Fourth Annual

WORLD MISSILE/SPACE ENCYCLOPEDIA

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STRATEGIC

U.S. strategic missiles become a major factor in the Cold War for the first time in 1960.

Several Air Force Atlas ICBM's became operational at Vandenberg AFB, Calif., in the fall of last year. But they were only a token.

By the end of 1960, one or more squadrons of Atlases are scheduled to be operational at Warren AFB, Wyo., and two Polaris submarines are scheduled to be on station somewhere in the seas off Russia.

Titan is scheduled to follow Atlas into operational

ATLAS (Air Force)

Military designation: SM-65
Type: ICBM surface-to-surface (fixed base)
Status: Operational
Prime contractor: Convair-Astronautics Division, General Dynamics Corp.
Performance: Range—more than 8000 n. miles. Speed—about 18,000 mph. Apogee—about 600 n. miles.
Frame: System contractor—Convair. Length—82.5 ft. Diameter—10 ft. Launch weight—260,000 lbs. Material (major)—stainless steel.
Guidance: System contractor: GE/Burroughs; Bosch Arma. Type—all inertial later models; radio-inertial command early models.
Booster: System contractor—Rocketdyne. Propellant—LOX and RP-1. Thrust—165,000 lbs. each of two boosters.
Sustainer: System contractor—Rocketdyne. Propellant—LOX and kerosene. Thrust—60,000 lbs.
Re-entry Vehicle: System contractor—General Electric/Avco. Warhead type—nuclear.
Ground support equipment: Launcher—Convair. Fueling—Arthur D. Little Co. Handling and service—Goodyear Aircraft. Transport vehicles—Goodyear Aircraft.
Remarks: Atlases with in-silo launch capability to be deployed beginning with squadron 8.

DEPLOYMENT

Squadrons planned: 13
Bases planned: 10
Squadron strength: 6 to 12 missiles
Initially operational: Sept. 9, 1959 at Vandenberg AFB, Calif.
Total number of missiles: 129

Squadron Locations

Vandenberg AFB, Lompoc, Calif. One squadron—6 missiles, soft, non-dispersed
Warren AFB, Cheyenne, Wyo. Three squadrons—(1) 6 missiles, soft, non-dispersed; (2) 9 missiles, soft, semi-dispersed; (3) 9 missiles, semi-hard, dispersed
Offutt AFB, Omaha, Neb. One squadron—9 missiles, semi-dispersed, soft
Fairchild AFB, Spokane, Wash. One squadron—9 missiles, dispersed, semi-hard
Forbes AFB, Topeka, Kans. One squadron—9 missiles, dispersed, semi-hard
Schilling AFB, Salina, Kans. One squadron—12 missiles, dispersed, hard
Lincoln AFB, Lincoln, Neb. One squadron—12 missiles, dispersed, hard
Altus AFB, Altus, Okla. One squadron—12 missiles, dispersed, hard
Dyess AFB, Abilene, Kans. One squadron—12 missiles, dispersed, hard
Walker AFB, Roswell, N.M. One squadron—12 missiles, dispersed, hard
Plattsburgh AFB, Plattsburgh, N.Y. One squadron—12 missiles, dispersed, hard

←

An Atlas blasts off from a pad at Patrick AFB, Fla., in one of many successful shots of first operational U. S. ICBM.

MISSILES

service in mid-1961; Minuteman a year later. By 1965, the total of U.S. strategic missiles is expected to reach more than 1000—not counting air-launched Hound Dogs and Sky Bolts.

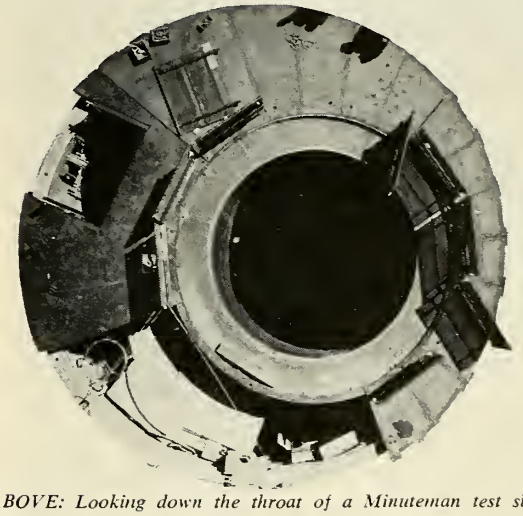
Two major trends have emerged: American strategic power is being vested mainly in mobile systems and large numbers of extremely hard, fixed bases that are widely dispersed. Which approach will be the dominant one was still to be determined at the beginning of the summer of 1960.

The Navy continued to press for the construction of a fleet of 45 Polaris-launching submarines, but the Administration maintained its position that if all tests proved to be successful 1961 would be time enough to accelerate the sub-building program. Meantime, the Air Force received authority to enlarge somewhat six Atlas squadrons and pushed ahead with its Minuteman and Sky Bolt programs.

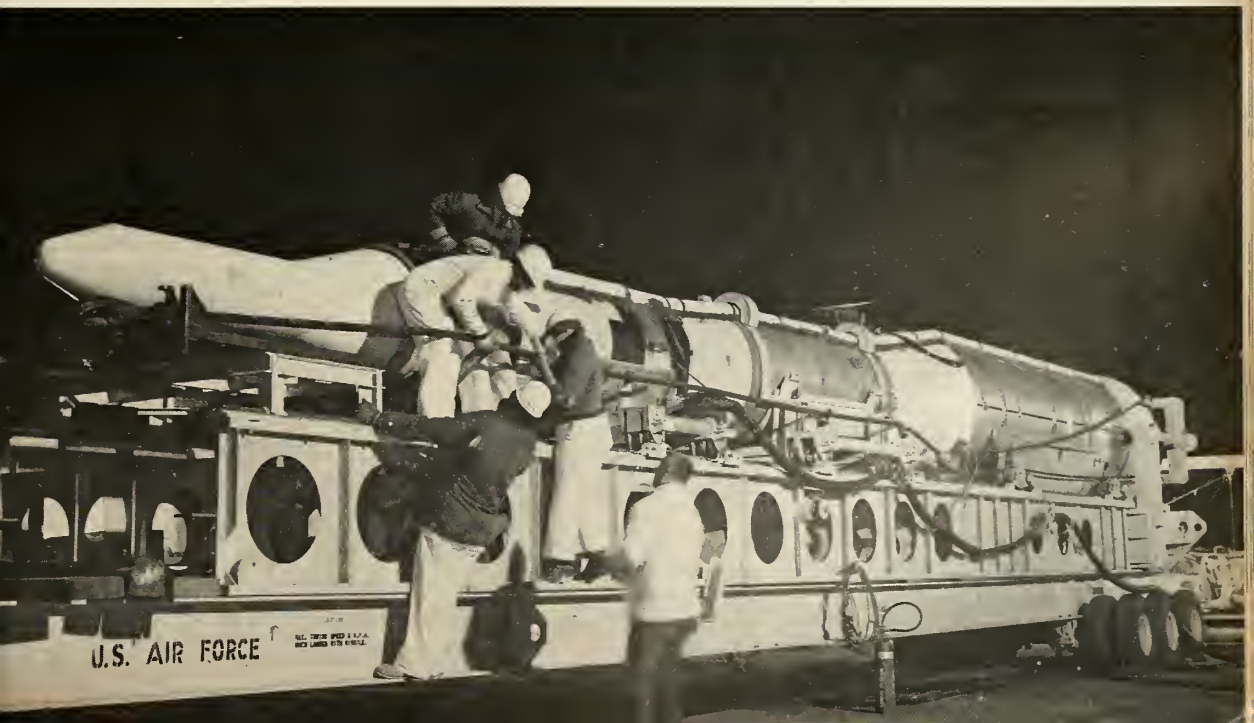
Mobility vs. Fixed Bases remained a problem for the new Administration.

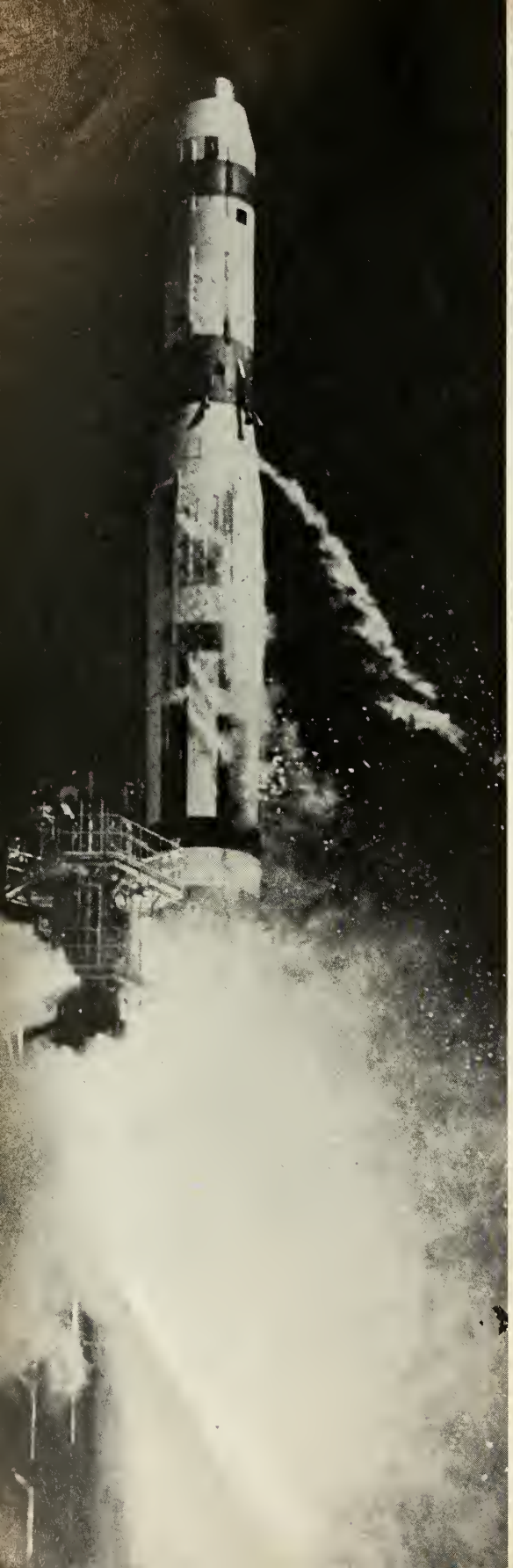
MINUTEMAN (Air Force)

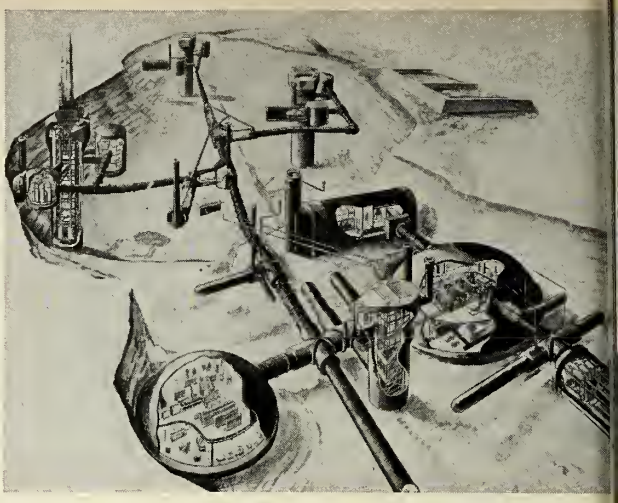
Military designation: SM-80
Type: ICBM surface-to-surface (fixed base and mobile)
Status: R&D
Major contractor: Boeing Airplane Co.
Performance: Range—5500 n. miles. Speed—more than 15,000 mph. Apogee—about 600 miles.
Deployment: Squadrons planned—about 14 (9 in fixed bases and about 5 on trains). Squadron strength—about 50 in silo-based units and 30 to 50 in train-based units. Trains per squadron—10. Initially operational—mid-1962. Total number of missiles—about 600. Squadron locations — Malmstrom AFB, Great Falls, Mont. (3 squadrons dispersed, hard in-silo launched).
Frame: System contractor—Boeing. Length—about 60 ft. Diameter—about 6 ft. Launch weight—about 65,000 lbs. Material (major)—steel (first two stages), titanium or plastic (third stage).
Guidance: System contractor—Autonetics. Type—all inertial.
Booster: System contractor—Thiokol. Propellant — solid. Thrust—about 160,000 lbs.
Second stage: System contractor—Aerojet-General. Propellant—solid.
Third stage: System contractor—Aerojet or Hercules Powder. Propellant—solid.
Re-entry vehicle: System contractor — Avco. Warhead type—nuclear.
Ground support equipment: Launcher—Boeing. Handling and service—Boeing. Transport vehicles—Boeing.



ABOVE: Looking down the throat of a Minuteman test silo.
BELOW: Full-scale Minuteman silo test missile on Trailer.







Operational base for Titan shown in an artist's cutaway conception. There will eventually be 10 such bases, 14 squadrons.

TITAN (Air Force)

Military designation: SM-68

Type: ICBM surface-to-surface (fixed base)

Status: R&D

Prime contractor: Martin Co.

Performance: Range—more than 5500 n. miles. Speed—1700 mph. Ceiling—about 600 miles.

Frame: System contractor—Martin. Length—98 ft. Diameter (max.)—10 ft. Launch weight—220,000 lbs. Material (major)—2014K aluminum.

Guidance: System contractor—Bell Telephone Laboratories/Sperry-Rand, A. C. Spark Plug. Type—radio inertial first six squadrons; later squadrons all inertial.

Booster: System contractor—Aerojet General. Propellant—LOX and RP-1. Thrust—300,000 lbs.

Sustainer: System contractor—Aerojet General. Propellant—LOX and RP-1. Thrust—80,000 lbs.

Re-entry vehicle: System contractor — Avco. Warhead type—nuclear.

Ground support equipment: Launcher—Martin. Fueling—Air Products/Cambridge Corp. Handling and service—Martin. Transport vehicles—North American Aviation, Douglas.

Remarks: Longer range Titan II will have a storable propellant and will be launched from its underground silo. Titan II will be deployed with Squadron 7.

DEPLOYMENT

Squadrons planned: 14
Bases planned: 10
Squadron strength: 9 missiles
Initially operational: July 1961
Total number of missiles: 126

Squadron Locations

Lowry AFB, Denver, Colo. Two squadrons — semi-dispersed, hard, elevated to surface for launching.

Ellsworth AFB, Rapid City, S.D. One squadron — semi-dispersed, hard, elevated to surface for launching.

Mountain Home AFB, Mountain Home, Idaho. One squadron—semi-dispersed, hard, elevated to surface for launching

Larson AFB, Moses Lake, Wash. One squadron — semi-dispersed, hard, elevated to surface for launching

Beale AFB, Marysville, Calif. One squadron — semi-dispersed, hard, elevated to surface for launching

Davis-Monthan AFB, Tucson, Ariz. Two squadrons—dispersed, hard, in-silo launched

McConnell AFB, Wichita, Kans. Two squadrons — dispersed, hard, in-silo launched

Little Rock AFB, Little Rock, Ark. Two squadrons—dispersed, hard, in-silo launched

←

Titan takes off from its launching facility at Patrick AFB.

POLARIS (Navy)

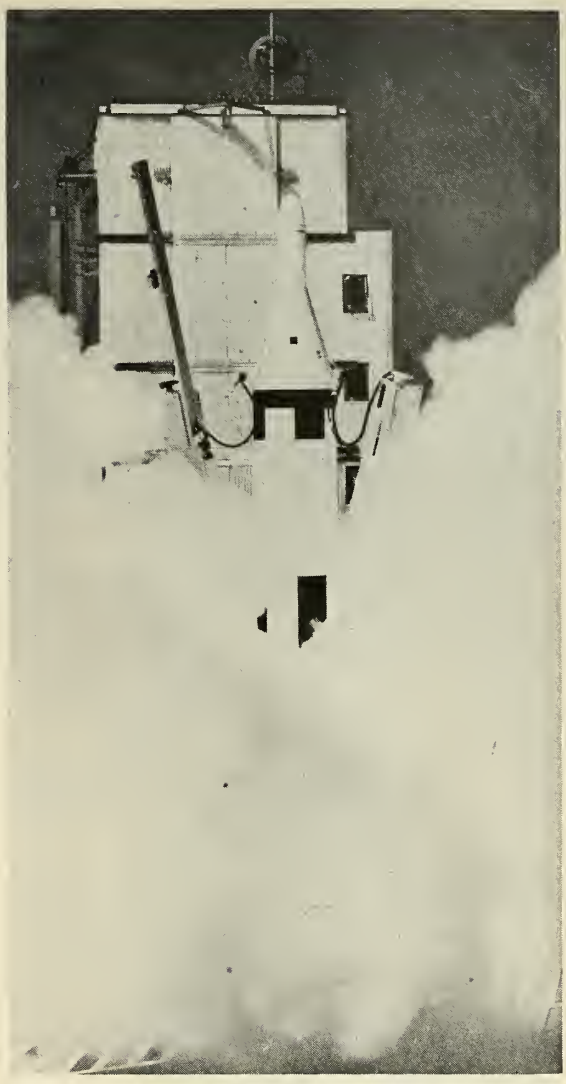
Military designation: FBM
Type: Submarine or surface ship-launched IRBM surface-to-surface (mobile)
Status: R&D
Prime contractor: Lockheed Missile Systems Division, Lockheed Aircraft Corp.
Performance: Range—1200 n. miles. Speed—about 8000 mph. Apogee—about 400 miles.
Frame: System contractor—Lockheed. Length—28 ft. Diameter—4.5 ft. Launch weight—28,000 lbs. Material (major)—steel
Guidance: System contractor—General Electric/MIT. Type—all inertial.
Booster: System contractor—Aerojet-General. Propellant—solid. Thrust—about 100,000 lbs.
Sustainer: System contractor—Aerojet-General. Propellant—solid.
Fire control: System contractor—General Electric.
Navigation: System contractor—Sperry-Gyroscope/Autonetics. Type—inertial (SINS).
Re-entry vehicle: System contractor—Lockheed. Warhead type—nuclear.
Ground support equipment: Launcher — Westinghouse. Handling and service—Westinghouse, Lockheed. Transport vehicles—Lockheed.
Remarks: Advanced 1500 n. mile and 2500 n. mile models under development. NATO nations may purchase for deployment as land-based NATO IRBM.

DEPLOYMENT

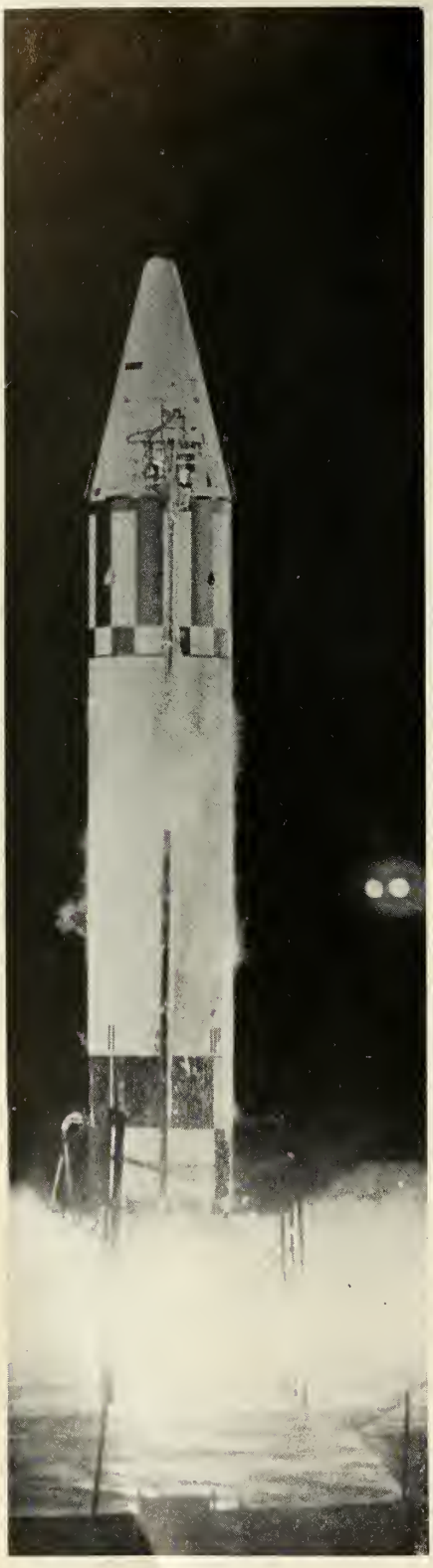
Missile-launching nuclear-powered submarines planned: about 45.
Submarines authorized part or whole: 21
Missiles per submarine: 16
Initially operational: Fall, 1960.
Total number of missiles (authorized): 336.

Polaris Submarines

George Washington 380 ft. 5600 tons commissioned 1960 Electric Boat
Patrick Henry 380 ft. 5600 tons commissioned 1960 Electric Boat
Theodore Roosevelt 380 ft. 5600 tons commissioned 1960 Mare Island
Robert E. Lee 380 ft. 5600 tons commissioned 1960 Newport News Ship
Abraham Lincoln 380 ft. 5600 tons commissioned 1960 Portsmouth Naval
Ethan Allen 410 ft. 6900 tons launching 1960 Electric Boat
Sam Houston 410 ft. 6900 tons launching 1961 Newport News Ship
Thomas A. Edison 410 ft.. 6900 tons launching 1961 Electric Boat
John Marshall 410 ft. 6900 tons launching 1961 Newport News Ship
Administration plans call for laying three more keels in FY 1961



ABOVE: A land based launching of a Polaris test vehicle.
BELOW: Nuclear-powered Patrick Henry, second Polaris sub.



JUPITER

JUPITER
(Air Force-Army)

Military designation: SM-78
Type: IRBM surface-to-surface (fixed base or mobile)
Status: Operational
Prime contractor: Chrysler Corp.
Performance: Range—1500 n. miles. Speed—10,000 mph. Apogee—380 miles.
Deployment: Location—Italy and Turkey. Initially operational in Italy and Turkey—1960. Total squadrons planned—two in Italy; one in Turkey. Total bases—three. Squadron strength—15 missiles. Total missiles—15.
Frame: System contractor—Chrysler. Length—58 ft. Diameter—8.75 ft. Launch weight—105,000 lbs. Material (major)—aluminum.
Guidance: System contractor—Ford Instrument. Type—all inertial.
Booster: System contractor—North American Aviation. Propellant—LOX and kerosene. Thrust—150,000 lbs.
Re-entry vehicle: System contractor—Goodyear/C.T.L. Warhead type—nuclear.
Ground support equipment: Launcher—Chrysler. Fueling—Chrysler. Handling and service—Chrysler. Transport vehicles—Chrysler.
Remarks: Jupiter was developed by the Army Ballistic Missile Agency and turned over to the Air Force for operational deployment.

THOR
(Air Force)

Military designation: SM-75
Type: IRBM surface-to-surface
Status: Operational
Prime contractor: Douglas Aircraft Co., Inc.
Performance: Range—1500 n. miles. Speed—10,000 mph. Apogee—about 400 miles.
Deployment: Location—Great Britain (military); Vandenberg AFB and Cape Canaveral (R&D and training). Initially operational in England—1959. Total squadrons—four. Total bases—four. Squadron strength—15 missiles. Total missiles deployed—60.
Frame: System contractor—Douglas. Length—65 ft. Diameter—8. Launch weight—110,000 lbs. Material (major)—aluminum.
Guidance: System contractor—A.C. Spark Plug. Type—all inertial.
Booster: System contractor—Rocketdyne. Propellant—LOX and JP4. Thrust—150,000 lbs.
Re-entry vehicle: System contractor—General Electric. Warhead type—nuclear.
Ground support equipment: Launcher—Food Machinery. Fueling—Daco. Transport vehicles—Fruehauf.

THOR

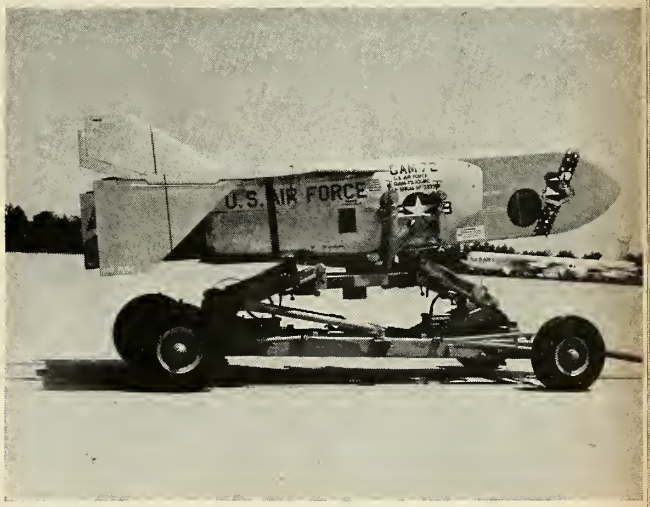
HOUND DOG (Air Force)

Military designation: GAM-77
Type: Air-breathing air-to-surface
Status: Operational
Prime contractor: North American Aviation, Inc.
Performance: Range—more than 500 n. miles. Speed—about Mach 2. Apogee — air-breather.
Deployment: Location—SAC B-52 bases in U.S. and overseas. Initially operational—1960. Total deployed missiles—expected to exceed 400.
Frame: System contractor—North American. Length—42.5 ft. Diameter—28 in. Wing span—12 ft. Launch weight—about 10,000 lbs.
Guidance: System contractor—Autonetics. Type—all inertial.
Powerplant: System contractor—Pratt & Whitney. Engine—J-52 turbo-jet. Thrust—7500 lbs.
Re-entry vehicle: Type warhead—nuclear.
Remarks: Hound Dog was developed as an interim weapon for use while the Air Force is developing the far superior Sky Bolt.

