments. Now, on Gemini, before each flight, the Gemini office would write each program office for a priority listing of their experiments on that flight. So OSSA would list their priorities, medical would do theirs, engineering, and so on. Now, the question of how you fix the priorities of these groups was determined pretty much by the program office and Mueller. This is what I suspect they're grumbling about. However, I really don't see why they should have, because science came out pretty well. Mueller's approach generally was this for Gemini: medicals got first priority, and they flew really on the increasing duration missions only, like IV, V, and VII. They didn't fly any of that on anything else, so they couldn't have hurt. I think that was a logical choice, at that point, when you're going to extend man's duration. The most significant thing to measure was what effect it had on the man, and so I think it was logical to give medical the high priority they had. They didn't fly on most of the other missions, and, therefore, they couldn't affect the science very much. Science, generally, was number two and there was so little technology that you won't affect it - so science, generally, fell right under medicine and the engineering experiments out of Houston.

Grimwood: Where did DOD fall?

Armstrong: Oh! Wait a minute! There was a hooker. DOD got in there pretty high. I don't know where they fit all the time, but they were usually right up in the upper block, and that was by NASA agreement with DOD long ago. There was a general rule set down that said that the first priority of experiments would be---

Grimwood: Operational.

Armstrong: That's right. Those that---

Grimwood: Second, DOD.

Armstrong: Roger.

Grimwood: Third, science.

Armstrong: That's right. And that's how the military got in high. That's right, and this was not Manned Space Flight's fault.

Grimwood: Did you know that DOD almost took over the whole program right about that time?

Armstrong: I wouldn't be surprised.

Grimwood: They had a real rough afternoon on that with Rubel, McNamar Seamans---

Armstrong: Oh? And they were going to absorb NASA?

Grimwood: No. The Gemini---

Putnam: The Gemini experiments?

Grimwood: Not Gemini experiments - Gemini.

Armstrong: It was going to become a DOD program. Instead of being MOL now, they would have picked up way back there.

Grimwood: How it came about was that Dr. Gilruth had always had an interest, from his old NACA days, of what you learn to be applicable to something - and he thought that the military would be interested in a program like Gemini, because that was going to become an operational program, you know. So he made that suggestion and Seamans said it sounded pretty sensible to them, so they talked about it, and McNamara happened to walk in. They had a pretty rough time around there for a while. He says, "What are you going to do? Take over Houston? You can't just take over a program. You have to take over everybody connected with it. You couldn't do it otherwise." And so they batted it back and forth. All right, go ahead with your DOD.

Armstrong: That was how DOD got the leverage on experiments. By operation - that was interpreted pretty loosely at first in proposing experiments, but Mueller put really tight reins on it when he assigned priorities and almost none of the Houston experiments ever qualified, in the strict sense, as operations. They thought they were going to be able to do it this way, and that's the way they proposed a lot of these experiments, but they didn't come out in the priority just that way. In fact, he was a little dissatisfied with a lot of the Houston experiments on Gemini, and they got the lowest priority of almost all the experiments flown. DOD, on the other hand, did get priority treatment over OSSA, and I guess they probably didn't like that; but other than DOD, OSSA got as good a shake as they could be given.

Grimwood: Did you ever hear anything on astronaut performance on DOD [experiments] affecting their ER's?

Armstrong: I've heard talk about it, but I don't believe it.

Grimwood: I just wondered.

Armstrong: I'd heard some people say that they were - that a couple of the astronauts were more or less warned that they were still in the military, but I never saw anything that really gave evidence that this was a fact.

Grimwood: Do you remember whether or not Cooper was one of them?

Armstrong: That's the one I heard.

Grimwood: All right.

Armstrong: Yes, I heard that. I heard he was told - he didn't want to do one of the DOD experiments.

Grimwood: Yes, he came out pretty shaken.

Armstrong: And I heard he was told, "God damn it, you're still in the Air Force, Buddy, and you'd better remember that when you're perform---when you're up there in flight with this experiment, because we've put a lot of money in it." I heard that was true, but whether it's a fact, I can't verify. It was hearsay to me, but it could be. I don't know. I heard it came - I don't remember - I believe it came through McKee's organization, Dan McKee. I mean - I believe - the word I had was that this message was transmitted down through Dan McKee.

