MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Thursday, March 12, 1959.

The committee met at 10 a.m., in room B214, New House Office Building, Hon. Overton Brooks, chairman, presiding.

(The committee considered problems related to another subject until 11:30, after which it resumed the general topic, "Relating to Missile Development and Space Sciences.")

The CHAIRMAN. This morning we have another witness I think we ought to hear, since he has come down here ,and that is Dr. J. Allen Hynek. I might say that members of the committee have requested the appearance of Dr. Hynek, who is Associate Director of the Smithsonian Astrophysical Observatory of Cambridge, Mass.

Doctor, if you will have a seat, we would appreciate it.

Dr. HYNEK. May I ask, Mr. Chairman, whether I could ask Mr. Leon Campbell, who is in charge of the moon watch program, to sit with me?

The CHAIRMAN. Yes, sir, Mr. Campbell, if you would come forward. Anybody else you want up with you, we will be glad to have them.

Dr. HYNEK. Thank you.

The CHAIRMAN. I might say this: This observatory, of which Dr. Hynek is Associate Director, has served as headquarters and nerve center for the optical tracking operations used successfully on several Soviet and American satellites. For that reason, we are especially interested in what you gentlemen will tell us this morning.

Do you have a prepared statement, sir?

Dr. HYNEK. Mr. Chairman, I do not have a prepared statement. As I indicated to Dr. Sheldon, I would be happy to try to answer some questions. I would like, however, to tell you something about the optical tracking program.

The CHAIRMAN. I wish you would do that for the benefit of the committee. Then, also, if you prefer, of course we will ask you in reference to your suggestions regarding failure to alert your observatory.

If you want to make a statement on that, we will be glad to have that. If not, we will question you.

STATEMENT OF DR. J. ALLEN HYNEK, ASSOCIATE DIRECTOR, SMITHSONIAN ASTROPHYSICAL OBERVATORY, CAMBRIDGE, MASS.

Dr. HYNEK. The Smithsonian Astrophysical Observatory, which is located in Cambridge, Mass., was during the IGY given the responsibility of the optical tracking of earth satellites. Optical tracking differs from radio tracking and other means of tracking in that optical instruments are used in the line of the traditional astronomical methods. Because, as far as the astronomers are concerned—and I am speaking now as an astronomer—satellites in general are an astronomical problem.

So that there was designed at the Observatory a special satellite tracking camera, the so-called Baker-Nunn cameras. I have some pictures here. This is one. This is the picture of the camera itself, and I have some photographs here of satellites taken with the camera, which you may wish to see later or may not.

The stations are located in 12 places around the world. I have one picture there, the top one, which I am particularly proud of, and that is the photograph of the Vanguard 6-inch sphere at a distance of essentially a thousand miles, 945 miles, I believe it was.

The stations are located in a belt about plus 40 to minus 40 latitude.

Very, very quickly from memory, the stations are in Hawaii, two in the United States, three in South America, one in India, one in Iran, one in Australia, and one in Japan.

In addition to this precision optical tracking, the instruments are capable of fixing—stopping the satellite in its track, so to speak—down to the accuracy of 1 second of arc. This is the angle subtended by a penny at a little more than 2 miles. This precision is needed in order that satellites be more useful as scientific vehicles. I would like to go into that a little more later also.

In addition to the precision optical tracking program, we have some 240 volunteer teams of so-called moon watch observers. This is an accuracy of a total difference of the order of about one-thousandth of the accuracy of the precision of the Baker-Nunn cameras. But the larger number gives, of course, much wider coverage. We have some 140 such teams in the United States, a great many in Japan, and many scattered in other countries.

In addition, then, if you have these stations, of course, around the world, this implies a rather efficient communications network, and it does also mean the existence and the fostering of a computation center, since merely to observe for the sake of observing without using those observations would be pointless.

I think this perhaps is sufficient. I might point out that we have obtained hundreds of photographs of the various satellites. There have been something like 8,700 observations, moon watch observations, from volunteer teams. I would like to point out there that in the volunteer teams, we did not pay at all for their time nor for the equipment that most of these people have built or purchased themselves.

I believe with that introduction, I am ready for any questions.

