Pershing Rockets for Europe

"The Small Deterrent" was the title we gave to an article in INTERAVIA 3/1961 dealing with the trend in American strategy towards creating a complete arsenal of guided nuclear missiles, from the two-stage *Pershing* rockets, with a range of a few hundred miles, to the smallest one-man infantry weapons equipped with atomic warheads. Now that development of the *Pershing* is nearly completed, and units of both the U.S. Army in Germany and the West German Land Forces are to be armed with this missile, we should like to give our readers a more exact picture of the most modern tactical medium-range rocket at present available to the West.

Among the most important tasks of the *Pershing* is to attack enemy long-range weapons and concentrations behind the battle area and, with a range of over 300 miles, the *Pershing* in fact commands an area of nearly 300,000 sq.m. Since the rocket can be put into action in any desired position within a matter of minutes, a few *Pershing* units can deal quickly, effectively, and decisively with critical battle situations. In its main features—robust construction, a high degree of mobility, and complete air-transportability—the *Pershing* compares very favourably with its predecessor, the *Redstone*. The complete weapon system, including all ground support equipment, can operate on any terrain and, to a large extent, avoid detection by the enemy.

When, in 1956, the U.S. Joint Chiefs of Staff decided that a new, mobile army rocket in the 300-mile class must be developed, their specification called for a surface-to-surface tactical missile with characteristics hitherto unknown in an army rocket, such as extensive miniaturization of the guidance system, reduction to a few minutes of the time required to prepare the rocket for launch, simplifications in pre-flight checkout, and so on. In 1958, the Orlando Division of the Martin Company in Florida was given the development contract and, by February 1960, barely two years later, the first *Pershing* trial projectile was fired at Cape Canaveral. As early as September, 1960, the Ordnance Guided Missile School, at Redstone Arsenal, Huntsville (Alabama), inaugurated a course in operating the *Pershing*.

