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NASA LONG RANGE GOALS

USING SATURN AND LARGER VEHICLES

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PRESENTED TO SPACE SCIENCE BOARD

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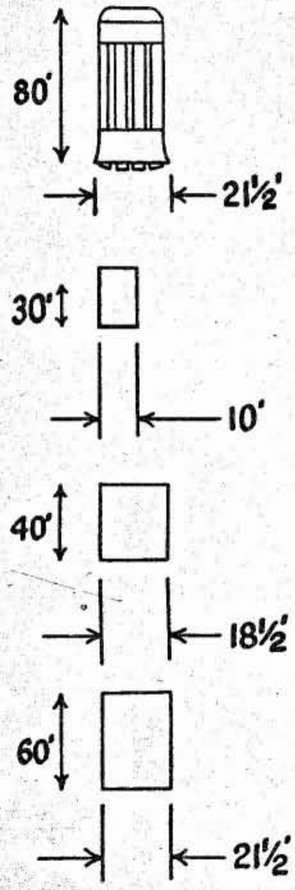
A description of the Saturn launch vehicles will be given as well as how they will be used in future missions. Included also is a discussion of the steps leading to the development of a larger vehicle than Saturn, the Nova. The material presented is condensed from a NASA presentation to an Ad Hoc Group of the President's Science Advisory Committee, October 26, 1960, with revisions to bring it up to date. It should be understood, however, that Saturn and larger vehicles are being studied intensively and plans presented may change considerably.

The Saturn is the largest launch vehicle under development in the United States. There are several versions of Saturn but before describing them, let us take a look at the various stages or building blocks that make up the Saturn. (Figure 1)

The base or first stage of the Saturn vehicle is approximately 22 feet in diameter and 80 feet tall. It uses a kerosene-like fuel, RPI, and liquid oxygen. The eight engines develop a total of 1,500,000 pounds thrust. These engines are somewhat simplified versions of those developed for Atlas, Thor and Jupiter. The stage is designed to perform its function in case one engine fails in flight. A test stand configuration of this stage has already been fired 376 seconds and the development thus far is quite sucessful.

BUILDING BLOCKS OF SATURN

APPROX DIM.



STAGE	THRUST	PROPELLANT	NO. ENGINES	FIRST FLIGHT
S I	1,500,000	RP1-02	8	1961
S V	35,000	H_2-O_2	2	1961
S IV	70,000	H_2-O_2	4	1963
S II	800,000	H_2-O_2	4	1965