HOUND DOG

QUAIL (Air Force)

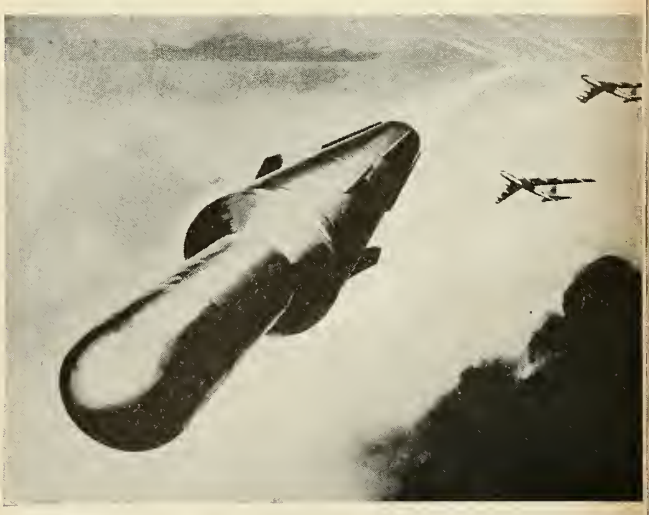
Military designation: GAM-72
Type: Air-launched missile ECM decoy
Status: R&D
Prime contractor: McDonnell Aircraft Co.
Performance: Range—about 200 n. miles. Speed—near sonic. Ceiling—more than 50,000 ft.
Deployment: Location—SAC air bases. Initially operational—1960.
Frame: System contractor—McDonnell. Length—13 ft. Wing span—65 in. Launch weight—about 1100 lbs. Material (major)—reinforced plastics.
Guidance: System contractor—Summers Gyro. Type—gyro autopilot.
Powerplant: System contractor—General Electric. Engine—J85-7 turbo-jet. Thrust—2000 lbs.
Payload: System contractor—Ramo-Wooldridge. Type—electronic counter measures.
Ground support equipment: System contractor—Bell Aircraft.
Remarks: Quail is designed to serve a dual role as a decoy for a strategic bomber and as a vehicle to carry ECM equipment.



QUAIL

SKY BOLT (Air Force)

Military designation: GAM-87A
Type: air-to-surface ballistic missile (ALBM)
Status: R&D
Prime contractor: Douglas Aircraft Co.
Performance: Range—1000 n. miles. Speed—hypersonic.
Deployment: Location — SAC and TAC air bases. Also RAF bases in England. (Sky Bolts to be launched from variety of aircraft besides bombers—particularly tankers and transports.) Initially operational—about 1964.
Frame: System contractor—Douglas.
Guidance: System contractor—Nortronics. Type—stellar-inertial.
Booster: System contractor—Aerojet. Propellant—solid.
Sustainer: System contractor—Aerojet. Propellant—solid.
Re-entry vehicle: System contractor — General Electric. Warhead type—nuclear.



SKY BOLT

SLAM (Air Force)

Type: Intercontinental nuclear-powered missile
Status: Study
Prime contractor: No contractor announced
Performance: Range—global. Speed—supersonic. Ceiling—low altitude.
Sustainer: System contractor—R&D being conducted by the Atomic Energy Commission, N.A.A. International and Marquardt (Project Pluto). Engine—nuclear-powered ramjet.
Payload: Warhead type—nuclear.
Remarks: Convair, North American and Chance Vought are principal competitors in studies submitted to the Air Force.

REGULUS I

REGULUS II

REGULUS I (Navy)

Military designation: SSM-N-8
Type: Air-breathing surface-to-surface (seaborne)
Status: Operational
Prime contractor: Chance Vought Aircraft, Inc.
Performance: Range—500 n. miles. Speed—about 600 mph. Ceiling—about 40,000 ft.
Deployment: Location—aboard five submarines (Growler, Barbero, Grayback, Tunny and nuclear-powered Halibut) and two cruisers (Los Angeles and Helena). Initially operational—1954.
Frame: System contractor—Chance Vought. Length—34 ft. Diameter—4.5 ft. Wingspan—21 ft. Launch weight—14,000 lbs. Material (major)—aluminum.
Guidance: System contractor—Sperry. Type—radio command.
Booster: System contractor—Aerojet. Propellant—solid. Number—two. Thrust—33,000 lbs. each.
Sustainer: System contractor—Allison. Engine—J33-18 turbo-jet. Thrust—4600 lbs.
Payload: Warhead type—nuclear.
Ground support equipment: Launcher—Fruehauf. Fueling—Chance Vought. Handling and service—Chance Vought. Transport vehicles—Fruehauf.
Remarks: Last of more than 500 Regulus I's were delivered in 1958. Production terminated. Warhead considered large.

REGULUS II (Navy)

Military designation: SM-N-9A
Type: Air-breathing surface-to-surface (seaborne)
Status: Operational as target drone.
Prime contractor: Chance Vought Aircraft, Inc.
Performance: Range—more than 800 n. miles. Speed—more than Mach 2. Ceiling—more than 65,000 ft.
Deployment: Location—PMR, Point Mugu, Calif., and Eglin Test Range, Fla. Initially operational: March, 1959. Total squadrons planned: Two.
Frame: System contractor—Chance Vought. Length—59.5 ft. Diameter: 50 in. Wingspan—20 ft. Launch weight—up to 30,000 lbs. Material (major) aluminum.
Guidance: System contractor—Bell. Type—radio command.
Booster: System contractor—Aerojet and Rocketdyne. Propellant—solid. Thrust—115,000 and 130,000 lbs.
Sustainer: System contractor—General Electric. Engine—J-79-3 turbo-jet. Thrust—more than 10,000 lbs.
Payload: Warhead type for military version—nuclear.
Ground support equipment: Launcher—Fruehauf. Fueling—Chance Vought. Handling and service—Chance Vought. Transport vehicles—Fruehauf.
Remarks: The Navy cancelled the Regulus II weapon system in December, 1958, on grounds that the missile had become obsolescent. The missile was in production.

SNARK

SNARK (Air Force)

Military designation: SM-62
Type: Air-breathing intercontinental guided missile
Status: Operational
Prime contractor: Northrop Corp.
Performance: Range—5500 n. miles. Speed—Mach 0.94. Ceiling—more than 50,000 ft.
Deployment: Location—702nd Strategic Missile Wing, Presque Isle, Maine. Initially operational—1959. Total squadrons planned—one. Total bases planned—one. Squadron strength—about 15.
Frame: System contractor—Northrop. Length—67.2 ft. Diameter—five ft. Wing span—42 ft. Launch weight—59,936 lbs. Material (major)—aluminum.
Guidance: System contractor—Northrop. Type—stellar-inertial.
Booster: System contractor—Allegany Ballistic Lab. Type—solid. Number—two. Thrust—33,000 lbs. each.
Sustainer: System contractor—Pratt & Whitney. Engine—J-57 turbojet. Thrust—10,500 lbs.
Payload: Warhead type—nuclear.
Ground support equipment: Launcher—Northrop. Fueling—Northrop. Handling and service—Northrop. Transport vehicles—Northrop.
Remarks: Capable of carrying very large warhead.

TACTICAL MISSILES

The development of advanced tactical missiles with ranges from several miles to 1000 miles is expected to call on the best talent of the Missile/Space Industry in the 1960's.

New tactical missiles already are revolutionizing military thinking.

The individual soldier of the very near future will have tremendous power in his hands with the deployment of nuclear-tipped Davy Crocketts. Highly mobile Little Johns and Sergeants will give the infantryman artillery support that will be far more powerful and effective than anything ever seen on a battlefield.

At the same time, the stand-off air-to-surface missile is expected to extend the life of military planes into the late 1960's. Such missiles as Corvus and Bullpup will enable aircraft to strike at heavily-defended targets that it would be nearly certain death to attack.

SURFACE-TO-SURFACE

PERSHING (Army)

Type: Surface-to-surface
Status: R&D
Prime contractor: The Martin Co.
Performance: Range—350 n. miles. Speed—supersonic.
Deployment: Location—to replace Redstone. Initially operational: about late 1961.
Frame: System contractor—Martin. Length—about 32 ft. Diameter—40 in.
Guidance: System contractor—Bendix. Type—inertial.
Booster: System contractor—Thiokol. Propellant—solid.
Sustainer: System contractor—Thiokol. Propellant—solid.
Payload: Warhead type—nuclear.
Ground support equipment: Transporter-erector-launcher—Thompson-Ramo Wooldridge. Handling and services—Vehicles—Food Machinery.
Remarks: Range could be greatly increased if desired. First R&D launching Feb. 25, 1960 from Cape Canaveral, Fla.

PERSHING

REDSTONE (Army)

Military designation: SXXM-A14
Type: Surface-to-surface
Status: Operational
Prime contractor: Chrysler Corp.
Performance: Range—200 n. miles. Speed—3800 mph. Apogee—55 miles.
Deployment: Location—U.S. troops in Germany. Initially operational—1958.
Frame: System contractor—Reynolds Metals. Length—70 ft. Diameter—5.5 ft. Launch weight—62,000 lbs. Material (major)—aluminum.
Guidance: System contractor—Ford Instrument. Type—inertial.
Booster: System contractor—North American Aviation. Propellant — Thrust—78,000 lbs.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Chrysler. Fueling—Chrysler. Handling and service—Chrysler. Transport vehicles—Chrysler.
Remarks: To be replaced by Pershing. Redstones are to be used in the Mercury program by NASA for early equipment test flights.

REDSTONE

MATADOR

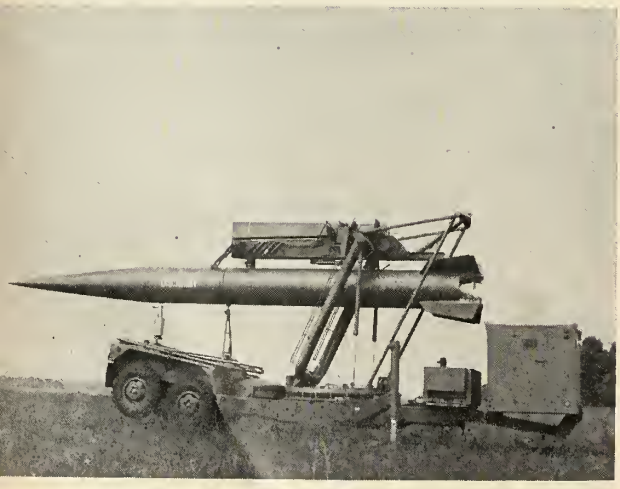
MATADOR (Air Force)

Military designation: TM-61C
Type: Air-breathing surface-to-surface
Status: Operational
Prime contractor: The Martin Co.
Performance: Range—500 n. miles. Speed—about 650 mph. Ceiling—more than 40,000 ft.
Deployment: Location — U.S. troops in West Germany, Far East. Also in hands of NATO allies. Initially operational: October, 1951. Total divisions—three. Divisional strength—about 50.
Frame: System contractor—Martin. Length—39.6 ft. Diameter—54 in. Wingspan—28.7 ft. Launch weight—12,500 lbs. Material (major)—aluminum and magnesium.
Guidance: System contractor—Air Force. Type—radar control
Booster: System contractor—Thiokol. Propellant — solid (JATO). Thrust—57,000 lbs.
Sustainer: System contractor—Allison. Engine—J-33-37 turbo jet. Thrust—4200 lbs.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Martin. Fueling—Martin. Handling and service—Martin. Transport vehicles—Martin.
Remarks: Relatively mobile Matadors are being replaced by more advanced Maces. Matadors in West Germany are being turned over to German troops.

MACE

MACE (Air Force)

Military designation: TM-76A and TM-76B
Type: Air-breathing surface-to-surface
Status: TM-76A operational. TM-76B flight-testing.
Prime contractor: The Martin Co.
Performance: Range—(A) more than 650 n. miles. (B) more than 1200 n. miles. Speed—(A) more than 650 mph. (B) same but supersonic in terminal dive. Ceiling—more than 40,000 ft.
Deployment: Location—(A) U.S. troops in West Germany. Initially operational—(A) 1960. Total divisions—at least two. Divisional strength—about 50.
Frame: System contractor—Martin. Length—44 ft. Diameter—54 in. Wingspan—22.9 ft. Launch weight—15,500 lbs. Material (major)—aluminum and magnesium
Guidance: System contractor—(A) Goodyear. (B) A.C. Spark Plug. Type: (A) ATRAN map-matching. (B) inertial.
Booster: System contractor—Thiokol. Propellant — solid (JATO). Thrust—100,000 lbs.
Sustainer: System contractor—Allison. Engine — J-33-41. Thrust—5200 lbs.
Ground support equipment: Launcher—(A) Goodyear. (B) Martin. Fueling—Martin. Handling and service—(A) Goodyear, Martin, Four Wheel Drive Auto Co. (B) Martin, A.C. Spark Plug. Transport vehicles—(A) Four Wheel Drive. (B) Martin.



SERGEANT

SERGEANT (Army)

Military designation: SSM-A26
Type: Surface-to-surface
Status: Nearly operational
Prime contractor: Sperry Utah Engineering Lab.
Performance: Range—75 miles. Speed—supersonic.
Deployment: Location—to replace Corporal. Initially operational—1960.
Frame: System contractor—Sperry. Length—36 ft. Diameter—31 in. Launch weight—10,000 lbs. Material (major) — steel and aluminum.
Guidance: System contractor—Sperry. Type—inertial.
Booster: System contractor—Sperry. Propellant—solid. Thrust—about 55,000 lbs.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—AMF. Fueling—Thiokol. Handling and service—Sperry. Transport vehicles—Fruehauf.

CORPORAL (Army)

Military designation: M-2
Type: Surface-to-surface
Status: Operational
Prime contractor: Firestone Tire & Rubber Co./Gilfillan Bros.
Performance: Range—75 miles. Speed—Mach 3.
Deployment: Location — U.S. troops in Europe. Battalion strength—two launchers; two batteries (one firing, the other service). Initially operational—late 1953.
Frame: System contractor—Firestone. Length—45 ft. Diameter—30 in. Launch weight—11,000 lbs. Material (major)—steel.
Guidance: System contractor—Gilfillan. Type—preset and command.
Booster: System contractor—Ryan. Propellant—nitric acid and aniline.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Firestone. Fueling—Firestone. Handling and service—Firestone.
Remarks: To be replaced by the solid-propelled Sergeant.

CORPORAL

HONEST JOHN

HONEST JOHN (Army)

Military designation: M-31
Type: Surface-to-surface
Status: Operational
Prime contractor: Douglas Aircraft Co./Emerson Electric
Performance: Range—12 miles. Speed—Mach 1.7.
Deployment: Location — U.S. forces in continental United States, Europe and the Far East. Also in the hands of U.S. NATO allies. Initially operational—late 1953. Battalion strength—four launchers.
Frame: System contractor—Douglas/Emerson. Length—27 ft. Diameter—30 in. Launch weight—5800 lbs. Material (major) steel.
Guidance: Type—free-flight ballistic missile.
Booster: System contractor—Hercules Powder. Propellant—solid.
Spin rockets: System contractor—Thiokol. Propellant—solid.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Rock Island Arsenal.
Remarks: Douglas is producing an Improved Honest John made of aluminum with a solid booster manufactured by Allegany Ballistic Lab. The improved version has a range of more than 12 miles, weighs 1000 lbs. less and is three inches shorter.

LITTLE JOHN (Army)

Military designation: M-51
Type: Surface-to-surface
Status: Operational
Prime contractor: Emerson Electric Co.
Performance: Range—10 miles. Speed—supersonic.
Deployment: Location—missile in hands of training units in the United States. Initially operation—1960. Battalion strength—four launchers.
Frame: System contractor—Emerson Electric. Length—14 ft. 5 in. Diameter—12.5 in. Launch weight—760 lbs. Material (major)—steel and aluminum.
Guidance: Type—free-flight ballistic missile.
Booster: System contractor—Army Ordnance Missile Command/Hercules Powder. Propellant—solid.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Rock Island Arsenal.
Remarks: A highly mobile and easily airlifted missile.

LITTLE JOHN IV

LACROSSE (Army)

Military designation: M4E2
Type: Surface-to-surface
Status: Operational
Prime contractor: The Martin Co.
Performance: Range—20 miles. Speed—transonic.
Deployment: Location—Two U.S. battalions in West Germany; five more in training in the United States. Initially operational—1959. Total battalions—seven. Battalion strength—four mobile launchers.
Frame: System contractor—Martin. Length—19 ft. Diameter—20.5 in. Launch weight—2300 lbs.
Guidance: System contractor—Martin. Type—command.
Booster: System contractor—Thiokol. Propellant—solid.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher—Martin. Handling and service—Martin.

LACROSSE

DAVY CROCKETT (Army)

Military designation: XM-388
Type: Surface-to-surface
Status: Nearly operational
Prime contractor: Rock Island, Ill. Arsenal
Performance: Launched from either two tube-shaped launchers (XM-28 and XM-29) of varying size for different ranges. Range is relatively short.
Deployment: Location—U.S. troops overseas and in continental United States; also NATO allies. Initially operational: about 1961.
Booster: Propellant—solid.
Payload: Warhead type—nuclear. (frational yield).
Remarks: Smaller launcher can be carried by two men. Crockett is inserted into its launcher in the same fashion as a rifle grenade. The warhead is larger than the tube.


DAVY CROCKETT

SHILLELAGH (Army)

Type: Surface-to-surface
Status: R&D
Prime contractor: Ford Aeronutronics Div.
Performance: Designed to provide heavy firepower for close-in support of troops.
Deployment: Location—to be deployed with U.S. combat troops. Initially operational—mid-1960's.
Fire control: System contractor—Raytheon
Payload: Warhead type—nuclear.
Remarks: There will be hand-carried and vehicle mounted versions.

MISSILE A (Army)

Type: Surface-to-surface
Status: R&D
Prime contractor: None announced
Performance: Range—about 10-20 miles.
Frame: Launch weight—under 500 lbs.
Remarks: The Army Rocket and Guided Missile Agency at Huntsville, Ala., is acting as systems manager for a series of components that have been under development.

M-55 (Army)

Type: Surface-to-surface
Status: Operational
Prime contractor: Norris Thermador Co.
Performance: Range—relatively short. Launched from 45-tube T-145 launcher.
Deployment: Location—U.S. combat troops in the United States and overseas. Initially operational: 1960.
Frame: Diameter—115 mm.
Guidance: Type—free-flight.
Booster: Propellant—solid.
Payload: Warhead type—chemical agents.
Remarks: The Army in FY '61 is planning to buy more than 100,000 M-55's with an undisclosed number of launchers.


ARMY MULTIPLE ROCKET LAUNCHERS

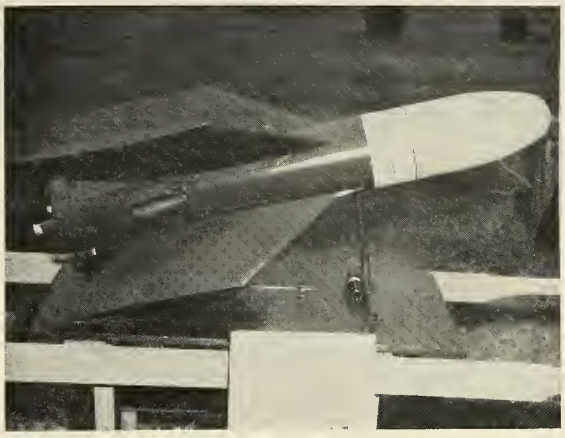
SS-10 (Army)

Type: Anti-tank
Status: Operational
Prime contractor: Nord Aviation, Paris, France; General Electric Co. (U.S. licensee)
Performance: Range—5250 ft. (effective). Speed—180 mph.
Deployment: Location—U.S. Army combat units (launched from jeeps, helicopters and other mobile vehicles). Also see Foreign Missiles section
Frame: System contractor—Nord (GE secondary source). Length—34 in. Diameter—six in. Wingspan—30 in. Launch weight—33 lbs.
Guidance: System contractor—Nord. Type—wire.
Booster: System contractor—Nord. Propellant—solid.
Payload: System contractor—Strim. Warhead type—armor-piercing HE.
Remarks: Initial U.S. Army procurement began in April, 1959. SS-10 can be carried and launched by one man.

SS-10

SS-11 (Army)

Type: Anti-tank
Status: Operational
Prime contractor: Nord Aviation, Paris, France
Performance: Range—1650-11,500 ft. (effective). Speed—more than 400 mph.
Deployment: Location—under evaluation by Army units. Also see Foreign Missiles section.
Frame: System contractor—Nord. Length—46 in. Diameter—six in. Wingspan—20 in. Launch weight—62 lbs.
Guidance: System contractor—Nord. Type—wire.
Booster: System contractor—Nord. Propellant—solid.
Payload: System contractor—Strim. Warhead type—armor-piercing HE.



SS-11

COBRA (Marines)

Type: Anti-tank
Status: Operational
Prime contractor: Boelkow Entwicklungen, Munich, Germany, and Daystrom, Inc.
Performance: Range—5940 ft. (max.); 5280 ft. (effective). Speed—191 mph.
Deployment: Location—Marine evaluation units.
Deployment: Location—1st Marine Division, Camp Pendleton, Calif., and Marine Corps Landing Force Development Center, Quantico, Va., to conduct evaluation in 1960. Also see Foreign Missiles section
Frame: System contractor—Boelkow (Europe); not determined for U.S. Length—30.7 in. Diameter—3.9 in. Height—13.6 in. Wingspan—19 in. Launch weight—20.2 lbs. Material (major)—plastic
Guidance: System contractor—Boelkow (Europe); Daystrom (U.S.) Type—wire.
Booster: System contractor—Oerlikon (Europe). Not determined for U.S. Propellant—solid.
Payload: Warhead type—armor-piercing HE (5.5 lbs.)
Remarks: Missile can be launched and guided by one man.

COBRA

BULLPUPS ON NAVY FJ FURY

AIR-TO-SURFACE

BULLPUP (Navy and Air Force)

Military designation: ASM-N-7 and GAM-83A
Type: Air-to-surface
Status: Operational
Prime contractor: The Martin Co.
Performance: Range—three to six n. miles. Speed—supersonic.
Deployment: Location—U.S. carriers, Marine Corps units and the Tactical Air Command. Initially operational—April, 1959, aboard the Carrier Lexington.
Frame: System contractor—Martin. Length—11 ft. Diameter—about one ft. Launch weight—571 lbs. Material (major)—aluminum.
Guidance: System contractor—Martin. Type—command (visual reference).
Booster: System contractor—Allegany Ballistics Lab and Thiokol. Type—solid and packaged liquid (Guardian).
Payload: Warhead type—HE (250-1000 lb.) or nuclear.
Remarks: The Air Force originally planned a radically different version of Bullpup called White Lance, but switched to buying only slightly modified Bullpups. Bullpups are usually carried by tactical jet aircraft, but Marines also have fired a Bullpup from a helicopter.

CORVUS (Navy)

Military designation: XASM-N-8
Type: Air-to-surface
Status: Pre-operational testing
Prime contractor: Temco Aircraft Corp.
Performance: Range—more than 100 n. miles. Speed—supersonic.
Deployment: Location—designed for carrier-based aircraft. Initially operational—1960-61.
Frame: System contractor—Temco.
Guidance: System contractor—Maxson and Texas Instrument. Type—radar homing.
Booster: System contractor—Thiokol. Propellant—packaged liquid (Patriot).
Payload: Warhead type—HE or nuclear.
Remarks: First guided test flight March 15, 1960, from an A3D jet over PMR sea test area. Most information about Corvus classified, but missile is reported to be designed to penetrate highly defended areas by homing on electronic equipment such as radar.

ADVANCED TACTICAL MISSILES

Project	Contractors	Description	Status
ARM (Air Force)	No contracts announced	Air-to-surface anti-radar missile	R&D
COBRA (Navy)	No contracts announced	Anti-ship, anti-radar missile	R&D
CLAYMORE (Army)	No contracts announced	Anti-personnel missile	R&D
GPSSM (Army)	No contracts announced	General purpose surface-to-surface missile	Study
LOBBER (Army)	No contracts announced	Surface-to-surface cargo carrier; 10-15 m. range; also can drop napalm	Study
RAVEN (Navy)	No contracts announced	Air-to-surface; about 500 m. range	Study
WAGTAIL (Air Force)	Minneapolis-Honeywell-prime	Air-to-surface; solid propellant; designed to hug terrain	R&D
WILLOW (Army)	Chrysler, prime	No details available	

CORVUS

Air/Space Defense

A revolution in air defense missiles is coming quickly.

Such surface-to-air missiles as Nike-Hercules and Bo-arc, along with air-to-air missiles like Sidewinder and alcon continue to be America's main weapons against tacking aircraft.

But the emphasis is switching rapidly to defense against issiles and spacecraft.

So far, Nike-Zeus is the only U.S. anti-ICBM funded for ll development. But both the Army and Navy are work-g on tactical anti-missile missiles. And all three services e looking ahead beyond Zeus.

America must defend itself not only against incoming issiles but also against satellites and spacecraft.

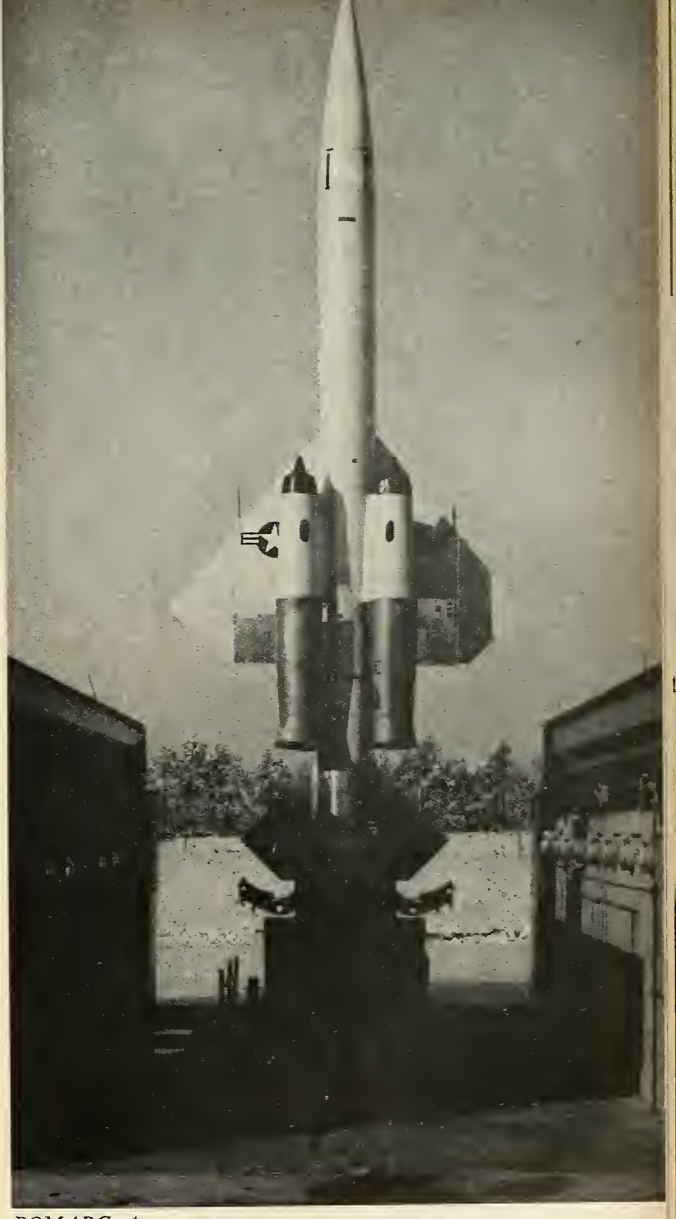
ANTI-AIRCRAFT

OMARC A (Air Force)

ilitary designation: IM-99A
ype: Air-breathing surface-to-air
atus: Operational
ime: Boeing Airplane Co.
erformance: Range—250 n. miles. Speed — supersonic. Ceiling—more than 68,000 ft.
eployment: Location—McGuire AFB, N.J.; Suffolk County AFB, N.Y.; Otis AFB, Mass.; Dow AFB, Maine; and Langley AFB, Va. Initially operational—1959. Total bases planned—five. Total squadrons planned—five. Squadron strength—average about 40 missiles.
rame: System contractor—Boeing. Length—47 ft. Diameter —35 in. Wingspan—18 ft. Launch weight—15,000 lbs. Material (major)—stainless steel.
Guidance: System contractor—IBM and Westinghouse. Type: command and homing radar. (IBM SAGE guides missile to vicinity of target when homing radar assumes command.)
Booster: System contractor—Aerojet. Propellant—liquid.
Sustainer: System contractor—Marquardt. Engine—(2) RJ-43 ramjets.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher-erector—Food Machinery.