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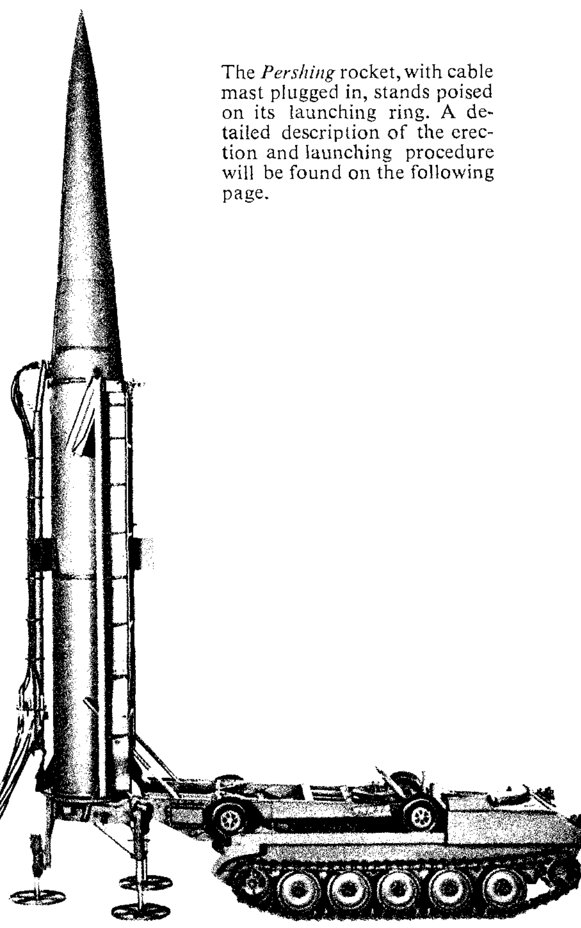
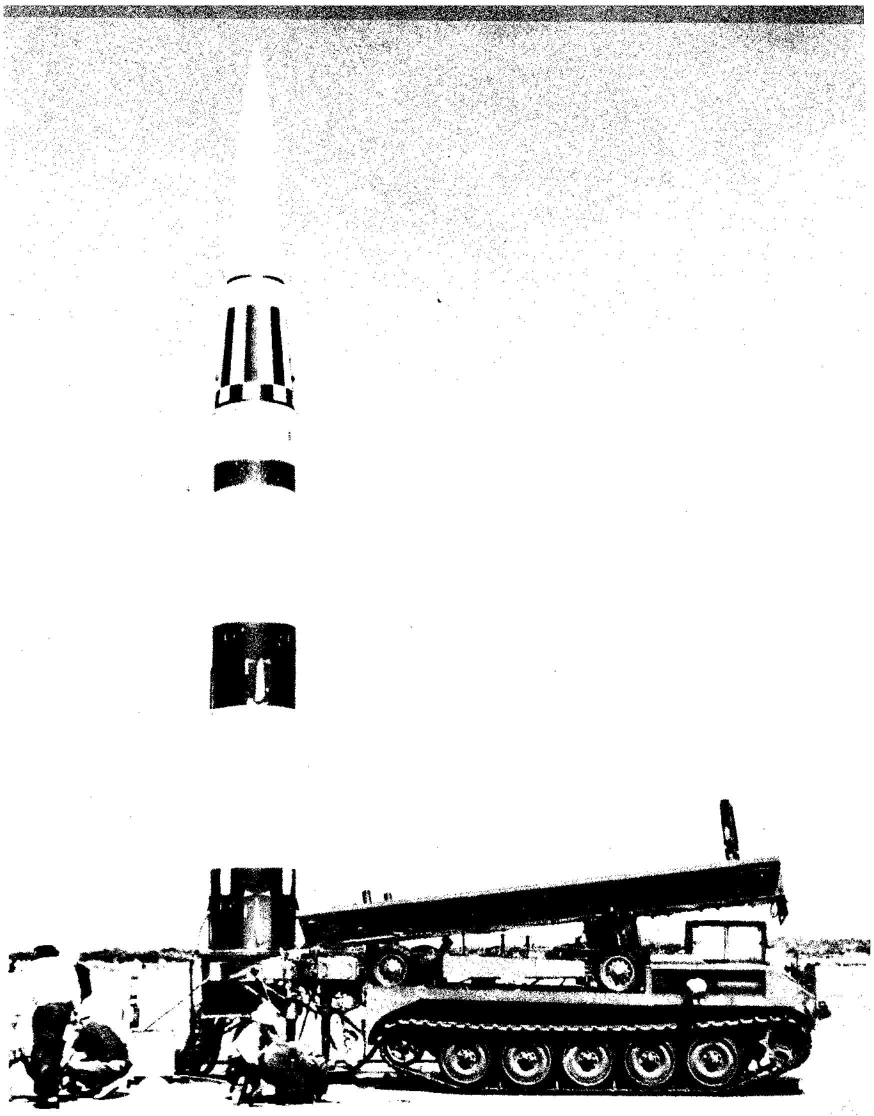
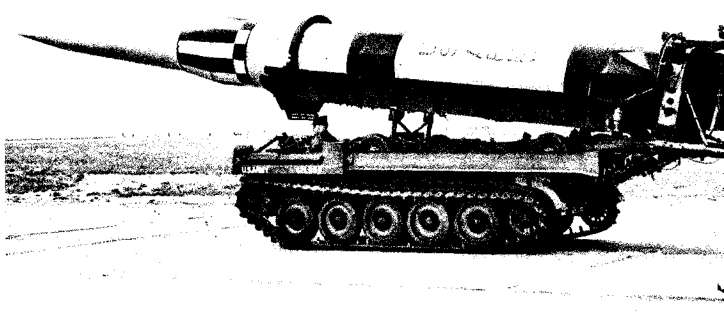
As stressed at the outset, the main objects in the creation of the *Pershing* were a complete weapon system with a high degree of mobility and very brief total reaction time. The *Pershing's* great mobility is achieved by use of a new specially developed wheeled vehicle, known as a transporter-erector-launcher (TEL). This is so designed that the rocket can be quickly erected, aligned with the target, and fired. This mobile TEL, and all the rest of the ground support equipment, can be mounted on tracked vehicles suitable for cross-country operation. The *Pershing* convoy can travel about anywhere in the battle area, making it very difficult for the enemy to detect the launch position; on the other hand, it can go into firing position within a few minutes and send the rocket on its way, before enemy



The *Pershing* rocket, with cable mast plugged in, stands poised on its launching ring. A detailed description of the erection and launching procedure will be found on the following page.



