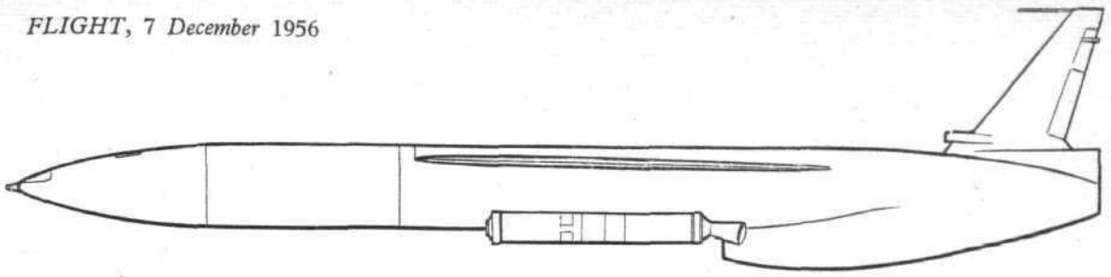

Snark. SSM with 11,000 lb-thrust J57 turbojet; launched by two 33,000 lb-thrust solid-propellant boost motors. Overall length, 74ft; span, 42ft; height, 15ft; body depth, 67in; weight, 35,000-38,000 lb; cruise speed, M=0.9; range, at least 4,000 miles.

Guided Missiles 1956 . . .

(United States of America—continued)

were carried out from Point Mugu, Cal, and from the U.S.S. *Norton Sound* and the carrier *Princeton*. The large submarine *Tunny* has for over a year had a Regulus hangar and launching gear, and *Barbero* recently joined the Fleet with similar equipment. In June last there were four carriers, four cruisers and two submarines equipped for Regulus SSM operations. A recent improvement was the development of a neat steel-tube dolly with which Regulus can be catapulted from a carrier; previously it had been necessary to use a large wheeled platform with RATO bottles.

Snark. This unique long-range, aircraft-type, cruise missile was developed to the high-subsonic formula in 1947. At that time Northrop Aircraft were well advanced in the design of tailless machines and this was the configuration adopted.

Requirements of the original Air Force specification were a range of 4,000 miles at 600 m.p.h., with suitability for mass production at a reasonable price. Extensive development was conducted with various test vehicles (P-61s were used for guidance trials) and it was from this work that the company became interested in sleds, which were used for many early Snark tests. By 1949 a scale model was flying, with a span of 32ft and an Allison J33 for power.

The real Snark (originally B-62 and now SM-62) is much larger. Of particular interest is the wing, the 45-deg sweep of which was exceptional at the time of design. The outer panels have increased leading-edge chord, and the trailing edge carries elevons. Much of the wing is skinned with very large cast magnesium-alloy panels; sandwich is used in the secondary structure and light members are stabilized by foamed-in-place fillers.

All the systems are housed in the capacious 74ft fuselage. At the front is the warhead, which can be of the thermo-nuclear type. Next comes the advanced, and reliable, Mk I celestial guidance system, which automatically tracks stars. All the central portions are filled with fuel, and at the rear is a ventral duct housing a Pratt and Whitney J57 turbojet. Earlier Snarks had an Allison J71 which, although lighter, had about 20-per-cent higher fuel consumption; the change to the Pratt and Whitney—the most expensive missile engine at present in use—allowed the guidance system (which weighs twice the original 500-lb estimate) to overflow into bays originally occupied by tankage, without any reduction in range.

Manufacture of complete Snarks has gone ahead at Hawthorne since 1951. Curiously, 68 per cent of the work (i.e., £50.3m) has been financed by production contracts, although there has been no production as such. Since the end of 1954 SM-62s have been flown to Patrick inside C-124 transports, each of which can accept a complete Snark in dismantled condition. Flight trials have gone well in recent years, although 13 flew into the Atlantic prematurely as a result of guidance malfunction. Several have flown 2,000 miles down the range and back, to be landed by skids and a tail parachute (this recalls the round-trip "autobomber" version of Snark projected in 1953).

Launching is effected from a zero-length rail. Once the big boost motors are off, the missile climbs to about 60,000ft at constant i.a.s. and cruises at about Mach 0.9 at the high angle of attack characteristic of tailless machines. An evasive path can be programmed before the final dive, all control being exercised through an autopilot. The latter is continuously fed with intelligence from the star-tracking head, produced by Northrop's Anaheim Division. In its construction there is a great assortment of advanced optics, together with large castings which are machined and then hand-lapped to ± 1 sec of arc.

Although the cost of the SM-62 is only about five per cent of that of a B-52—so it is stated—it is unlikely to be built in quantity. In February there was a chance of an order for 50 or more Snarks per month, but the SM-64 and SM-65A now seem to have developed too rapidly.

Thor. At the end of 1955 the Air Force were given control of all new SSM projects in the 1,000/1,500-mile range class—in addition to having sole responsibility for ICBMs. An Air Force IRBM was authorized as Weapon System 315A, and this programme has since had first priority.

