Guided Missiles 1956 . . .

(United States of America—continued)

worked out how to handle a ten-ton IRBM (with a hydrogen warhead) in a rough sea. Programmes for ship-conversion are listed in the descriptions of the missiles concerned. The eventual number of missile cruisers has been put at "dozens," of which those ordered after about 1959 will be built as such from the keel up.

The principle U.S. Navy missile establishment is the Missile Test Center, Point Mugu, Cal. Other important locations are the Naval Ordnance Testing Station, China Lake and Inyokern, Cal., and a missile range at Bonham A.F.B., Hawaii.

U.S. ARMY. Probably no other armed force can point to such a fearsome quartet as Honest John, Corporal, Nike and Jupiter A (or Redstone, as the last-named was originally known). All are products of Army Ordnance contracts and all are in service now.

Jupiter A is in several ways an exceptional weapon. Not the least of its peculiarities is that it was designed almost wholly by a team, employed by the Army, working at Redstone Arsenal. Such a practice is not to be perpetuated, and at present over 80 per cent of all Army missile research and development funds is going into industry. Even the development of less-complex weapons than missiles is now no longer the prerogative of arsenals.

Another, and even more far-reaching, change is currently taking place in Army thinking. Until 1955 the U.S. Army bought only what might be termed the "obvious" missiles; but, such is the revolution in military operations since that year, contracts are now in hand for troop-carrying missiles—and it would not surprise us to learn of a guided missile capable of making soup or digging a foxhole. Army missile procurement has more than doubled—to £289m—in the past year.

Greatest of the U.S. Army's missile problems is the perennial IRBM which—as the Jupiter family—is now being developed by Chrysler and the Redstone arsenal, independently of the Navy. Lacking the massive technical man-power of the U.S. Air Force, the Army have set up a Ballistic Missile Agency, on a "crash" basis. Head of the A.B.M.A.'s development operations is Dr. W. von Braun, principal designer of the German A-4 (V.2) and of the original Redstone weapon. Redstone Arsenal is still the major clearing-house of Army missile information, although most new design work is being farmed out to industry and universities. Chief test establishment is the Army Missile Test Center, White Sands Proving Ground, New Mexico, and other important establishments are the Army Ordnance Center at Aberdeen Proving Ground, Maryland, and the Army Center for Surface-to-air Missile Testing, Fort Bliss, Texas.

AIR-TO-AIR

BDM. These letters signify Bomber Defense Missile, and identify a system which has caused much controversy.

General Electric's Special Products Division holds a prime Air Force contract in respect of a bomber-defence missile. In this work they are being assisted by Hughes Aircraft, Bell Telephone Laboratories and the Raytheon Manufacturing Co. The guidance of this BDM should be adequate, since that is the speciality of each of the co-operating firms (a curious arrangement).

Raytheon now also hold a new Air Materiel Command contract for BDM work, and their Hawk SAM may be a basis for development. Two other major Air Force BDM contracts, both of which were re-evaluated last month, were held by Republic Aviation (with Westinghouse as subcontractor) and G.E. (with McDonnell as subcontractor). At the same time, the Arma Division of American Bosch hold an Air Force study contract for a BDM in competition with both.

Cherokee. This name refers to a new air-to-air weapon for the Air Force. Cook Research Laboratories are systems managers, and work began this year.

Diamondback. No details are available regarding this Navy study project for an air-to-air missile. It is known, however, that it succeeds Sidewinder, and may well be a heat-homer.

Ding Dong. Several years ago the Air Force discussed the practicability of an AAM with a nuclear warhead. It was argued that such a missile would be lethal even if it failed to pass in what was termed "close proximity" to its target. Disadvantages were that it would probably weigh at least 5,000 lb—partly on account of warhead size and partly owing to its obvious need for above-average range—and the fact that fall-out might prove hazardous to friendly territory.

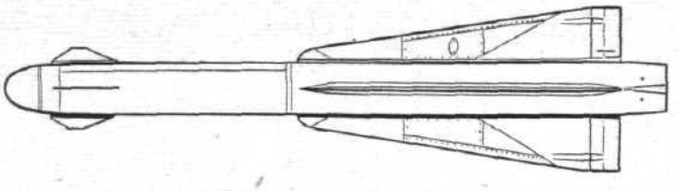
The latter factor was studied on April 6 last year, when a DB-36 launched a special nuclear weapon at a pattern of smoke trails laid at 30,000ft above Nevada. It was concluded that no dangerous radiation would reach ground level.

In February it was announced that a contract had been signed with Douglas Aircraft for a nuclear AAM with the above name. Guidance and fire-control is being developed by Hughes and propulsion will be by an N.A.A. Rocketdyne liquid-propellant motor. Air Defense Command are to gain experience with a device named Ting-a-Ling, ballistically identical but carrying only a spotting charge of explosive.

Duck This name is believed to identify one of the intercepter missiles forming part of the B-58 weapons system. Blue Goose (which may be an offshoot from Goose, described under SAMs) is a similar missile, likewise of Fairchild origin.