Grimwood: You know Cooper got way behind on training.

Armstrong: Yes, I do know that. He, in fact, caused probably Houston more trouble than any of the flights, because he got behind on training and ended up having to delay the flight because of this. Mueller was damned unhappy, damned unhappy, and he crawled all over Deke about this. I guess he did - and that was the last time training was ever used as an excuse for slipping a flight. In fact, they pressed the schedule down to where they were able to go on six weeks centers, and as I understand, initially - I know, initially, that three months was out of the question. So Mueller was effectively able to reduce the schedule time. No question about that.

Putnam: Did weight ever become a constraint on experiments?

Armstrong: There was always a constraint. We were always bumping the weight limit, almost in every mission that I can think of. It was just - we would have never made it if the uprating of the booster had not been what it was, and it they had not been willing to relax some of the ---

Grimwood: Some of the three sigma---

Armstrong: Yes, that was basically what it was. You just backed off on what was originally your considered requirements - that was the only way we could lift them - because they would never have taken the experiment growths they did, if they hadn't backed off. The growth of the spacecraft, plus the addition of experiments, would have been such you just couldn't launch.

Grimwood: When they knocked off the paraglider, did the experimenters see this as a big pad and come in and try to overload or not?

Armstrong: No. The experiments came in pretty steadily all the way through the program, and I think Mueller's approach to it was to load as much as you possibly could on there, and when you run out, you don't put any more on. He really pressed Houston to - well, I'll say this - without Mueller's influence on the program, experiments would have gotten nowhere, because Houston's attitude to experiments, initially, was very negative all through the center.

Grimwood: Don't you think we got started kind of late?

Armstrong: Yes, we did.

Grimwood: Don't you think the lack of a real scientific type down there---

Armstrong: Probably was a great contribution to this. Because there's no focal point at the center to stimulate interest.

Grimwood: Because it's an old aircraft group?

Armstrong: That's right. And it's still even true today - that resentment, resistance. Another thing that became very evident in the Gemini program - one of the things that created trouble with the experimenters - since I have been up here and have been going to

these scientific get-togethers with the principal investigators on a bi-monthly basis, it became real apparent that, during operations, the experiments were getting the short shake. You'd lay out a general plan for doing the experiment. Then, as soon as you got into some kind of a problem, there was no real contingency planning, and the first thing they did was say, "Chop out experiments." You get a little power problem? Cut these experiments off. There was no thought about whether you were going to benefit your mission any by cutting the experiment off or not. It was just automatic. The experiments go right out the window as soon as you get a problem. And this wasn't corrected until the very last, or next to the last, flight, where the operations people under Kraft began to really consider the experiments as a system, assign this responsibility to a guy who could sit in the control room and act as an experiments flight monitor, just like you have medicine, or the astronaut, the ECS system, all these other systems. The experiments became a system; they had an experiments officer on the floor. I think it was on XI or XII. On XI it began to take shape, and on XII, they got it into operation. It had a tremendous effect, because on XII, the same incident occurred, as I was told - they got into a power problem, as you remember, and the immediate reaction of the flight director was to cut off the experiments; and this guy says, "Wait a minute. We've got an experiment running, that's true. But look at the power it's drawing, five-tenths of a watt. You've got all kinds of power problems. Cutting that experiment off isn't going to solve your problem." So, after all, they got their data. Otherwise, it would have just been clicked off. And this was the general trend through Gemini up until the very end, and they just began to appreciate the necessity of managing the experiments, figuring out contingencies, so that if you got into difficulties in flight, you had a way of going back and still trying to recoup some of the data. Mueller made a point of asking the things we learned from Gemini. This was one of the things we learned from Gemini, I think, that you need this kind of real time support in the control center for experiments. He also stressed the necessity of a quantitative assessment of crew training, not just letting the crew train until they thought they were trained, and say, "Okay, now, I'm ready to go on to the next task." He wanted them to carry out training in such a way that you could sit back and quantitatively analyze their performance, and say, "Yes, it looks like they're ready." That hasn't been put into - it's hard to see the effects of that yet, but I think that was one of the things that was needed, and hopefully will carry into Apollo and Apollo applications programs. He felt that the loss of M-5 data on a couple of flights was due, in