The CHAIRMAN. Doctor, would you object to giving us something of your background now? I read, insofar as I had information from an article in the paper. Tell us about where were you born, where

you were educated, and your background and experience for the record.

Dr. HYNEK. I shall be happy to. I was born in Chicago in 1910, and obtained both my bachelor's and doctor's degrees at the University of Chicago. Then I was, and still am, for many years a professor of astronomy at Ohio State University. I am actually at present on leave from the Ohio State University, working in the capacity as Associate Director of the Smithsonian Observatory and directly in charge of the optical satellite tracking.

The CHAIRMAN. How long have you been there?

Dr. HYNEK. I have been at Smithsonian now for some 3 years.

The CHAIRMAN I read something in the press in reference to your statement indicating you had not been notified of the recent launching of a satellite. You felt that perhaps, if you had been notified, your service might have been helpful in locating that.

Could you tell us something about that?

Dr. HYNEK. Yes; I should be happy to tell you the circumstances of that, because I believe there is a certain area of misunderstanding surrounding that.

A reporter called up to ask whether we had been tracking the Discoverer and I said in direct answer to the question, I said, no, we had not been. He, of course, wished to know whether we had alerted our stations and I mentioned that we had not.

He naturally asked why not, whereupon I pointed out that we had received no official information or request to do so.

He then immediately went on to ask whether, had we been so notified, could we have tracked it? At that point my answer was solely directed to the capabilities of our system for tracking, and I pointed out that in view of the fact that we had photographed many, many satellites, in particular the 6-inch sphere, that as far as the capabilities of the system were concerned, we certainly could have tracked it.

However, it is certainly well known, and I was fully aware of this, that the visibility of the satellite is, of course, a function of the size and shape of the orbit, of its inclination to the equator, and particular in the case of a high inclination orbit, to the time of launching. At the particular time this object was launched, it was not in the general visibility zones of our stations.

Had the launching taken place, however, some 3 hours later, it would have been visible to all of our stations. It is an extremely critical thing. But I wish to emphasize for the record that when I pointed out that we could have tracked it, I was referring solely to the capabilities of the system.

The CHAIRMAN. What was the reason for launching it 3 hours earlier than you were able to detect it from your station?

Dr. HYNEK. This, sir, I don't know. This project, I believe was militarily classified. We had no advance information on either why it was being put up or otherwise. However, it may very well be that they had specific reasons for launching it at that time, and hence felt that there was no point to alerting us.

The CHAIRMAN. You stated, I believe, that rivalry among the U.S. space programs was blamed for failure to be alerted. Is that correct?

Mr. HYNEK. No, sir; it is not. I believe I have with me the actual statement. I felt I was particularly careful to stay away from state-

ments over which I have, first of all, no competence to discuss. My job is——

Mr. FULTON. Do you have the original statement you gave out with you?

Dr. HYNEK. I do not, sir. About a week later I made some notes to the best of my recollection. But after I answered those specific questions, I was conscious of a rather strong desire to hang up and get off the hook——

The CHAIRMAN. Most of us know what you mean there, Doctor.

Dr. HYNEK. I had to answer those questions or hang up, and it just isn't courteous to just hang up. But I felt that once I had answered those specific questions, that anything further I went on to say, could very easily be misinterpreted.

I do believe that—I am quite certain that I at not time stated matters of rivalry or lack of cooperation, because as far as cooperation is concerned, we have had a tremendous amount of cooperation from the various services.

Mr. FULTON. Was this an unintentionual mistake as distinguished from a better method of doing it, rather than an intentional mistake, which may have been read into your words?

Dr. HYNEK. Sir, intentional on whose part?

Mr. FULTON. On the part of the scheduling officers on the shot as to the time of launching, where on a 3-hour difference they could have picked it up on a worldwide tracking system that you have set up for precision optical tracking, it would seem to me either somebody made a mistake, or somebody intentionally didn't do it at the right time. So which is correct?

Dr. HYNEK. I would have no way of knowing that, sir.

The CHAIRMAN. Doctor, in the light of what happened there with the Discoverer shot, could you say that your stations, had they been alerted, might have been of help in tracking that satellite?

Dr. HYNEK. I could certainly say that had the launching been at a different time, say 3 hours later, I believe certainly that we could have been of help, as we have been in many other launchings.