OMARC B (Air Force)

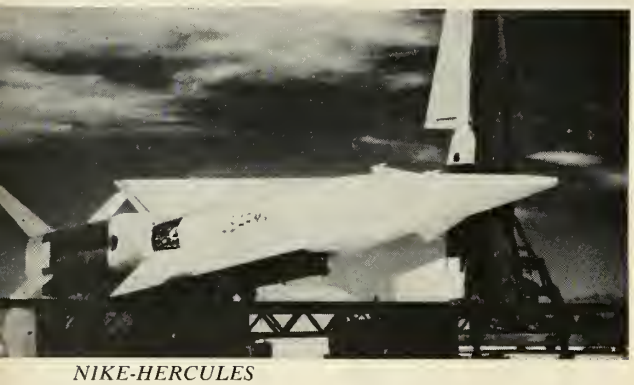
ilitary designation: IM-99B
ype: Air-breathing surface-to-air
tatus: R&D/production
erformance: Range—400 n. miles. Speed — supersonic. Ceiling—more than 70,000 ft.
eployment: Location — continental United States (Duluth, Minn.; Niagara Falls, N.Y.; Kincheloe AFB, Mich.) and Canada. Initially operational: Total squadrons — (U.S.) three: (Canada) two. Total bases planned—five. Squadron strength—average about 40 missiles.
rame: System contractor—Boeing. Length—45 ft. Diameter —35 in. Wingspan—18 ft. Launch weight—16,000 lbs. Material (major)—stainless steel.
Guidance: System contractor—IBM and Westinghouse. Type —command and radar homing. (IBM SAGE guides missile to vicinity of target when homing radar takes command.)
Booster: System contractor—Thiokol. Propellant—solid.
Sustainer: System contractor—Marquardt. Engine—(2) RJ-43 advanced ramjets.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launcher-erector—Food Machinery.
Remarks: Original number of squadrons planned was sharply cut.



BOMARC A

BOMARC A'S AT McGUIRE AFB, N. J.

NIKE-AJAX



NIKE-HERCULES

TALOS

NIKE-AJAX (Army)

Military designation: SAM-A-7
Type: Surface-to-air
Status: Operational
Prime contractor: Western Electric Co.
Performance: Range—25 miles. Speed—Mach 2.5. Ceiling—60,000 ft.
Deployment: Location—United States, Western Europe, Far East. Initially operational—1953. Total battalions—about 40. Battalion strength—4 batteries. Battery strength—9 launchers. Total launchers—nearly 1500.
Frame: System contractor—Douglas. Length—31 ft. Diameter—12 in. Wingspan—52 in. Launch weight—2300 lbs. Material (major)—aluminum and steel.
Guidance: System contractor—Western Electric. Type—command.
Booster: System contractor—Thiokol. Propellant—solid.
Sustainer: System contractor—Thiokol. Propellant—liquid.
Payload: Warhead type—HE.
Ground support equipment: Launchers — Consolidated Western Steel. Transport vehicles—Fruehauf.
Remarks: Nike-Ajax is being replaced by the far more advanced Nike-Hercules.

NIKE-HERCULES (Army)

Military designation: SAM-A-25
Type: Surface-to-air (anti-missile capability)
Status: Operational
Prime contractor: Western Electric Co.
Performance: Range—more than 75 n. miles. Speed—Mach 3 plus. Ceiling—more than 150,000 ft.
Deployment: Location—United States, Western Europe, Far East. Initially operational—mid-1958. Total battalions—about 20. Battalion strength—4 batteries. Battery strength—9 launchers. Total launchers—more than 700.
Frame: System contractor—Douglas. Length—39 ft. Diameter—31.5 in. Wingspan—90 in. Launch weight—10,000 lbs. Material (major)—aluminum and steel.
Guidance: System contractor—Western Electric. Type—command.
Booster: System contractor—Hercules Powder. Propellant—solid.
Sustainer: System contractor—Thiokol. Propellant—solid.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launchers — Consolidated Western Steel. Transport vehicles: Fruehauf.
Remarks: New General Electric radars give Nike-Hercules the capability of intercepting incoming tactical missiles. The Army plans to install improved system in Europe and other appropriate areas. The Army also is expected to build mobile Nike-Hercules anti-missile batteries for deployment in the field.

TALOS (Navy)

Military designation: SAM-N-6
Type: Surface-to-air and surface-to-surface (Seagoing)
Status: Operational
Prime contractor: Bendix Aviation Corp. System engineer—Vitro Corp.
Performance: Range—more than 65 n. miles. Speed—about Mach 2.5. Ceiling—extremely high altitude.
Deployment: Location—aboard the Missile Cruiser Galveston. To be deployed aboard at least six more cruisers including the nuclear-powered Cruiser Long Beach. Initially operational—1959.
Frame: System contractor—McDonnell. Length—about 30 ft. Diameter—about 30 in. Launch weight—7000 lbs. (booster alone weighs 4000 lbs.) Material (major)—steel
Guidance: System contractor—Bendix/Sperry. Type—beam riding.
Booster: System contractor—Allegany Ballistics Lab. Type—solid.
Payload: Warhead type—nuclear or HE.
Ground support equipment: Launchers—Naval Weapons Plant.
Remarks: Improvements in the Talos system have led to work on an anti-missile system called Typhon.

TERRIER

ADVANCED TERRIER

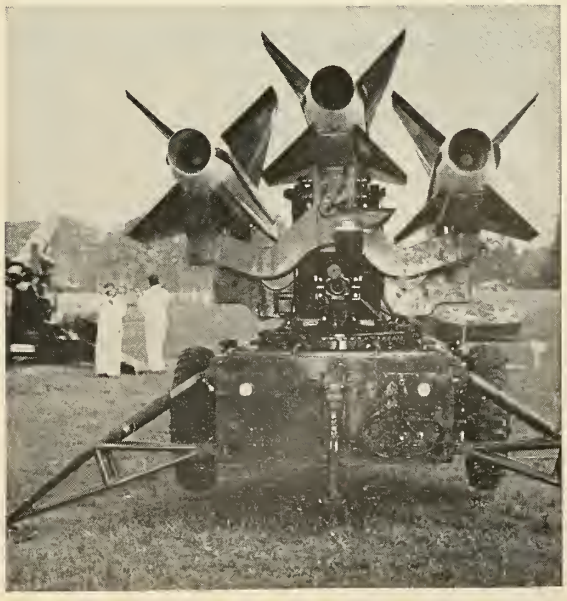
TERRIER (Navy)

Military designation: SAM-N-7
Type: Surface-to-air (seagoing)
Status: Operational
Prime contractor: Convair Division, General Dynamics Corp. System engineer—Vitro Corp.
Performance: Range—about 10 n. miles. Speed—supersonic. Ceiling—more than 50,000 ft.
Deployment: Location—aboard U.S. destroyers, frigates and cruisers. Also used in a mobile version by Marines. Initially operational—1956.
Frame: System contractor—Convair. Length—29 ft. (with 15 ft. booster). Diameter—12 in. Launch weight—2500 lbs.
Guidance: System contractor—Reeves/FTL, Sperry. Type—radar beam rider.
Booster: System contractor—Allegany Ballistics Lab. Propellant—solid.
Sustainer: System contractor—Allegany Ballistics Lab. Propellant—solid.
Payload: Warhead type—HE.
Remarks: Terrier is being replaced by the Convair Advanced Terrier. The Advanced Terrier's performance is about 100% greater than Terrier's. The new Frigate Dewey is the first ship to be armed with Advanced Terrier.

TARTAR

TARTAR (Navy)

Military designation: Mark 15
Type: Surface-to-air (seagoing)
Status: Operational
Prime contractor: Convair Division, General Dynamics Corp. System engineer—Vitro Corp.
Performance: Range—more than 10 n. miles. Speed—supersonic. Ceiling—high-altitude.
Deployment: Location—to be installed aboard 21 destroyers and three cruisers. Initially operational—1960.
Frame: System contractor—Convair. Length—15 ft. Diameter—12 in. Launch weight—about 1500 lbs.
Guidance: System contractor—Raytheon.
Booster: System contractor—Aerojet. Propellant—solid.
Payload: Warhead type—HE.
Ground support equipment: Launcher — Puget Sound Naval Shipyard. Handling—Washington Technological Associates/Naval Weapons Plant.



HAWK

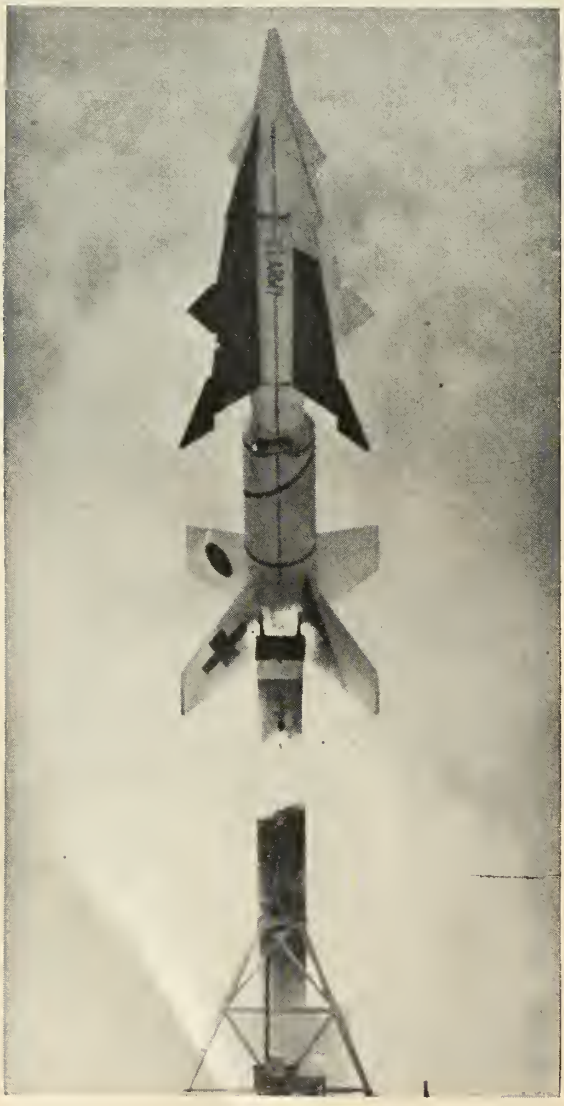
HAWK (Army)

Military designation: XM3E1
Type: Surface-to-air
Status: Operational
Prime contractor: Raytheon Co.
Performance: Range—about 22 n. miles. Speed—Mach 2 plus. Ceiling—tree-top level to about 40,000 ft. (Hawk is specifically designed for use against low-flying aircraft.)
Deployment: Location — U.S. troops training with Hawks in the United States. Initially operational—1959. Battalions—two. Battalion strength—3 to 5 batteries. Battery strength—6 to 12 launchers (3 missiles per launcher). Also to be used by Marine Corps and NATO allies.
Frame: System contractor — Raytheon/Northrop, Temco. Length—17 ft. Diameter—14 in. Wingspan—48 in. Launch weight—1275 lbs. Material (major) — aluminum and steel.
Guidance: System contractor—Raytheon. Type—semi-active radar homing.
Booster: System contractor—Aerojet. Propellant—solid.
Sustainer: System contractor—Aerojet. Propellant—solid.
Payload: Warhead type—HE.
Ground support equipment: Launcher—Northrop. Handling and service—Raytheon, Northrop, Food Machinery and RCA. Transport vehicles—Food Machinery.
Remarks: Although Hawk is not an anti-missile missile, it has successfully intercepted an Honest John in a test. Hawk is highly mobile.

REDEYE (Army)

Type: Surface-to-air (shoulder-launched)
Status: Nearly operational
Prime contractor: Convair Division, General Dynamics Corp.
Performance: Designed to intercept low-flying jet aircraft. One man can operate and carry.
Deployment: Location—to be deployed with Army and Marine combat troops. Initially operational—late 1960.
Frame: System contractor—Convair. Length—4 ft. Diameter—3 in. Launch weight—20 lbs.
Guidance: System contractor—Philco/Convair. Type—Infrared.
Booster: System contractor—Atlantic Research. Propellant—solid.
Payload: Warhead type—HE.
Remarks: Redeye is shipped, carried and launched from a disposable bazooka-shaped container.

REDEYE



NIKE-ZEUS

ANTI-MISSILE

NIKE-ZEUS (Army)

Type: Surface-to-air anti-ICBM and IRBM.
Status: R&D
Prime contractor: Western Electric Co.
Performance: Range—about 200 n. miles. Speed—est. Mach 4.
Deployment: Location — continental United States (particularly around soft SAC bases). Initially operational—about 1964. Total batteries—undetermined. Battery strength—about 50 launchers.
Frame: System contractor—Douglas. Length—about 65 ft. Diameter—about 5 ft.
Guidance: System contractor—Western Electric. Type—command.
Booster: System contractor—Thiokol. Propellant—solid.
Sustainer: System contractor—Grand Central. Propellant—solid.
Payload: Warhead type—nuclear.
Ground support equipment: Launcher—Douglas. Handling and service—Douglas.
Remarks: The future of the Nike-Zeus system is in doubt. The Eisenhower Administration refused to permit the Army to begin production thereby causing deployment to slip. However plans for flight-testing the missile in the Pacific in mid-1961 against live missiles were approved.

TYPHON (Navy)

Type: Surface-to-air (anti-missile missile)
Status: R&D
Prime contractor: Westinghouse Electric Corp./Applied Physics Lab
Performance: Designed to intercept both incoming tactical missiles and missiles launched from submerged submarines seconds after launching. Range—est. 100 n. miles. Speed—supersonic.
Deployment: Location—aboard cruisers, destroyers and possibly hydrofoil destroyers.
Payload: Warhead type—nuclear or HE.
Remarks: Two types are being developed—Long Range Typhon (formerly called Super Talos) and Medium Range Typhon (formerly called Super Tartar).

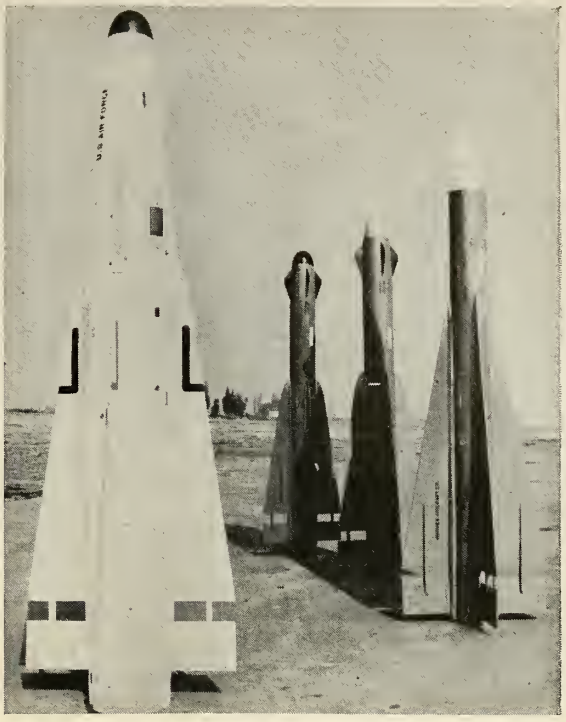
MAULER (Army)

Type: Surface-to-air (anti-missile missile)
Status: R&D
Prime contractor: Convair Division, General Dynamics Corp.
Performance: Designed to intercept incoming tactical missiles and jet aircraft.
Deployment: Location—to be put in hands of Army combat units in near forward positions.
Guidance: Type—radar.
Booster: Propellant—solid.
Remarks: Mauler will be launched from tracked vehicle manned by crew of only several men. System will be self-propelled and highly mobile and compact. Seagoing version has been proposed.

AIR-TO-AIR

FALCON (Air Force)

Military designation: GAR-1 through GAR-4, GAR-9 and GAR-11
Type: Air-to-air
Status: Operational (GAR-1 through GAR-4) and R&D (GAR-9 and GAR-11)
Prime contractor: Hughes Aircraft Co.
Performance: Range—about 5 n. miles. Speed—supersonic. (Greater ranges and speeds for GAR-3 and GAR-4, GAR-9 and GAR-11)
Deployment: Location—Air Defense Command aircraft (F-89, F-101, F-102 and F-106). Initially operational — 1957 (first versions).
Frame: System contractor—Hughes. Length—about 6.5-7 ft. (GAR-11 is more than 7 ft.). Diameter—6.4 in. GAR-11 is 7 ft. 11 in.) Wingspan—20 in. Launch weight—more than 120 lbs. (GAR-11 is more than 200 lbs.)
Guidance: System—contractor—Hughes. Type—(GAR-1D and GAR-3) radar homing; (GAR-2 and GAR-4) infrared.
Booster: System contractor—Thiokol. Propellant—solid.
Payload: Warhead type—(GAR-1 through GAR-4) HE; (GAR-11 and probably GAR-9) nuclear.
Remarks: GAR-3 and GAR-4 are known as Super Falcons. GAR-9 was originally designed for the now-cancelled F-108 Mach 3 interceptor.



FALCONS (FROM LEFT): GAR-11, GAR-1D, GAR-2A, GAR-3

GENIE (Air Force)

Military designation: MB-1
Type: Air-to-air
Status: Operational
Prime contractor: Douglas Aircraft Co.
Performance: Range—1.5 n. miles. Speed—supersonic.
Deployment: Location—aboard Air Defense Command aircraft (F-89's, F-101's, F-106's). Initially operational—about 1958.
Frame: System contractor—Douglas. Length—eight ft. Launch weight—nearly 1000 lbs.
Guidance: Type—free flight.
Booster: System contractor—Aerojet. Propellant—solid.
Payload: Warhead type—nuclear.
Ground support equipment: Launcher—Douglas. Handling and service—Douglas. Transport vehicles—Fruehauf.

GENIE

SPARROW III

SPARROW III (Navy)

Military designation: AAM-N-6A
Type: Air-to-air
Status: Operational
Prime contractor: Raytheon Co.
Performance: Range—more than 5 n. miles. Speed—more than Mach 2.
Deployment: Location—carrier-based U.S. Navy aircraft. Also with Marine units. Initially operational—August, 1958, replacing Sparrow I.
Frame: System contractor—Raytheon. Length—12 ft. Diameter—8 in. Launch weight—400 lbs. Material (major)—aluminum.
Guidance: System contractor—Raytheon. Type—radar homing.
Booster: System contractor—Aerojet. Propellant—solid (A new version of Sparrow with greater capability has Thiokol booster with packaged liquid propellant.) Thrust (solid)—7800 lbs.
Payload: Warhead type—HE.
Ground support equipment: Handling and service—Raytheon.
Remarks: Sparrow gave the Navy an all-weather missile when Sidewinder had only IR guidance.

SIDEWINDER (Navy-Air Force)

Military designation: AAM-N-7 (Navy) and GAR-8 (Air Force)
Type: Air-to-air
Status: Operational
Prime contractor: Philco Corp./ General Electric Co.
Performance: Range—about 2 n. miles. Speed—supersonic. Ceiling—more than 50,000 ft.
Deployment: Location—carried by carrier-based Naval aircraft and Air Defense Command aircraft. Also widely used by U.S. allies. Initially operational—mid-1956.
Frame: System contractor—Norris Thermador/Hunter-Douglas. Length—9 ft. Diameter—5 in. Launch weight—about 155 lbs. Material (major)—aluminum.
Guidance: System contractor—Philco/GE. Type—Infrared.
Booster: System contractor—Naval Propellant Plant. Propellant—solid.
Payload: Warhead type—HE.
Remarks: Philco is prime contractor for Sidewinder I-C, a second-generation missile with greater speed and range. I-C will have switchable IR and radar homing warheads. The Naval Ordnance Test Station at China Lake, Calif., developer of Sidewinder, also is developing I-C.

SIDEWINDER

EAGLE (Navy)

Military designation: XAAM-N-10
Type: Air-to-air
Status: R&D
Prime contractor: Bendix Corp.
Performance: Range—est. 100 n. miles. Speed—more than Mach 3.
Deployment: Location—to be launched from new low-speed, long-endurance plane called Missileer which is to be developed and deployed on carriers.
Frame: System contractor—Grumman. Length—est. 15 ft. Launch weight—about 2000 lbs.
Guidance: System contractor—Bendix. Type—radar homing.
Booster: System contractor—Aerojet. Type—solid.
Payload: Warhead type—nuclear or HE.
Remarks: Eagle introduces a new Navy concept of putting high performance into an air-launched missile that will be fired from a low-speed aircraft.

ZUNI (Navy)

Type: Air-to-surface
Status: Operational
Prime contractor: Naval Ordnance Test Station, China Lake
Performance: Range—about 5 n. miles. Speed—about 3000 ft./sec.
Deployment: Location—carrier-based aircraft. Initially operational—1957.
Frame: Length—110 in. Diameter—5 in. Launch weight—107 lbs.
Guidance: Type—free flight.
Booster: System contractor—Hunter-Douglas. Type—solid. Thrust—7000 lbs.
Payload: Warhead type—HE (also variety of other conventional warheads including flares.)
Remarks: The four-rocket launchers, which also are used for transporting and storing Zunis, can be jettisoned from plane after rockets are launched. AD-type Naval aircraft can carry up to 48 Zunis.

ZUNI

Anti-submarine

The decade of the 1960's is seeing the missile come into its own as a weapon for attacking submarines.

ASROC—the greatest step forward in the development of an ASW missile in a decade—is already operational. SUBROC is expected to be operational in less than a year.

Meantime, improvements in both systems are under consideration.

The stumbling block continues to be detection. Any improvements in detection can be quickly followed by improvements in the missiles themselves.

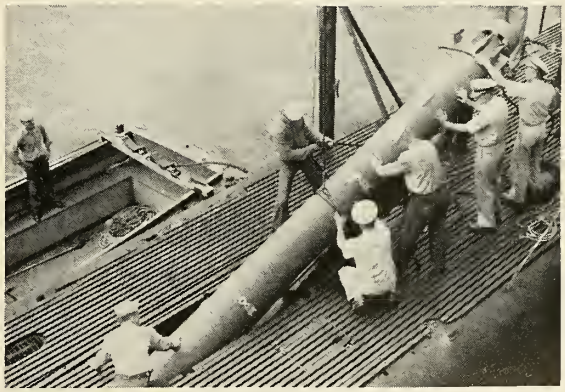
WEAPON ALFA (Navy)

Type: ASW surface-to-underwater
Status: Operational
Prime contractor: Navy
Performance: Range—about 900 yards
Deployment: Location—aboard U.S. destroyers and cruisers. Initially operational—1952
Frame: System contractor—Avco. Length—8.5 ft. Diameter—12.75 in. Launch weight—500 lbs.
Guidance: Type—free flight
Booster: Propellant—solid
Payload: Warhead type—HE depth charge
Remarks: Alfa is launched from guns mounted in turrets

WEAPON ALFA

ASTOR (Navy)

Type: ASW rocket torpedo
Status: R&D
Prime contractor: Westinghouse Electric Corp.
Performance: Range—reported to be about 11 n. miles
Deployment: Location—aboard U.S. fleet submarines
Frame: System contractor—Westinghouse. Length—nearly 20 ft. Launch weight—more than 2000 lbs.
Guidance: Type—reported to be partly wire.
Powerplant: Type—reported to be electric and rocket-boosted. Propellant—solid
Payload: Warhead type—nuclear or HE.



ASTOR

ASROC (Navy)

Type: ASW surface-to-underwater
Status: Operational
Prime contractor: Minneapolis-Honeywell Regulator Co.
Performance: Range—about 8 n. miles. Speed—nearly Mach 1.
Deployment: Location—Destroyer Leader Norfolk and Destroyer Peary. The Navy plans to install ASROC aboard a total of 150 destroyers and cruisers within the next few years. Initially operational: 1960. Launcher capacity—eight. (Some ships will carry reloads)
Frame: System contractor—Minneapolis-Honeywell. Length—15 ft. Torpedo-warhead length—100 in. Missile diameter—1 ft. Overall diameter—2.5 ft. Launch weight—about 1000 lbs.
Fire control: System contractor—Librascope. Type—digital computer operated.
Sonar detection: System contractor—Sangamo Electric. Type—SQS-23.
Booster: Propellant—solid.
Payload: Warhead — General Electric Mark 44 acoustic homing torpedo or depth charge. Type—HE (depth charge can be nuclear)
Ground support equipment: Launcher—Universal Match

ASROC

SUBROC (Navy)

Type: ASW underwater-to-underwater
Status: R&D
Prime contractor: Goodyear Aircraft Corp.
Performance: Range—about 25 n. miles.
Deployment: Location—aboard nuclear-powered attack submarines. Scheduled to be installed first aboard the Thresher. Initially operational—1961.
Frame: System contractor—Goodyear.
Guidance: System contractor—Kearfott.
Fire control: System contractor—Librascope.
Booster: System contractor—Thiokol. Type—solid.
Payload: Warhead type—nuclear or HE.
Remarks: Subroc will be launched underwater from a conventional submarine tube, leave the water, travel through the air and re-enter the water to strike an enemy submarine

Directory of Rocket Engine

The biggest engines in America's inventory today still are propelled by the liquid combination of LOX and RP-1.