Final launch preparations at the Cape Canaveral missile range.



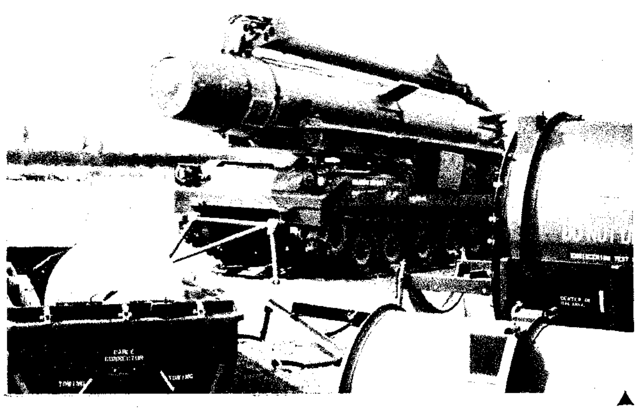
The rocket ready for the road on the XM-474 transporter.

artillery or long-range rocket units have had a chance to establish its position.

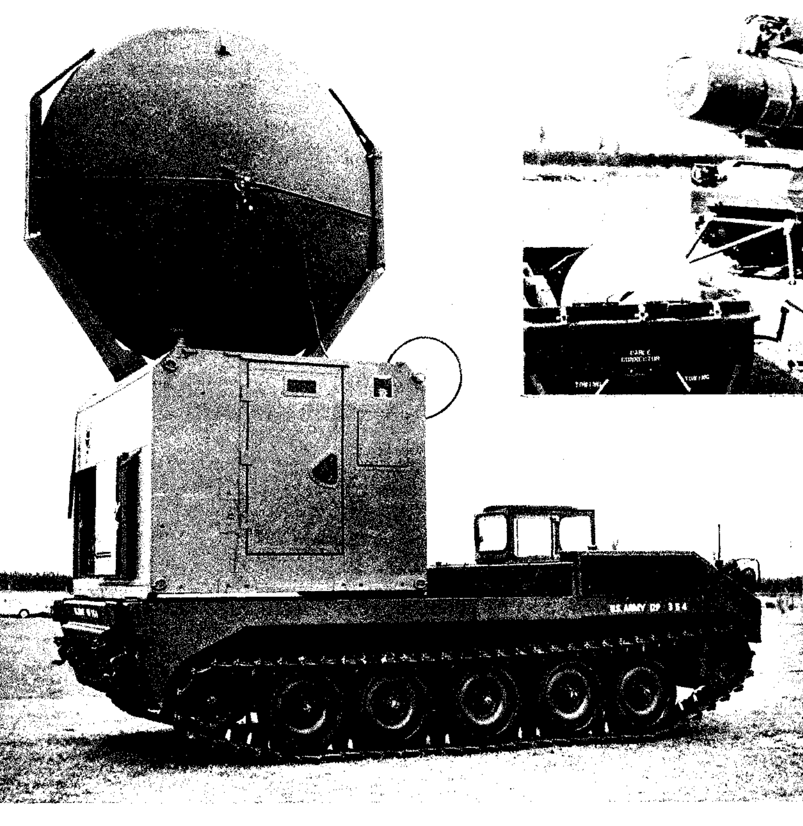
Thanks to relatively small dimensions (the 34-ft long *Pershing* is some half the length of the *Redstone*), field handling of the rocket has been considerably simplified. During the whole operative phase, the rocket remains on the 4-wheel TEL vehicle. The same vehicle can be used to transport it by helicopter, air freighter, or sea-going vessel.

The transporter-erector-launcher, built by the Thompson Aircraft Products Corporation, a Division of Thompson Ramo-Wooldridge Inc. of Cleveland, Ohio, includes a dual-track erector supported on the transporter chassis. The launching platform is mounted at the rear of the transporter and is pivoted so that it can be rotated to the ground, where it is supported by levelling jacks. During transport, the missile is carried in a horizontal position on the erector, which is also pivoted at the rear of the transporter. At the firing site, after the launch pad is rotated to the ground and levelled, the erector rises to the vertical position, placing the missile on the launcher. The erector then returns to the horizontal position, leaving the missile resting in a vertical position on the azimuth ring of the launcher. Under command of the fire control unit, the azimuth position of the missile is accurately adjusted before firing.

