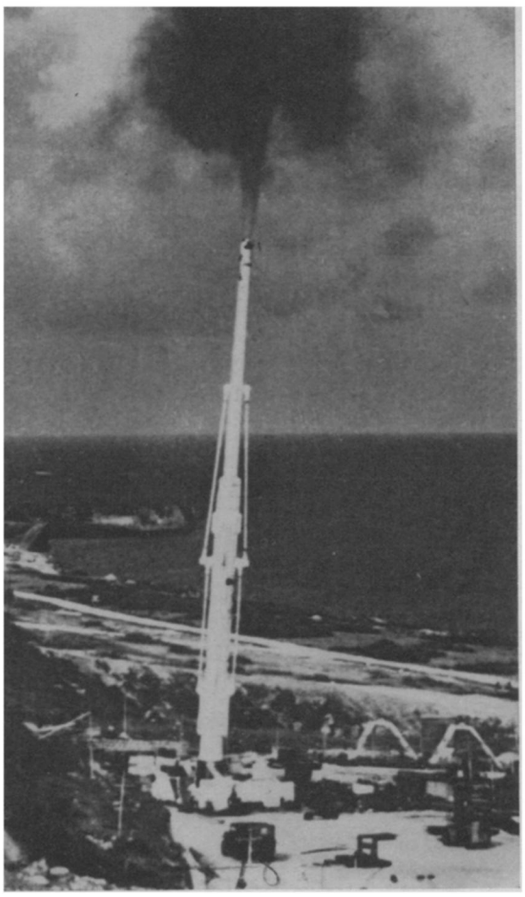

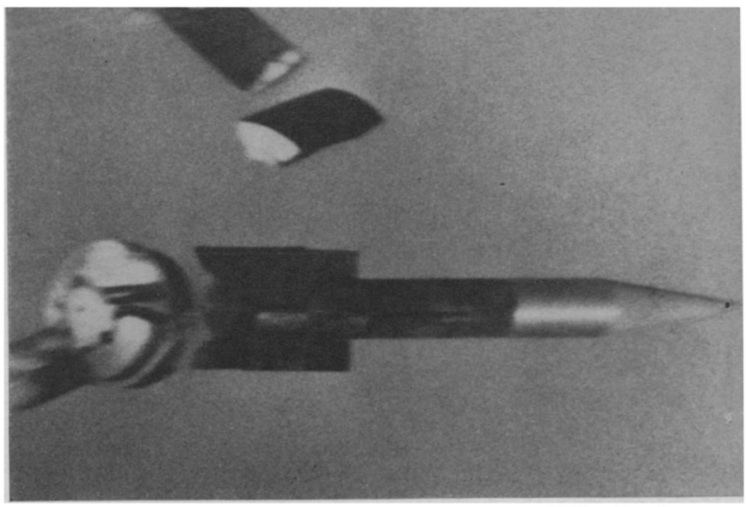

SRI Lockheed

SRI's mammoth 100-foot gun at Barbados (left) lofts sabot-equipped probes (top right) to new heights, while fluid-filled rocket guns (bottom right) intrigue the Army.

SPACE TECHNOLOGY

Gunning for space

Mammoth guns that shoot sounding probes and rockets instead of shells are making a big bang in research

by Jonathan Eberhart

In 1865, Jules Verne described an epic journey in which three travelers circumnavigated the moon in a capsule fired out of a huge cannon. The barrel, as long as three football fields, was sunk into the ground like a monstrous well.

A century later, man is approaching the moon with different tools—projectiles that fire themselves—but Verne's vision has not been forgotten. Converted naval guns, while not shooting for the moon, are sending payloads as high as the altitudes reached by Gemini astronauts, and higher and farther are constantly on the space-gunners' minds.

The launching of high-altitude sounding probes from guns is a fledgling science, some five years younger than the still-youthful Space Age. Yet in this short time, fully instrumented payloads have been lofted as high as 129 miles and have attracted the interest of the Army, the Navy, the Environmental Science Services Administration, the Canadian and British Governments and several companies and universities.