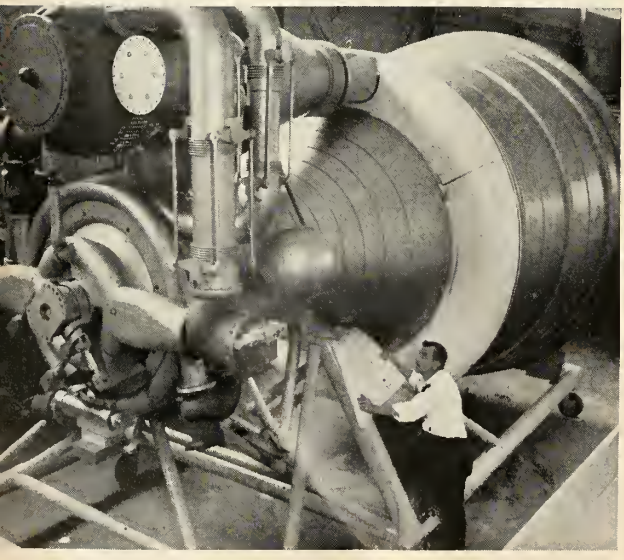
The Rocketdyne 150,000-lb.-thrust engine is the basic U.S. power plant for large liquid rockets. Developed for the Jupiter IRBM, it has been adapted for the Thor IRBM, used in pairs for the Atlas ICBM and modified for clustering into the Saturn booster. The same combination propels the F-1, the largest single engine under development, and the booster powerplant of the Titan ICBM.

However, current propulsion trends are moving toward the high-energy LOX-liquid hydrogen system, storable propellants in liquids and increased use of solids where instant readiness, mobility and low price are major factors.

LIQUID ENGINES

NOVA ENGINE (NASA)

Manufacturer: Rocketdyne
Manufacturer's number: F-1
Propellants: LOX, kerosene
Nozzle config. & exp. ratio: Modified bell, regen. cooled, more than 12:1
Nozzle material: Unsettled
Length: About 20 ft.
Width (maximum): About 12 ft.
Weight: About 18,000 lbs.
Start system: Solid propellant
Ignition: Pyrophoric, tri-ethyl aluminum
Propellant supply: Turbopumped
Average thrust: 1,500,000 lbs.
Specific impulse, sea level: about 260 sec.; average during flight: about 290 sec.
Burning time: according to tank capacity
Status: R&D. Thrust chamber test this summer; first engine test next summer; pre-flight rating test complete by summer of 1963. Cluster of several F-1's—or a single F-1 and several H-1's—will be the booster of the Nova vehicle.



ROCKETDYNE'S F-1

SATURN BOOSTER ENGINE (NASA)

Manufacturer: Rocketdyne
Manufacturer's number: H-1
Propellants: LOX, kerosene
Nozzle config. & area ratio: Bell, regen. cooled, 8:1
Nozzle material: Nickel
Length: About 8 ft.
Width (maximum): 60 in.
Engine weight: About 1400 lbs.
Start system: Solid propellant
Ignition: Pyrophoric; tri-ethyl aluminum
Propellant supply: Turbopumped
Average thrust (sea level): 165,000 lbs; later to be 188,000 lbs.
Specific impulse (sea level): 255 sec.
Burning time: According to tank capacity
Status: R&D. Earlier versions operational in Jupiter, Thor, Atlas

ATLAS BOOSTER (Air Force)

Manufacturer: Rocketdyne
Manufacturer's numbers: MA2, MA3
Propellants: LOX, kerosene
Nozzle config. & area ratio: Bell, regen. cooled, 8:1
Nozzle material: Nickel
Length: About 8 ft.
Width (maximum, one engine): 60 in.
Weight (one engine): 1418 lbs.
Start system: MA2—LOX-kerosene gas gen.; MA3—solid propellant
Ignition: MA2 — pyrotechnic; MA3—pyrophoric, tri-ethyl aluminum
Average thrust: MA2—300,000 lbs.; MA3—330,000 lbs.
Number of engines: 2 with common pumpage
Propellant consumption (total): MA2—1240 lb./sec.; MA3—classified.
Burning time: 2 min.
Status: MA2 operational. MA3—R&D.

TITAN BOOSTER (Air Force)

Manufacturer: Aerojet-General
Military numbers: LR-87-AJ-3 and -5
Propellants: -3—LOX, kerosene; -5—nitrogen tetroxide and Aerozene-50 (50-50 mix of UDMH and hydrazine)
Nozzle config. & area ratio: Bell, regen. cooled; 8:1
Nozzle material: Stainless steel
Length: About 10 ft.
Width (maximum): About 9 ft.
Engine weight: About 3700 lbs.
Start system: -3—ground-supplied and bootstrap; -5—self-contained
Ignition: -3—pyrotechnic; -5—hypergolic
Propellant supply: Turbopumped
Number of engines: 2 fed by common tankage
Average thrust (sea level): -3—300,000 lbs.; 5—more than 400,000
Burning time: 120 sec.
Status: -3 has completed qualification tests; -5 is to complete qualification in about two years.

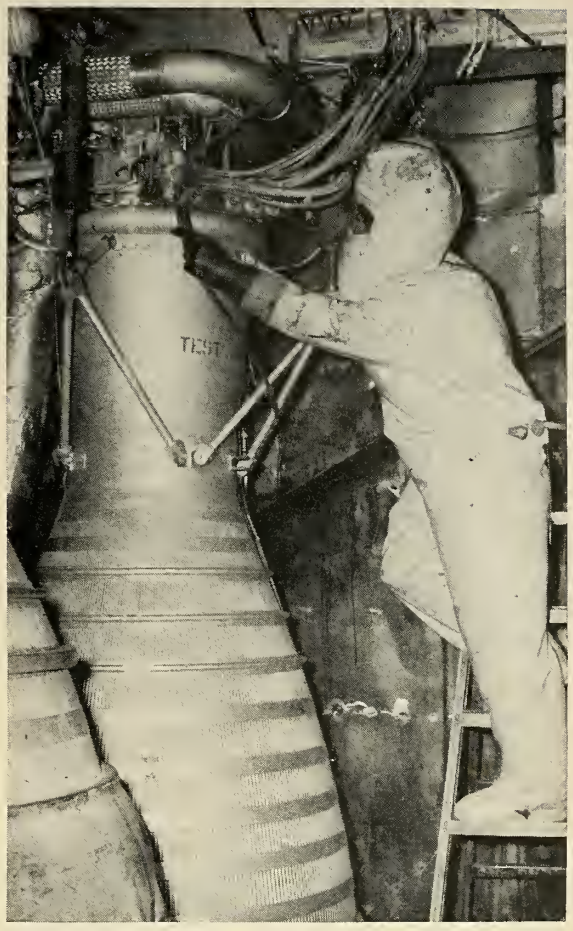
SATURN MIDSTAGE ENGINE (NASA)

Manufacturer: Rocketdyne
Manufacturer's number: J-2
Propellants: LOX, liquid hydrogen
Nozzle config. & area ratio: Bell, regen. cooled; over 30:1
Engine weight: About 2500 lbs.
Start system: LOX-hydrogen gas generator
Average thrust: 200,000 lbs.
Specific impulse (vacuum): More than 420 sec.
Burning time: More than 100 sec.
Status: NASA chose Rocketdyne in June, 1960, to conduct a three-year program leading to preflight rating test. Many engine details unsettled.

Motors

ATLAS SUSTAINER (Air Force)

Manufacturer: Rocketdyne
Manufacturer's number: S-4 (part of propulsion systems MA2 and MA3)
Propellants: LOX, kerosene
Nozzle config. & area ratio: Bell, regen. cooled, 25:1
Nozzle material: Nickel
Length: About 8 ft.
Width (maximum): About 60 in.
Engine weight: 984 lbs.
Start system: Same as booster
Ignition: Same as booster
Thrust: 57,000 sea level, 80,000 vacuum
Burning time: About 270 sec.
Status: Operational in MA2; R&D in MA3.



ATLAS SUSTAINER

TITAN SUSTAINER (Air Force)

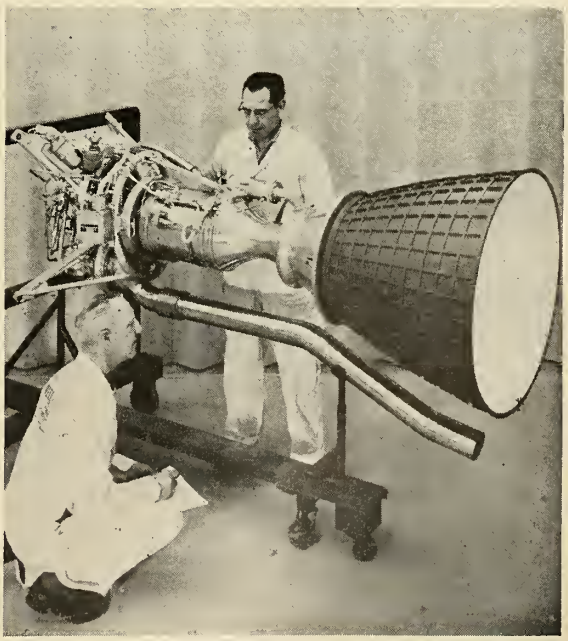
Manufacturer: Aerojet-General
Military numbers: LR-91-AJ-3 and -5
Propellants: -3—LOX, kerosene; -5—nitrogen tetroxide and Aerozene-50
Nozzle config. & area ratio: Bell, partly regeneratively cooled, 25:1
Nozzle material: Stainless steel
Length: About 7 ft.
Width (maximum): About 4 ft.
Engine weight: About 1300 lbs.
Start system: Self-contained
Ignition: -3—pyrotechnic; -5—hypergolic
Propellant supply: Turbopumped
Average thrust (vacuum), lbs.: -3—80,000; -5—slightly higher
Burning time, sec: 150
Status: -3 is completing qualification tests; -5 is to complete qual. tests in about two years.

CENTAUR ENGINE (NASA)

Manufacturer: Pratt & Whitney
Military number: LR-115
Propellants: LOX, liquid hydrogen
Nozzle config. & area ratio: Bell, regen. cooled, over 30:1
Nozzle material: Stainless steel
Start system: Bootstrap hydrogen expansion pump
Ignition: Electric
Average thrust: 15,000 lbs.; almost 20,000 lbs. in later version
Specific impulse: 30% higher than LOX-kerosene; number not given
Burning time: About 5 min. in Centaur
Status: R&D; to be flown in Centaur in 1961; to be used in Saturn upper stages beginning in 1963.

AGENA ENGINE (Air Force and NASA)

Manufacturer: Bell Aircraft
Military numbers: XLR-81-BA-5, -7 and -9
Propellants: IRFNA, UDMH
Start system: -5 single start, -7 and -9 restartable in space
Ignition: Hypergolic
Propellant feed: Turbopumped
Average thrust: 15,500 except 16,000 in -9
Burning time: -5—about 120 sec.; -7 and -9—about 240 sec.
Propellant weight: -5—8500 lbs.; -7 and -9—17,000 lbs.
Status: -5 operational in Agena A; -7 coming into operation in early Agena B; -9 in production for later Agena B.



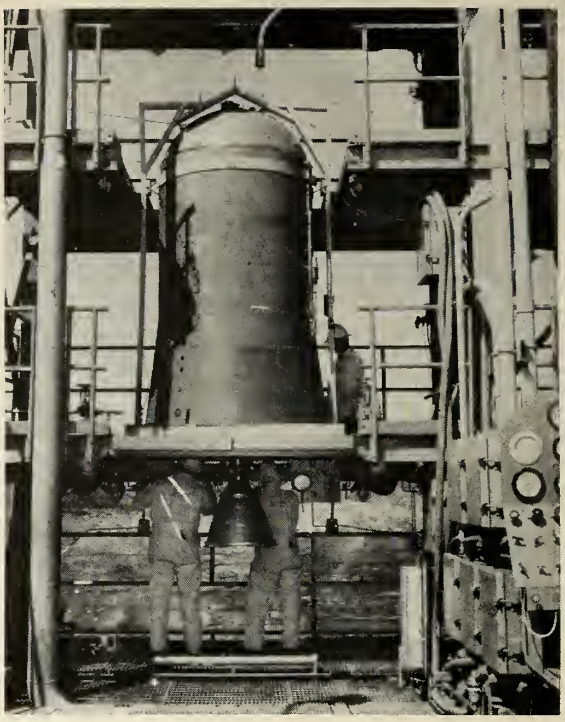
BELL'S AGENA ENGINE

VANGUARD-VEGA ENGINE (NASA)

Manufacturer: General Electric
Military numbers: X405; X405H
Propellants: LOX, kerosene
Nozzle config. & area ratio: 405—single-CD single-pass double shell, 5.5:1; 405H—tube bundle, 25:1
Nozzle material: Steel
Length: 405—80 in.; 405H—65 in.
Width: 405—40 in.; 405H—27.5 in.
Weight: 405—421 lbs.; 405H—458 lbs.
Propellant supply: Turbopumped
Ignition: 405 — pyrotechnic; 405H—pyrophoric tri-ethyl aluminum
Thrust, sea level: 405—28,000 lbs.; 405H—35,000 lbs.
Burning time: 405—150 sec.; 405H—250 sec.
Status: X405, the booster engine on Vanguard, has now phased out. X405H was developed for use as an upper stage, atop an Atlas, for the Vega vehicle. Although the Vega vehicle was cancelled, X405H development was continued through preflight rating test.

VARIABLE THRUST ENGINE (Air Force)

Manufacturer: Aerojet-General
Military number: LR-113-AJ-1
Propellants: Nitrogen Tetroxide, UDMH
Nozzle config. & area ratio: Conical, film-cooled, about 6:1
Nozzle material: Steel
Length: About 5 ft.
Width: About 2½ ft.
Weight (maximum): About 1000 lbs.
Ignition: Hypergolic
Propellant supply: Pressure-fed
Thrust (sea level): 50,000-150,000 lbs.
Burning time (full thrust): About 10 sec.
Status: Qualified for sled use.



ABLESTAR ENGINE

GAMMA ENGINE (British)

Manufacturer: Bristol Siddeley
Manufacturer's number: A. S. Gamma Mk. 201
Propellants: 85-7% hydrogen peroxide, kerosene
Nozzle configuration: Bell, regen. cooled
Length: 90 in.
Width (maximum): 36 in.
Engine weight: 700 lbs.
Ignition: Catalytic decomposition & hypergolic
Propellant feed: Turbopumped
Number of chambers: 4
Total thrust: Sea level—16,000-16,800; Vacuum—19,000
Status: Operational in the Black Knight Re-entry research vehicle.

NUCLEAR

ROVER NUCLEAR ENGINE (AEC and NASA)

Manufacturer: Los Alamos Scientific Lab.
Propellant: Liquid hydrogen
Nozzle config.: Bell, regen. cooled
Total weight: 39,000 lbs.
Reactor power: 1,000 megawatts thermal
Thrust (sea level): 52,000 lbs.
Propulsion time: More than 5 minutes.
Status: R&D. Tests of non-flying Kiwi engines began last summer. NASA says will be ready for orbital flight test by 1965. AEC says system could be proved sooner with ground-launched test.

ABLE SERIES ENGINES

The Aerojet-General Able series of engines originated with the second stage of Vanguard and was adapted for the Thor-Able. The Able still has two flights with the Atlas-Able scheduled this year before it phases out in favor of Delta in NASA vehicles and Ablestar in some military satellites.

ENGINE	AJ10-101 (ABLE)	AJ10-110 (DELTA)	AJ10-104 (ABLESTAR)
Propellants	IRFNA, UDMH	WIFNA, UDMH	IRFNA, UDMH
Nozzle configuration & area ratio	Bell, tube bundle, 20:1	Bell, tube bundle, 20:1	Bell, tube bundle to 20:1; Uncooled extension to 40:1
Nozzle material	Aluminum	Stainless steel	Aluminum to 20:1; titanium extension
Length, in. (including tanks)	About 190	About 190	About 207
Width (maximum), in.	About 32	About 32	About 55
Start system	Self-contained, wet	Self-contained, wet	Wet or dry, restartable
Ignition	Hypergolic	Hypergolic	Hypergolic
Propellant supply	Helium pressure feed	Helium pressure feed	Helium pressure feed
Average thrust (vac.) lbs.	About 7800	About 7800	About 8000
Burning time, sec.	About 120	About 120	About 300

SOLID MOTORS

Solid propulsion has made large strides in the last year, particularly in the development of rocket hardware. The Polaris Fleet Ballistic Missile and the Scout satellite launcher are nearly operational and the Minuteman ICBM has progressed to the point where even larger solid motors are being considered.

ALGOL (NASA)

Manufacturer: Aerojet-General
Propellant: Polyurethane composite
Nozzle config. & exp. ratio: Cone, 4.7:1
Nozzle material: Steel
Length: 358 in.
Width (maximum): 40 in.
Weight (maximum): 22,640 lbs.
Weight unloaded: 3360 lbs.
Ignition: Squib
Average thrust (sea level): 104,500 lbs.
Burning time (web): 36 sec.
Total impulse (integrated, sea level to altitude): 4,080,000 lb.-sec.
Case material: Steel
Status: An early Polaris test vehicle, Algol was adapted for use as Scout booster. Engine development is complete.

CASTOR MOTOR (NASA)

Manufacturer: Thiokol
Propellant: Polybutadiene acrylic acid composite
Nozzle config. & exp. ratio: Cone, 16:1
Nozzle material: Steel
Length: 244 in.
Width: 31 in.
Total weight: 8870 lbs.
Weight unloaded: 1430 lbs.
Ignition: Squib
Total impulse (vac.): 1,940,000 lb.-sec.
Burning time (web): 27 sec.
Average thrust: Vacuum—63,050 lbs.; sea level—55,000 lbs.
Case material: Steel
Status: Operational. Castor, a modification of the motor in the Sergeant missile, is used as second stage of Scout and as a component in Little Joe and several sounding-type vehicles.

ANTARES MOTOR (NASA)

Manufacturer: Hercules-ABL
Military number: X254
Nozzle config. & area ratio: Cone, 25:1
Propellant: Double-base
Length: 115 in.
Width (maximum): 30 in.
Weight (maximum): 2300 lbs.
Weight unloaded: 180 lbs.
Ignition: Squib
Average thrust (web, vacuum): 14,500 lbs.
Burning time (web): 37 sec.
Total impulse: 534,000 lb.-sec.
Specific impulse (vacuum): 256 sec.
Case material: Fiber glass and resin
Status: Developed specially for use as Scout third stage; development complete.

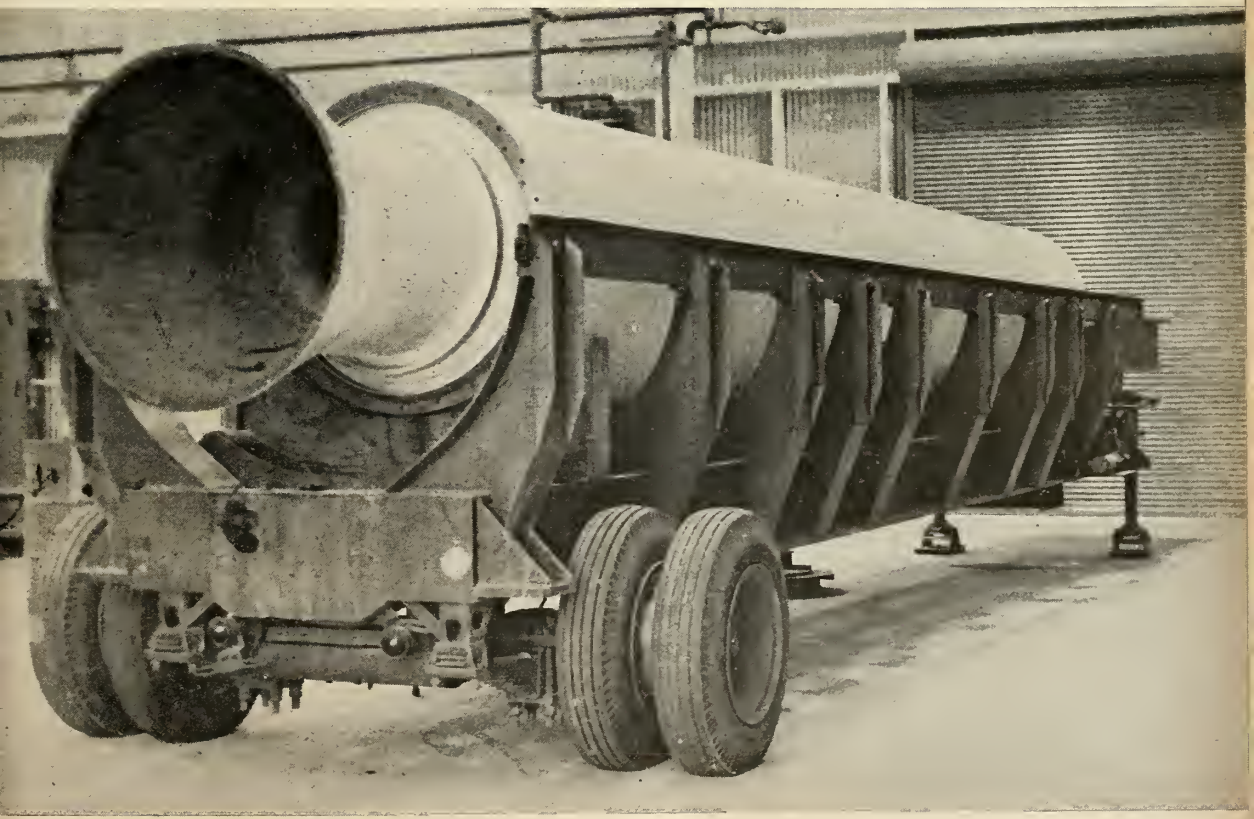
NIKE (Army)

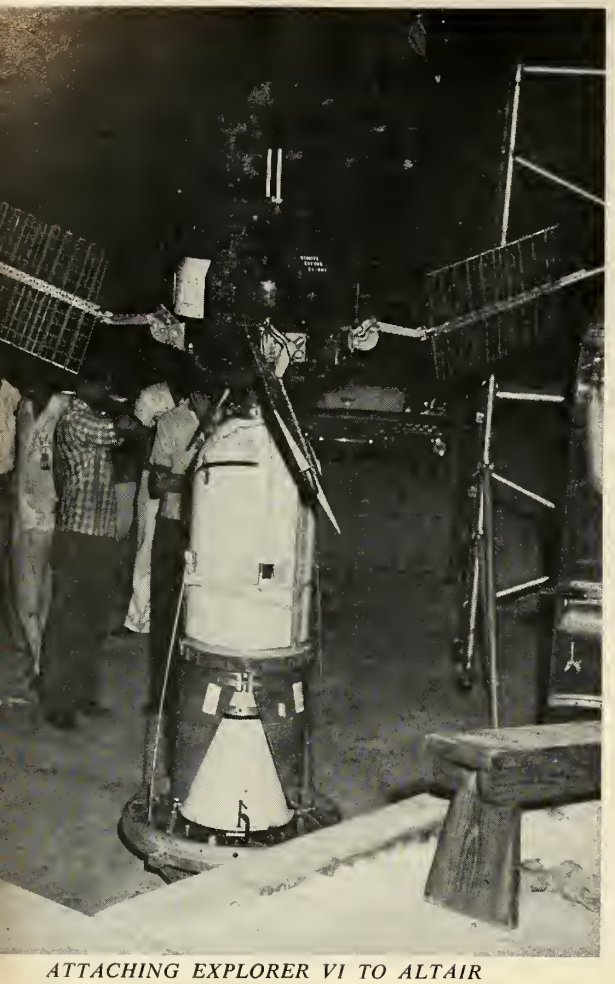
Manufacturer: Hercules-ABL
Propellant: Double-base
Length: 150 in.
Diameter: 16 in.
Total weight: 1170 lbs.
Ignition: Squib
Average thrust: 50,000 lbs.
Case material: Steel
Status: Developed originally for the Nike-Ajax, this rocket is used in a cluster of four to boost Nike-Hercules. It is also widely used in sounding rockets and for sled propulsion.

LANCE MOTOR

Manufacturer: Grand Central
Manufacturer's number: GCR-S-394A
Propellant: Polysulfide composite
Nozzle config.: Straight
Nozzle material: Steel, graphite
Length: 185 in.
Diameter: 15.1 in.
Total weight: 1682 lbs.
Weight unloaded: 490 lbs.
Ignition: Pyrotechnic
Total impulse (sea level, (70°F): 258,000 lb.-sec.
Average thrust (web, sea level): 38,800 lbs.
Burning time: Web—6.65 sec.; total—8 sec.
Case material: Steel, 150,000 psi min. yield
Grain design: 5 pt. star burning
Status: In production.

AEROJET'S ALGOL





ATTACHING EXPLORER VI TO ALTAIR

ROCKETDYNE'S MEGABOOM

ALTAIR MOTOR (Navy and NASA)

Manufacturer: Hercules-ABL
Military number: X248
Propellant: Double-base
Nozzle config. & exp. ratio: Cone, 25:1
Nozzle material: Plastic
Length: 58 in.
Width (maximum): 18 in.
Weight (maximum): 514 lbs.
Weight unloaded: 52 lbs.
Ignition: Squib
Average thrust (web, vacuum): 3060 lbs.
Burning time (web): 38 sec.
Total impulse (vacuum): 116,500 lb.-sec.
Specific impulse (vacuum): 256 sec.
Case material: Fiber glass and resin
Status: Operational

METEOR MOTOR (NASA)

Manufacturer: Grand Central
Manufacturer's number: GCR-350
Propellant: Polysulfide composite
Nozzle config.: Straight DeLaval
Nozzle material: Steel, graphite
Length: 57.4 in.
Diameter: 18 in.
Total weight: 431 lbs.
Weight unloaded: 49.5 lbs.
Ignition: Gas generator
Total impulse (vacuum, 60°F): 90,800 lb.-sec.
Average thrust (web, vacuum): 2776 lbs.
Burning time: Web—28 sec.; total—37 sec.
Case material: Stainless steel, 135,000 psi min. yield
Grain design: 5 pt. star burning
Status: Used in early versions of Vanguard

RECRUIT MOTOR (NASA)

Manufacturer: Thiokol
Propellant: Polysulfide composite
Nozzle material: Steel
Length: 107 in.
Diameter: 9¼ in.
Total weight: 350 lbs.
Ignition: Squib
Burning time: 1.5 sec.
Average thrust: About 35,000 lbs.
Case material: Steel
Status: Operational; developed for use in X-17 research vehicle, Recruit has been used widely in sounding and test vehicles.