a large measure, to this - the crew hadn't really familiarized themselves with the mixing process you have to go through to mix this tritiated water with the urine, which was necessary to get a good measurement of the volume, and he brought this point up, and it is noted in the MSFEB minutes that Mueller felt this way. I think the idea of simulating experiments during the mission simulations just began to take hold before the end of the program, recognizing the need for this certainly as you go into AAP. So, some of these lessons, I think, came out of Gemini that will benefit experiments as you go downstream.

Putnam: How about the time problem, both in terms of training and mission time? Bill Schneider said that the experiments, once they got on board, tended to stretch out in the amount of data the guy wanted or how much time the astronauts would have to spend, and how much of the flight plan they would take up. It got to be a problem for flight planning.

Armstrong: It probably did, but I think that may be a somewhat biased opinion. I don't believe the requirements of the experiment expanded a great deal - maybe in some instances. It generally shrunk, simply because you found out that what you wanted to do, and agreed to initially, was out of the question, that the time involved was just such that you couldn't do it. So you cut back. Maybe the experimenter asked for ten hours time, and you'd only be able to give him five when you got down to the final analysis. But the reason this happens is most experimenters are going to ask for the most they can get, and you can't really definitize what you can give him until you finalize your mission pretty well, and that doesn't occur until you get down to four months, maybe three months, before flight, when you've really got it latched in. As you begin to zero in on your real time line, that's when you find out you couldn't hack what this guy asked for, and you may have to turn back. That happened in, I'm sure, a good number of cases. There may have been other cases where the experimenter really felt that he needed to expand his time requirements, but the general case, I'd say, would have been the other direction - but not through faulty plans. It's just one of those things that evolves as you nail down the mission.

Grimwood: Bill, we've gotten the kind of negative side here on Air Force. They did put $20 million in it. What did they get for their money?

Armstrong: Certainly the biggest loss they had was the D-12. That was their most expensive experiment, the AMU. They didn't get very much out of their photography experiments, you know those D-1, 2, and 6, I guess it was. They were unable to fly on but one mission, and one of the experiments, I forget which one it was - the space object photography, they didn't get to, at all. The other was---

Grimwood: What didn't they get?

Armstrong: Those are the only ones I know of that you'd say they got sort of negative results. They got fairly good results on the navigation experiments that they had, and I think they had two of those, 5 and 9. The equipment failed on one of the missions; but in general, I think, they got pretty good data on navigation experiments. The D-10 experiment was a real - yes, D-10, ion sensing attitude control - that turned out to be terrific. They got excellent data on two flights on that. I don't know how good the data on the D-15, light image intensification, was; but, as far as I know, they got data and they verified the guy could see the imaging all right; but it didn't turn out, from what I understand, quite as good as expected. I'd say that was a qualified successful experiment. Their radiation in the spacecraft worked perfectly good. They got good measures on that twice. The D-5 and 7, the space object radiometry - D4-7. It was celestial radiometry and space radiometry. They measured four or five different sources of radiation, like the moon, the earth, the little thing they kicked out, the Agena. They measured some nearby space object - you know, the missiles they fired. Anyway, they had good, excellent data on this thing - they'll be reducing that for two years.

Grimwood: What's your assessment of the planning and engineering of their experiments program?

Armstrong: It's probably the best. In the---

Grimwood: With the exception of the AMU.

Armstrong: Well, that wasn't their fault.

Grimwood: The engineering?

Armstrong: That problem was an EVA problem that we had, not the experiment.

Grimwood: There are some who blame all of us and the program office; they blame MAC on placement; blame themselves for not hooking in and getting it planned themselves and forcing MAC. And they blame the Air Force for having a clumsy machine.

Armstrong: This is all subjective, so I can give you my personal opinion. I think that we started off on EVA with a real big bang and thought, boy, everything is glossy, smooth, and nothing to it, and we never came to grips with the thing again. We got into trouble. We tried it again on - what was it - VIII?