The CHAIRMAN. Your statement that you could have been of help is conditioned on the fact that it should have been launched 3 hours later.

Dr. HYNEK. That is correct, sir.

The CHAIRMAN. Launching as it was, you could not have been of any assistance, is that right?

Dr. HYNEK. That is correct. I was mentioning, when I indicated rather hurriedly to the reporter that we could have tracked it, I was speaking solely of the capabilities of the camera and of the moon watch teams to have tracked it.

Mr. FULTON. Actually the first time you heard about this satellite was when you either heard it on the radio or read it in the newspapers, wasn't it, as to the time it was launched?

Dr. HYNEK. That is correct.

The CHAIRMAN. Didn't that give you enough notice even then because it came over your area on, as I recall it, the third orbit?

Dr. HYNEK. I think perhaps I should say here that because of a polar launching—let me start this way—optical tracking as opposed to radio tracking, is at least until such time as satellites have flashing

lights on them, visible only in the morning and evening twilight periods, like a high-flying jet.

Consequently, any satellite will, on the average, come over any one geographical area twice a day, but only if that time coincides with the morning or evening twilight can one observe it optically.

The CHAIRMAN. Didn't it come over your area at twilight?

Dr. HYNEK. Not at twilight; no, sir. In fact at no place at twilight. At that launching time, the twilight zones—I have a chart here if we need to go into it later—but the twilight zones were quite far to the north and to the south.

The CHAIRMAN. So even had you been notified, unless the time for launching had been changed, you could not have been of any assistance?

Dr. HYNEK. That is entirely correct.

The CHAIRMAN. Your colleague who is sitting with you there, are you in charge of the moon watch program?

Mr. CAMPBELL. I am, sir.

The CHAIRMAN. What would be your statement in reference to that? Do you make the same statement that your program would not have been of any assistance unless the time of launching would have been different?

Mr. CAMPBELL. I concur with Dr. Hynek's statements on that. I have not looked into the visibility zones.

Mr. FULTON. Were you consulted as to the time of launch so that you could be given the chance to have your tracking facilities operate for this precision optical tracking?

Were you contacted ahead of time?

Dr. HYNEK. In this particular instance we were not. However, I think it is appropriate to say that in a great many other instances, we have been.

Mr. FULTON. Why weren't you in this instance? We are trying to develop what is wrong with the procedure that one of our chief Government agencies in astronomy does not know of a shot going up in a way that their own program can be correlated with it. You see, obviously it wasn't the best scientific approach to the shot because you could have added a lot; could you not?

Dr. HYNEK. Predicated on a different launching time, perhaps so; yes.

Mr. FULTON. Did they consult with you as to the optimum launching times in order to get the best use of the facilities? We are interested in this not only with you people, but to correct it with our allied countries in the free world and also the Soviet Union, if they will assist.

Why were you left out of the consultation?

Dr. HYNEK. The direct answer to your first question is that we were not consulted on the best launching time.

Mr. FULTON. Should you have been?

Dr. HYNEK. That is very difficult for me to answer since I don't know what the nature of the experiment was in this particular satellite. It may be that they just had to launch it at that particular time, and they felt, therefore, that there was no point in notifying us in advance.

The CHAIRMAN. Their statement was, of course, that you were not notified because you could not have rendered any assistance with that launching time. And your statement confirms that.

Dr. HYNEK. That is entirely correct; yes.

Mr. FULTON. The problem was, was the correct decision made as to the correct launching time when it left the Smithsonian facilities, the precision optical tracking, out, which is a great scientific gain.

If so, wouldn't it be more careful to check with you each time to find whether you could be of assistance on a change of launching time?

Dr. HYNEK. I would like to answer that in this way, if I may. Just yesterday we were visited by an agency concerned with the coming Venus probes. I obtained permission to be permitted to say this——

Mr. FULTON. From whom?

Dr. HYNEK. From the Space Technology Laboratories.

The CHAIRMAN. You don't need that, do you?

Dr. HYNEK. You are quite right. I don't need permission, but I thought it was a matter of courtesy I should ask.

The CHAIRMAN. You are a man who speaks out fearlessly anyway, judging by this article. So I think we all understand that.

Mr. FULTON. He is, or he was? He sounds as if he has sort of reefed his sail a little bit.