ASP MOTOR

Manufacturer: Cooper Development
Manufacturer's number: RM 1100
Propellant: Polysulfide composite
Nozzle config. & exp. ratio: Cone, 6.41:1
Nozzle material: Steel, graphite
Length: 106.9 in.
Diameter: 6.5 in.
Total weight: 192 lbs.
Weight unloaded: 42 lbs.
Ignition: Jellyroll
Average thrust (sea level, 80°F): 5982 lbs.
Burning time: Web—4.4 sec.; total—5.9 sec.
Total impulse (sea level): 31,706 lb.-sec.
Specific impulse: 215 sec.
Case material: Steel, proof to 1900 psia
Grain design: Tapered internal cylinder
Status: Operational

CAJUN (NASA)

Manufacturer: Thiokol
Propellant: Polysulfide composite
Nozzle configuration: Varies with mission
Nozzle material: Aluminum, graphite
Length: Mod I—108 in.; Mod II—107 in.; Mod III—104 in.
Width: 6¾ in.
Weight (maximum): Mod I—172 lbs.; Mod. II—171 lbs.; Mod III—166 lbs.
Ignition: Squib
Average thrust: 8100 lbs.
Burning time: 2.8 sec.
Case material: Aluminum
Grain design: Internal star
Status: Operational. Mod I used for high-altitude research, beginning with the International Geophysical Year; Mod II for rocket sled propulsion; Mod III in target missile systems.

SALUKI (British)

Manufacturer: Imperial Chemical
Length: Body—126.9 in.; overall—150.9 in.
Diameter: 24 in.
Case material: Steel
Status: Under development for the Ministry of Aviation, Saluki is apparently the largest British solid motor. Other details are unavailable.

RAVEN MOTOR (British)

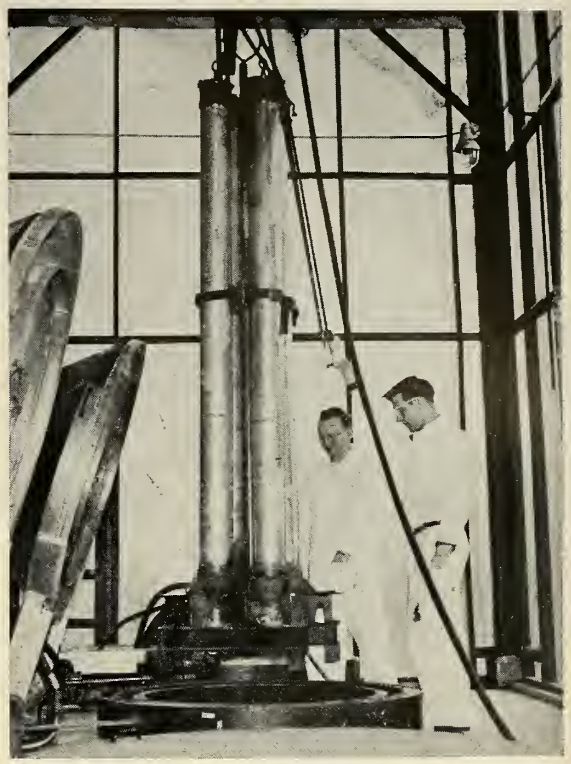
Manufacturer: Wescott R. P. E.
Propellant: Case-bondable composite
Length: 184 in.
Diameter: 17.4 in.
Total weight: 2200 lbs.
Weight unloaded: 400 lbs.
Average thrust: 12,000 lbs.
Burning time: 30 sec.
Specific impulse: 177 sec.
Case material: Steel
Status: Operational in Skylark sounding rocket.

BULLDOG MOTOR (British)

Manufacturer: Imperial Chemical
Nozzle material: Steel
Length: High-thrust model—127.6 in.; Low-thrust model—125.9 in.
Diameter: 17.5 in.
Ignition: Electrical
Average thrust: High model—46,700 lbs.; Low model—25,500 lbs.
Burning time: High thrust—2.5 sec. Low thrust—6.9 sec.
Case material: Steel
Status: R&D for the Ministry of Aviation

CUCKOO MOTOR (British)

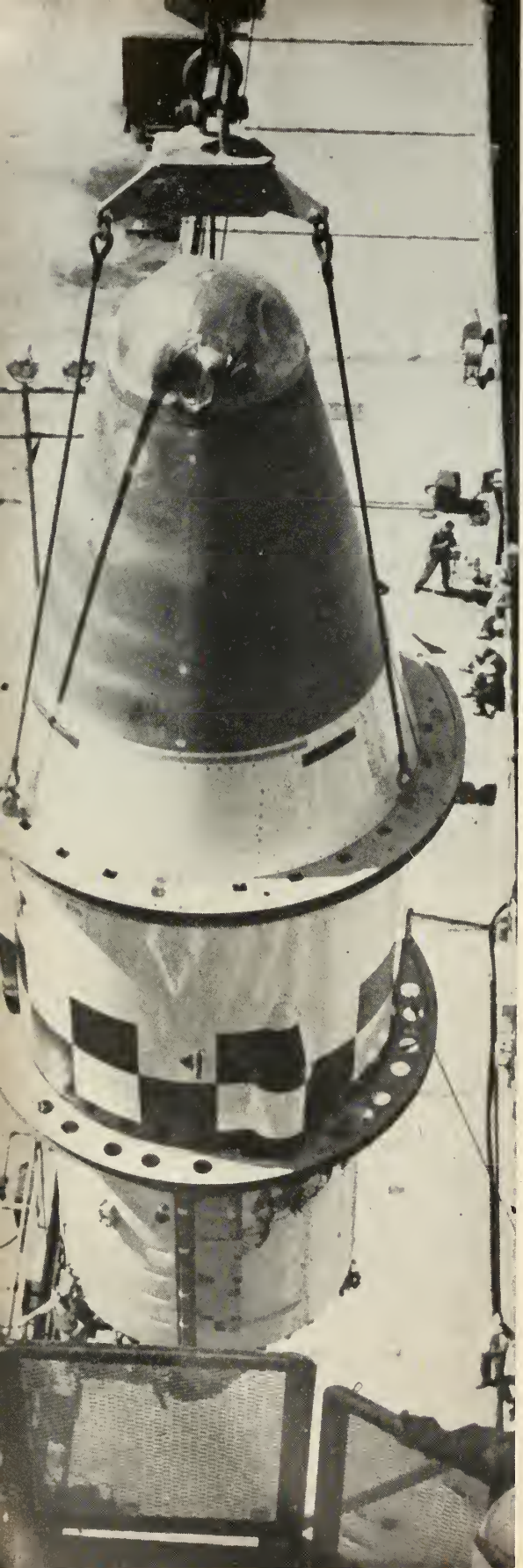
Manufacturer: Westcott R. P. E.
Propellant: Case-bondable composite
Burning time: About 4 sec.
Total impulse: 81,000 lb.-sec.
Status: Becoming operational as booster for Raven in Skylark sounding rocket.



THIOKOL APACHE MOTORS ABOVE CURING PIT

SOME OTHER SOLID MOTORS

Name	Manufacturer	Propellant	Total Wt. (lbs.)	Average Thrust (lbs.)	Burning Time (sec.)	Application
MEGABOOM	Rocketdyne	Butyl rubber	9460	100,000	10	Sled
APACHE	Thiokol	Polysulfide	223	N.A.	N.A.	Sounding (lifts 35 lbs. to 40 miles)
RECRUIT	Thiokol	Polysulfide		35,000	1.5	Sounding
JAVELIN	Grand Cent.	Polysulfide	351.1	18,000	3.2	Sled, missile
SABER	Grand Cent.	Nitrile	213	10,000	3.3	Sled, drone, sounding
ARCON	Atlantic Res.	Polyvin. Chlor.	213.1	945	33.0	Sounding
VIPER	Grand Cent.	Polysulfide	190.4	5070-7700	4.25-6	Sled, sounding
SWORD	Grand Cent.	Polysulfide	95.1	3020	4.75	TITAN separation
ARCAS	Atlantic Res.	Polyvin. Chlor.	64.5	350	28.4	Sounding
DART	Grand Cent.	Butyl rubber	42.0	100	44	Dual-range thrust; Start 640 lbs. 1.8 sec.
SKYDART	Grand Cent.	Butyl rubber	46.0	116	37	Dual-range thrust; Start 620 lbs. 1.9 sec.
ARROW	Grand Cent.	Polysulfide	17.8-24.4	1790-2400	1.1-2.1	Sled, drone, sounding
MARC 8	Atlantic Res.	Polyvin. Chlor.	17.4-17.7	860	1.48	THOR retro, MERCURY escape
TE-316	Thiokol	Polysulfide	N.A.	1000	N.A.	MERCURY orbital brake
MARC 7	Atlantic Res.	Polyvin. Chlor.	4.8-5	410	1.1	ATLAS retro, MERCURY separation, EXPLORER VI orbital control
MARC 6	Atlantic Res.	Polyvin. Chlor.	3.35-3.55	214	1.0	THOR-ABLE vernier, satellite orbital control
MARC 5	Atlantic Res.	Polyvin. Chlor.	1.3-1.37	121	0.51	Spin stabilization, de-spin ATLAS-ABLE, EXPLORER, DISCOVERER
MARC 4	Atlantic Res.	Polyvin. Chlor.	.62-.64	46	1.05	Retro, spin VANGUARD, PIONEER, SCOUT, DELTA, DISCOVERER
FANG	Grand Cent.	Polysulfide	1.0	37	1.3	Nose cone spin, component stabilizer
MARC 3	Atlantic Res.	Polyvin. Chlor.	.085	5	0.3	TIROS spin stabilization



Space Vehicles

America's two major bids for a large role in space exploration are NASA's huge Saturn booster and the Air Force's Dyna-Soar space bomber.

But Saturn's first operational flight is still several years away at best; Dyna-Soar on its present schedule several times that.

Meantime, Russia and the United States continue to race to put the first man in orbit with the odds of success still heavily in favor of Russia.

In the field of military space satellites, the United States appears to be doing better. But some congressmen have charged that these programs, too, are not being pushed to the limit.

Lack of financial support continues to be the problem.

SATELLITES/SPACECRAFT

MIDAS (Air Force)

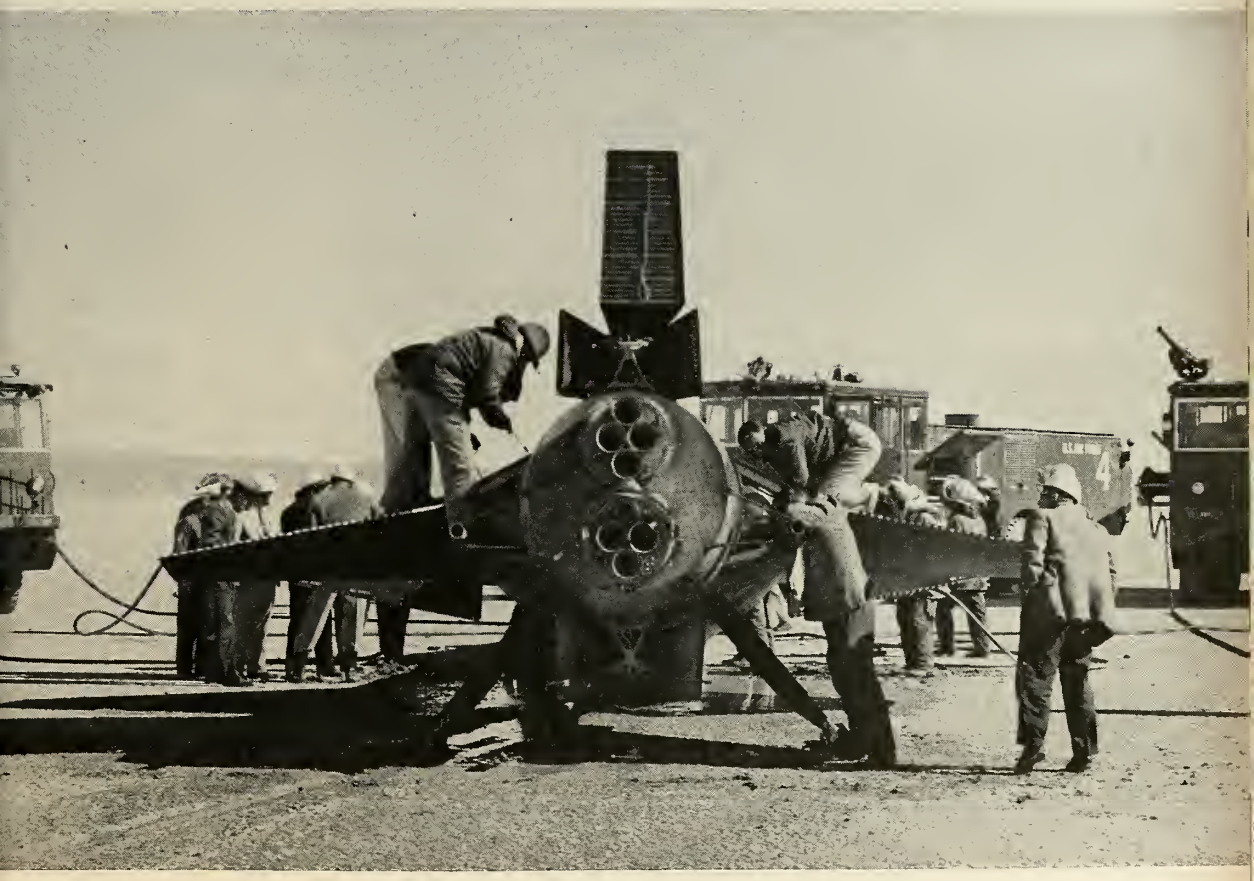
Type: Early-warning satellite
Status: R&D
Prime contractor: Lockheed Aircraft Co.
Performance: Orbit—about 300 n. miles; polar.
Deployment: Initially operational—about 1963. Number satellites—more than a half-dozen.
Frame: System contractor—Lockheed. Height—22 ft. Diameter—S ft. Weight—about 5000 lbs. (operational weight about 3000 lbs.)
Instrumentation: Type—IR scanner designed to detect exhaust flames of a long-range ballistic missile seconds after it is launched; data link telemetry; tape-fed programer
Booster: System contractor: Convair. Type—Atlas ICBM. Propellant—liquid.
Sustainer: System contractor—Lockheed. Type—Agena. Propellant—liquid.
Remarks: Midas II successfully launched May 24, 1960, into 300/319 mile orbit, but an equipment failure made testing of the IR scanner impossible. The launching of Midas I failed because of a breakdown in the second stage. Estimated life of Midas II—40 months.

DYNA-SOAR (Air Force)

Type: Boost-glide space bomber
Status: R&D
Prime contractor: Boeing Airplane Co.
Performance: Range — global. Speed—ultimately orbital.
Deployment: Initially operational—late 1960's.
Frame: System contractor—Boeing. Configuration—glider.
Booster: System contractor—Martin. Type—modified Titan ICBM. Propellant—liquid.
Remarks: The program is divided into phases beginning with the dropping and launching of unmanned gliders. The first manned gliders will be boosted down the Atlantic Missile Range.

LEFT: MIDAS

and Satellites



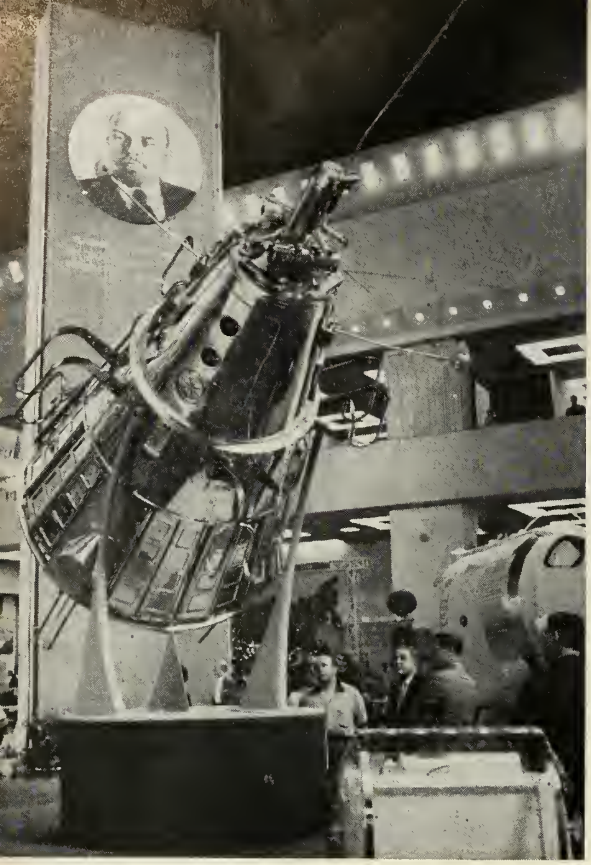
X-15

X-15 (Air Force-Navy-NASA)

Type: Manned R&D rocket plane
Status: R&D
Prime contractor: North American Aviation, Inc.
Performance: Range—400 n. miles. Speed—3600 mph. Ceiling—50-100 miles.
Frame: System contractor—North American. Length—50 ft. Launch weight—31,275 lbs. Landing weight—12,971 lbs. Capacity—18,304 lbs. Wingspan—22 ft.
Booster: System contractor—Thiokol. Propellant—LOX and liquid ammonia. Thrust—50,000 lbs. Type—XLR99.
Power units: System contractor—General Electric.
Remarks: The X-15 program is aimed at exploration of the atmosphere at the fringes of space.

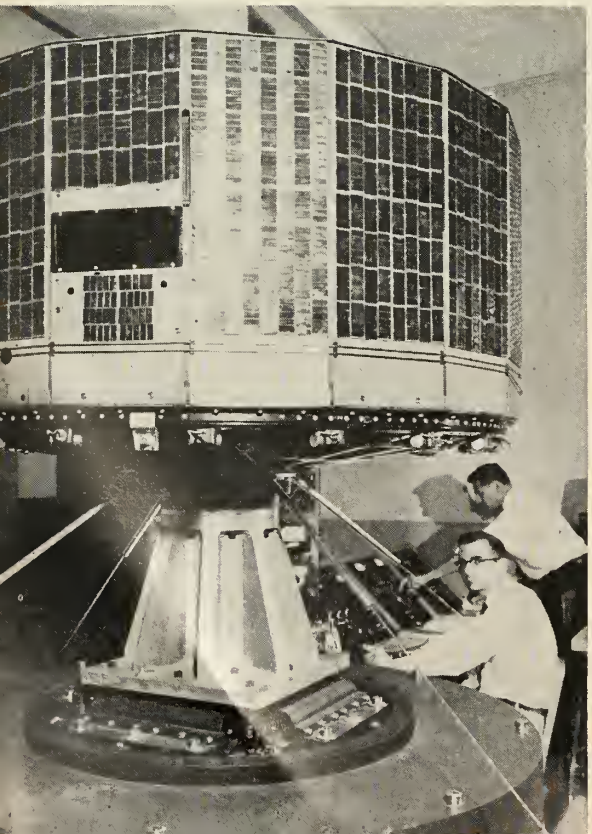
SAMOS (Air Force)

Type: Reconnaissance satellite
Status: R&D
Prime contractor: Lockheed Aircraft Co.
Performance: Orbit — Polar, several hundred miles.
Deployment: Initially operational—late 1963. Number of satellites—less than 6.
Instrumentation: System contractor—Lockheed.
Booster: System contractor—Convair. Type—Atlas. Propellant—liquid.
Sustainer: System contractor—Lockheed. Type—Agena. Propellant—liquid.
Remarks: Samos will provide a continuous reconnaissance of the world.



SPUTNIK III REPLICA

TIROS CHECKOUT



SPUTNIKS I to III (Russia)

Type: Data-collecting experimental satellites.
Status: No longer in orbit.
Performance: Orbits—(SI) 142/588; life 10/4/57 to 1/4/58. (SII) 140/1038; life 11/3/57 to 4/14/58. (SIII) 135/1167; life 5/15/58 to 3/15/60.
Frame: Diameter—(SI) 22.8 in. (SII) undisclosed. (SIII) 11 ft. 9 in. long, 5 ft. 8 in. wide at base. Launch weight—(SI) 184 lbs. (SII) 1120 lbs. (SIII) 2925 lbs.
Payload: (SI) transmitters, measuring instrumentation. (SII) transmitters, measuring instrumentation, dog "Laika." (SIII) transmitters, measuring instrumentation.
Boosters: In all three cases the Soviets used large military rockets. Thrust—about 600,000 lbs.
Power units: (SI) chemical batteries. (SII) chemical batteries. (SIII) chemical batteries and solar cells.

COURIER (Army-ARPA)

Type: Delayed-repeater communications satellite
Status: Operational 1960
Prime contractor: Army Signal Research and Development Laboratories.
Performance: Orbit—about 650 n. miles. Operational life—about 1 year.
Frame: System contractor—Philco Corp. Diameter—about 50 in. Launch weight—about 475 lbs.
Instrumentation: System contractor — Philco. Type — microwave receivers, VHF transmitters.
Booster: System contractor—Douglas. Type—Thor.
Sustainer: System contractor—Aerojet. Type—Able-Star.
Power units: Type—solar cells (about 20,000); nickel-cadmium batteries.
Remarks: Courier will be the nation's first active satellite communications system. Follow-on systems under development by ARPA and the Army and Air Force are generally lumped under the project name—Advent. These include polar-orbiting and 24-hour instantaneous repeater satellites.

TIROS (NASA)

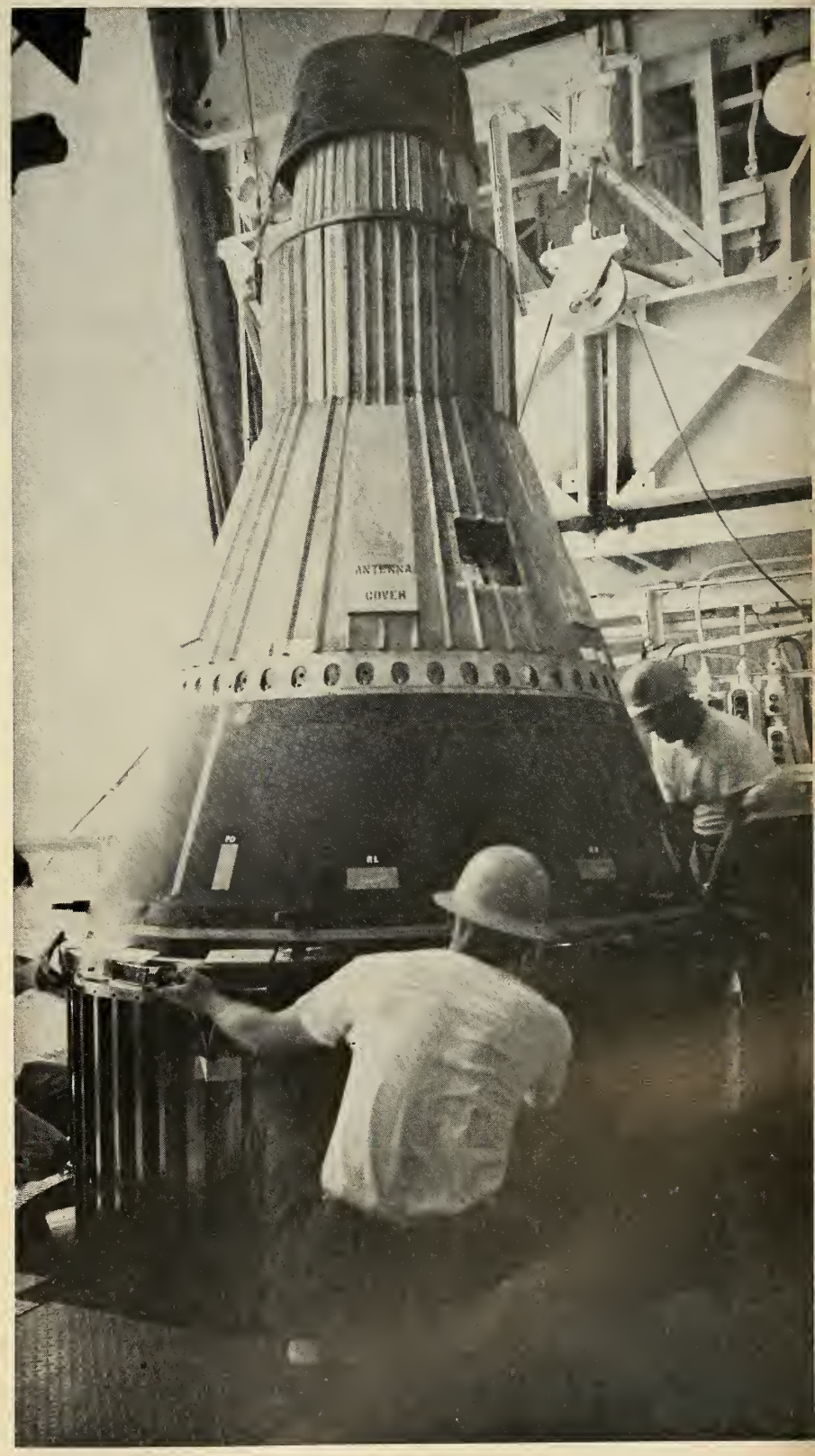
Type: Weather observation satellite
Status: R&D
Prime contractor: RCA
Performance: Photographs cloud cover and transmits on ground command.
Frame: System contractor—RCA. Diameter — 42 in. Height—19 in. Weight—270 lbs.
Instrumentation: System contractor—RCA. Types—Narrow and wide-angle camera, magnetic drag measurement.
Power units: System contractor—Hoffman Electronics. Type—solar cells.
Remarks: Tiros I transmitted 22,952 pictures during 78-day life. A second shot is planned for the fourth quarter of 1960. An advanced Nimbus weather satellite is scheduled for the fourth quarter of 1961.