Grimwood: You're saying that, in the long run, IV hurt us?

Armstrong: Well, I don't know that it hurt us, but I think that we thought we had it by the tail, and then we got into some problems. And we never stopped and sat back until we had the trouble on XI and said, "Now, wait a minute. What kind of difficulties are we getting into, and what should we do about it?" In my personal opinion---

Grimwood: What about IX?

Armstrong: They got in trouble on IX, but they went ahead and flew XI, too, before they stopped. XII was a big EVA mission and they just regrouped for XII, and changed the EVA program completely, and had a tremendous success on XII. It proves that EVA is nothing mysterious, nothing difficult. You don't get into anything that you wouldn't normally sit down and expect to get into, but you've got to provide a capability to work out there if you're going to do anything, and if you do that, the guy can do anything you expect him to. So I think that we didn't stop to take this assessment early enough. I think we could have flown the AMU if you'd done this on, say, IX or X, if we'd just anticipated the kind of problems that we should have anticipated.

Grimwood: Why did we not get it back on XII? The Air Force kind of hoped to get it back on XII.

Armstrong: We went too far, I think, and I don't really know the answers to all of this, because this was a high-level decision, but I think Mueller, at the time we ran into all the trouble, decided, "I can't operate EVA this way any more," you know, without getting down the fundamentals. And I think you needed that fundamental flight before you took on a complex task like the AMU. I think it was probably a wise decision to cancel.

Grimwood: A part of our problem, also, was that we had a competitive system. It was smaller.

Armstrong: Yes, but I don't think that had anything to do with us not flying the AMU. I know a lot of people may say so but I don't believe that. I think the reason the AMU wasn't flown was because we had not gained the confidence in EVA that we needed to fly this complex task, and Mueller decided, I suppose with guidance from the Center at Houston, that we were going to have to back off and latch down these problems before you go into this complex task. I think if you'd done on XI the mission that you did on XII, you'd have flown the AMU on XII. And I think you could have gotten into it, too. I think that, with the kind of planning that went into the XII flight, if they'd have planned to handle the AMU, designed just exactly like it was, they'd have gotten into it and flown it. That's my personal opinion. You'll probably find people who won't agree with me, but I think that's true.

Grimwood: I was talking with Andy Meyer on it.

Armstrong: They probably take the other approach but I don't believe that. I think the AMU---

Grimwood: He was pretty hard on everybody. I mean - he's not tough, but he was just trying to be objective there.

Armstrong: I am, too, and I say, in general, the Air Force did a better job on their experiment developments and holding to schedules, delivering what was required when it was required, seeing that the crew was properly indoctrinated, that they had the training unit there - I think, on the whole, that the DOD experiments were better managed than all the others. Yes, I'm quite sure they were.

Grimwood: That's what Andy said, from the program office viewpoint.

Armstrong: This contributed to the success of it. They only had one equipment failure as far as I know.

Grimwood: On the scientific side, did we provide our people with enough resources to do it? Seemed like the money was pretty low---

Armstrong: It was the quality management system, to be perfectly honest with you. The center didn't have - hadn't gotten hold of how to manage experiments when the early phase of this went on. I think

that, when Piland's shop got into operation, by the time you were at the end of the program, you weren't having any trouble with delivery of the scientific experiments, either. They were working.

Grimwood: Let's take one here that the group has always been irritated on, from Mercury on.

Armstrong: I know what that is.

Grimwood: The UV.

Armstrong: That isn't the one I was talking - go ahead.

Grimwood: Which one were you thinking about?

Armstrong: I was thinking about our good buddy, Dr. Nye. Ney

Grimwood: I was thinking about the UV window which they were going to put in on the right side of the spacecraft. The ultraviolet window.

Armstrong: What about it. They never did.

Grimwood: Why didn't they do it?

Armstrong: I don't know whether I can answer it any better than anybody else, but I think it was - it wasn't Houston's fault, really.

Grimwood: No, they told McDonnell to do it.

