orbital capability in the order of 8,000 to 9,000 pounds, and when you strap on the five segmented two boosters to the Titan II, making the Titan III–C out of it, you are at about 25,000 pounds payload. Now, we are already at 40,000 pounds with the unboosted version, and we go from there so you are actually talking about two different animals. You can see you are comparing the DC–9 with the Boeing 707 here. We can add on, and they can add on, but when they add on all that they can add on, they get to about the point where we start, unboosted, so that it is really incorrect to say that the Uprated Saturn I and the Titan III are two competing vehicles. No, it is a case of a small vehicle versus a big vehicle. I think it is as simple as that.

Mr. MELDRUM. To summarize this, the outstanding characteristic that attracts attention here is this versatility.

I want to thank you, Doctor, for the talk, I couldn't have done better myself. Here is another way of looking at the same data. Here we are with the Saturn I–B. With direct injection we run out of payload capability at around 500 nautical miles. With a Hohmann Transfer Ellipse, with S–IV–B restarting, we carry this up to 20,000 pounds escape capability.

Mr. LOWREY. You'd better tell them what a Hohmann Transfer is.

Mr. MELDRUM. Well, I'll quote Dr. von Braun. When you put the payload into an elliptical orbit, when you get it to the apogee (the furthest point away) you give it a kick in the apogee. This ability to restart, with a kick in the apogee, is the essence of the Hohmann Transfer Ellipse.

With the 7 segment bird, again, there's no great improvement in direct injection; possibly you run out between 500 and 1,000 nautical miles, but again, with the restart capability we can go up to 110,000 pounds in near Earth orbit and up to 29,000 pounds to escape.

Now what does this mean to us to do a job like this? Obviously we can't answer all of the questions on this because it depends upon how many would need to be made and when they would need to be made, but if we're here today and we were authorized to do this job today, this SIP (Saturn Improvement Program) shows the personnel involved to do the engineering job; all of these would be engineers. So that, at the end of calendar year 1970 (3 years from now) we would be able to launch say bird 219 and 220, the 7th and 8th birds that will come from the follow-on program in the new configuration and thereafter we would be able to have versatility (see chart 35).

The birds would flow, and they could be flown either with no solid boosters, with two 5 segments, and with four 5 segments, two 7 segments, four 7 segments (you name it), depending upon what was needed.

Mr. LOWREY. I would like to point out our purpose in showing that.

Mr. MELDRUM. We have the people right here.

Mr. LOWREY. We now have more than are really needed.

Mr. MELDRUM. You don't have to build a new team—we've got the people here. We won't have when we get to 1968, but we do have now.

Now the other item on work other than NAS 8–4016 is the optical technology study area. We have worked on this under two contracts with NASA and our work has been, in a first phase, to identify, define, and provide the requirement justification for maximum value optical technology experiments in space. Our second phase was to develop a plan for the accomplishment of the experi-