Control cables, air ducts, and high pressure air lines necessary to precondition, checkout, and fire the missile are mounted in a cable mast. The lower end of the cable mast is mounted in a bracket attached to the launcher azimuth ring, and the upper end is engaged with electrical and air connections in the missile. During the firing procedure, just prior to ignition, the upper end of the cable mast is automatically ejected from engagement with the missile. While the upper end of the mast is ejected from the missile sufficiently far to provide clearance for firing, a brake in the bracket at the lower end quickly stops movement of the mast and holds it in a near vertical position. Since the mast is prevented from falling to the ground, it is not damaged and may be used repeatedly as a permanent part of the TEL. The cable mast is so constructed that the exhaust gases do not destroy either the cable or the mast.



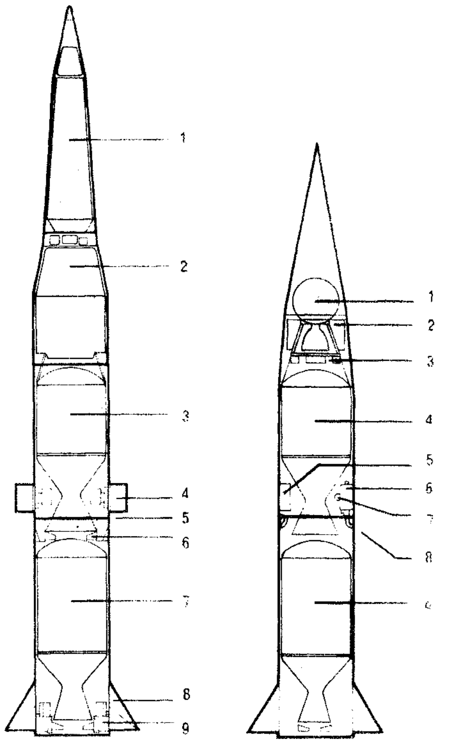
▲ Normally, the *Pershing* is not transported with its warhead attached. The warhead itself is in the container in the left foreground, and will be transported on a separate tracked vehicle, together with its associated test equipment.



◀ The radio equipment is installed on another SM-474 chassis. Whilst in transit, the inflatable parabolic antenna and the folding telescopic antenna supports are stowed in the top of the radio unit.

For movement both across country and on normal roads the *Pershing* rocket, resting on its TEL, is carried on a tracked vehicle, designated XM-474, built by the Food Machinery and Chemical Corp. This vehicle is a development of the M113 armoured personnel carrier, undertaken on behalf of the U.S. Army Ordnance Tank Automotive Command. It features a low silhouette and, with a gross weight of about 5 tons, has a speed of up to 40 m.p.h. on flat roads.

The rocket is provided with an inertial guidance system, comprising a gyro-stabilized platform and integrating accelerometers. The main contractor for this guidance system is the Eclipse-Pioneer Division of the Bendix Corporation at Teterboro, N.J., which also furnishes certain field checkout and production test equipment. With a view to maximum precision, the gyros of the stabilization platform are sealed in miniature metal cylinders, friction being reduced to almost zero. These cylinders in their turn "float" inside an outer cylinder. Microscopic air jets in the outer cylinder "float" the gyros on an air-cushion, in order to eliminate all direct contact between gyro and container.



To the left: Sectional drawing of the military *Pershing* rocket: 1 – Nuclear warhead; 2 – Control and guidance system; 3 – Second-stage rocket engine; 4 – Aerodynamic control surfaces; 5 – Separation element between first and second stages; 6 – Jet controls; 7 – First-stage rocket engine; 8 – Aerodynamic control surfaces; 9 – Jet controls.

To the right: Sectional drawing of the *Pershing* satellite booster: 1 – Third-stage rocket engine; 2 – Payload; 3 – Control and guidance system; 4 – Second-stage rocket engine; 5 – Instrumentation; 6 – Liquid nitrogen tank; 7 – Peroxide tank; 8 – Control jets; 9 – First-stage rocket engine.

