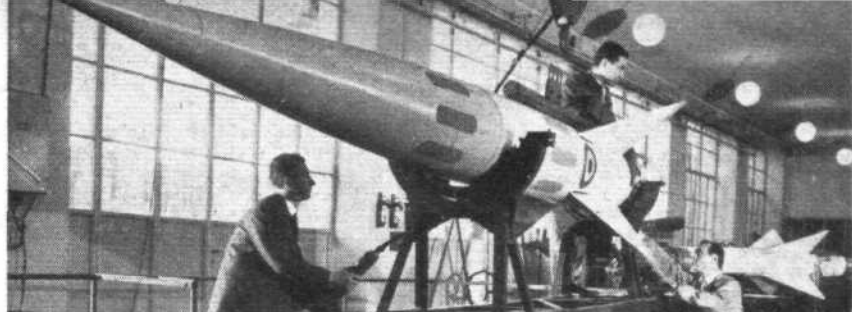


MISSILES 1958...



Anti-aircraft missiles of Contraves-Oerlikon type are manufactured by Contraves Italiana as the MTG-CI-58 (p. 892). These missiles are here seen in production in the Rome plant

and air defence generally was in its infancy. The resulting system is thus complex, immensely costly and far from being as efficient as it might be; but it is a *fait accompli*, too huge to be altered.

Nike Ajax as a missile is likewise complicated, expensive (the cost per round has, admittedly, been brought down by the enormous production) and not particularly efficient. Its successor, Nike Hercules, puts right everything that was wrong, except for the fact that it has to fit into the established Nike system and the American air-defence environment. It has been suggested that Hercules is "15 times as effective" as Ajax, and, while this assertion means little, it does give an indication of the vast difference in lethality between the two weapons.

Like Ajax, Hercules is the prime responsibility of Western Electric. Its manufacture has succeeded that of Ajax at the Charlotte Ordnance Missile Plant operated for the Army by Douglas Aircraft, who handle further Nike work at Burlington, Greensboro and Winston-Salem (like Charlotte, all in North Carolina). The vehicle is very much larger than Ajax. The canard configuration of the earlier missile has given way to a cruciform of acute delta wings with trailing-edge control surfaces, resulting in a much higher order of manoeuvrability, especially at high altitudes.

Boost propulsion is provided by a tandem package made by Radford Arsenal and Borg-Warner, incorporating four Ajax-size boost motors by the Hercules Power Co.; a Thiokol self-destroying booster is under evaluation. The sustainer is one of the new series of high-impulse solid motors by Thiokol, made at the Army Ordnance works at Marshall, Tex., operated as Thiokol's Longhorn division. The solid charge is situated around the missile c.g. and is connected to the nozzle through a long blast tube. Airborne power services are energized by an accessory power unit by AiResearch.

Guidance has to remain radar command, involving the three basic radars, ground computer and auto plotting boards which are to be found at all Nike sites. Radar power is being substantially increased to match the greater range of the new missile. It is hoped to introduce terminal homing ability, although a non-homing round fired publicly at White Sands in July was detonated less than 50ft from a 650 m.p.h. target at a range of 50 miles. Hercules carries a large and very effective warhead, and a nuclear-tipped version is also just coming into production. General Electric fuzing is employed for the latter.

Production at Charlotte is now running at a high rate. Concurrently, immense sums are being spent on converting existing Nike sites to handle and fire both the present stocks of Ajax and the Hercules now being delivered. Launching and major handling units have to be replaced, and this work is being done by Consolidated Western Steel, assisted by Wayne Pumps, A.M.F. and Douglas. Shipping and storage containers are made by Food Machinery and transporters by Douglas and Fruehauf. Western Electric are receiving large contracts for the improved guidance units, typical sums being \$129.6m in March (plus \$3.4m for "preparation of ordnance documentation"), \$47.97m in May and \$66m in June of this year. Site conversion is being done by local building contractors, whose contracts are running at about \$1.5m each.

Like Ajax, Hercules is installed in units comprising four batteries, occupying 150 acres of Army-owned land (plus a further 350 acres in "easements"). By June of this year all the batteries around New York City, Washington D.C. and Chicago had been converted to the new missile, and a complete Hercules battalion went to Formosa in October. In the latter month eight distributed units were operational, and by the middle of next year almost all the Army's 73 anti-aircraft missile battalions (only 13 are left with guns) will be Hercules-equipped. The Army missile has had a hard fight to retain its place in competition with

the Air Force IM-99, but Continental Air Defense Command has agreed to the operation of both indefinitely.

SAM-A-25 Nike Hercules: overall length, about 26ft 9in (41ft 6in with booster); body diameter, 28in; wing span, 105in; firing weight, approximately 5,000 lb (10,000 lb with booster); burn-out speed, Mach 3.35; effective ceiling, over 90,000ft; maximum slant range, at least 70 miles.

NIKE ZEUS

United States Army.

Type: anti-ICBM missile for integration into the existing Nike/SAGE system.

INTENSIVE research into the problems of intercepting the warhead of a ballistic missile—an ICBM in particular—started some three years ago, and appraisals of the work done in the past were contained in our 1956 and 1957 missile review issues under the heading of "Antis." The picture has now been rationalized, and the missile portion of the system is to be the Army's Nike Zeus. It is to be deployed in 1964.