Dr. HYNEK. Gentlemen, this is my very first experience in a meeting of this sort, and I am naturally a little timid—not intimidated, just a little timid.

Mr. FULTON. This is a higher orbit than you had been expecting?

Dr. HYNEK. This is a higher orbit; yes, sir.

The CHAIRMAN. Why not do this, Doctor, since you are here, give us a general idea of your work there, and then the members want to ask you a few questions.

Mr. KING. He was about to make a statement on the Venus probe. I want to hear it.

The CHAIRMAN. Go right ahead with your Venus probe.

Dr. HYNEK. The Agency is quite anxious that we do everything we can to obtain optical observations of this, and we are consulting as to the best launching times, the best methods of communicating between us, and so forth.

Mr. FULTON. Would you recommend that in the future your group be consulted as to the optimum launching times so that we can get the proper precision optical tracking that seems to be necessary?

Dr. HYNEK. Insofar as we can be of any service, I would say so, yes.

Mr. FULTON. Then it was a mistake when they didn't check with you, isn't it, because they just assumed you wouldn't be able to help, and they didn't know what 3 hours difference would have made to you, did they?

Dr. HYNEK. They, I believe, assumed that in this instance we couldn't have helped, yes.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. King, do you have questions?

Mr. KING. No.

Mr. WOLF. Mr. Chairman, might I ask a question at this point of you, sir?

The CHAIRMAN. I think I recognized Mr. Moeller.

Mr. MOELLER. I will yield.

The CHAIRMAN. All right.

Mr. WOLF. I am wondering if anyone has inquired—he says that he doesn't know—Dr. Hynek says he doesn't know the reason. Has

anyone from this committee inquired, or do we intend to have someone here to possibly tell us in executive session why this thing was done in this manner?

The CHAIRMAN. We asked in open session the witnesses why these particular stations were not alerted. I called attention to the statement of which I have a copy which appeared in the New York Times. At that time the committee was informed that the reason they were not notified was the satellite was not coming within the sphere of their activity, and therefore they could not have rendered any service.

That was the answer.

But in the light of the request from members of the committee, we thought we would ask the doctor to come down here. If you wish to, we can go further into the matter.

Mr. WOLF. We had better.

The CHAIRMAN. Have you finished interrogating the witness?

Mr. WOLF. I think I said we had better go further into it. There seems to be a wide difference of opinion here now.

Mr. MOELLER. Mr. Chairman, this seems to tie in with some of the testimony we received, which indicated that the information to be desired from this particular satellite was gathered without this assistance, is that correct?

The CHAIRMAN. I can't tell you whether it is correct or not.

Mr. MOELLER. That is an assumption I operated under.

The CHAIRMAN. I have not made up my mind definitely on the matter, except as to this: If the good doctor's facilities can help in this program, he certainly ought to be alerted and be permitted to assist.

Mr. FULTON. May I suggest to Mr. Moeller, he ask the doctor the question directly.

Mr. MOELLER. You heard the question, Doctor. I think you alluded to it also, Doctor, that possibly the information they received on this particular instance, they got without your assistance.

Dr. HYNEK. That is entirely possible.

Mr. FULTON. But you don't know it?

Dr. HYNEK. I don't know it.

Mr. FULTON. Why don't you know it? This is your field. Why are you not alerted on these things, because in the future some of us want you to be alerted and be part of this.

Dr. HYNEK. If I may speak to that point, and dropping the specific instance for a moment, as we prepare to put man into space, clearly we should use every possible tracking means we have, not just optical, radio, but every possible means to see that he gets back safely.

Under those circumstances I would heartily concur and agree that there should be full coordination.

However, it is entirely possible if an agency has an experiment, a very particular experiment for perhaps classified military purposes, then they might feel that it is not wise.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. That is exactly what I wanted to bring out, Doctor. We all appreciate what you are doing. You are doing a very fine job.

I think in this particular case this was supposed to be a military project. They may have had a special reason for not notifying you. I am glad to hear you say that you accept that.

Dr. HYNEK. Yes, I do.

Mr. ANFUSO. Under certain circumstances you don't care to be notified?

The CHAIRMAN. If he can be of assistance, he should be notified.