MERCURY (NASA)

Type: Manned earth-orbiting capsule
Status: R&D
Prime contractor: McDonnell Aircraft Co.
Performance: Orbit—about 120 miles. Initially operational—1961.
Frame: System contractor—McDonnell. Length—9.5 ft. Diameter—6.5 ft. Weight—about 2000 lbs.
Instrumentation: System contractor—McDonnell. Types and functions — physio-psychological; attitude; navigation.
Boosters: System contractors—Convair/Redstone. Type — Atlas and Redstone. Propellant—liquid.
Power Units: System contractor —McDonnell. Type—battery. Life—mission plus 12 hours. Output—(6) 1500 watt/hour batteries.
Remarks: Initial flights call for boosting first unmanned, then manned capsules down the Atlantic Missile Range.

ECHO (NASA)

Type: Inflated balloon passive communications satellite
Status: R&D
Prime contractor: NASA
Performance: Reflect radio signals off surface of 100-ft. sphere.
Frame: Plastic film—G. T. Schjeldahl Co. Gas container—Kaiser Fleetwings Inc.
Instrumentation: None. Telemetry beacon in third stage rocket.
Power units: Mercury batteries.
Boosters: Thor-Delta.
Remarks: First attempt to launch sphere in 1000-mile circular orbit failed May 13.



MERCURY INSPECTION

VANGUARD

VANGUARD (NASA)

Type: Data-collecting experimental satellite

Status: Phased out

Prime contractor: NRL

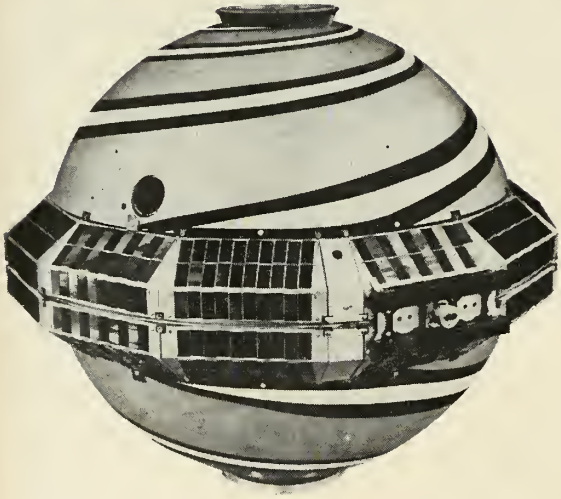
Performance: Report on space environment

Frame: System contractor—NRL. Dimensions—Sphere 6 in. or 20 in. diameter.

Instrumentation: NRL. Types—measurement of temperatures, geodetic measurements.

Power units: Mercury batteries and solar converters

Remarks: Vanguard I, still transmitting, has provided important data on the shape of the earth.



TRANSIT

TRANSIT (Navy-ARPA)

Type: Navigation satellite.

Status: R&D

Prime contractor: Applied Physics Laboratory.

Performance: Orbit—about 500 n. miles. (2 polar, 2 equatorial.)

Deployment: Initially operational about 1962. Number of satellites—four.

Frame: System contractor—APL. Configuration—36 in. sphere. Weight—(Transit-1B) 265 lbs.; (Transit IIA) 223 lbs. (Operational weight about 50 lbs.)

Instrumentation: System contractor — APL. Type — two ultra-stable oscillators, IR scanner, electronic clock.

Booster: System contractor—Douglas. Type—Thor. Propellant—liquid.

Sustainer: System contractor—Aerojet. Type—Able-Star. Propellant—liquid.

Power Units: Solar cells and storage batteries.

Remarks: Transit IIA was successfully launched into a 563/460 mile orbit June 22, 1960. It carried a piggy-back satellite—NRL I—into orbit with it and released it, thereby becoming the first two-in-one satellite. Transit will enable surface ships and submarines—particularly Polaris submarines—to fix their position by better than a quarter of a mile.

DISCOVERER

DISCOVERER (Air Force)

Type: Experimental military satellite series

Status: R&D

Prime contractor: Lockheed Aircraft Co.

Performance: Orbit—ellipitical and varied. (polar)

Frame: System contractor—Lockheed. Length—19.2 ft. Diameter—5 ft. Weight—about 1700 lbs.

Re-entry vehicle: System contractor — General Electric. Type—capsule. Length—27 in. Diameter—33 in. Weight—about 300 lbs.

Instrumentation: IR horizon scanner, telemetry, other instrumentation varied.

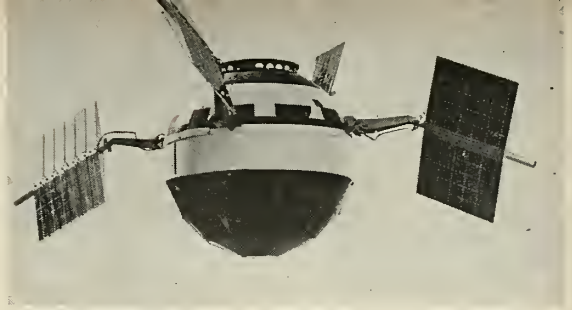
Booster: System contractor—Douglas. Type—Thor. Propellant—liquid.

Sustainer: System contractor—Lockheed. Type—Agena. Propellant—liquid.

Remarks: The Discoverer program beginning early in 1959 has launched a series of R&D satellites into orbit aimed at stabilization of a satellite in space and recovery of a capsule from orbit. While other objectives have been achieved, the Air Force failed to recover a capsule through the first dozen tries. The program calls for eventual recovery of mice and monkeys in the capsule, which would be either air-snatched by planes or picked up by ship. Discoverer is closely tied to the Samos and Midas programs.

PADDLEWHEEL (NASA)

Type: Data-collecting experimental satellite
Status: Operational
Prime contractor: STL
Performance: Report on space environment.
Frame: System contractor—STL. Dimensions variable. Weight —94 to 372 lbs.
Instrumentation: Various scientific groups. Types—Measurement of radiation, magnetism, radio background, aspect; photo scanning.
Power units: System contractor —Hoffman Electronics. Type —solar cells (on paddlewheel vanes).
Remarks: The Explorer VI satellite and the Pioneer V space probe were paddlewheel payloads. Another will be carried on the forthcoming Atlas-Able moon probe.



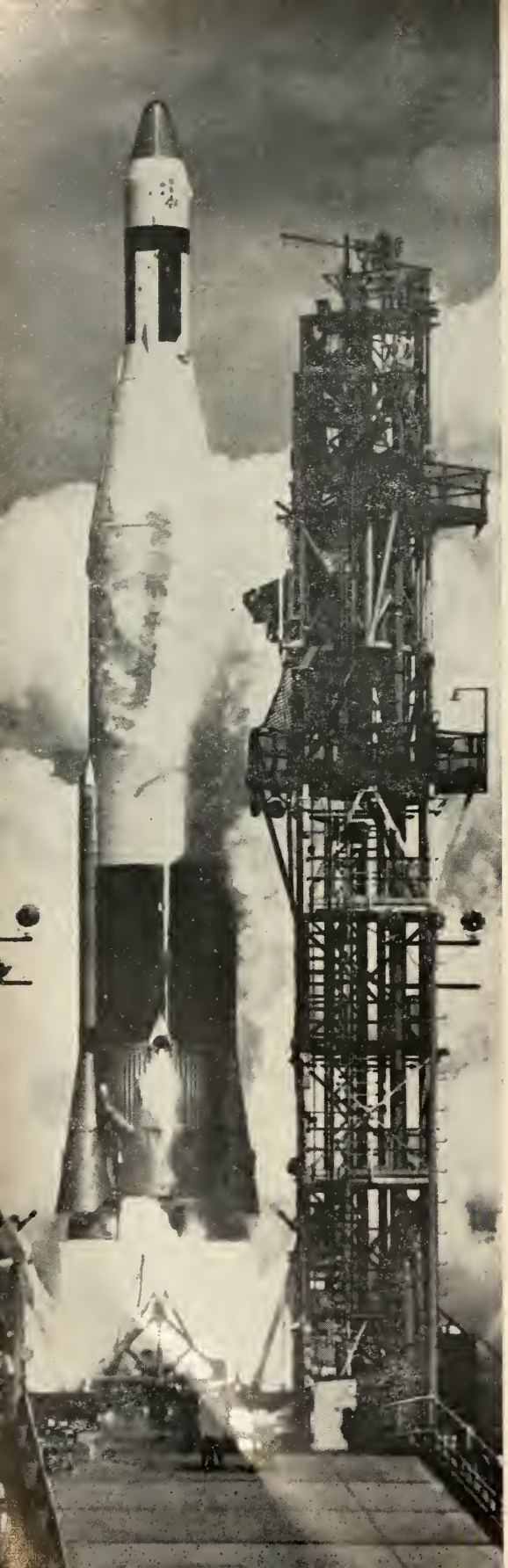
PADDLEWHEEL

DEEP SPACE PROBES

Name and Country	Weight (lbs.)	Launch Vehicle	Launch Date	Trajectory and Purpose	Remarks
LUNIK I (MECHTA), RUSSIA	3245	N.A.	1/ 2/59	Escape earth in direction of moon	Believed in 15 mo. solar orbit; passed within 5000 miles of moon
PIONEER IV, U.S.	13.4	JUNO II	3/ 3/59	Escape earth in direction of moon	In solar orbit of about 12 mo.; passed within 35,000 miles of moon
LUNIK II, RUSSIA	780 (incl. final stage)	N.A.	9/12/59	Lunar impact; radiation and magnetism measurements	Achieved impact
LUNIK III, RUSSIA	About 614	N.A.	10/ 4/59	Earth-moon orbit, apogee 291,000 mi., perigee 30,000 mi., very long lifetime	Took first picture of far side of moon
PIONEER V, U.S.	94.8	THOR-ABLE	3/11/60	Solar orbit between earth and Venus orbits; long-range radio communications; radiation, space environment measurements	Transmitted data more than 20 million miles; 5-watt transmitter weakening but still in operation

SATELLITES IN ORBIT

Name and Country	Weight (lbs.)	Launch Vehicle	Launch Date	Est. Life	Current Apogee & Perigee (mi.)	Purpose	Remarks
EXPLORER I, U.S.	30.8	JUPITER C	1/31/58	3-5 yrs.	1198.5; 216.8	Radiation measurement	Discovered Van Allen belt
VANGUARD I, U.S.	3.25	VANGUARD	3/17/58	200-1000 yrs.	2462.9; 405.7	Test VANGUARD concept	Solar battery-powered radio still operating
VANGUARD II, U.S.	20.7	VANGUARD	2/17/59	50 yrs.	2050.4; 345.8	Test weather-scan concept	
EXPLORER VI, U.S.	142	THOR-ABLE	8/ 7/59	1 yr.	26,357; 156 (at last report)	Radiation, space environment measurements	First "paddlewheel" satellite
VANGUARD III, U.S.	About 100	VANGUARD	9/18/59	30-40 yrs.	2321; 320.8	Radiation, space environment measurements	Ended VANGUARD program
EXPLORER VII, U.S.	91.5	JUNO II	10/13/59	20 yrs.	672.7; 343.7	Radiation, space environment measurements	Still transmitting some data
DISCOVERER V CAPSULE, U.S.	Under 300	THOR-AGENA	8/13/59	Several months	1074; 134	Carry satellite, which came down 9/28	Believed destroyed later discovered & thought Russian
TIROS I, U.S.	270	THOR-ABLE	4/1/60	50-100 yrs.	468.3; 428.9	Picture-taking weather satellite	Transmitted 22,952 cloud-cover photos in 78-day instrument lifetime
TRANSIT IB, U.S.	265	THOR-ABLESTAR	4/13/60	16 mo.	454.6; 229	First R&D Navigational satellite	ABLESTAR achieved first known restart in space
SPUTNIK IV, Russia	10,008	N. A.	5/15/60	Fairly brief	409; 181	Test support systems, cabin for manned flight; attempted return from orbit	Original apogee 229, perigee 188; poor retro orientation spoiled return attempt
MIDAS II, U.S.	5000	ATLAS-AGENA A	5/24/60	40 mo.	319.6; 300.1	IR scanning for early warning of missile launchings	Telemetry failed 5/26; AGENA B restarted in space
TRANSIT II-A, U.S.	223	THOR-ABLESTAR	6/22/60	50 yrs.	650.4; 389.1	Second R&D navigational satellite	Carried "piggyback" for first twin satellite launching
GREB, U.S.	40	THOR-ABLESTAR	6/22/60	50 yrs.	650.4; 389.1	Radiation measurements	Passenger aboard TRANSIT II-A



SPACE VEHICLES

ATLAS-AGENA (Air Force and NASA)

Type: Launch vehicle

Status: Operational with Agena A. R&D with Agena B.

Prime contractor: None

Performance: (Payload in 300-mile orbit): Agena A—3600. Agena B 5300. Agena B will accelerate 800 lbs. to escape velocity.

Frame: Manufacturers—Convair, Lockheed. Length overall—99-101 ft. Diameter—10 ft. Gross weight—Agena A 265,000 lbs., Agena B 275,000 lbs. Major material—steel.

Propulsion: All liquid.

Guidance: (Only Agena B) Minneapolis-Honeywell. Type: All-inertial.

Stages: 1. Modified Atlas ICBM. 2. Agena. Engine—Bell XLR-81.

Remarks: Atlas-Agena A first flown successfully May 24, 1960, to launch Midas II. Atlas-Agena B to begin service in 1961.

ATLAS-ABLE (NASA)

Type: Early deep space launch vehicle.

Status: Two shots this year, then phase-out.

Prime contractor: None.

Performance: Escape velocity—800 lbs.

Frame: Length—112 ft. Diameter—10 ft. Gross weight—255,000 lbs.

Propulsion: 2 liquid stages, 1 solid.

Guidance: Only in booster stage.

Stages: 1. Modified Atlas ICBM. 2. Able. 3. Hercules-ABL Altair.

Remarks: First two shots failed in 1959. Shortage of Atlas vehicles delayed backup shot until this summer or fall.

SCOUT (NASA)

Type: Launch vehicle for small satellites.

Status: R&D.

Prime contractor: NASA Langley Research Center.

Performance: 300-mile orbit—about 200 lbs.

Frame: Manufacturer—Chance Vought. Length overall—72 ft. Diameter—40 in. Gross weight—36,100 lbs. Major materials—steel and plastic.

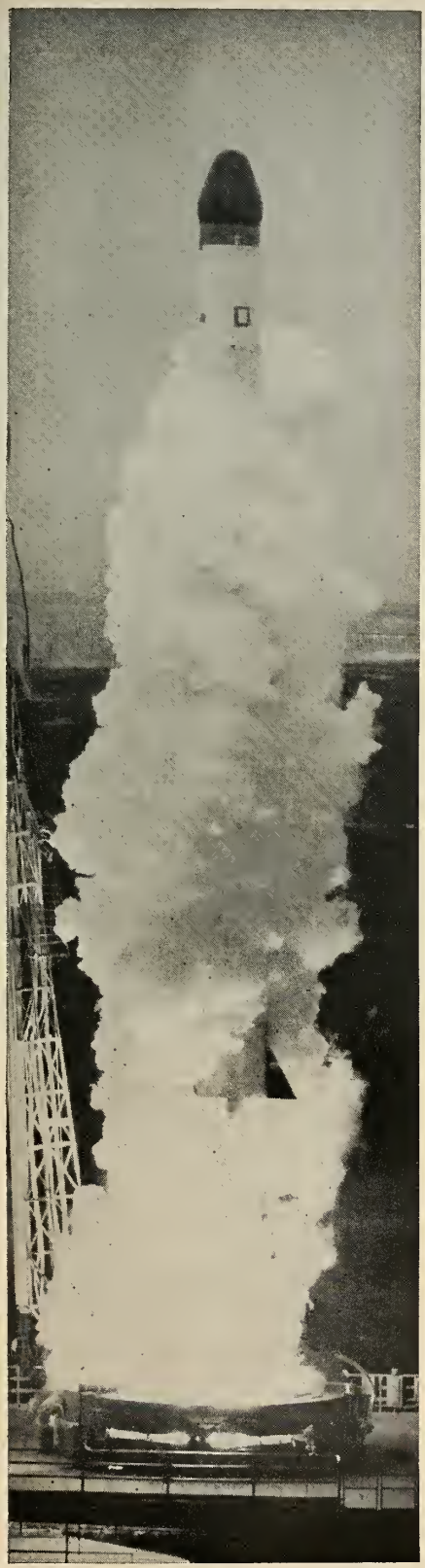
Propulsion: All solid.

Stages: 1. Aerojet Algol. 2. Thiokol Castor. 3. Hercules-ABL Antares. 4. Hercules-ABL Altair.

Guidance: Minneapolis-Honeywell. Type—semi-inertial.

Remarks: Flight tests of full vehicle began this month; to be operational this year. After next year will replace all liquid-propelled vehicles for orbiting small payloads. Air Force has similar vehicle called Hyper-Environmental Test System 609A.

LEFT: ATLAS-AGENA



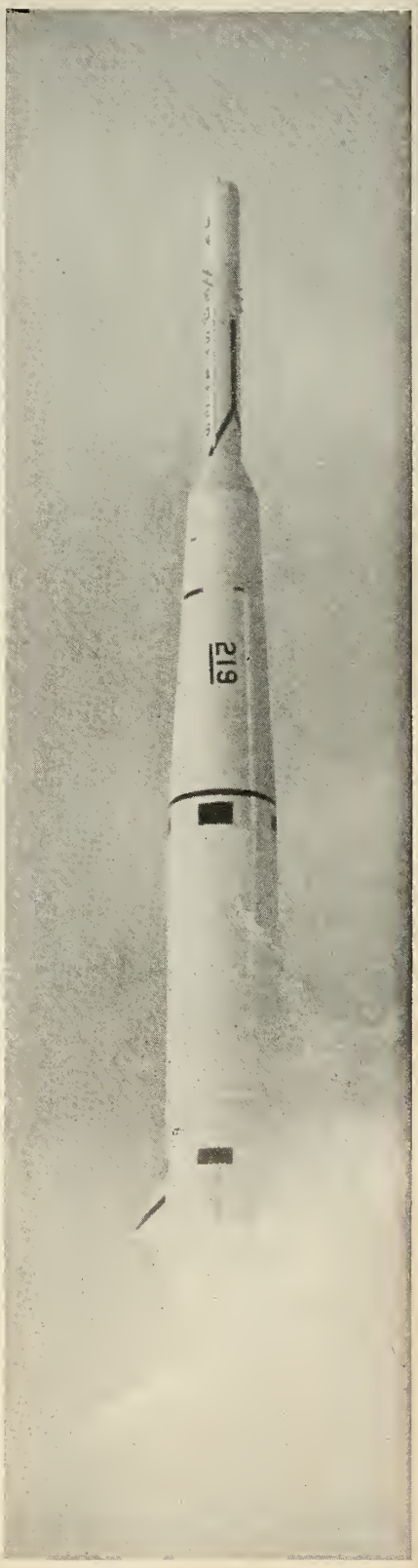
THOR-ABLESTAR

THOR-ABLE, THOR-ABLESTAR, THOR-DELTA (Air Force, NASA)

Type: Launch vehicle
Status: Thor-Able now phased out. Thor-Ablestar operational. Thor-Delta becoming operational.
Prime contractor: Douglas, except Aerojet-General for Ablestar vehicle stage.
Performance (payload in 300-mile orbit: Able—200 lbs. Ablestar—800 lbs. Delta—480 lbs.
Frame: Length overall—Able & Delta 92 ft., Ablestar 90 ft. Diameter—8 ft. Gross weight—Able 105,000 lbs., Ablestar 110,000 lbs. Delta 112,000 lbs. Major material—aluminum.
Propulsion: Able & Delta 2 liquid stages and one solid. Ablestar 2 liquid.
Guidance: (only Delta) Bell Telephone. Type: radio command.
Stages: 1. Modified Thor IRBM. 2. Able, Ablestar or Delta. 3. (Able and Delta only) Hercules-ABL Altair.
Remarks: The original Thor-Able, which made use of upper stages developed for Vanguard, was used successfully in some of this country's earliest launches. Thor-Ablestar, with a restartable, scaled-up Able, is used in the Navy's Transit program and will be used for the Army's Courier satellites. Delta, which coasts for 15 minutes before ignition of the guided third stage, is used for the Echo 100-ft. balloon satellite and a variety of other NASA programs.

CENTAUR (NASA)

Type: Multipurpose launch vehicle.
Status: R&D.
Prime contractor: Convair.
Performance: 300-mile orbit—8500 lbs. Escape velocity—1450 lbs.
Frame: Length overall—105 ft. Diameter—10 ft. Gross weight—291,000 lbs. Major material—steel, aluminum.
Stages: 1. Modified Atlas ICBM. 2. Centaur. Manufacturer—Convair; engines—Pratt & Whitney LR-115 (2).
Guidance: Minneapolis-Honeywell. Type—all-inertial.
Remarks: First flight 1961. Will provide for the first time U.S. lift capacity equal to Sputnik I and will be most powerful U.S. vehicle until Saturn is available.



THOR-ABLE IV

SATURN SPACE VEHICLE'S SUPER BOOSTER

SATURN C-1 (NASA)

Type: Multipurpose launch vehicle for very heavy payloads.

Status: R&D.

Prime contractor: NASA Marshall Center.

Performance: 300-mile orbit—22-25,000 lbs. Escape velocity —9000 lbs.

Frame: Length overall (without payload)—150 ft. Diameter—22 ft. Gross weight—1,000,000 lbs. Major material—aluminum.

Propulsion: All liquid.

Guidance: NASA Marshall center. Type—all-inertial.

Stages: 1. Saturn booster. Manufacturer—NASA Marshall Center; engines—Rocketdyne H-1 (8).

2. S-4. Manufacturer-Douglas; engines—Pratt & Whitney LR-115 (4)

3. S-5. Manufacturer-Convair; engines—Pratt & Whitney LR-115 (2)

Remarks: First flight 1961 with dummy upper stages. First three-stage vehicle flight 1963. Operational 1964. Next vehicle, Saturn C-2, will have stage made of 4 Rocketdyne J-2 engines inserted between first and second stages of C-1. A third Saturn may be an all-chemical vehicle with another J-2 stage inserted just above the J-2 stage in the C-2, or it may be a chemical-nuclear vehicle.

The Saturn program, begun under ARPA and the Army and transferred to NASA this year, is the civilian space agency's "main chance" space vehicle in the international space race. The Saturn vehicle in its later forms will be capable of sending a manned spacecraft around the moon. It also will be capable of putting into orbit around the earth multi-ton segments of a space station for assembly there.

THOR-AGENA (Air Force and NASA)

Type: Launch vehicle
Status: Operational with Agena A. R&D with Agena B.
Prime contractor: None
Performance: Agena A—300 lbs. in 300-mile orbit. Agena B—1600 lbs. in 300-mile orbit.
Frame: Manufacturers—Douglas, Lockheed. Length overall—Agena A 78.6 ft., Agena B 81 ft. Diameter—8 ft. Gross weight—Agena A 118,500 lbs., Agena B about 123,000 lbs. Major material—aluminum
Propulsion: All liquid.
Guidance: (Only Agena B) Minneapolis-Honeywell. Type: All-inertial.
Stages: 1. Modified Thor IRBM. 2. Agena. Engine—Bell XLR-81.
Remarks: Thor-Agena A in use in Discoverer program. Thor-Agena B, with restartable upper stage, will be used by both Air Force and NASA beginning in 1961.

JUNO II (NASA)

Type: Early launch vehicle.
Status: Operational.
Prime contractor: NASA Marshall Center.
Performance: 300-mile orbit—100 lbs. Escape velocity—13½ lbs.
Frame: Length overall—77 ft. Diameter—8¾ ft. Gross weight—122,000 lbs. Major material—aluminum.
Propulsion: 1 stage liquid, 3 solid.
Guidance: Upper stage unguided except spin.
Stages: 1. Modified Jupiter IRBM. 2. Cluster of 11 scaled-down Sergeants. 3. Cluster of 3 scaled-down Sergeants. 4. Scaled-down Sergeant.
Remarks: Launched 3 Pioneers and one Explorer. Four more shots planned this year and next.

JUPITER C (Army)

Type: Launch vehicle.
Status: Phased out.
Prime contractor: ABMA.
Performance: 300-mile orbit—30 lbs.
Propulsion: 1 liquid, 3 solid.
Guidance:: Upper stages unguided except spin.
Stages: 1. Modified Redstone missile. 2. Cluster of 11 scaled-down Sergeants. 3. Cluster of 3 scaled-down Sergeants. 4. Scaled-down Sergeant.
Remarks: Orbited Explorer 1, America's first satellite.

VANGUARD (NASA)

Type: Early launch vehicle.
Status: Phased out.
Performance: Up to 100 lbs. in 300-mile orbit.
Prime contractor: Martin.
Frame: Length—72 ft. Diameter—45 in. Gross weight—22,600 lbs.
Propulsion: 2 liquid stages, 1 solid.
Guidance: Minneapolis-Honeywell. Type—Semi-inertial.
Stages: 1. General Electric X405. 2. Aerojet-General Liquid AJ 10. 3. Hercules-ABL solid X248 (earlier versions used Grand Central Meteor).
Remarks: Orbited three satellites. Components and techniques used in many subsequent space programs.