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FIGURE 1

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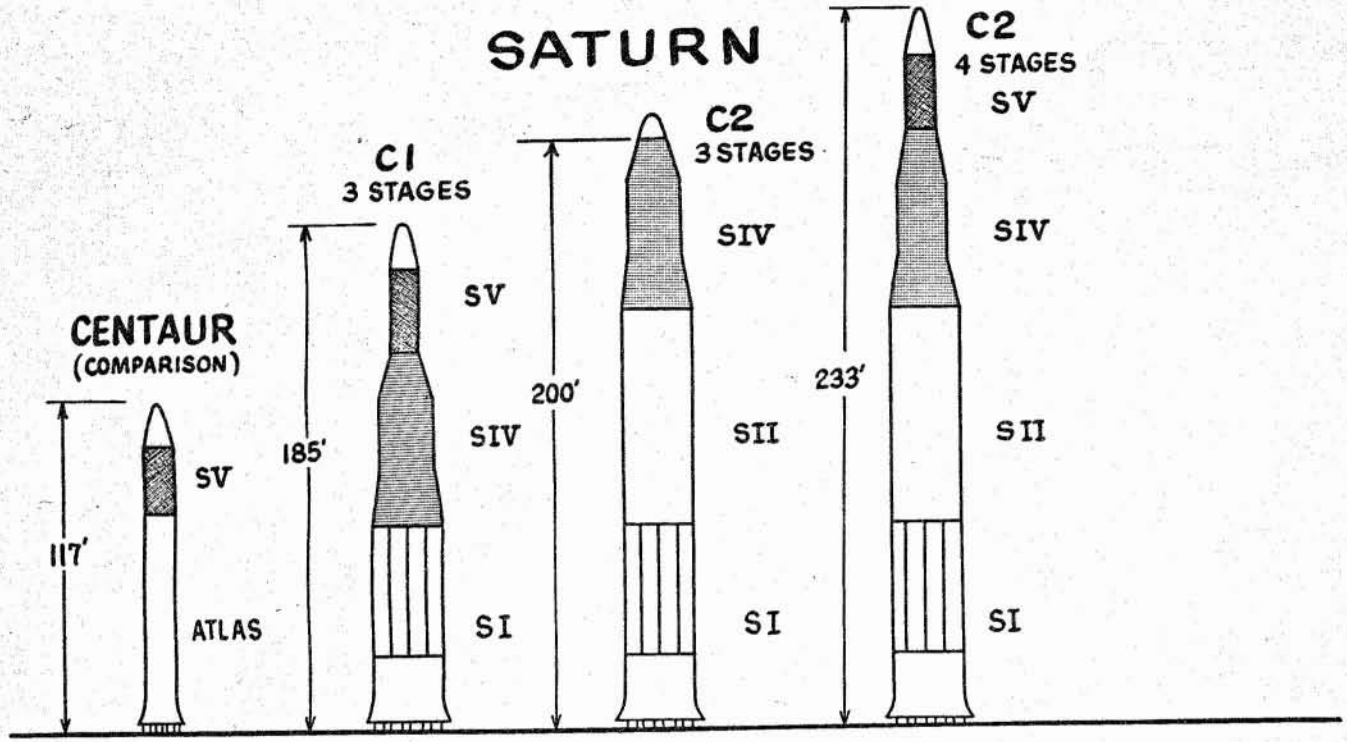
The SV, SIV, and SII stages use liquid hydrogen and liquid oxygen. The SV stage is powered by two P&WA engines for a total of 35,000 pounds thrust. The first version of this stage is on the Centaur vehicle scheduled to be test flown this year. The SIV stage uses four of the same type P&WA engines; its first flight will be in 1963. The SII stage is still in the planning stage and is needed for a later model of Saturn. It will be the same diameter as the SI stage and about 60 feet high. It will use four H_2-O_2 engines, developing 200,000 pounds each. This new engine is now under development by Rocketdyne.

Figure 2 shows the Saturn concept and capability with Centaur for comparison.

The Saturn C1 has three stages; SI, SIV, and the SV, the last from Centaur development as mentioned. It will be ready for missions in 1964 and will put 19,000 pounds in an earth orbit, 5,000 pounds to escape velocity, and 2,500 pounds to Mars and Venus. This is about double the Centaur capability. Later versions of Saturn, called C2, will be either three or four stages using the same building blocks as C1 with a new stage SII. The three-stage C2 will place 45,000 pounds in an earth orbit, 15,000 pounds to an escape velocity, and 11,000 pounds to Mars and Venus. With the SV as a 4th stage it will increase the payload to Mars and Venus 36% to 15,000 pounds.

SATURN CONCEPT & CAPABILITY



AVAILABILITY FOR MISSIONS	1963	1964	1967	1967

PAYLOAD CAPABILITY, POUNDS

EARTH ORBIT	8500	19000	45000	—
ESCAPE & LUNAR MISSIONS	2500	5000	15000	18,000
MARS & VENUS	1500	2500	11000	15,000

FIGURE 2

Saturn missions, shown by figure 3, are unmanned lunar exploration, (Prospector), unmanned planetary and inter-planetary exploration, (Voyager), manned orbital laboratories, and manned lunar circumnavigation (Apollo), and advanced technology which includes development of rendezvous techniques, orbital operations, and advanced propulsion leading to manned lunar landing and planetary exploration. Let us briefly examine these missions and the reasons why large launch vehicles are needed.

The use of Saturn for the exciting and challenging unmanned exploration of the moon, the planets, and other parts of the solar system can be best understood if we look briefly at the entire program, shown by figure 4.

