launch vehicle and the reentry heat shield of the spacecraft as well as its control systems during this year leading to the first manned flights on Saturn V in Earth orbit in the next year.

We will be carrying out simulations of the lunar missions on the Saturn V and Earth orbit until such time as we develop the procedures and verify the operations of the equipment so that we can proceed to the final lunar landing mission.

Turning to the next pair of viewgraphs (figs. 3 and 4, MA66–9171 and MC66–10263), I would like to review just briefly the results of the flights of the Apollo/Saturn 201, 202, and 203 which took place during 1966. The first of these, 201, and the third, 202, were tests of the launch vehicle with its new second stage, the SIVB and tests of the reentry heat shields. One of these flights was designed to provide us with information concerning a peak heat impulse, the peak heating rate that will occur coming back from the Moon. The other, a flight profile, which provided a maximum total heat input which again was equal to that which we will experience coming back from the Moon. It was necessary to divide the test into those two parts because of the limited velocities that we can attain with the uprated Saturn I. These were passed successfully and the design certification preview board in November and December declared the command and service module and the launch vehicle ready for manned flight. The hydrogen experiment carried out on AS203 last summer was also a completely successful test of what was and is a relatively new field of engineering which is the distribution and control of liquids in a zero gravity environment. Now, although we speak of a zero gravity environment there is enough air drag in the upper reaches of the atmosphere so that there is some deceleration of these vehicles when they are traveling around the Earth. In order to counteract that and to provide enough countergravity or counteracceleration to keep the liquids at the bottom of the tank, we introduced a new concept. This was to use the normal vent gases of the hydrogen to provide thrust in a forward direction thus more than counteracting the drag in the atmosphere and keeping the fluid at the bottom of the tanks. It was questionable whether you could actually control the thrust to the degree required to keep the fluid settled. We are talking about something on the order of a thousandth of a G which is a thousandth of the gravitational pull of the Earth. At these very low levels, it was just not understood what would happen to large quantities of hydrogen in that kind of environment. In fact, it settled nicely. The importance of the test was that this is the method we had planned to use with the third stage of the Saturn V and we had need of being sure that it would in fact work before we committed the Saturn V to it. That experiment again was completely successful.

Mr. FULTON. Could you submit in a short statement as to how it works?

Dr. MUELLER. I will be pleased to.

(The information requested follows:)

LIQUID HYDROGEN EXPERIMENT

A main point of concern in the orbital use of hydrogen is assurance that the fuel can be settled to the lower bulkhead or bottom of the fuel tank and kept there, covering the engine pump inlet and ready to supply the engine pump with fluid—not gas—when it is time to restart the main engine.