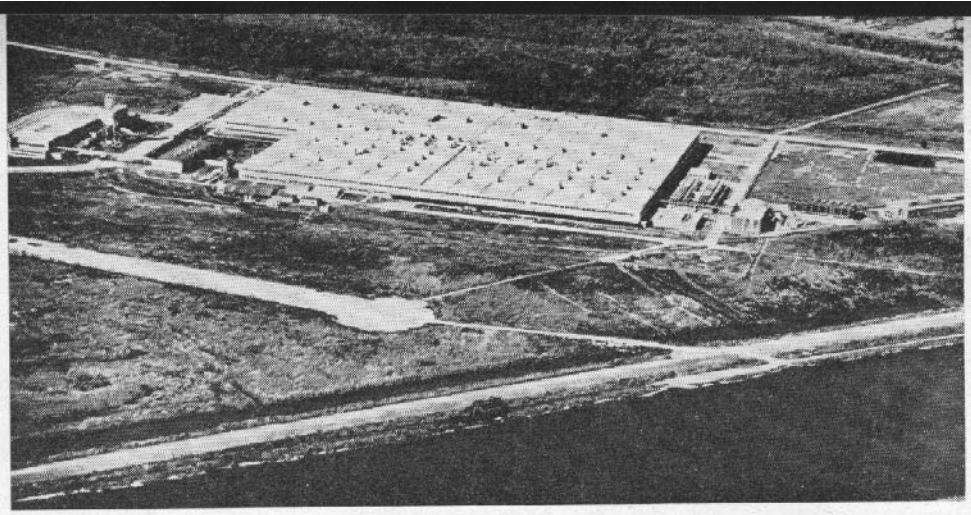


The next generation of NASA's big boosters will be built at Michaud ordnance plant, 15 miles east of New Orleans, which should begin operation next year with the manufacture of Saturn stages

Nevertheless, Dr Pickering reported, a considerable amount of scientific information had been obtained from the early Pioneer probes and the more recent Ranger 1. Looking beyond the lunar flights to the exploration of the planets Venus and Mars, the launch times would be critical because of the limited and infrequent periods during which near-planetary shots would be possible. The first probes launched in the planetary programme would be designed to "fly-by" Venus or Mars and to make *en route* observations. The spacecraft used would be Mariners, followed by the Saturn-launched Voyagers.

For interplanetary exploration just as much as for, say, communication satellites, Dr Pickering emphasized, one needed a spacecraft lifetime measured in years. A large technological effort must be directed towards ensuring long life. Vanguard 1 was still transmitting after more than 3½ years, he remarked, which in this respect was very good.

Manned Spaceflight Much of the immediate interest in Dr Pickering's unmanned lunar spacecraft stems from their significance in relation to President Kennedy's accelerated programme to place three men on the Moon, and return them to Earth, by 1970 (this remains the official date, although individual NASA scientists are hopeful for 1967). The manned lunar mission, expressed simply, involves the following approximate velocities: 17,000 m.p.h. to achieve Earth orbit, an additional 7,000 m.p.h. to go to the Moon, a decrease of 1,500 m.p.h. to go into orbit around the Moon and a further decrease of 4,000 m.p.h. to land on the Moon. Repeating these steps in reverse order brings the spacecraft back to Earth. This does not imply that the manned lunar flight will necessarily be made in these stages; merely that a total velocity change of approximately 25,000 m.p.h. is needed in the vehicle (from Earth orbit back to Earth orbit).

A review of the whole area of manned spaceflight was given by Mr Robert R. Gilruth, Director of NASA's Manned Spacecraft Center (now located at Langey Field, Virginia, but soon to move to a new installation at Houston, Texas). This included an appraisal of the achievements of Project Mercury and the plans and problems of Project Apollo; because of its importance and technical interest this contribution merits extensive reporting here.

In Project Mercury today, Mr Gilruth said, we were approaching "the end of the beginning." Although modest in comparison with currently planned programmes, Mercury had been a difficult but inspiring task. In the three years since its inception, the project had passed through the stages of research, development, engineering, design and manufacture, and was now "deep in the qualification flight-test phase."