The Ranger project for 1961 and 1962 will be capable of viewing the lunar surface with television and measure gamma radiation during its decent to the moon. It will eject a survivable capsule containing a seismometer. Surveyor, which soft-lands instruments on the moon, comes in the 1963-1965 period. In the 1965-1966 period, a part of the Surveyor project is intended for missions involving a precise orbit about the moon. Following these comes the Prospector on the Saturn which will soft-land a greater instrument load and provide mobility on the surface as well. It will be used both for scientific purposes and in

SATURN MISSIONS

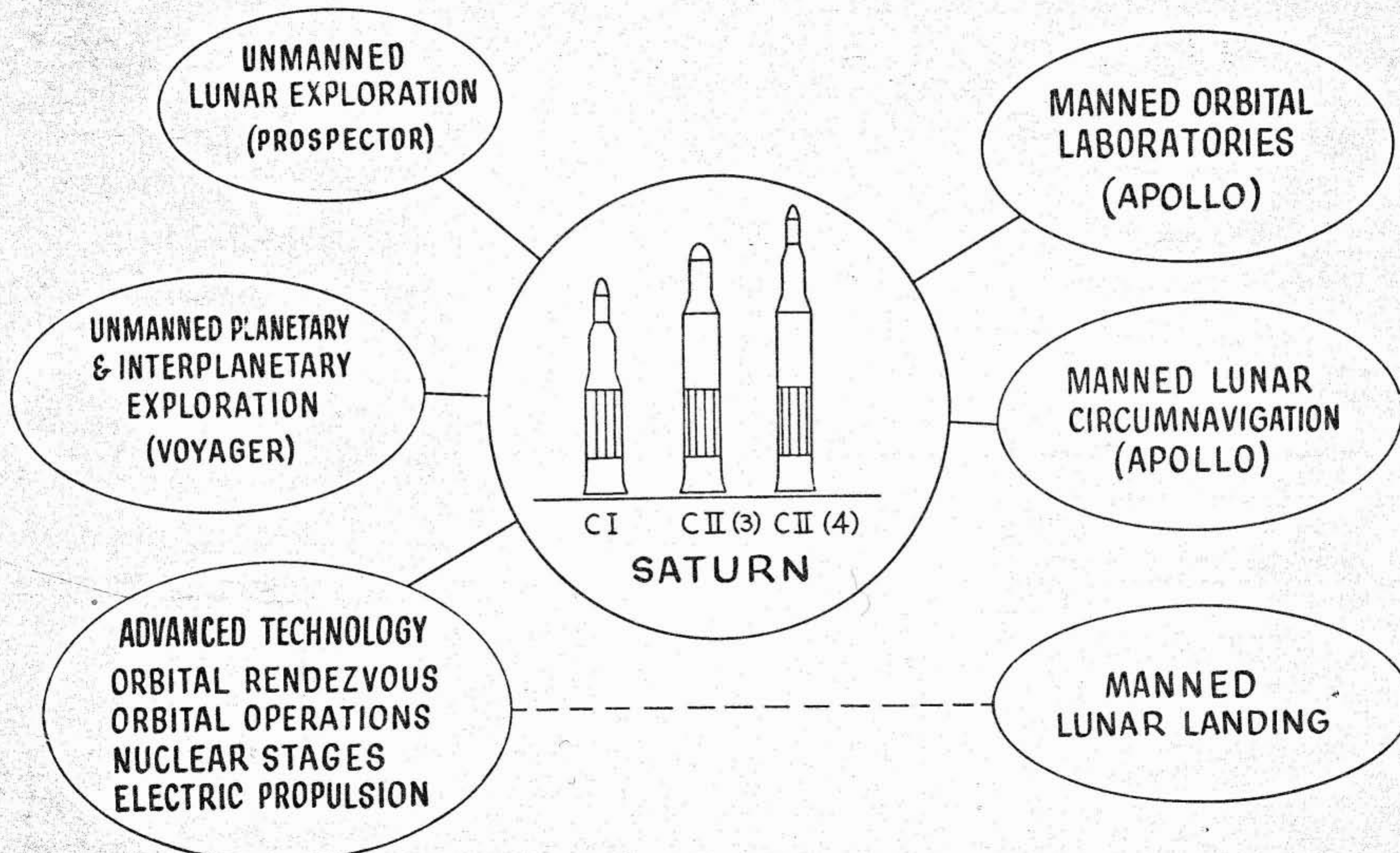


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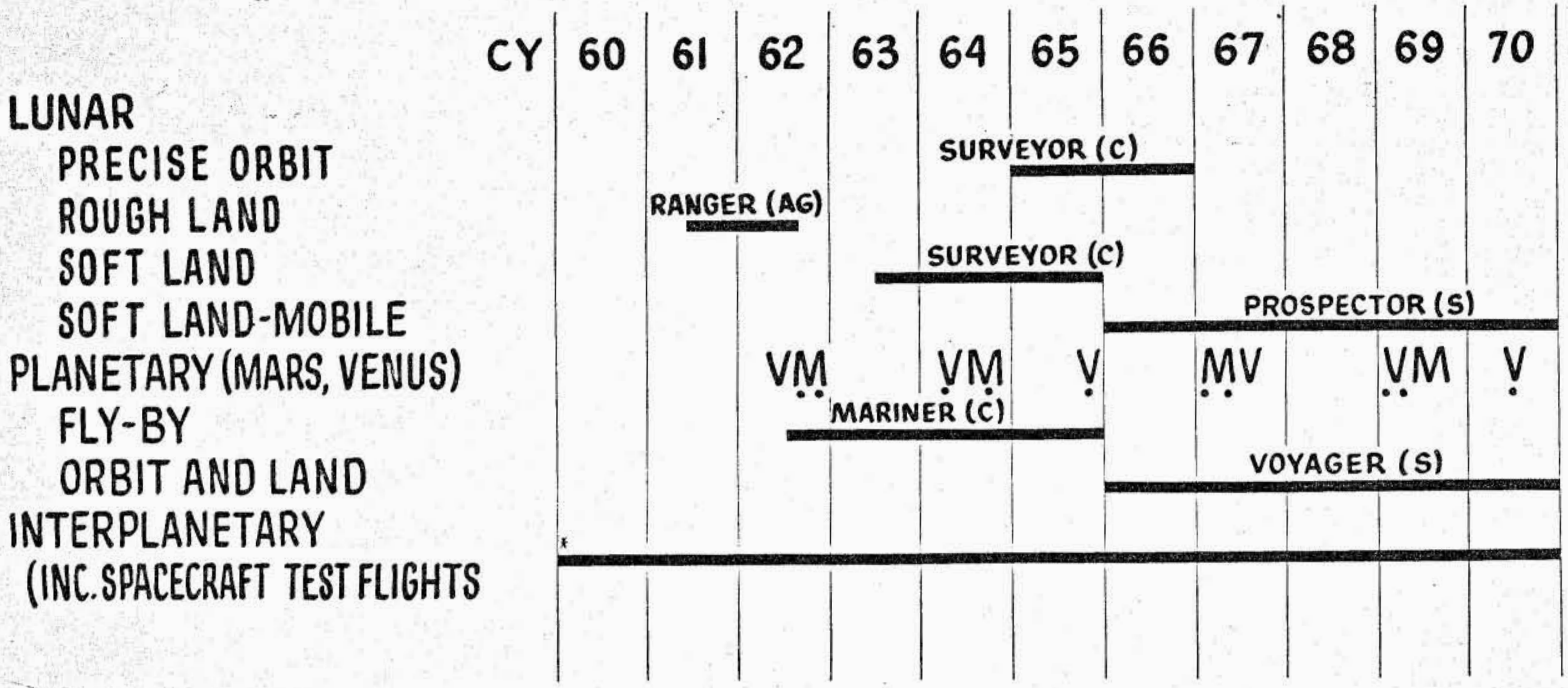
FIGURE 3

LUNAR & PLANETARY PROGRAM



V VENUS
M MARS

AG AGENA
C CENTAUR
S SATURN

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FIGURE 4

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support of manned lunar landing. In the planetary program, the fly-by mission of Mars and Venus will extend from 1962 to 1965. Following this is the Voyager series using Saturn. In the interplanetary program, all spacecraft are to be sent deep into space to gather data on magnetic fields, particles, radiation, or other phenomena to be found there.

The new and increasingly difficult scientific tasks in space require a new group of more complex spacecraft. This evolution which, of course, follows the growth of launch vehicle capability, is shown by figure 5.