The inclusion of full instrumentation is no small matter—indeed, it was a major obstacle—since equipment had to be designed to withstand shocks as high as 60,000 times the force of gravity. (The worst shocks on a manned space flight, including launch and reentry, are only seven g's.)

One of the major probe-shooting centers is the Space Research Institute, now part of Norwich University in Vermont. Started in 1962 by Dr. Gerald V. Bull of McGill University in Montreal, SRI was supported, by both Canadian and U.S. dollars, until last year, when Canada's Ministry of Industry and Defense Production, on debating about how its limited funds should be spent, withdrew its support. McGill told SRI that it would have to stand on its own feet; the institute decided to cross the border to greener pastures.

SRI's basic idea is that a gun's performance can be greatly improved by using a smaller and lighter projectile than the one for which the gun was designed, such as an eight-inch-diameter load in a 16-inch gun, while keeping the powder charge the same. To hold pressure in the gun until the projectile leaves the barrel, the projectile body is fitted with a sabot. Though the word means shoe in French, it is more like a collar, threaded onto the projectile and just fitting the inside of the barrel. Once outside the gun, the sabot automatically falls away.

Most of SRI's work is done in Vermont, where 5-, 7-, and 16-inch guns are fired horizontally along a camera-equipped course into an instrumented hillside, as well as straight up to test the probes and instruments themselves. The most spectacular installation, however, is at Barbados in the West Indies, where a 16-inch gun handles a variety of projects. To keep pressure behind the payloads longer, thus increasing altitude, SRI engineers welded a second barrel on the end of their gun, producing a tube reaching more than 100 feet in the air. A 150- or 160-footer is planned in about six months, says SRI's president, Jack Woolley.

In the past, the big gun has been used horizontally to skip a payload across the ocean to a recovery ship waiting dozens of miles away. Most of the work, however, is vertical. In March the gun provided Britain with that country's first high-altitude vapor cloud studies of earth's magnetic field.

Another probe-shooter is the U.S.

Army, whose Ballistic Research Laboratory fires instrumented payloads from Alaska, New Mexico, Arizona, Vermont and the National Aeronautics and Space Administration's launch site at Wallops Island, Va. Besides sunsensors to monitor spin rate and telemetry to report it, the Army flies a variety of radar-reflective chaff particles to test electronic countermeasures.

The most important use of the guns, however, may be yet to come. Shooting payloads into orbit, chorus Woolley and Dr. Bull, is just over the horizon.

"If we had money," says Woolley, "we could do it in six months to a year." Here the gun's biggest advantage over rocket-launchings really stands out: economy. Woolley estimates that an orbital launch could be made for one percent of the cost of a rocket firing, or as little as $30,000.

A major reason, he says, is that a rocket, besides being more expensive in the first place, is unstable when it is slowly beginning its flight, so it needs costly, sophisticated control and guidance equipment. "With a gun," he says, "we just aim and fire, and the projectile leaves the barrel at a speed at which it's stable."

SRI has already computed that a 64-inch-diameter gun (which would have to be created) could put 12,000 pounds in a 200-mile-high orbit.

A variation that may interest the military more directly is the use of a gun as the stationary first stage of an actual rocket, which would not ignite until after it had been fired out of the barrel. Lockheed Propulsion Co. in Redlands, Calif., and Kearfott division of General Precision in New Jersey are both working on such systems, while the Navy is conducting experiments of its own with an 8-inch gun.

One technique developed at Lockheed is to surround the projectile in the gun barrel with a fluid of the same mean density as the projectile in order to equalize the internal and external stresses on the rocket. "Otherwise, without heavy walls it would shatter," says a company official. "This way we could launch a banana or even an egg without breaking it." Lockheed has been experimenting with both weapon-type rockets and instrumented probes, ranging from .30-caliber up to 155-mm loads more than half a foot across.

Much of the early work in gun-launched probes was done under Project HARP (High Altitude Research Project), but that has been over for a year. SRI's international clientele shows that the economy of gun-probings may be paying off, and Lockheed's rocket-gun test range is in use five days a week. "Bigger and better guns," says Dr. Bull, "are not only possible, but desirable."