DISCOVERER ON THOR AGENA

Foreign Missiles

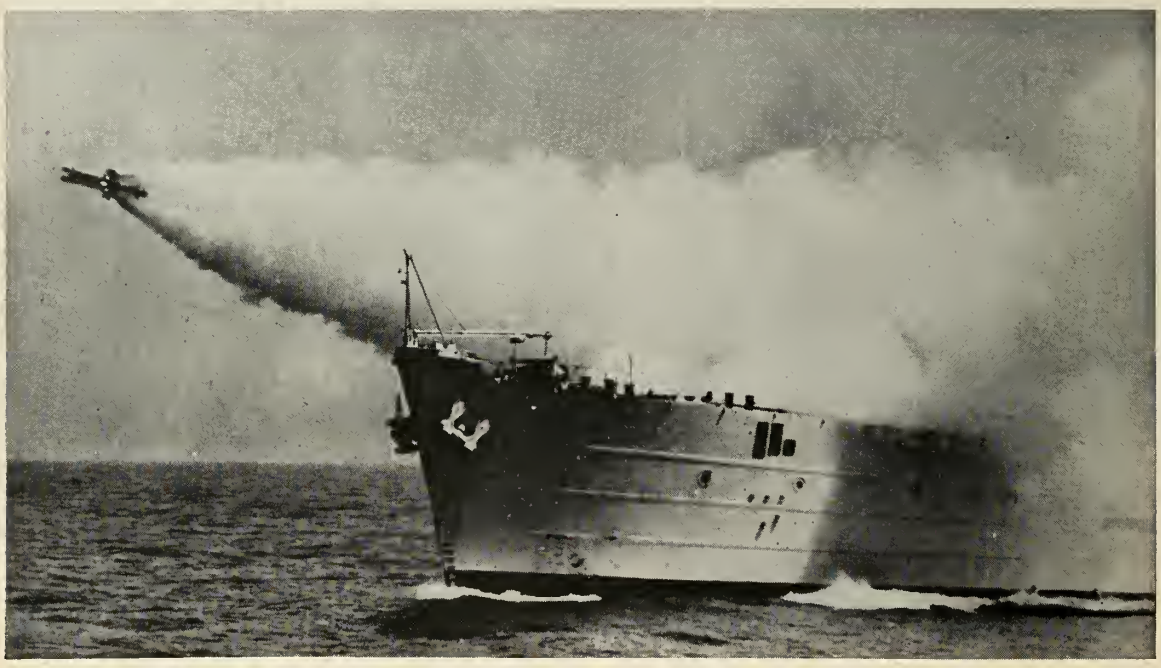
Russia and the United States continue to dominate the world of missilery.

Russia's already large rockets appear to be getting larger as the Soviets push further into space. Meantime, the Soviets are reported to be improving their missile air defenses and rapidly increasing their ICBM strength and their already huge arsenal of tactical missiles.

The other nations of the world continue to lag behind in the field of big missiles. But much work is going on in almost every industrialized country in development of smaller tactical missiles and research rockets.

Next to Russia and the United States, Britain and France are farthest along. Japan also is beginning to move ahead swiftly.

Red China remains a question mark. The Red Chinese are reported to have some missiles and to be developing a nuclear bomb. But the missiles, at least for the present, apparently are of Russian origin.



SEASLUG

GREAT BRITAIN

SEASLUG (Navy)

Type: Surface-to-air
Status: Operational
Prime contractor: W. G. Armstrong Whitworth Aircraft, Ltd.
Performance: Range—long.
Deployment: Location—to be deployed aboard Navy cruisers. Initially operational—1960.
Frame: Length—19.5 ft. Diameter—1.5 ft. Wingspan—4.5 ft.
Guidance: System contractor—General Electric. Type—beam riding.
Booster: Type—solid (4).
Sustainer: Type—solid.
Payload: Warhead type—HE (nuclear later).

FIREFLASH (RAF)

Type: Air-to-air
Status: Operational (training)
Prime contractor: Fairey Aviation Ltd.
Performance: Range — several miles. Speed — more than Mach 2.
Deployment: Location — RAF squadrons use for training.
Frame: Length—7 ft. 5 in. Wing span—28.1 in. Diameter—5.5 in. Launch weight—300 lbs.
Guidance: Type—beam riding.
Booster: Type—solid. Number—two.
Payload: Type—HE.
Remarks: Fireflash has been replaced as an operational missile by the Firestreak.

BLUE STEEL (RAF)

Type: Air-to-surface (tactical)
Status: R&D
Prime contractor: A. V. Roe & Co., Ltd.
Performance: Range—about 400 miles. Speed—supersonic. Ceiling—about 60,000 ft.
Deployment: Location—to be air-launched from British V-bombers.
Frame: Length—36 ft. Wingspan—about 13 ft. Launch weight—about 15,000 lbs.
Guidance: System contractor—Elliott. Type-inertial.
Powerplant: Propellant—liquid
Booster: System contractor—de Havilland. Propellant—liquid. Thrust—16,000 lbs.
Payload: Warhead type—nuclear or HE.

BLOODHOUND I (RAF)

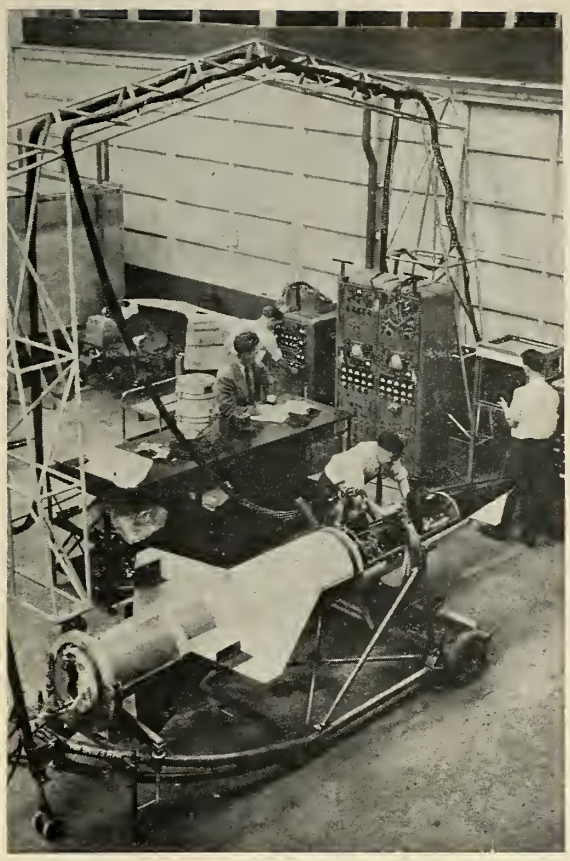
Type: Air-breathing surface-to-air
Status: Operational
Prime contractor: Bristol Aircraft Ltd.
Performance: Range—about 35 miles. Speed—Mach 2.3.
Deployment: Location—combat units in Britain and Australia. Also has been sold to Sweden.
Frame: Length—25.2 ft. Launch weight—4500 lbs.
Guidance: System contractor—Ferranti, Ltd. Type—radar homing.
Boosters: Type—solid (4)
Sustainers: System contractor—Bristol-Siddeley. Engine—Thor ramjets. Thrust—total 15,000 lbs.
Remarks: Bristol Aircraft is developing an advanced version called Bloodhound II. It will have anti-missile capability.

Pye P.V.

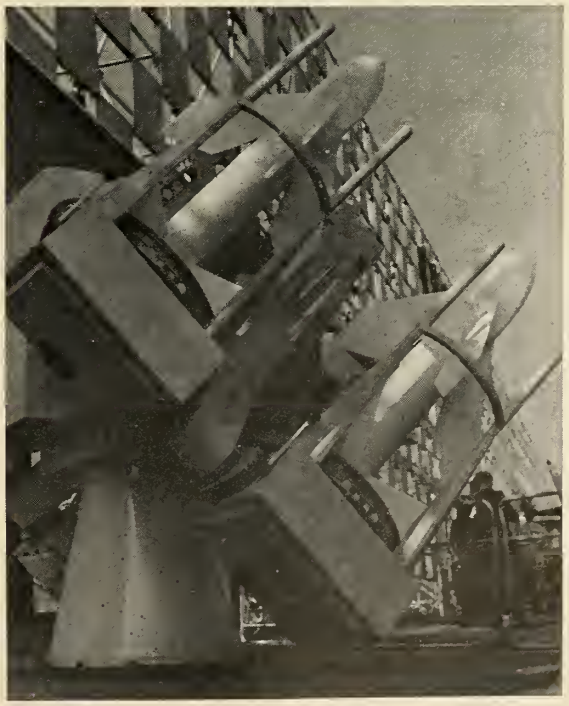
Type: Surface-to-surface (anti-tank)
Status: R&D
Prime contractor: Pye, Ltd.
Performance: Not available.
Frame: Length—5 ft. Fin span—2 ft. Launch weight—80 lbs.
Booster: Propellant—solid
Guidance: Type—wire.
Powerplant: Type—2 stage solid.
Remarks: Proposals submitted.

SEACAT (Navy)

Type: Surface-to-air
Status: Operational
Prime contractor: Short Bros. and Harland Ltd.
Performance: Range—short.
Deployment: Location—aboard Royal Naval destroyers and cruisers. Also ordered by Swedish, Australian and New Zealand navies. Initially operational—1960.
Guidance: Type—radio command.
Frame: Length—4 ft. 10 in. Wingspan—2 ft.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE.
Remarks: Four missiles on one battery.



BLUE STEEL



SEACAT

VIGILANT

Type: Surface-to-surface (anti-tank)
Status: Operational
Prime contractor: Vickers-Armstrongs, Ltd.
Performance: Range—about 1700 yards. Speed—350 mph.
Deployment: None. NATO countries considering.
Frame: Length—3 ft. Diameter—4.5 ft. Launch weight—about 26 lbs.
Guidance: Type—wire.
Booster: Propellant—solid
Remarks: Designed for use by infantrymen.

RED TOP (RAF)

Type: Air-to-air
Status: R&D
Prime contractor: De Havilland Propellers, Ltd.
Performance: Range—about 9.5 miles. Speed—supersonic.
Deployment: Location—to replace Firestreak on various aircraft.
Guidance: Type—infrared.
Booster: Type—solid.
Payload: Warhead type—HE (68 lbs.).
Remarks: Apparently designed within the same concept as the U.S. Navy's Eagle.

TIGERCAT

Type: Surface-to-air
Status: R&D
Prime contractor: Short Brothers and Harland Co., Ltd.
Performance: Designed as mobile anti-aircraft to be launched from armored carriers.
Remarks: Under consideration by British Army.

FAIREY A-T (Army)

Type: Surface-to-surface (anti-tank)
Status: Study
Prime contractor: Fairey Engineering, Ltd.
Performance: Not available.
Guidance: Type—reported to be radar.

THUNDERBIRD (Army)

Type: Surface-to-air
Status: Operational
Prime contractor: English Electric Aviation, Ltd.
Performance: Range — 25 n. miles. Speed—about Mach 2.
Deployment: Location — with British Army combat troops. Initially operational—1959.
Guidance: System contractor—Marconi Instruments. Type—radar homing.
Booster: System contractor: D. Napier. Type—solid (4).
Sustainer: System contractor: D. Napier. Type—solid.
Payload: Warhead type—HE.
Remarks: Launched from mobile carriers. Advanced Thunderbird with low-level capability and increased range under development.

THUNDERBIRD

BLUE WATER (Army)

Type: Surface-to-surface (tactical)
Status: Operational
Prime contractor: English Electric Aviation Co., Ltd.
Performance: Range—about 100 miles.
Deployment: British Combat troops. Also sold to West German Army.
Booster: Type—solid.
Payload: Warhead type—nuclear or HE.
Remarks: Highly mobile.

FIRESTREAK (RAF)

Type: Air-to-air
Status: Operational
Prime contractor: De Havilland Propellers, Ltd.
Performance: Range—about 4.5 miles. Speed—Mach 2.3.
Deployment: Location — with RAF squadrons and air units of the Royal Navy.
Frame: Length—10.5 ft. Diameter—3.5 in. Launch weight —300 lbs.
Guidance: Type—infrared.
Booster: Type—solid.
Payload: Type—HE.

BLUE STREAK (RAF)

Type: IRBM surface-to-surface
Remarks: Program cancelled 1960.

TRIDENT

FRANCE

TRIDENT (Army)

Military designation: SE 4400
Type: Air-breathing surface-to-air.
Status: R&D
Prime contractor: Sud-Aviation
Performance: Range—24.8 n. miles. Speed—Mach 3.3. Ceiling—164,000 ft.
Deployment: Location—to be used for French space experiments.
Frame: Length—26.5 ft. Launch weight—2640 lbs.
Guidance: Type—radar homing.
Booster: Type—solid.
Sustainer: Type—ramjet.
Payload: Warhead type—HE.

MARUCA (Navy)

Type: Surface-to-air
Status: Operational (training)
Prime contractor: Ruelle Naval Arsenal
Performance: Range—about 10 n. miles.
Deployment: Location — used aboard French Experimental Missile Ship Ile-D'Oléron (converted transport) for training.
Frame: Length—15 ft. Wingspan—5 ft.
Guidance: Type—radar command.
Booster: Type—solid (4).
Sustainer: Type—liquid (nitric acid/aniline).
Payload: Warhead type—HE.
Remarks: Development vehicle for Masurca.

ACAM 5301 (Army)

Type: Surface-to-air
Status: R&D
Prime contractor: Nord Aviation
Performance: Range—nearly 10 n. miles. Speed—about Mach 2.
Deployment: Location—to be deployed with Army combat troops, particularly for use against low-flying aircraft.
Frame: Length—14.5 ft. Wingspan—about 5 ft. Launch weight—1600 lbs.
Guidance: Type—radar.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (nearly 90 lbs.)

MASURCA (Navy)

Type: Surface-to-air
Status: Operational
Prime contractor: Ruelle Naval Arsenal
Performance: Range—more than 20 n. miles. Speed—Mach 2.6.
Deployment: Location—to be installed aboard French warships as the French Navy's top air defense weapon. Initially operational—1960.
Frame: Length—18.5 ft. Wingspan—3 ft. Launch weight—3200 lbs.
Guidance: Type—radar beam rider.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (220 lbs.)

R-422B2 (Army)

Type: Surface-to-air
Status: Operational
Prime contractor: MATRA
Performance: Range—about 40 n. miles. Speed—Mach 2.6.
Deployment: Location—metropolitan France. Initially operational—1960.
Frame: Length—30.5 ft. Launch weight—3500 lbs.
Guidance: Type—radar command and homing.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (110 lbs.).
Remarks: R-422B2 is mobile. MATRA R-431, designed to intercept high-altitude supersonic bombers, is under development. R-431 will be powered by a solid booster and a Nord ramjet.

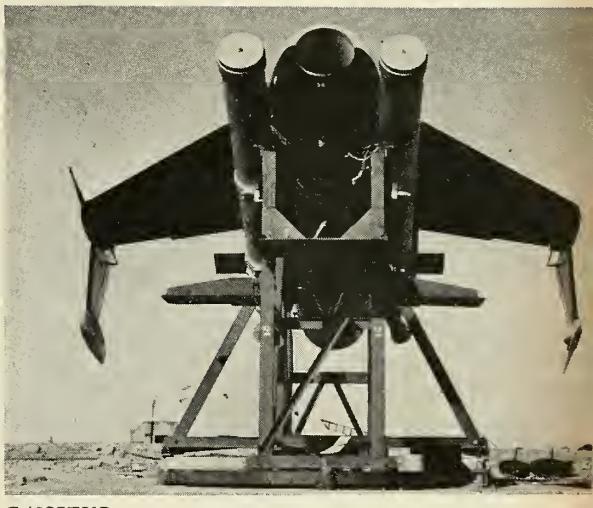
R-422B2

MALAFAC (Navy)

Type: Surface-to-surface
Status: R&D
Prime contractor: Societe Industrielle D'Aviation Latecoere
Performance: Range—about 25 n. miles.
Deployment: Location—to be installed aboard French surface warships.
Frame: Length—20.5 ft.
Guidance: Radio command.
Booster: Type—solid.
Sustainer: Type—liquid (acid/furaline).
Payload: Warhead type—HE.
Remarks: Malafac test missiles have been launched many times at sea.

CAISSEUR (Army)

Military Designation: SE4200
Type: Air-breathing surface-to-surface (tactical)
Status: Operational
Prime contractor: Sud-Aviation
Performance: Range—16 to 55 n. miles. Speed—Mach .8.
Deployment: Location—French Army combat troops. Initially operational—1950.
Frame: Length—11.5 ft. Wingspan—9 ft. 9 in. Launch weight—2075 lbs.
Guidance: Type—radar command.
Booster: Type—solid (2).
Sustainer: Engine—ramjet.
Payload: Warhead type—HE.
Remarks: Launched from mobile carrier.



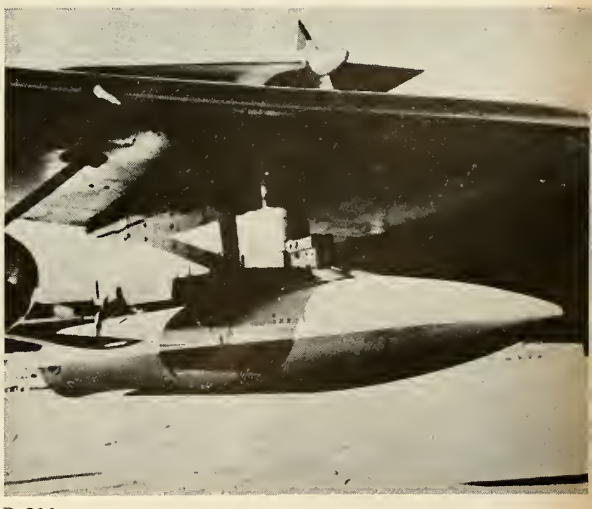
CAISSEUR

AA-20 (Air Force)

Type: Air-to-air and air-to-surface
Status: Operational
Prime contractor: Nord Aviation
Performance: Range—2.5 miles. Speed—supersonic.
Deployment: Location—in hands of Air Force and Navy units.
Frame: Length—8.5 ft. Launch weight—(a/a version) 300 lbs. (a/s version) between 295 and 375 lbs.
Guidance: Type—radio command.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE.
Remarks: Nord has an adaptation of the AA-20—the ACAM 5301—under development for the French Army. Also the follow-on AA-30 for the Air Force.

R-511 (Air Force)

Type: Air-to-air
Status: Operational
Prime contractor: MATRA
Performance: Range—about 5 miles. Speed—supersonic.
Deployment: Location—carried aboard French interceptors.
Frame: Length—10 ft. Diameter—10 in. Launch weight—about 400 lbs.
Guidance: Type—radar homing.
Booster: System contractor—Hotchkiss-Brandt. Type—solid. Thrust—3500 lbs.
Sustainer: System contractor—Hotchkiss-Brandt. Type—solid. Thrust—440 lbs.
Payload: Warhead type—HE.
Remarks: To be replaced by advanced MATRA R-530 about 1962.



R-511

SS-12 (Army)

Type: Surface-to-surface (anti-tank)
Status: R&D.
Prime contractor: Nord Aviation.
Performance: Range—more than 4 miles. Speed—Mach 1.
Deployment: Location—to be deployed with French Army combat troops. Also, can be launched from light aircraft and helicopters.
Frame: Length—about 6 ft. Wingspan—about 32 in. Launch weight—150 lbs.
Guidance: Type—wire. Also radar version.
Booster: Type—solid.
Payload: Warhead type—nuclear and HE.
Remarks: SS-12 scheduled to be in production by May 1961. SS-12 is an advanced version of the Nord SS-10 and SS-11 (See U.S. missiles) which are in the hands of a large number of NATO armies.

MASALCA (Navy)

Type: Air-breathing surface-to-air
Status: Nearly operational
Prime contractor: Societe Industrielle d'Aviation Latecoere
Performance: Range—about 65 n. miles.
Deployment: Location—aboard French cruisers. Initially operational—1960.
Frame: Launch weight—6000 lbs.
Guidance: Type—beam rider.
Booster: Type—solid.
Sustainer: Type—ramjet.
Payload: Warhead type—HE.

SSBS-1

Type: IRBM surface-to-surface
Status: R&D
Prime contractor: Societe d'Etude et de Realisation d'Engins Balistiques
Performance: Range—2300 n. miles.
Payload: Warhead type—nuclear.

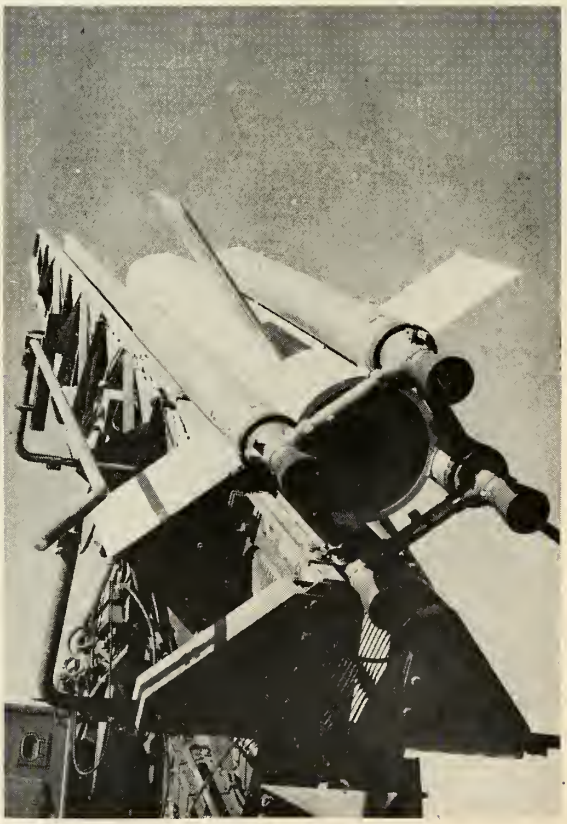
MALAFON (Navy)

Type: Surface-to-underwater (ASW)
Status: Nearly operational
Prime contractor: Societe Industrielle d'Aviation Latecoere
Performance: Range—more than 10 n. miles.
Deployment: Location—first deployed aboard the 3750-ton ASW Command Ship La Galissoniere. Initially operational—fall 1960.
Frame: Type—rocket-boosted homing torpedo similar to U.S. Navy's Asroc.
Guidance: Type—sonar and radio command.
Booster: Type—solid.
Payload: Warhead type—HE.

SS-12

BB-10 (Air Force)

Type: Air-to-surface
Status: Operational
Prime contractor: Sud-Aviation
Performance: Speed—Mach 1.
Deployment: Location—deployed with French Air Force.
Frame: Length—11 ft. Wingspan—2.5 ft. Launch weight—900 lbs.
Guidance: Type—radio command. (BB-10 carries TV camera so pilot can guide the missile to its target.)
Booster: Type—solid.
Payload: Warhead type—HE.



PARCA

ENTAC (Army)

Type: Surface-to-surface (anti-tank)
Status: R&D
Prime contractor: Nord Aviation
Performance: Range—about 1 mile. Speed—about 180 mph.
Guidance: Type—wire.
Booster: Type—solid.
Payload: Warhead type—HE.
Remarks: Recently turned over to Nord by DEFA.

PARCA (Army)

Type: Surface-to-air
Status: Operational
Prime contractor: DEFA
Performance: Range—15 miles. Speed—supersonic. Ceiling—80,000 ft.
Deployment: Location—in hands of French combat troops. Used mainly for training.
Frame: Length—18 ft. Launch weight—2200 lbs.
Guidance: System contractor—C. F. Thomson. Type—radar command.
Booster: Type—solid (4).
Sustainer: Type—solid.
Payload: Warhead type—HE.
Remarks: Advanced for use against Mach 3 aircraft under development.

ITALY

HSS-R 80/100

Type: Surface-to-surface (tactical)
Status: Operational
Prime contractor: Boscarri, Meccanemica, Hispano-Suiza
Deployment: Location—Egyptian troops.
Guidance: Type—free.
Booster: Type—solid.
Payload: Warhead type—HE.
Remarks: Bombardment rockets fired in salvoes of 20.

C-7 (Air Force)

Type: Air-to-air
Status. Nearly operational
Prime contractor: Societa Italiana Sviluppo Propulsione a Reazione
Performance: Range—6 miles. Speed—Mach 1.9.
Deployment: Location—aboard Italian Air Force interceptors.
Frame: Length—6.5 ft. Wingspan—25 in. Diameter—6 in. Launch weight—155 lbs.
Guidance: Type—infrared.
Booster: System contractor—Thiokol. Type—solid.
Payload: Warhead type—HE (55 lbs.)
Remarks: Later models to have alternate radar guidance and Italian booster.

AIRONE (Army)

Type: Surface-to-surface (tactical)
Status: Operational
Prime contractor: Polverificio Giovanni Stacchini
Performance: Range—6 miles.
Guidance: Type—free.
Booster: Type—solid.

SWITZERLAND

RSD-58

Type: Surface-to-air
Status: Operational
Prime contractor: Contraves AG and Oerlikon Machine Tool Works Buhrle & Co.
Performance: Range—18.6 miles. Speed—Mach 2.5. Ceiling—65,000 ft.
Deployment: Location—Combat units in Switzerland, Italy and Japan.
Frame: Length—20 ft. Launch weight—about 900 lbs.
Guidance: System contractor—Brown, Boveri & Co. Type—beam rider.
Booster: Type—liquid.
Payload: Warhead type—HE.
Remarks: RSA-54 is an earlier model. RSC-57 is a training model.

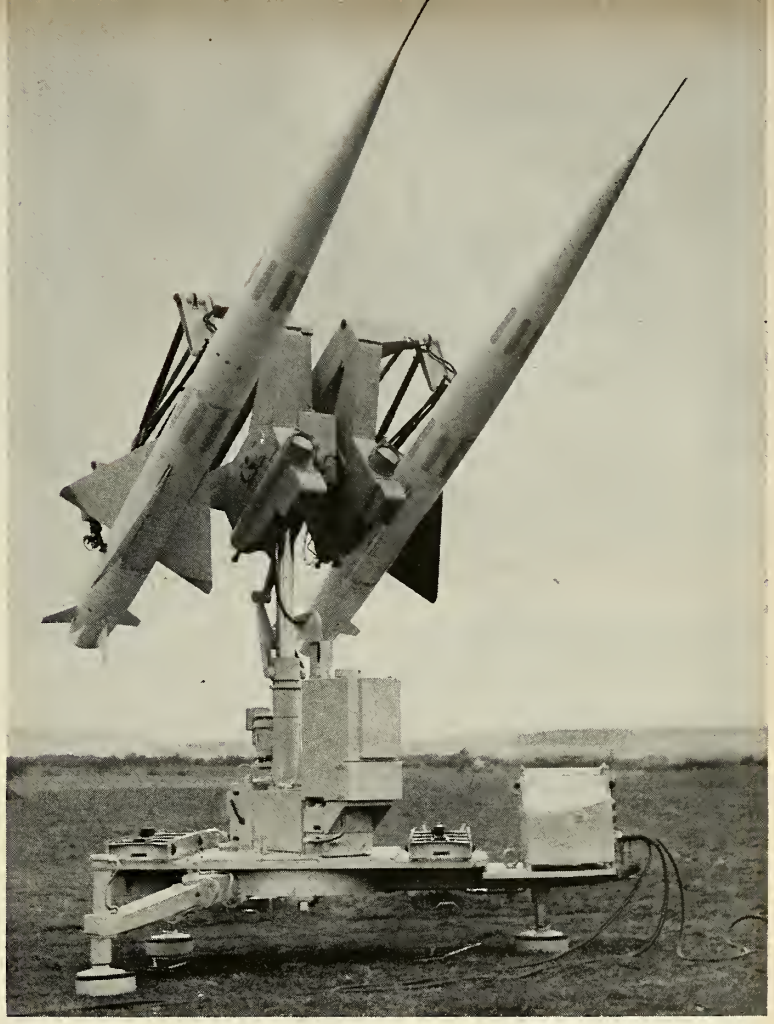
MOSQUITO (Army)

Type: Surface-to-surface (anti-tank)
Status: Operational
Prime contractor: Contraves AG and Oerlikon Machine Tool Works Buhrle & Co.
Performance: Range — about 6200 ft. Speed—200 mph.
Deployment: Location — Swiss Army units.
Frame: Length—3 ft. Launch weight—23 lbs.
Guidance: Type—wire.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (7 lbs.).