The first generation of spacecraft, in the 1959-1960 period, ranged from 13 to 366 pounds and were capable of one to nine experiments. The experiments of the second generation beginning this year range from 750 to 15,000 pounds. (The three shown are for lunar exploration.) Ranger rough lands a small capsule, Surveyor soft-lands about 250 pounds of instruments, and Prospector not only soft lands over 800 pounds of instruments, but is capable of moving about the lunar surface and making measurements at a variety of places.

A view of Prospector is shown by figure 6.

A consideration of the weight breakdown of the Prospector spacecraft discloses why the Saturn C2 is needed.

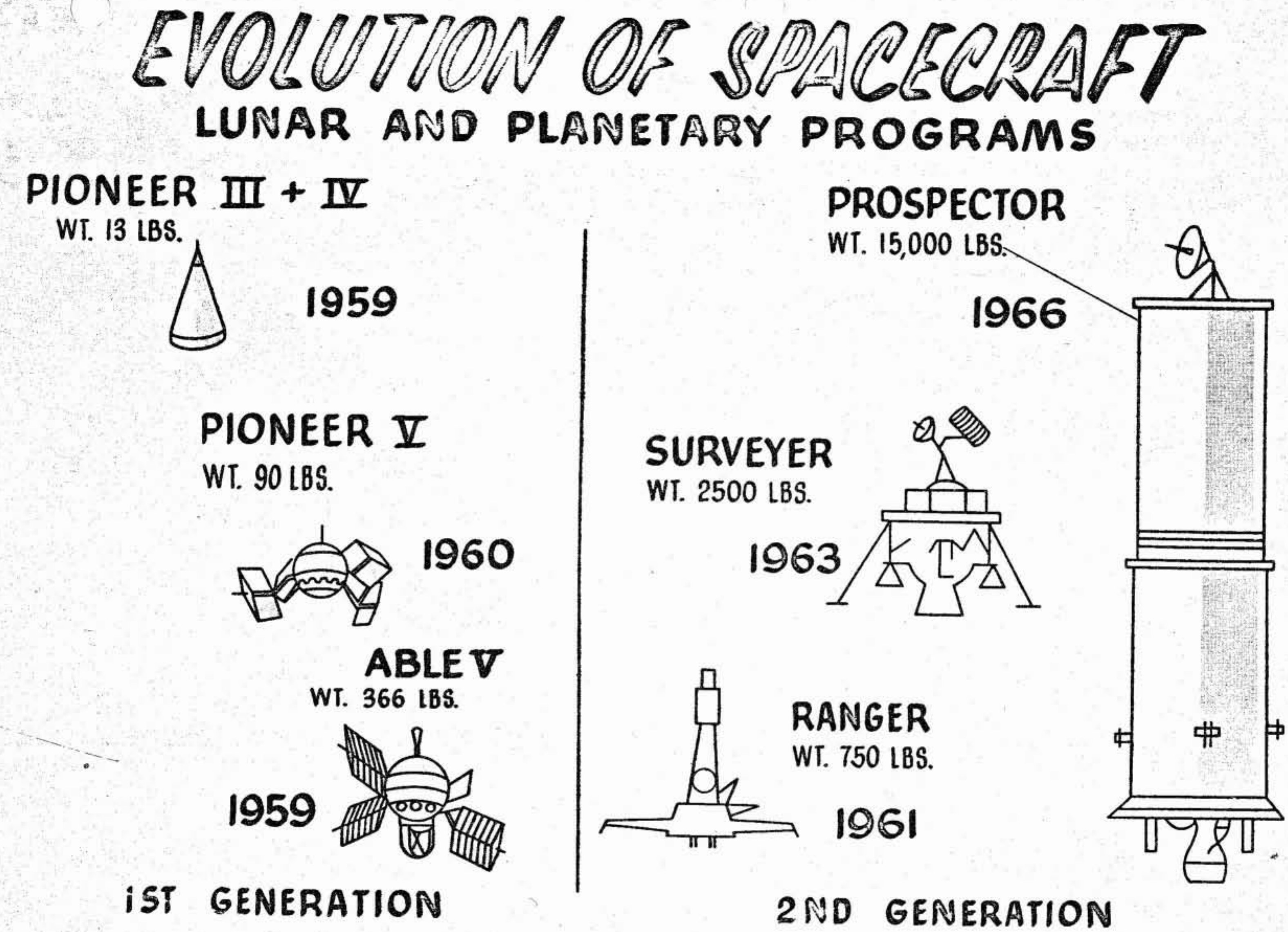

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FIGURE 5

PROSPECTOR MOBILE PAYLOAD

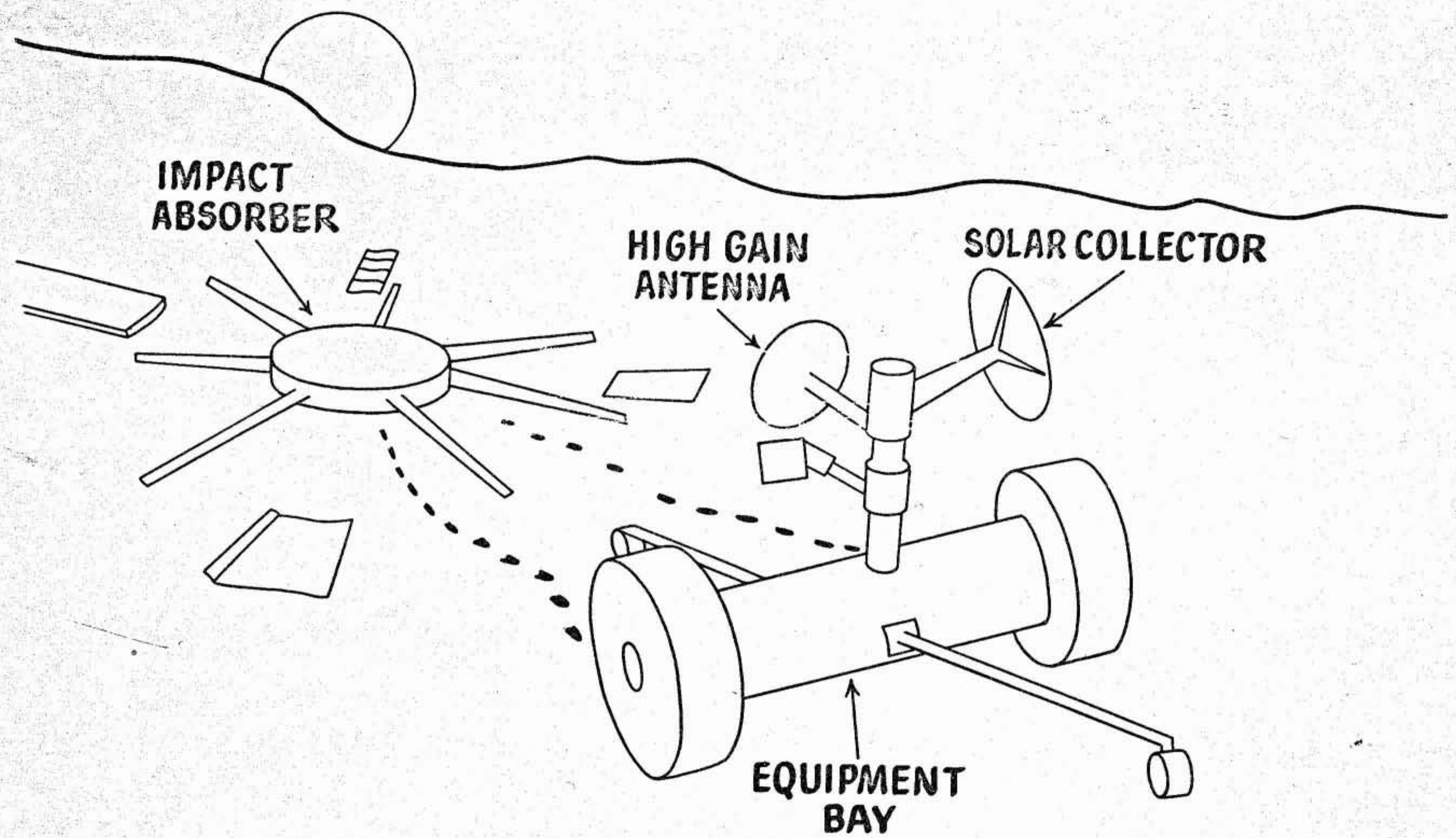

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FIGURE 6