Mr. ANFUSO. If you can be of assistance, certainly if you are notified you will be glad to give all your cooperation, as you have in the past.

Dr. HYNEK. Entirely.

Mr. FULTON. Will my friend from New York yield?

Mr. ANFUSO. Yes.

Mr. FULTON. Don't you think he should be given the opportunity on his own agency to determine whether he feels that his group can be of assistance with his own technical assistants by prior consultation to the time of launch to help set the time of launch so that all facilities will be used?

Don't you think that should be done?

Mr. ANFUSO. I concur in that. But, as I said, I think they had a special reason for what they did. I don't think you can inquire from Dr. Hynek as to that special reason because he certainly doesn't know.

Mr. FULTON. What does the doctor think, in answer to my question? Don't you think that should be done?

Dr. HYNEK. If it turns out that we can be of help; yes, I do think it should be done.

Mr. FULTON. So you feel you should have been consulted on this one because just a 3-hour change in the launch would have given you full use of your facilities and you might have picked something else up extra.

Dr. HYNEK. That is certainly within the range of possibilities, yes; we could have. But again——

Mr. FULTON. He is a brave man right now.

Mr. ANFUSO. Do you feel any slight that you were not notified?

Dr. HYNEK. No, sir, in view of the fact I feel that we may not have been notified because there were extremely good military reasons for not having been notified.

Mr. ANFUSO. And you accept those reasons?

Dr. HYNEK. Yes, I do.

Mr. ANFUSO. Can you give us any information on trying to track Mechta?

Dr. HYNEK. That is so far out now that tracking would be quite impossible.

Mr. ANFUSO. Do your observations tell you how large the Soviet sputniks are?

Dr. HYNEK. They can give us quite a good indication. For instance, in the matter of the weight of the sputniks, simply in this manner. One can see how bright they are; one knows how the period changes. The rate of period change is a function of the mass–surface area ratio.

Since we can get the surface area by the brightness, we know how the period changes. We can, therefore, arrive at the mass.

Mr. ANFUSO. Have you arrived at any conclusions as to the size of the Soviet sputniks?

Dr. HYNEK. Yes, of the total weight. The total weight, I believe, was something of the order of 3 tons, the second sputnik.

The CHAIRMAN. Will the gentleman yield? What do you mean by period changes there?

Dr. HYNEK. The time that it takes the satellite to go around the earth once is the period; and if the earth had no atmosphere, then a satellite—any satellite—would stay up forever unless it suffered collision.

But because most satellites so far have been operating in the area of very rarefired atmosphere—still, I believe, several million molecules per cubic inch—this constitutes a frictional force. The energy of the satellite is sapped away, and it must then spiral down.

The rate at which it changes its motion gives us then the information on the friction, and the friction is dependent on both the mass and the surface area that it presents to the atmosphere.

The CHAIRMAN. The size, rather than the weight so much?

Dr. HYNEK. Correct. It is the ratio of the two.

Mr. ANFUSO. I am finished.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Doctor, if we are to assume that there were some military reason why you were not informed, has there been any time since the launching of the Discoverer when it would have fallen between the zone wherein you have your observatory facilities and your moon watch stations?

Dr. HYNEK. I haven't looked into this in detail, but by and large I believe not, simply because, launched directly as a polar orbit, the regression of the nose—that is, the rate at which the orbit skews around—is zero.

It increases as the inclination approaches the Equator. Consequently, the only thing that would bring the orbit into twilight zones in, say, around the Equator, is the earth's own orbital motion around the sun, which would take some 3 months before this brings it around to that.

The same 3 months' effect could have been accomplished by a 3-hour difference in launching. But this is the difference.

Mr. DADDARIO. You say you believe not, and you have given an explanation. Is that all on what you believe to be the situation, or have you since the launching been given specific information so that you have been able to determine that with the specific figures in mind?

Dr. HYNEK. We received the official notification on the launching of Discoverer giving the orbital elements some 8½ hours or so after the launching. It actually arrived in our office at 1 a.m. or so on Sunday morning.

Then, using those figures, it is possible—although I have not done it personally—to deduce where it would be visible.

Mr. DADDARIO. I didn't get the last part?

Dr. HYNEK. It would be possible to deduce, to compute, over which stations it would be visible.