Armstrong: They finally did. There was a lot of foot-dragging in the beginning and a lot of trumpeting and talking up here in the OSSA offices, saying how badly they needed this. And then when it came down to the real facts of life, how much it was going to cost to get it, they didn't have enough experiments to justify that kind of outlay.

Grimwood: You hit the point. You know what it would have taken? Another unmanned flight, for qualification. That's what it would have cost.

Armstrong: Well, it was more - even $400,000 just to make installation. They [experiments] wouldn't have paid for that even. Forget the point - forget the point. It wouldn't have paid the $400,000. As it turned out, the open hatch thing worked just as good or better. So I think it was just a matter of not really understanding what it was

going to cost to do it until they sat down and went through the exercise, plus the fact that I think OSSA initially felt that they had a lot more demand for that than it turns out they really did. When you come down to the basic facts, they only had one experiment that had to go through that window, S-13. And, at the time they were yelling for the window, I don't even think they had this one identified. They just generally felt that a UV window was desirable and I don't think they'd ever come to grips of what they were going to do with it or how much it was going to cost. The same kind of rigmarole went into Apollo but they dropped this early.

Grimwood: You remember they had this ultraviolet camera, or something, that was going in the periscope place in Mercury. And it got kicked out and they were mad about that.

Armstrong: There's a lot of truth in that.

Grimwood: That's the background to even this story, really.

Armstrong: I think that's, to a large, degree, probably true.

Grimwood: What's the Nye story, then?

Armstrong: Oh, he was an impossible guy to work with. Everybody at Houston and everywhere else had trouble with him. He just---

Grimwood: Who is he?

Armstrong: He's a doctor out at Minnesota, had the S-1 experiment. He was perpetually late on delivery of anything he had to deliver. He just wasn't responsive to the program once he got approved. And somehow he must hold blackmail over somebody in OSSA, because you could never turn him down. They were always putting him on flights. He has just never been cooperative. He wasn't cooperative in meeting schedules. Then he raised all kinds of cain with the center about how they screwed up his film and he wasn't allowed to develop it, and created the issue to the point where it had been determined that the center will not have responsibility for this. This is the experimenter's prerogative and he took the data and developed it to suit himself. That started back in Mercury, too. Goldarn it, people picked up film off the Cape and carried it off when I had left it over in the photo shop to be developed the next morning to Nye's specifications, and I didn't know anything about it and neither did the photo people. They went home at five o'clock; Nye and Dr. Gill

went in and picked the film up, walked off the base illegal as hell, and hauled it off and reproduced it and never did give us back some of the copies. And it didn't turn out worth a darn. And the next morning Kleinknecht was jumping up and down and wanting me to tell him where the film was, and I didn't know. I thought it was over there and we hunted and hunted and finally traced down what happened. This was the kind of attitude we've had all along.

Putnam: And you know, then, he complained about that in the articles that he wrote.

Armstrong: He sure did.

Grimwood: That the Government had scratched his film.

Armstrong: That's right. And so Gilruth was actually, well, was practically directed by Mueller to turn it loose to him and now he won't report his data to us. We've had all kinds of trouble trying to get him to come through - we wrote a letter to Newell, complaining, from Mueller, that we weren't getting support in publishing reports through NASA channels. So he's been a headache all the way through the program.

Putnam: Is he going to be on Apollo?

Armstrong: No, not yet.

Grimwood: We've got an example there, but what about the typical deals on Gemini in the science area, the scientific community? Have you had that problem all the way through?

Armstrong: No. I would say, in general, the scientific principal investigators have been quite cooperative and I think, as they learned the program - I think all of them felt they were being overly burdoned by documentation and qualification and trips and what not - but as they really got into the program, they understood it a lot better and have generally acclimated to the need for it and I think most of them have been pretty responsive. I think, in general, you can say that the average scientist that participates does the job he's supposed to do pretty well, probably as good as we do ours in support of it.

Grimwood: Roughly how many did we have in the science field?

Armstrong: There were 12. No - more than that. There were about

15 or 16 of them, I guess. I don't remember what they were, but 15 or 16 altogether.