The whole fire control and test checkout equipment for use in the field is mounted on a separate XM-474 chassis. This equipment includes the portable remote fire control box, by means of which the officer commanding the *Pershing* convoy can release the rocket from a position of safety. The same chassis carries a small power supply unit, which feeds the various electrical testing systems and provides test compressed air. The power supply unit also feeds the mobile radio equipment, which is used for communication with surrounding command centres. The lens-shaped antenna is inflatable and, when inflated, has a diameter of about 8 ft. The radio equipment is also installed on an XM-474. The nuclear warhead of the *Pershing*, together with its checkout test installations, is mounted on a separate tracked vehicle of the same type, so that the *Pershing* convoy is made up of four vehicles altogether.

The nose cone of the *Pershing* rocket has an ablatable heat-dissipating protective layer, which can be easily and cheaply applied and which serves to protect the nuclear warhead against excessive heat effects during re-entry into the earth's atmosphere.

The *Pershing* has been developed almost entirely by American industry, that is without direct assistance from the Army Ballistic Missile Agency, which did no more than retain certain rights of supervision and advisory functions. This conception is new, but the successful launchings of complete rockets with ignition of both stages (one trial launch from Cape Canaveral on April 21st, 1961, travelled over 250 miles) leave no doubt that this approach to the problem is the right one.

It is not yet certain when the *Pershing* will be operational in Europe. In any event, the Federal German Government has ordered a large number of these rockets in place of the original Martin *Maces*, and Germany will shortly make available DM 480 million for *Pershings*, about the same amount as was originally appropriated for the purchase of *Mace* rockets. Martin has meanwhile gone ahead with the development of *Pershing* and, early this year, received an additional $76 million order from the U.S. Army.