Falcon. The smallest homing missile yet developed, Falcon is nevertheless a lethal little weapon which can be fired in salvo from the latest U.S.A.F. intercepters. As far as is known (i.e., excluding Russia) it was the first AAM to enter service with any air force.

Its genesis was a General Electric guided-rocket study for the U.S. Air Force shortly after World War 2. Known as Project Dragonfly, this study was cancelled before much hardware had been made, but was reinstated in 1950 with Hughes Aircraft as prime contractor. At their main plant in Culver City, Cal, this firm have developed many remarkable examples of military electronic gear. Falcon is certainly one of their greatest achievements, for its guidance package includes the world's smallest production homing receiver; yet the whole missile is designed to accept no less than 58 g during the launching phase.



Falcon 1. AAM with 6,000 lb-thrust solid-propellant motor; no boost motor. Length, 6ft 6in; span, 2ft 6in (reduced to 1ft 6in in a later variant); body diameter 6in; weight, 112-122 lb; burn-out speed, M=2.8; operational range, 4 miles.

By the autumn of 1952 Hughes knew that they had a workable weapon. The Air Force made available a large government plant in Tucson, Ariz, and Hughes moved in with a "producability" contract and tooled up. In November 1953 the complete missile (which was then designated F-98, as if it were a fighter aircraft) was tested in the gas dynamics tunnel at Tullahoma, and air-firing was also intensified. A few months later the U.S.A.F. discarded the idea of a second-source contract—they had furnished another electronics manufacturer with "sufficient Falcon data for educational purposes"—and in June 1954 the Tucson plant was enlarged to 1m sq ft, bringing the total government outlay on the facility to £5m.

The missile itself then began to engender a family of related, but improved, weapons. The basic designation became GAR-98 and finally GAR-1, and very large production orders were placed in 1954. The cost per missile, originally £31,600, came down to £9,000 in October 1955, when production was averaging 100 per month. Employment at Tucson had at this time reached 5,500 and the total GAR-1 backlog was standing at over £357m. When production reached 250 per month the cost was down to £6,800 and the ultimate price per missile at 350 per month—which should now be reached—is £3,600. Approximately half the cost is for subcontracted parts.

As the drawing shows, Falcon has a trim cylindrical fuselage. This is an assembly of precision-cast magnesium rings and skin, made by Solar at Des Moines, Iowa. Falcon is steered by a cruciform of rudders, similar to those of supersonic aircraft, used in conjunction with the nose fins; the delta wings provide lift and stability. Extensive use is made of glass-fibre-reinforced phenolic plastic, which can accept working temperatures of 500 deg F. The extreme nose is formed by a small radome, covering the forward-facing radar dish. Later Falcons are to have a rather more pointed radome than that shown. There is no booster, propulsion being provided by a single Thiokol solid-propellant motor giving 6,000 lb thrust during the 1½ seconds of burning time. In consequence, although the missile is quite "clean" the range is fairly short—but still much better than that of any aircraft gun.

During early trials Falcons showed exceptional accuracy—characteristic of homing weapons—and "hit drones repeatedly in vital parts so that, even with an inert warhead, QB-17s were often knocked down." With an explosive warhead, said Trevor Gardner, Asst. Sec. of the Air Force, "virtually every hit is a kill"—as p. 883 emphasizes.

At present the weapon is standard equipment for intercepter squadrons of Air Defense Command, although it may also be employed on day fighters. The most important carrier of the missile is the supersonic Convair F-102—and, no doubt, its derivative the F-106. The former carries six Falcons in an internal bay, the missiles being lowered on a tray and fired, in any chosen sequence, by the automatic Hughes fire-control system. By the spring of this year squadron tests had proved that the F-102A had "satisfactory systems capability." It was found that the Falcon could be fired up while the F-102 was still climbing towards its target. Another carrier of the Falcon is the Northrop F-89H Scorpion, which can take three inside each wing-tip pod and one on a pylon below each wing.

These aircraft became operational during the past few months, and squadrons are now training intensively, and very successfully, using Ryan Q-2 targets. Bulk deliveries are made by rail, with the missiles packed in Craig welded-aluminium boxes measuring 21in square by 88in. Hughes have spent £5.4m on test gear and flight-simulation equipment, and the Electronic Engineering Company produce a simulator which automatically checks out Air Defense Command rounds and notes any deviation from standard on a punched card.

Early in 1955 it was announced that "much more advanced guided missiles than the Falcon are close to production." The whole family is developing rapidly to keep A.D.C. armed with the latest of the several derived versions; in particular, the guidance is being improved steadily to keep one step ahead of any possible countermeasures. Development is done at Culver City, but all production engineering and bulk manufacture is concentrated at Tucson.

Sidewinder. In many ways this slim air-to-air missile is unique. It is a heat-homer, it is of incredibly small diameter and its development must have broken all records for rapidity.

Sidewinder started as XAAM-N-7 at the Naval Ordnance Test Station (NOTS) at China Lake, Cal. This sprawling 1,000-square-mile establishment in the Mojave Desert employed a strong team, led by

Sidewinder. AAM with solid-propellant motor; no boost motor. Length, 9ft 2in; span, about 1ft 7in; body diameter, about 5in; weight, about 150 lb; burn-out speed, over M=2.