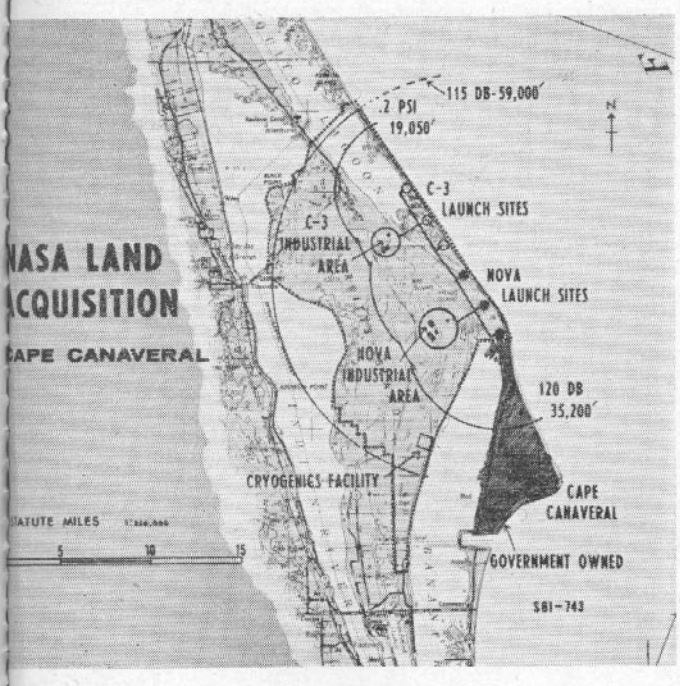
The challenge in Mercury was, first, to investigate man's capabilities in the space environment; and secondly (but concurrently) to develop manned spaceflight technology for use as a basis for the conduct of much more ambitious undertakings, including manned exploration of space and the planets. Mr Gilruth went on to list the following major accomplishments:

(1) A major management resource had been developed, and was now being expanded, for the conduct of manned spaceflight research activity.
(2) The design of the Mercury spacecraft had been selected and verified in flight.
(3) A family of launch vehicles—Little Joe, Redstone and Atlas—with which to carry out the flight programme had been selected.
(4) Industrial know-how and capacity for the design and manufacture of very complex spacecraft and related systems had been developed and expanded.
(5) A progressive build-up of flight operations had been drawn up and was now well underway. Included in the flight programme [which at that time, prior to the MA-5 flight reported on page 872, had included flights by 22 Mercury spacecraft] were flights by "two small rhesus monkeys, a friendly chimpanzee named Ham, and two friendly fellows named Shepard and Grissom."
(6) An earth-girdling tracking, data collection and flight control network had been built.
(7) A pool of trained space pilots had been developed.

All of this experience and capability is in being now [Mr Gilruth continued]. We as a nation are now confronted with a new and tremendously more complex challenge. It is the challenge spelled out by President Kennedy before the Congress on May 25, 1961. It is the national goal which he set of sending man to the Moon, accomplishing a successful landing on the Moon and return to Earth in this decade . . .

The manned segment of the lunar landing programme is known as Project Apollo. I would like to underscore here that Apollo is only the manned segment. It is by no means the only project involved—nor can we accomplish the desired end-result alone. . .

As a step toward the three-man Apollo mission, we feel at this time that considerably more manned spaceflight experience is desirable. I am thinking here of an expanded manned orbital flight development programme, probably with Mercury-type spacecraft.



EVALUATION OF LAUNCH SITES

	National ownership	Launch vehicle impact hazard	Overflight hazard	Water transport	Interrupt intra-coastal waterway	Adjacent to existing capabilities	Relative facilities cost index
Brownsville, Texas	US	yes	yes	yes	yes	no	1.07
Cape Canaveral	US	no	no	yes	no	yes	1.02
Christmas Island	UN	no	no	yes	—	no	3.00
Cumberland Island, Ga	US	no	no	yes	yes	no	1.07
Hawaii	US	no	no	yes	—	no	1.87
Mayaguana, Bahamas	GB	no	no	yes	—	no	2.41
White Sands, New Mexico	US	yes	yes	no	—	yes	1.00

A major expansion of NASA launch facilities is planned at Cape Canaveral, as indicated on this map, which shows the existing launch-site area in heavy shading. Above, factors influencing the choice of launch site for the space administration's Saturn-class vehicles