Mr. DADDARIO. Have you been able to compute that and have you so determined that it would not at any time go over any of the stations which belong in your system?

Dr. HYNEK. I think I can quite safely say it would not go over any of the major stations. It might go over some of the far northern moon watch stations.

Mr. DADDARIO. Then, if we are to take all of this into consideration—and the reason I am interested in this is because there is so much confusion—we can determine, can we not, that the Department of Defense and NASA and all of these operations actually do cooperate with you; and in this particular case, because of the fact that it would not have been likely that the satellite Discoverer would have fallen anywhere within the purview of your stations, that that was the reason you were not informed and the only reason, because in this case you could not really have added any material value to the experiment?

Dr. HYNEK. Predicated on that launching time, I would agree completely, sir.

Mr. WOLF. Will the gentleman yield?

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. I was just wondering, Doctor, can you track optically without first being given some orbital information obtained from electronic tracking? In other words, the moon watch teams might not have been able to discover Discoverer.

Dr. HYNEK. If we know in advance the anticipated launching conditions, then we can, with a high degree of probability, tell the moon watch stations where and when to watch.

If the actual orbit turns out to be in the same ballpark with the anticipated orbit, then even the Baker-Nunn stations we can have send advance predictions based on an anticipated orbit.

The CHAIRMAN. Doctor, since you are down here now, will you give the committee a general idea of your work very briefly because the hour is getting a little late. Could you make any recommendations as to your work?

Dr. HYNEK. The work, as I mentioned, is optical tracking. Optical tracking has the primary benefit in that it is the most precise method of tracking. It has the disadvantage that at least at present it is usable only during the twilight periods. This will be changed when satellites are placed in orbit that have flashing lights on them, or infrared techniques are developed to detect them during the daytime; and work is going on on that also.

The CHAIRMAN. How far out would you be able to observe a light on a satellite?

Dr. HYNEK. This would be just entirely a function of how much power, how many batteries, the thing could carry; how powerful the light could be. Work is now going on to see whether a monochromatic flash lasting just a few thousandths of a second, but extremely powerful and therefore using power for just a short interval, would not be the way of solving that problem. It may very well be.

The CHAIRMAN. How far out were you thinking, did you have in mind that you might observe that?

Mr. FULTON. And wouldn't it depend on the point where the satellite is, whether it is in the earth's shadow or in the sun?

Dr. HYNEK. It would. The optical program so far has been designed primarily for earth satellites that are reasonably close to the earth. The present optical tracking program, until either the light gets considerably brighter or the objects themselves get much larger, would not be very good for distant spaceships or distant probes.

The CHAIRMAN. This shot which bypassed the moon: You would not have observed it even with the light that far off, would you?

Dr. HYNEK. You are quite right, sir—not that far out. However close to the earth on its way out, if accurate observations are obtained of that, then the total orbit can be computed with much greater accuracy than otherwise.

Mr. FULTON. Actually, we don't have any kind of candlepower available that would give you a light of any kind from the distance of the moon. It is the candlepower of probably a thousandth power.

Dr. HYNEK. Yes, that is quite right. I have here some figures.

Mr. FULTON. What is it—16 to the 10th power? Sixteen times ten to the tenth?

The CHAIRMAN. What do you say, Doctor?

Dr. HYNEK. I have simply some calculations as to the size versus distance. I am just assuming reflected sunlight. For instance, a thousand-foot sphere at the distance of the moon would appear as a seventh-magnitude star. That is, a star that is just a little fainter than can be seen with the unaided eye.

But this is a thousand-foot surface.

Mr. QUIGLEY. Diameter?

Dr. HYNEK. A thousand feet in diameter; yes, sir.

The CHAIRMAN. What about your ability to use instruments other than visual tracking in your stations? Do you have any such ability?

Dr. HYNEK. We are at the present very carefully looking into electronic types of tracking other than radio—that is, popularly television techniques. The television-type camera is far more sensitive. They say it has a quantum efficiency of better than a hundred times that of the photographic plate.

The only reason that we use the photographic process is because it is the time-honored astronomical method of doing it. Also, at the time we had to get this thing done in a virtual hurry, and it was by far the best way of doing it to get the accuracy that we needed.