Putnam: Do you have any feeling for whether they seem to be generally satisfied?

Armstrong: Most of them were very happy. Going down the list: Nye got exceptionally good data on a couple of flights; he didn't do so well on others. That one that Ames had, the S-2 that broke down, of course, created all kinds of trouble but that was not NASA's fault - not MSC's fault - that was just faulty development. But then, from there on, I don't know of any scientific experiment that didn't yield good data. I think every one of them, they got good data on - in contrast to DOD, where they had several that didn't - they had enough flights programmed that I don't know of a single experimenter that didn't come out - except for the frog, sea-urchin egg - that didn't get realy good data.

Grimwood: Real peculiarly placed.

Armstrong: Yes, it was.

Grimwood: Gill was kind of mad at him for yanking off the handle---

Armstrong: She's all wet, there. That's just a matter of quality control. They didn't have the control on that device that is required to have assurance of flight success. You did a cheap job and you got cheap results. That's what it turned out to be.

Grimwood: I think what made her mad is the statement he made after it. He said it was probably a poor experiment, anyway. I think that's what really hacked her.

Putnam: It was the poor handle.

Grimwood: He made that statement and - I was doing the Mercury history at that time - and, boy, she was fuming over it.

Armstrong: Who made this statement? Grissom?

Ertel: He made a bad remark about 15 minutes before the flight, too. "What the hell am I supposed to do with this thing?"

Armstrong: The old boys had a lot more negative attitude toward experiments, generally speaking, than the newer astronauts; and

that's been apparent, I think, to everybody. It's worked smoother when you got into the second generation of the crews. They may not like doing all this stuff, but they made a real conscientious effort to do the job right, and, as a result, they got pretty good results on the experiments. In general, even though they had failures on one flight or another, I think for each experiment they had at least one flight where they got some good data that gave them the kind of material they were looking for. Now I can't think of any offhand - well, may be one or two of those later ones like S-51 didn't work out, and one or two of the latest additions, which were sort of afterthoughts after the program had been settled, they didn't do so well on those. Actually, one thing - it's almost a certain thing - you've got to plan well, carefully, well in advance if you're going to have any success, and this stuff that you just throw on at the last minute never works, almost invariably gives you trouble.

Ertel: How about on 204, Bill? Are they going to have a lot of experiments on there?

Armstrong: No.

Ertel: It's started out to four days operational, then open-ended up to 14.

Armstrong: Yes, but it's mostly medical. There was a few science on there. A couple of pick-up - very simple ones at that - and a few simple medical ones, and 205 has only two major experiments, and that's the S-19 and 20, the UV stellar stuff and the UV x-ray solar stuff, and those are two pretty significant experiments, but other than that - that's all you've got. The others are medical, which isn't too significant, in my opinion.

Ertel: Well, starting out in this program though, you've got to---

Armstrong: Apollo is going to have its scientific contribution only in the lunar mission. You won't get any of that earth-orbiting stuff now, until you go to AAP.

Grimwood: Apollo is going to be all operational---

Armstrong: They had a good program but, you see, you lost the vehicle. When we lost AS205, that wiped out---

Grimwood: That's another thing that's caused bitterness, right there.

It caused the Gemini bitterness. I think that was because---They interviewed them up here in December, the week between when this was taking place - right after 205 was cancelled---

