and satellite weather systems, reconnaissance systems, communication systems, and scientific space programs. Included in these launchings was a demonstration of the feasibility, practicability, and utility of launching large rockets from ships at sea.

This initial space research was followed by the Navy development of the Aerobee sounding rocket for the conduct of experiments in space. Over 100 launchings of this rocket have been accomplished since 1947. Valuable data have been obtained on cosmic radiation, the Earth's magnetic field, communications phenomena and high altitude photography of the Earth. Early space environment and bioastronautic experiments were conducted. These investigations are an essential prelude to manned space flight. The Aerobee rocket is used universally as a scientific launch vehicle for experiments up to altitudes of 75 miles.

As space technology expanded, the Navy developed the Viking rocket to fill the need for a research probe vehicle which would lift larger instrumented payloads up to 500 pounds to altitudes above 100 miles for upper atmosphere investigations. This liquid rocket vehicle used the first gimballed rocket motor for flight control. This technique is now universally used on all liquid rocket systems in this country. In May 1950 a Viking was successfully launched from the USS *Norton Sound*.

The instrumented payloads of Viking rockets obtained data on cosmic radiation and on the temperature and pressure of the atmosphere above 100 miles. The results of this research led directly to the successful development and operation of the Vanguard Earth satellite. Viking research pioneered space photography and demonstrated the feasibility of satellite weather observation and reconnaissance and contributed greatly to present programs such as Tiros and Samos.

In parallel, another phase of space research was undertaken by the Navy using stratosphere balloons to carry out research at very high altitudes with large instrumented payloads and to recover the data obtained safely. In this program the Office of Naval Research developed the Skyhook balloons. This program led further to manned gondolas which provided the first data on the space environment and the means of surviving in space. The knowledge gained from these experiments has enabled the Navy to provide much of the space survival information required by NASA for Project Mercury. Also, as part of the program, the first telescopic observations were made above the atmosphere of the planet Venus which led to the finding of the presence of water vapor on that planet. Such research as this is being contained by NASA in their orbital astronomical satellite.

Beyond space probes and in the field of Earth satellites, the Navy is similarly proud of its record. As early as 1946, the Navy recognized the potential of satellites and initiated, jointly with the Army Air Corps, the first United States Earth satellite effort. During the 1946–48 period, over one million dollars in research and development funds were expended to develop flight techniques, equipment and payload design, controls and the booster vehicle. This rocket was a very advanced design and included a liquid hydrogen-liquid oxygen rocket motor.

Although this program was terminated in 1948 by the OSD Research and Development Board, this early start made a substantial contribution. The USAF space studies by the Rand Corp. evolved from this effort, and early hydrogen rocket research was stimulated.

In 1954, Project Orbiter was sponsored initially by the Office of Naval Research. This was a satellite vehicle concept that eventually evolved into the Army Explorer satellite project.

Later, in 1955, a special OSD committee chaired by Dr. Homer J. Stewart was convened to review several proposals for an Earth satellite. The committee voted to accept the Navy's proposal for Vanguard as the International Geophysical Year program for an Earth satellite.

The Vanguard satellite and space vehicle was developed by the Navy at the Naval Research Laboratory. This project resulted in the successful orbiting of an artificial Earth satellite to obtain scientific data. From the Vanguard satellites data were obtained on the Earth's magnetic field, intensity of solar radiation, meteorite penetration, dust erosion, space temperatures and related phenomena which has brought about a new and basic understanding of space environment. This fundamental knowledge has contributed directly to all follow-on satellite programs.