However, now in the 3 years that have elapsed, electronic techniques have come a long way. We are looking very strongly into the possibility of—again to use a popular term—using electronic telescopes for future work, which I think would then extend the range of optical tracking to the moon.

The CHAIRMAN. You have no such recommendation at this time?

Dr. HYNEK. The only recommendation I would have, sir, is that we—as a matter of fact, I do have and will shortly have a proposal to NASA, in this direction.

The CHAIRMAN. You mean that type of proposal?

Dr. HYNEK. That type of proposal, yes, sir.

Mr. FULTON. How soon should we plan on a telescope that is operating on a satellite or that you can adopt to missile propulsion?

Dr. HYNEK. There is work now very actively going on under the auspices of NASA on a telescope in a satellite. I would feel that in a matter of 2 or 3 years we might expect that.

Mr. FULTON. You spoke on your photographic plates, I believe, that the spaces between the solid lines on the photographic plate when you took the satellite in its course were caused by the rotating of the satellite.

Actually don't you mean that it was going end over end rather than rotating on its axis? It was tumbling, wasn't it?

Dr. HYNEK. That particular photograph, sir, I believe was the photograph of 1958 Beta II, which is a 6-inch sphere. In that case I think it would be rotating. If it were a pencil like this, then it would be proper to speak of it as tumbling.

Mr. FULTON. If it was a sphere, how does it happen you get blank spaces on your plate? Are you sure it was not the shutter of your camera or a flutter in your camera?

Dr. HYNEK. I can answer that one easily. Because if it had been a flutter in the camera, then it would have shown up in the star trails also. These don't show it. The matter of fact is, I am fairly certain that this was caused by—I don't have a convenient sphere here. But if you recollect the pictures of the 6-inch Vanguard, it had little windows for the solar batteries; and as the sphere turns, those come in line of sight; and it is those that interrupt the reflection of light and make the breaks in the trail.

Mr. FULTON. As the sphere goes, it would always have the same reflection from any planet or from the sun, wouldn't it?

Dr. HYNEK. The solar battery windows are black, and of course the sphere——

Mr. FULTON. So it would be that which would cause it?

Dr. HYNEK. It would be that which would cause it; yes, sir.

Mr. FULTON. Let me just finish with this, and I am through. You have said that if there had been 3 hours' difference in time of launch it would have meant a 3-months difference in the use of the Smithsonian facilities for this precision optical tracking.

Dr. HYNEK. Virtually that, yes.

Mr. FULTON. Do you think that it could have been a better launch had they first consulted with you to find that out?

Dr. HYNEK. I am not really competent to answer that question, sir, since I don't know which particular experiments were contemplated in that particular satellite.

Mr. FULTON. At least you could have tracked it visually if they had just simply launched it 3 hours later.

Dr. HYNEK. That is correct.

Mr. FULTON. You were not given the chance to balance out what your program might have been as against other programs that were built into the particular satellite, were you?

Dr. HYNEK. That's right.

Mr. FULTON. That is all.

Mr. QUIGLEY. Mr. Chairman, may I just ask one question?

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Doctor, to date what has been the maximum range at which you have made effective visual tracking from Cambridge? How far from the earth?

Dr. HYNEK. The general order of about, I would say, 10,000 miles. This is in conjunction, of course, with satellites that don't go out much beyond that.

Mr. QUIGLEY. How large a satellite was that?

Dr. HYNEK. In that event that was Explorer 4, which incidentally I might say we had been consulted on considerably in advance, because you see, in order for the geiger counts to be significant, it is necessary to know where the satellite is when the counts are coming in.

Smithsonian provided for Dr. Van Allen and his group so-called

ephemerides, minute by minute positions of the satellites, so the count could be correlated with the space position.

I am sorry, sir. The specific question?

Mr. QUIGLEY. The specific question was the maximum range at which you have been able to come up with effective visual tracking.

Dr. HYNEK. I would have to check that, but I think about 10,000 miles.

Mr. QUIGLEY. How about on the several moon probes? Did you track those successfully for a time?

Dr. HYNEK. The moon probes go out so rapidly and so fast they become so faint so quickly that it is almost pointless.

Mr. QUIGLEY. So you have done your work almost exclusively on the satellites in orbit?

Dr. HYNEK. Yes.