Armstrong: Well, there is a danger in this, of course; and I'm sympathetic in a way. Here's the other side of the coin. You take a scientist that you can induce to fly on a spacecraft - this guy is a well-respected individual in his field, maybe almost in the top bracket of that type of investigation; and he's committing a lot of his resources, because his career and his capability to maintain his stature depends on his producing results. So now he commits himself to a manned space flight and puts a year and a half or two years of his career life into that; and then he's dependent on being able to get out some good results which will enhance his scientific stature. You wipe him out - all of that time is down the drain and there's no way to repay the guy for that, absolutely dead loss. And you do this many times and you have lost the scientific community support. I don't care how sympathetic you are to them. You do this a couple of times and they'll say, "The risk is too great. I'll stay on something that I have assurance of productivity of my time," and NASA can't afford to have that happen very often and not have the scientific community a complete loss. You'd be finished. Anyway, I think that's one of the major items that has to be kept in mind when you're dealing with high-level people - high-level scientists - which is what you want to attract. Then if you wipe the guy off, if you don't produce results for him, you're going to lose this whole segment, because, as soon as a few of them get disappointed and don't produce anything and their reputation is affected by this, the rest of the people are going to say, "Boy, I don't want anything to do with manned space flight." And I think Mueller's aware of this, I think a lot of people - I'm not sure that a lot of people at the center look at it this way but - boy, this is bread and butter to these people and you'd feel the same way if you were one of them. So it was a serious blow and you had some fine investigators on 205. And Mueller has tried his best to try to recruit these. Now I don't know that they're doing such a good job. We haven't got them all relocated yet. It's a terrible job trying to get these things back on another vehicle. That's a big loss. And that wiped out the Apollo development program right there. That was a flight that was - 204 just has peanuts on it - but you had $10 million worth of experiments on 205. And that will defer it at least a year and a half at the very best. Some of them are lost completely.

Putnam: There isn't any way, however, on the other hand---

Armstrong: There's nothing you can do about it. I'm just saying this is one of the things that's a big risk and if you had this happen very often, people would lose confidence in the program. I'm not saying we could do anything about it. I don't think you could. When you blew that vehicle, boy, you - there's nothing you could do. Mueller had a bigger problem than just the experiments to worry about. He had to weigh it and he did. Believe me, he spent many hours thinking about the experiment problem that he had on 205 and talking with experimenters in the various offices and emphasizing ways to get around the problem that they had, but he had a program to get to the moon, too, and he had to try and maintain that schedule somehow; and I think that was the over-riding factor and that's why we pulled 14 out of the line. I'm sure that was a difficult decision for him to make. I think he realized what he was doing - I know he did, because he contacted each PI himself. At least, that's what I was told, I don't know; but that's what I understand. He talked to these people himself, and undoubtedly they were bitter and it may have tainted their reaction. I'm trying to be fairly objective in analyzing this program. I think there's arguments on both sides of the fence - that MSC and OMSF didn't do a lot of things they could to help the experimenters. And on the other hand, there was some bad attitudes and bad performances on the other people's part. But even despite this, the Gemini program as a whole was a very successful experiment effort. I think the results showed it. Got good medical data, proved a guy can fly without any problems, so the medical stuff was successful.

Grimwood: It quieted all that.

Armstrong: That's right. We flew almost all the science - the major science experiments, anyway, were successful; and you had a good portion - you had some failures in the DOD, but we had some very successful ones there. A good number of the more significant MSC experiments were successful. Not on every flight but in the entirety.

Putnam: What do you think the results of the Gemini program, if you look at it in the whole context of the running controversy of manned versus unmanned---

Armstrong: From the experiment standpoint?

Putnam: Do you think this has helped out the argument for the usefulness of man in flight? Do you think there are enough results in the

experiment---

Armstrong: That's real difficult to say. I think, in all honesty, you can sit down and look at the program and I think a lot of people - it would be objective to say that a lot of these, while they were easy to do on Gemini, could have been carried out as successfully on an unmanned launch, and that experiments - the kind of experiments you did on Gemini - wouldn't justify a manned program. I'm not saying there aren't experiments that could, but the kind that we carried to date - I don't think you could justify a Gemini launch on that basis. You certainly - once you got that vehicle going, you want to try to make use of it; and there are cases where a man definitely enhanced the experiment. Some of the photographic tasks that were carried out were probably done better and with more refinements than you'd have gotten on an unmanned vehicle, but he sure wouldn't have paid the bill for development of a manned vehicle on that basis. I'm not even sure that you would for AAP, in my own personal opinion, but you have that one paid for in Apollo - the development, anyway - so now all you're doing is buying vehicles. And here you're talking about really big experiment loads and there's a lot of arguing back and forth there. I don't know.

Putnam: You're really in trouble if you try to justify it - it's purely unrelated.

Armstrong: That's right. You sure couldn't [justify] Gemini with it. But I think you showed in Gemini that astronauts could be used successfully to enhance your experiment investigation.