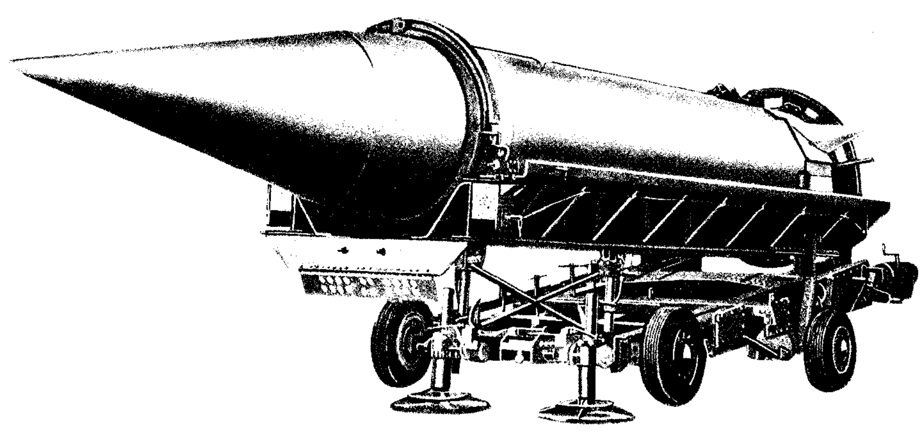
The Pershing as a Satellite Booster

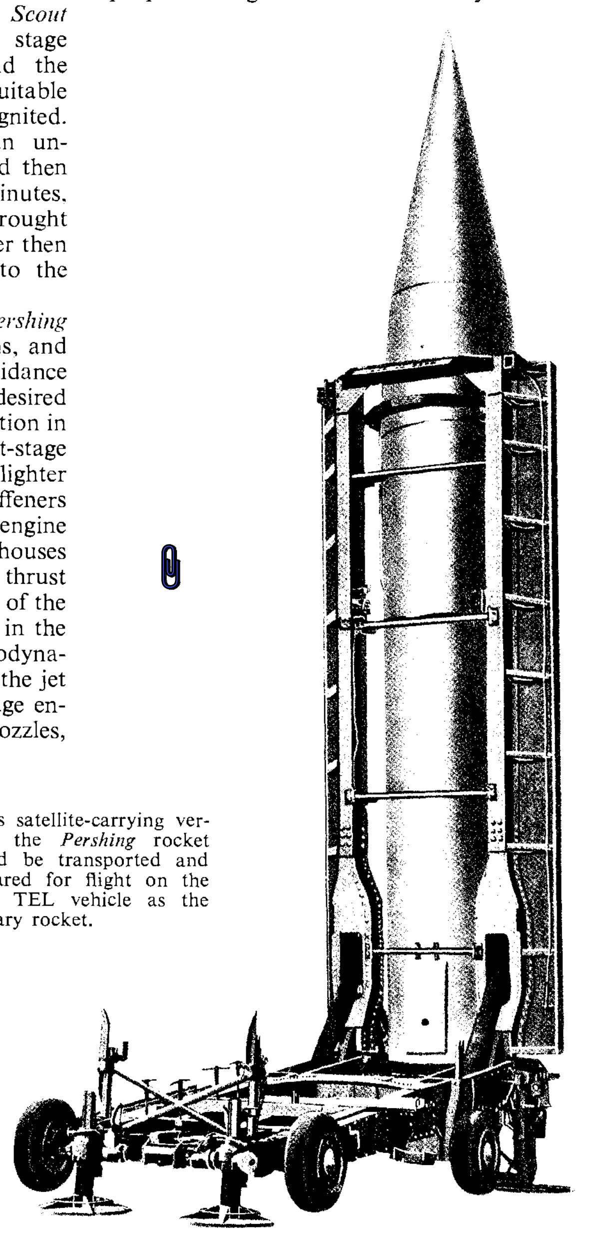
Economy, reliability, and immediate availability are undoubtedly qualities which could make a satellite carrier rocket look attractive for European countries, too. If, moreover, the carrier rocket could be launched from practically any desired meadow, this would take care of another problem, which has played a major part in discussions concerning the basis of a European space programme.

Martin is now offering a carrier vehicle, developed from the first and second stages of the military *Pershing* rocket, which fulfils the abovementioned conditions, and could be available in the space of about a year. According to calculations made by Martin's engineers, a three-stage satellite carrier rocket, based on the *Pershing*, would be able to put a payload of 60 lb into circular orbit at an altitude of 210 miles, or into elliptical orbit with an apogee of about 700 miles. For the guidance and radio-tracking of the carrier rocket during climb, as well as for orbital tracking, methods similar to those adopted in the case of the American *Vanguard* and *Scout* boosters could be used. When the first stage vertical climb has been completed and the remainder of the vehicle directed into a suitable orbital path, the second stage would be ignited. After second-stage burnout, there is an unpowered phase of over four minutes, and then the third stage ignites. During these four minutes, the remaining sections would have to be brought into an exactly horizontal position, in order then to be accelerated by the third stage into the required trajectory speed.

The first two stages of the military *Pershing* would require only insignificant alterations, and moreover a simple and, therefore, lighter guidance system would be sufficient to achieve the desired result, thus bringing about a marked reduction in the total weight of the rocket. The first-stage rocket engine could be made substantially lighter by the elimination of certain longitudinal stiffeners and by reconstructing the casing round the engine jets. The bay on the second stage, which houses the inertial guidance system, and the special thrust reversal device (an ejector port at the front of the second-stage engine) would be eliminated in the satellite carrier rocket. Moreover, the aerodynamic control surfaces of the first stage and the jet control surfaces of the military second-stage engine could be replaced by peroxide jet nozzles, thus also saving weight. The nose casings surrounding the third-stage engine and the payload could also be jettisoned after leaving the atmosphere. The entire third stage rests on a turntable for torque stabilization. The guidance and control systems could also be accommodated in the third stage (see diagram). For launching, the TELs already developed for the military *Pershing* would be made use of, and these could also be mounted in seagoing vessels.

According to information furnished by Martin, ten men are enough to bring the carrier rocket to the launch point, set it up, and prepare it for firing. This carrier rocket could also be used for vertical climbs as a space probe, in which case it would be possible to add a fourth solid-propellant rocket stage. In this way, a payload of 60 lb could be carried to an orbital height of over 875 miles, or a payload of 120 lb to about 300 miles. As Martin points out, the third and fourth stage engine could be developed from solid-propellant engines which are already available.





In its satellite-carrying version, the *Pershing* rocket would be transported and prepared for flight on the same TEL vehicle as the military rocket.