The CHAIRMAN. Doctor, I want to ask you one more question. You say that the 3 hours' difference would have been the equivalent of 3 months. In other words, to get in the proper position again, we will have to wait 3 months for that satellite. Is that correct?

Dr. HYNEK. I would have to check those figures, sir. But my recollection now is that the orbit being as it is, that it would be the earth's orbital motion around the sun that would bring it into the normal twillight visibility zones.

I don't know the anticipated life of the satellite.

The CHAIRMAN. Would you make the effort now at the end of that period to see whether or not you can visually observe that satellite?

Dr. HYNEK. I think we certainly would, sir.

The CHAIRMAN. If it is still in orbit.

Dr. HYNEK. If it is still in orbit.

The CHAIRMAN. If it is rotating, then you ought to be in position at the end of 3 months' time to observe it perhaps as well as you would have been had it been launched 3 hours later. Is that correct?

Dr. HYNEK. That is correct, sir.

Mr. FULTON. That would be the time—3 months at the equator; but it would not be 3 months at every one of the stations about which you have commented.

Dr. HYNEK. I really wish I had the model of the earth here. A polar orbit differs so much from these others, that since the twilight goes almost from north to south, as the orbit moves into that, you almost get twilight visibility along the whole cut, you see.

Mr. FULTON. So there is not any appreciable time difference as to the inclination from the equator?

Dr. HYNEK. Right.

The CHAIRMAN. You might observe it on any station?

Dr. HYNEK. Yes, sir.

The CHAIRMAN. That covers it. I am going to ask counsel, when this testimony is transcribed, to submit it to the operating authority there and ask them why the satellite was not launched 3 hours later, as suggested by the doctor.

Mr. MOELLER. May I ask one more question of the doctor?

The CHAIRMAN. Mr .Moeller.

Mr. MOELLER. Dr. Hynek, this is a very elementary question, but what is the scope of astronomy? Where do you go and where do you stop?

Dr. HYNEK. Astronomy is the study of the whole universe, literally.

Mr. MOELLER. Unlimited?

Dr. HYNEK. Absolutely unlimited. You have given me an opportunity to say at this point that with the coming of telescopes in satellites, that will mean as much to astronomy as Galileo's building of the telescope in the first place.

It is an entirely new dimension.

Mr. MOELLER. In other words, all these probes that we will engage in are right, so to speak, in our alley?

Dr. HYNEK. That is correct.

Mr. FULTON. May I suggest to the Reverend Mr. Moeller, when God's laws take over, man's laws leave off.

The CHAIRMAN. We thank you very much, Doctor, for your coming here today.

Mr. FULTON. I want to thank you on the record for appearing, too.

The CHAIRMAN. We will adjourn until tomorrow morning at 10 o'clock.

(The letter from ARPA relating to Dr. Hynek's testimony is as follows:)

ADVANCED RESEARCH PROJECTS AGENCY,
Washington, D. C., March 20, 1959.

HON. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics,
House of Representatives.

DEAR MR. CHAIRMAN: Mr. Johnson has requested that I respond to your letter of March 14, 1959, respecting the testimony of Dr. J. Allen Hynek on the recent launching of the Discoverer I satellite vehicle.

As you are aware from previous testimony, the Discoverer series of launchings has as one of its long-term objectives the establishment of a capability for recovery of a space vehicle package. As an inherent element of this long-range programing, it has been necessary to plan the launching of the Discoverer satellites so that they will be in the recovery area of the Pacific Ocean during daylight hours. It would obviously be infinitely more cumbersome and difficult to attempt night recoveries of such vehicles. Even though no recovery attempt was programed for this vehicle, it was considered that these long-range requirements and certain preliminary measurements necessitated a launching which would place this vehicle over the Pacific Ocean area during daylight hours.

Although Dr. Hynek is a continuing and valued contributor to the overall space track network operated by the Department of Defense, it was considered that the requirements for daylight operation outweighed in this instance the possibility of utilizing Dr. Hynek's visual observation capability.

Sincerely yours,

W. H. GODEL,
Director, Policy and Planning.

(Whereupon, at 12:30 p.m., the committee recessed, to reconvene Friday morning, 10 a.m., in room B–214, Old House Office Building, to consider another subject.)