Grimwood: Do you look on Gemini now as, maybe, our first effort at a manned space flight laboratory?

Armstrong: In a very embryonic way, yes, I think that's probably true. You even did this to a small degree in Mercury, you know. Gordo had a pretty good load of experiments. That was the only one we did---

Ertel: That was the only one that was long enough to do anything.

Armstrong: Right. Everything else was too short. But Wally wasn't about to carry any on his flight. We proved on---

Grimwood: And he was the command pilot on---

Ertel: He was the chimp.

Grimwood: ---on Apollo, on your big experiments Apollo flight.

Armstrong: Yes, he sure was, and he was giving them hell, too.

Grimwood: That's what you were saying awhile ago - on the old group. As you were making that statement there, I was just wondering about who the command pilot was there, how he would have fitted in with those $10 million worth of experiments. Sounds like a waste.

Armstrong: There were some problems. I don't know how it would have turned out. I think he would have been almost committed to have to perform. I think his status as a pilot would have been too greatly affected if he had just sluffed them off. You can't turn your back on 10 million bucks worth of effort and high-level scientists, and he had some good ones. The best scientists probably in the program, some of the best ones, were on these Apollo 205 experiments. You couldn't ignore these guys. There's quite a lot of to-ing and fro-ing going on and I think he would have had to perform.

Ertel: He was involved in the most emphasized experiment in Gemini - the corned beef sandwich.

Armstrong: In Gemini?

Ertel: He bought the corned beef sandwich and gave it to John to take up.

Armstrong: Is that right? That's right, he did. He sure did.

Ertel: That's the kind of experiments that Wally likes.

Armstrong: That's right. Well, the kind he likes is flying around. He loved to rendezvous. He worked hard at that. He's the old operations pilot type; he doesn't want to be cluttered up with this other stuff. You can't justify a very long manned space flight that way. We're going to have to prove that manned space flight is going to do major experiments or you aren't going to be flying. I don't know that Gemini proved this. I don't think it did. I think it just proved that a guy can work up there, if you give thim the right kind of stuff to do it with. But I think in AAP you've got to

look for the kind of mission - they've got some maybe that may do it. I don't know. The ATM is controversial. There are some scientists that say that an unmanned vehicle would have done just as - or would have been a way to go. You could get a long time to stay, two or three years - whereas with man you've got maybe 14 to 28 days and maybe even 56. You don't have the staytime. A lot of people say the man so enhances the program that there's no question that's the way you should've gone. I'm not a good enough scientist to say. There's problems with the man in it, but he certainly gives you some capabilities you wouldn't have otherwise, without an extremely expensive system that may have fizzled up once you got it in orbit.

Grimwood: Just need the properly motivated one, eh?

Armstrong: And I think, without a doubt, the guys that fly ATM will be - they'll be operating the vehicle strictly as a carrier to get them there and their prime concern is going to be to make that system work. There'll probably be scientist astronauts on that. But I think you could take this second or third generation - most of them would be good. I don't think you could find a guy more dedicated than McDivitt or Borman or Lovell - these guys really went all out to culminate their flight plan. Conrad was good, too. There were a couple that weren't so good. Tom Stafford - I don't know about him, too much. I can't really say, but he's been around Wally quite a bit. Pete was around Gordo a good while, too, but he turned out to do a real good job on XI - a hell of a good job on that flight. Williams never liked Cooper.

Grimwood: He didn't?

Armstrong: Williams didn't like experiments, either.

Ertel: That time that Gordo spent a week chasing kangaroos in Australia after John's flight and not making it back in time for the New York parade - he got back in time, but--- I was in a hotel room up here and Walt said, "You son of a bitch, you be back or else."

Armstrong: That's the way they need someone to ride herd on them. That's just not done anymore. But they've always been given - that's NASA's own fault, of course. You make a hero and that's fine, but, when you do, then you've got little control over his activities. Then you've got to have - if you're going to make these missions perform the kind of things you want them to be, then you've got to have that

kind of disciplinary control, which is not too much in effect now.

End of Tape