First link in the chain must be a surveillance radar of immense power and discrimination. To be produced by R.C.A., this is likely to be an improved version of the existing FPS-17 sets which have long been used for tracking Russian ballistic missiles from sites in Turkey and Iran. As an acquisition radar it is almost certain to employ twin pencil beams, one at an elevation a fraction of a degree higher than the other, and both beams will be rapidly swept in azimuth across a horizontal arc. The lower beam will be the first to pick up a return from the approaching missile, and the latter's trajectory can then be calculated from its passage across the two beams in succession. Three of these radars are to be set up in the Arctic under a \$160m appropriation in the current fiscal year; each will sweep 45 deg in azimuth, so the three together will blanket the entire Soviet land-mass.

Data from these giant installations will be fed to the next stage, which will consist of parabolic-scanner tracking radars, by Sperry. Each of these will be essentially similar to that at Millstone Hill, Mass., currently used for tracking missiles fired from Cape Canaveral and elsewhere. The Millstone radar has an 84ft dish, producing a 2-deg beam with a peak power of about one megawatt. The tracking radar will be capable of locking-on and determining the trajectory of the oncoming vehicle with sufficient accuracy for its target to be alerted and an "anti" to be fired with fair certainty of effecting an interception.

The anti itself is the Zeus missile, which represents the third stage in the Nike family. A mighty weapon system, with a big missile, the programme is already in a stage of development in which any major change would cause severe disruption of hardware. Prime contractor is, as before, Western Electric, plus Bell Telephone Laboratories and Douglas Aircraft for programme development and airframe development. The vehicle configuration is generally similar to that of Hercules, although on a larger scale, and Thiokol, the boost contractor, recently static-tested a 450,000 lb-thrust solid-propellant booster which seems to suit the missile exactly. The sustainer and vectoring motor will be by the Grand Central Rocket Co. Douglas will make the airframe, with tremendous scientific backing in such fields as hypersonic aerodynamics (or super-aerodynamics), heat-resistant structures and other related problem-areas, by ten powerful agencies.

At the firing site there will be two main radars, both by Western Electric, for tracking the incoming warhead and the missile. Linked by a computer, these sets will guide the Zeus on its journey of some hundred miles into the interception region, where the missile and

incoming warhead meet. The Zeus will have its own seeker, by Ryan, inside a ceramic radome (Coors Porcelain Co.), as well as a doppler (Ryan) to pick out the speeding warhead among a possible host of slower decoys. The Zeus warhead will, of course, be nuclear.

Name of the Army weapon system is Project Plato. The competing Air Force system was Wizard, but the latter has been shelved, apart from special research into data-processing and detection radars which are more sophisticated than those of the Plato system. At present no decision has been taken to put Zeus into production—at present its kill-probability is placed at only 25 per cent—but the research and development phase is being hastened along on a broad front. An immense army is at work on it (42 contractors have already been named), and fiscal year 1959 allocates \$130m to be "obligated for maximum effort on the development of Zeus as a defense system against ballistic missiles." Incidentally, the system could well profit from British developments in the sphere of long-range detection.

Nike Zeus: overall length, possibly 60ft with booster; firing weight, at least 20,000 lb with booster; burn-out speed, probably more than Mach 5; interception range, about 100 miles.

PARCA

French Army.

Type: Command-guided surface-to-air weapon system. Drawing: p. 891.

SINCE our 1957 review, in which the history and characteristics of this missile system were outlined, no further information on its progress has become available. A canard, guided by a Nike-type radar command system, Parca is launched at any angle between 30 and 90 deg under the thrust of four wrap-round boost motors, thereafter climbing on the S.E.P.R. solid sustainer. A considerable number of rounds have been fired at Colomb-Bechar and Parca is known to be in limited service as a training weapon with the French Army.

Parca: length, 16ft 5in (approximately 18ft with boosters); wing span, 63in; firing weight, 2,200 lb; burn-out speed, Mach 1.5; effective ceiling, 65,600ft.

R.422

French; no information is available on whether or not this missile has been adopted for use.

Type: Radar-guided surface-to-air missile. Drawing: p. 891.

ONE of the first surface-to-air missiles to be developed in France, the R.422 is intended for the interception of bombers flying at between 10,000 and 66,000ft at between Mach 0.5 and 2. More than one type of R.422 has been fired, the first version having boost propulsion by a tandem package of four solid-propellant motors and the latter version having a large single boost. The missile is a canard and guidance is effected by a Nike-type system, with radars for tracking the target and missile (which carries a transponder) so that, with the aid of a computer, the courses of the target and missile can be continuously compared and the weapon steered by radio command. When the missile is in the neighbourhood of the target, terminal guidance of the semi-active homing variety is brought into action, and the warhead is finally detonated by the proximity fuze. The homing receiver incorporates four aeriads disposed within a radome on the nose of the missile.

R.422 is fired from a rotatable launcher at an elevation which can be varied between 30 and 90 deg. Prime contractor is Soc. Matra, chief sub-contractors being Cie. Francaise Thomson-Houston (radars), SFENA (radio command and terminal homing), S.E.A. (computer) and S.E.P.R. (boost and sustainer motors).

R.422: no quantitative information available.