Full systems responsibility was assigned last January to Douglas, Santa Monica. Named Thor, the new missile is a single-stage weapon, with all major components derived from existing parts of ICBM systems. Development has been extremely rapid, reflecting the ability and experience of the design teams. Propulsion is by a liquid-oxygen motor under development by N.A.A. Rocketdyne Division; guidance is by A.C. Electronics Division, with help from Bell Telephone Laboratories and Remington Rand (Univac); the nose cone is a G.E. responsibility; and A.M.F. are developing auxiliary propulsion and accessory units. The first Thor arrived at Patrick last month and many firings should be carried out next year.

Titan. During 1955 the Air Force considered that the ICBM programme was so vital that it would be worthwhile starting a second programme to back-stop the first (Atlas). The second ICBM is Weapon System 107 and in October last year The Martin Company were named systems manager.

WS-107, or Titan as it is named, is a weapon which, although it uses essentially similar components to those already developed for Atlas, is of quite different configuration. In this way two approaches to the problem can be evaluated for an expenditure only 10 per cent greater than that required by Atlas alone. The two missiles are identical in all major performance characteristics.

Unlike Atlas, Titan is a two-stage missile. Although Martin engineers are very interested in novel lateral-staging configurations, Titan will have a conventional one-above-the-other layout. Aerojet-General are making the first-stage motor, with R.M.I. a major subcontractor for chambers. The guidance system has been awarded to G.E., who are also responsible for the nose cone. Martin themselves are building a half-million square foot plant for Titan, on a 5,000-acre site south of Denver, Colorado. Ground was broken in February and the building was finished last month; it cost the company over £7m and will employ over 5,000 on WS-107 next year.

Triton. Probably the ultimate development of Project Bumblebee, Triton is a large Navy BuOrd missile originally evolved by JHU/APL. Designed for "just under Mach 2.5," the missile is certain to be similar to a scaled-up Terrier (q.v.). Overall length is about 45ft, body diameter 57in and launching weight 19,000 to 20,000 lb. One report avers that Triton will be manufactured by Boeing.

FRANCE

AIR-TO-AIR

Matra AA.20. Powered by a single-barrel 2,760-lb S.E.P.R. motor running on RFNA and petrol, the AA.20 is a Mach-1.5 weapon with a length of no less than 15ft. Effective air-to-air range is to be not less than 10 miles. It is about to pass into pre-production, for ultimate issue to Mystère IV squadrons.

Matra M.04. Although extensively test-fired from various aircraft (such as the Halifax and Grognard) at Colomb-Bechar, this vehicle is really a two-thirds scale model of a larger weapon. Development began in 1952 and the Société Matra have collaborated with Sud-Est Aviation in perfecting it. Later variants will be ground-launched, with a longer burning-time than the 14 sec of the present S.E.P.R. motor. A surface-launched A.A. weapon may result.

Matra R-051. This is almost unique in being a fighter-launched missile with an aircraft-type (one set of wings) configuration. It is claimed to have exceptional range, and it has been adopted as a standard piece of ordnance for the all-weather Vautour. Launching is carried out from a zero-length shoe. It has a two-stage solid-propellant motor and is 9ft 10in in length; the weight is 353 lb and the burn-out speed 1,100 m.p.h. Flight testing has been carried out with several machines, including N.F. Meteors.

Nord 5103. Developed originally by l'Arsenal, which became S.F.E.C.M.A.S. before merging with the Nord aircraft group, the 5103 is an air-to-air missile with a swept-wing cruciform—a very unusual design. The drawing shows the missile without boost, although it is alleged—surprisingly—that a boost is used.

Both boost and sustainer are solid-propellant rockets, and guidance is effected initially by beam riding. A proximity fuse is fitted and the controls appear to be hinged to the wing cruciform. Flight tests have been conducted from Meteor night fighters.

SURFACE-TO-AIR

Parca. Bearing a name formed from the initial letters of its designated function—a practice common with French missiles—this close-knit weapon is nearing the production stage. It has been developed by the D.E.F.A. (Directions des Etudes et Fabrication d'Armement).

As the drawing shows, it is a canard, with a large proximity-fused warhead, and wrap-round boosts. When the latter are jettisoned the missile does not look untidy. It has been tested at Colomb-Bechar and is stated to have destroyed targets flying "at the speed of sound at 10,000 m (32,800ft)."

S.N.E.C.M.A. Largest aero-engine firm on the Continent, this company are developing two missiles for the Aéronavale. They are known as MARUCA and MASALCA, which indicate that they are both anti-aircraft weapons.

S.E.4100. Developed by Sud-Est Aviation, a major nationalized aircraft firm, the 4100 is a fairly slow SAM, reminiscent of German work in 1945. It is, nevertheless, a weapon with great punch for its size and cost. Composite construction is used, and the sustainer uses nitric acid and petrol, the booster being cordite-filled. Configuration is shown by a sketch.

Sud-Est 4300. The design of this weapon seems a remarkable achievement. Intended to be operational at all heights up to 65,000ft,