AUSTRALIA

MALKARA (Army)

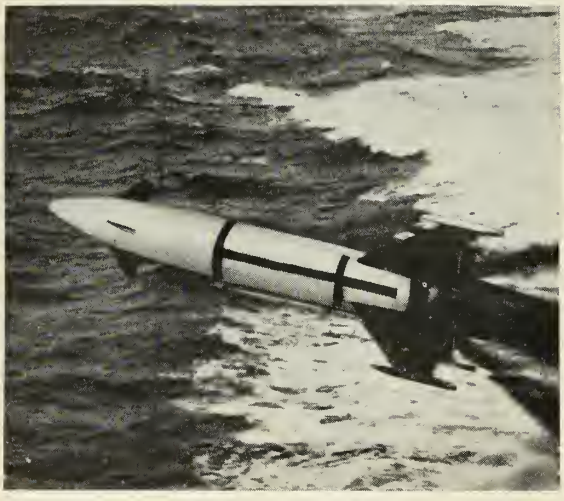
Type: Surface-to-surface (anti-tank)
Status: Operational
Prime contractor: Government Aircraft Factories
Performance: Range—about 2 miles.
Deployment: Location — British combat troops.
Frame: Length—6.5 ft. Wingspan—2.5 ft. Launch weight—206 lbs.
Guidance: Type—wire.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (55 lbs.).



RSD-58

MOSQUITO

BANTAM



ROBOT 315

PSR-1

JAPAN

TLRM-1 (Army)

Type: Surface-to-air
Status: R&D
Prime contractor: Shin Mitshubishi, Mitshubishi Shipbuilding and Engineering Co.
Performance: Range — long. Speed—about 255 mph.
Frame: Length—10.5 ft. Launch weight—about 560 lbs.
Guidance: Type—possibly radar.

TMA-1 (Air Force)

Type: Air-to-air
Status: R&D
Prime contractor: Shin Mitsubishi and Mitsubishi Electrical.
Performance: Speed — supersonic.
Frame: Length—about 10 ft. Launch weight—more than 200 lbs.
Booster: System contractor—Fuji Precision. Type—solid.
Payload: Warhead type—HE.
Remarks: MM-1 is a test vehicle for the TMA-1.

TAAM-1D (Air Force)

Type: Air-to-air
Status: R&D
Prime contractor: Fuji Precision Machinery Co., Ltd.
Performance: Range—about 1.5 miles. Speed—Mach 1.5.
Frame: Length—8 ft. Launch weight—335 lbs.
Guidance: Type—infrared.
Payload: Warhead type—HE.

TATM-1 (Army)

Type: Surface-to-surface (anti-tank)
Status: R&D
Prime contractor: Kawasaki Kokuki Kogyu Kabushi-iki Kaisha
Frame: Length—4.5 ft. Launch weight—300 lbs.
Remarks: TATM-2 model also under development. It is 3.2 ft. long.

SWEDEN

ROBOT 315 (Navy)

Type: Surface-to-surface (tactical)
Status: Operational
Prime contractor: Swedish Guided Missile Bureau and Royal Swedish Armed Forces Research Establishment
Performance: Range—10 to 20 n. miles. Speed—Mach .9.
Deployment: Location—aboard Swedish Destroyers Halland and Smaland.
Frame: Length—24 ft. Launch weight—3000 lbs.
Guidance: Type—not available.
Booster: Type—solid (4).
Sustainer: Type—pulsejet.
Payload: Warhead type—HE.
Remarks: Torpedoboat model known as Sjorobot.

BANTAM (Army)

Type: Surface-to-surface (anti-tank)
Status: Operational
Prime contractor: A. B. Bofors
Performance: Range—6500 ft. Speed—190 mph.
Deployment: Location — with Swedish combat troops.
Frame: Length—2.5 ft. Launch weight—13 lbs.
Guidance: Type—wire.
Booster: Type—solid.
Sustainer: Type—solid.
Payload: Warhead type—HE (3.1 lbs.).
Remarks: Bantam can be fired from an infantryman's hip.

ROBOT 304 (Air Force)

Type: Air-to-surface
Status: Operational
Prime contractor: Swedish Guided Weapons Bureau and Royal Swedish Armed Forces Research Establishment.
Performance: Range—about 3 miles. Speed—Mach 1.
Deployment: Location—Swedish Air Force.
Frame: Length—14.5 ft. Launch weight—1000 lbs.
Guidance: Type—radio command.
Booster: Type—solid.
Payload: Warhead type—HE.
Remarks: Designed for use against naval targets.

ARGENTINA

PSR-1 (Army)

Type: Surface-to-surface (anti-tank)
Status: R&D
Frame: Length—3.8 ft. Launch weight—19.5 lbs.
Booster: Type—Solid (1).
Payload: Warhead type—HE.
Remarks: Can be launched by one man.

PAT-1 (Air Force)

Type: Air-to-surface
Status: R&D
Performance: Range—about 12 miles.
Frame: Length—about 11 ft. Diameter—about 1 ft. Launch weight—2310 lbs. Material (major)—steel.
Booster: Type—liquid. Propellant—oxygen and methanol.

A3H (Air Force and Navy)

Type: Air-to-surface
Status: Operational
Performance: Range—3.8 miles.
Frame: Length—about 3 ft. Diameter—about 4 in. Launch weight—48 lbs. Material (major)—steel.
Guidance: Type—free.
Booster: Type—solid.
Payload: Warhead type—HE.

SOVIET UNION

GOLEM I (Navy)

Type: Surface-to-surface
Status: Near operational
Performance: Range—400 miles; Altitude—125 miles.
Frame: Length—54 ft.; Weight 16½ tons gross; single stage.
Remarks: Developed from German World War II plans for a sea-going V-2 (A-3). Liquid-fueled, radio-inertial guided. Designed to be launched from a capsule towed by a submarine. Nuclear capability.

GOLEM II (Navy)

Type: Underwater-to-surface
Status: RD&T
Performance: Range—1200-1300 miles.
Frame: Length—nearly 60 ft.
Remarks: Advanced version of the Golem I with improvements adopted from the Army T-2. Probably radio-inertial guided, liquid fueled. Nuclear capability.

GOLEM III (Navy)

Type: Underwater-to-air, surface-to-air
Status: Operational on surface vessels
Performance: Range—10 miles.
Frame: Length—15 to 20 ft.; Diameter—20 in.
Remarks: Solid-fueled, infrared-guided. Designed to give both submarines and surface ships anti-aircraft protection.

GOLEM IV (Navy)

Type: Surface-to-air
Status: Operational on surface vessels
Performance: Range—45 miles.
Remarks: A new missile, radar-guided and solid-fueled. May also be converted to submarine use.

M-2'S IN RED SQUARE

T-5B

T-1 (Army)

Type: Surface-to-surface
Status: Operational
Performance: Range—600-775 miles
Frame: Length—50 ft.; Weight—19 tons gross; single stage
Remarks: Mobile IRBM. LOX/hyrocarbon fueled booster generates 77,000 lbs. thrust. Radio-guided. Nuclear capability.

T-2 (Army)

Type: Surface-to-surface
Status: Operational
Performance: Range—1300-1500 miles; Speed—5000 m.p.h.
Frame: Length—between 85 and 91 ft.; Weight—55 tons; two stages.
Remarks: Liquid-fueled, 80,000 lb. thrust booster. The T-2 reportedly was the first Soviet rocket used to test an H-bomb warhead. Fired from Central Russia, the warhead was exploded at 120,000 ft. near Bennet Island in the Arctic.

T-3 (Air Force)

Type: Surface-to-surface
Status: Operational
Performance: Range—5000 miles; Speed—15,000 m.p.h.; Apogee—280 miles.
Frame: Two stages.
Remarks: Liquid-fueled with booster developing 500,000 lbs. thrust. Radio-inertial-guided. HE or nuclear warhead. Russia reportedly produced 50 T-3's in 1959 and has capability to build 1200 by the end of 1963.

T-3A (Army)

Type: Surface-to-surface ICBM
Status: Operational
Performance: Range (Model A)—6000 miles; Range (Model B)—7500 miles; Speed—15,000 m.p.h.
Frame: Model A—2 stages; Model B—3 stages.
Powerplant: Liquid-fueled. Model A first stage—525,000 lbs. of thrust; Model B first stage—700,000 lbs. of thrust.
Remarks: Production of the Model A is believed to have ceased in recent months in favor of the advanced version. Original production plans reportedly called for an equal number of T-3A Model A's and T-3's. The new booster stage on the Model B is believed to be a prototype for one used in the T-4A antipodal missile. Nuclear warhead.

T-4A (Air Force)

Type: Surface-to-surface antipodal missile
Status: Advanced RDT&E
Performance: Range—10,000 miles; Apogee—186.3 miles; Speed—13,660/m.p.h.
Frame: Length—121.02 ft.; Wing span—65.6 ft.; Max. Diameter—6.88 ft.; Launch weight—115 tons.
Powerplant: First stage has 3 LOX/kerosene engines developing 360,000 lbs. thrust.
Remarks: Catapulted from rail sled. Payload—2350 to 3100 lbs. This is the Soviet counterpart of the U.S. Dyna-Soar boost-glide bomber, stemming from the German Saenger-Bredt design conceived in World War II.

T-33 (Army)

Type: Surface-to-surface ICBM
Remarks: A new missile. No other details available.

T-4 (Army)

Type: Surface-to-surface IRBM
Status: Experimental
Performance: Range—1000 miles.
Powerplant: Two stages, both liquid-fueled.
Frame: Length—53 ft.
Remarks: 1800-lb. payload may be either nuclear or HE. Some of its configurations are believed to be worked into upper stages of the T-4A.

T-5 (Army)

Type: Surface-to-surface
Status: Operational with Red Army in Eastern Europe
Performance: Range—50-100 miles.
Frame: Length—about 36 ft.; 3 stages (advanced version may have 4 stages).
Powerplant: Solid-fueled.
Remarks: Designed for firing from multiple launchers for blitz-type saturation of target. HE or small nuclear warhead.

T-5A (Army)

Type: Surface-to-surface IRBM
Status: Operational
Remarks: Few details are available. Believed to be solid-fueled and guided.

T-5B (Army)

Type: Surface-to-surface
Status: Operational (but out of production)
Performance: Range—15-25 miles
Frame: Length—31 ft.; Diameter—3 ft.; Weight—6000 lbs.
Remarks: Similar to the U.S. Honest John. Launched from tracked vehicle. Unguided. Carries HE and possibly a nuclear warhead.

T-6 (Army)

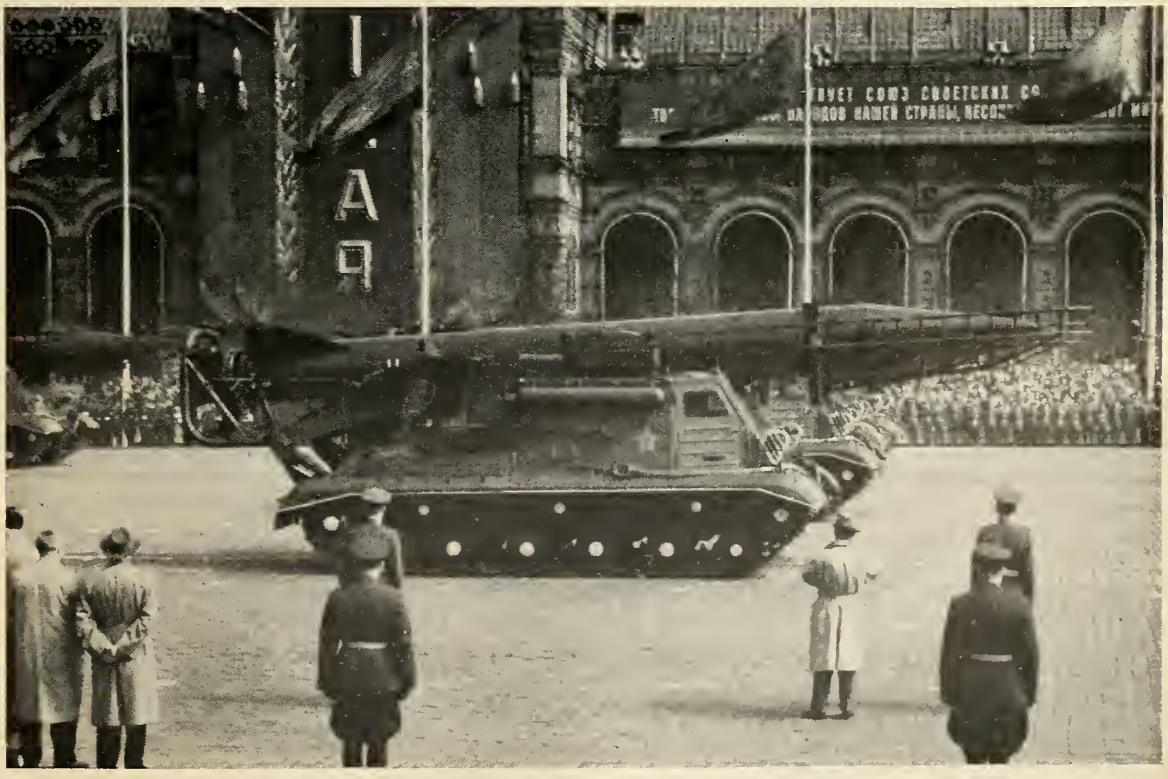
Type: Surface-to-air
Status: Operational
Performance: Range — 20-25 miles; Speed — 1500 mph; Ceiling—about 60,000 ft.
Frame: 2 stages
Warhead: HE with proximity fuze.
Powerplant: Solid fueled with cluster of 4 solid boosters.
Remarks: Fired from multiple launcher. An advanced version, the T-6A, is radar guided and believed to be operational.

T-7A (Army)

Type: Surface-to-surface
Status: Operational
Performance: Range—50 to 90 miles; Speed—Mach 5; radio command guidance.
Frame: Length—30 ft.; Diameter—2.5 ft.; Weight—about 10,000 lbs.
Powerplant: Solid fueled
Warhead: HE
Remarks: Has controllable rear fins.

T-8 (Army-Air Force)

Type: Surface-to-air (also air-to-air)
Status: Operational
Performance: Range—15 to 25 miles; Speed—Mach 2.5
Frame: Length — 13 ft.; two stages
Powerplant: First stage is cluster of two solid fueled boosters, second stage is liquid fueled.
Warhead: HE with proximity fuze



T-7A

M-100A (Air Force)

Type: Air-to-air
Status: Operational
Performance: Range—3½ miles; Speed—Mach 2.5
Remarks: Solid-fueled, semi-active radio-radar command guidance.

ME-IGOR (Army)

Type: Anti-tank
Frame: Length—24 in.; Diameter—3 in.
Remarks: Solid-fueled. Fired from bazooka tube. Was operational, but probably used now only for training.

J-3 (Navy and Army)

Type: Surface-to-surface
Status: Operational with the Red Army and at least 7 Baltic fleet cruisers.
Performance: Range—450-600 miles; Speed—supersonic.
Frame: Length—36 ft.
Remarks: Booster is cluster of 4 solid-fuel rockets; ramjet sustainer. Guidance presumably is beam-riding or programed. Nuclear capability.

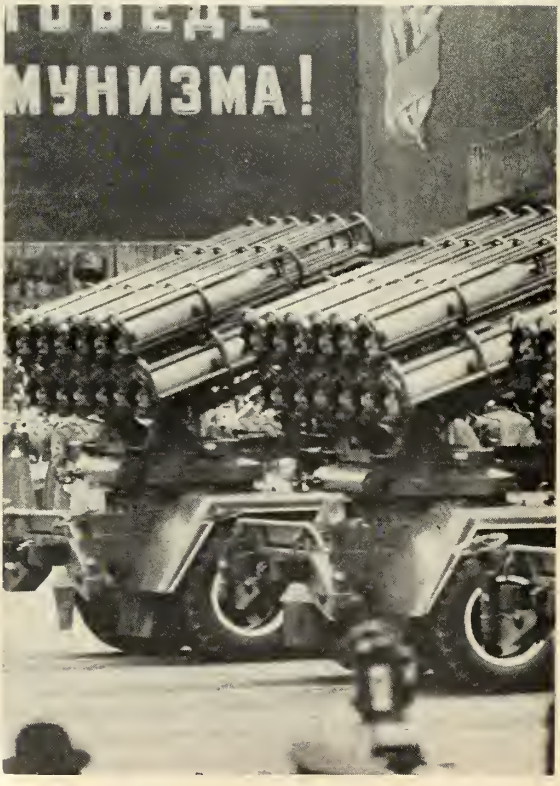
RS-82, RS-132, RS-132A (Air Force)

Type: Air-to-air
Frame: Length—unavailable; Diameter—5.2 in.
Remarks: Aircraft version of the GVAI. Used for training.

M-2 (Army-Navy)

Type: Anti-aircraft
Status: Operational with ground defense forces and aboard Baltic Sea cruisers.
Performance: Speed—Mach 2.
Frame: Length—about 25 ft.; 2 stages.
Remarks: Solid-fueled. Infrared, radar, or both used as guidance.

GVAI'S ON PARADE



GVAI (Army)

Type: Barrage rocket
Remarks: Multiple-tube launcher, fired in salvoes. May be phased out for more advanced versions.

KCAT-25 (Army)

Type: Anti-tank
Remarks: Never exhibited, believed to be operational.

KOMET I (Navy—CH 17 Army)

Type: Surface-tc-surface
Performance: Range—100 miles; Speed—3000 m.p.h.
Remarks: Solid-fueled, the CH17 is reported to be operational with the Red Army. A crash program is underway to put the Comet I into service aboard submarines and surface ships. HE and nuclear warheads.

KOMET II (Navy—CH 18 Army)

Type: Surface-to-surface
Performance: Range—600 miles.
Remarks: Operational with the Red Army and from a surface vessel in calm waters. Crash program in progress with ship motion simulator equipment; R&D for submarines. Solid-fueled, nuclear warhead.

KOMET D (Air Force)

Type: Air-to-surface standoff
Status: In development and test
Performance: Range—55 miles.
Frame: Length—33.5 ft.; Diameter—about 4 ft.
Remarks: An equivalent to the British Avro, the turbojet-propelled missile may have beam-riding guidance. Warhead can be either nuclear or HE.

RELIABILITY...

every missile must count. A wasted firing due to a minor-part malfunction results in appalling losses in time and money. Combat condition failures are even more disastrous. Vitro Laboratories, under contract with the U. S. Navy Bureau of Ships, has developed advanced mathematical approaches to make reliability a predictable feature of design. Over a thirty month testing period predicted failures correlated strikingly with actual results. Tested equipment included radars, radar repeaters, radio transmitters and receivers, and radio terminal equipment. Reliability is another reason why Vitro is a leading name in systems engineering today.

Vitro

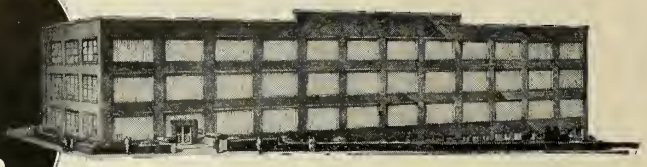
SCIENTISTS AND ENGINEERS: JOIN THIS TEAM.

VITRO LABORATORIES / Division of Vitro Corporation of America / SILVER SPRING, MD. • WEST ORANGE • EGLIN AFB, FLA. / OVERSEAS: GENEVA • MILAN • BOMBAY

OUR NEW HOME, DOUBLING OUR FORMER CAPACITY

Watch Master ELECTRONICS

Precision FREQUENCY STANDARDS AND FORK OSCILLATOR UNITS



Our instruments, 40 to 30,000 cycles, are used extensively by industry and on government projects where enduring accuracy and maximum durability are required. Your inquiries on related products are invited.

PRECISION FORK OSCILLATOR UNITS

TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.

Frequencies: 200 to 4000 cycles

Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)

Double triode and 5 pigtail parts required.

Input, Tube heater voltage and B voltage

Output, approx. 5V into 200,000 ohms

TYPE 2007-6

TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.

Frequencies: 360 to 1000 cycles

Accuracies:
2007–6 (± .02% at —50° to + 85°C
R2007–6 (±.002% at +15° to + 35°C
W2007–6 (±.005% at —65° to + 85°C

Input: 10 to 30 Volts, D. C., at 6 ma.

Output: Multitap, 75 to 100,000 ohms

TYPE 2001-2

Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles

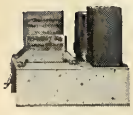
Accuracy: ±.001% at 20° to 30°C

Output: 5V. at 250,000 ohms

Input: Heater voltage, 6.3 - 12 - 28

B voltage, 100 to 300 V., at 5 to 10 ma.

ACCESSORY UNITS FOR 2001-2



L—For low frequencies multi-vibrator type, 40-200 cy.

D—For low frequencies counter type, 40-200 cy.

H—For high freqs, up to 30 KC.

M—Power Amplifier, 2W output.

P—Power supply.

PRECISION FREQUENCY STANDARDS

TYPE 2005A

Size 8" x 8" x 7¼" High
Weight, 14 lbs.

Frequencies:
50 to 400 cycles (Specify)

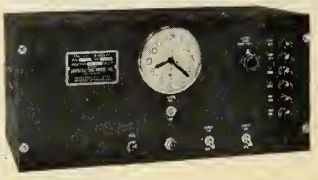
Accuracy:
±.001% from 20° to 30°C

Output, 10 Watts at 115V

Input, 115V. (50 to 400 cy.)

TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.



Output: 115V
60 cycles, 10 Watt

Accuracy:
±.001% 20° to 30°C

Input,
115V (50 to 400 cy.)

TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cy.

Accuracy:
(±.002% at 15° to 35°C)

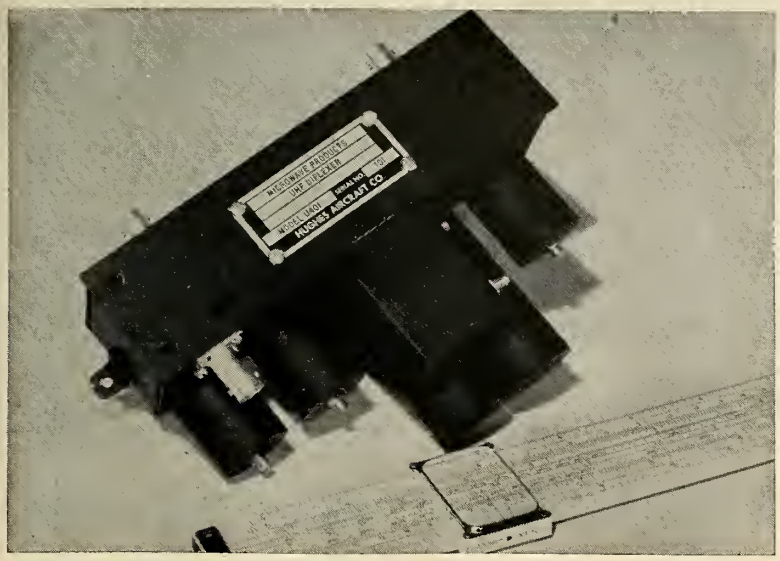
Output: 115V, 75W.

Input: 115V, 50 to 75 cy.

WHEN REQUESTING INFORMATION, PLEASE SPECIFY TYPE NUMBER

ATP

American Time Products Inc.
61-20 Woodside Avenue
Woodside 77, N. Y.



UHF Missile Diplexer

A lightweight UHF diplexer has been developed by Hughes Aircraft Co.

Known as Hughes Model U401, the diplexer permits a 100-watt transmitter and sensitive receiver to be operated simultaneously with a single antenna in the 225-400 MC band. With the transmitting frequency separated by less than ten per cent from the receiving frequency, isolation in excess of 100 db is provided in the receiving circuits, the announcement said.

To conserve transmitter power, the insertion loss between transmitter and antenna is only 0.2 db with a VSWR of 1.1. Design is such that no operational interaction between receiver and transmitter is experienced.

The unit consists of a special combining circuit together with a bridged-T network and a π– section filter on the receiving side. The assembly, which weighs less than one pound, has successfully withstood accelerations up to 150 g as well as other tests applicable to high-altitude rocket and missile environments.

Circle No. 225 on Subscriber Service Card.

APU Automatic Battery

Extremely high current output is featured in a silver-zinc primary battery designed for use in missile and space vehicle auxiliary power units by Cook Batteries. The battery is automatically activated by a reliable solid-propellant gas mechanism which has only one moving part.

The Model P80A provides 200 amps at 28 v. Maximum current is 400 amps, and discharge time is 1.8 min. An extremely efficient cell is used to provide high rate of discharge.

Circle No. 226 on Subscriber Service Card.

Printed Coax Mixer

Premier Instrument Corp. is producing a printed circuit broadband coax mixer which utilizes a replaceable printed circuit diode. The PC-Mix is a compact, low noise figure mixer with local oscillator level adjustment. The PC-Mix is capable of withstanding severe vibration and shock and is available in frequency ranges of 250 mc to 8000 mc in five basic units.

Circle No. 227 on Subscriber Service Card.

Linear Potentiometer

The Computer Instruments Corp. has added Model 111 Linear Motion Potentiometer to their present line of precision film components.

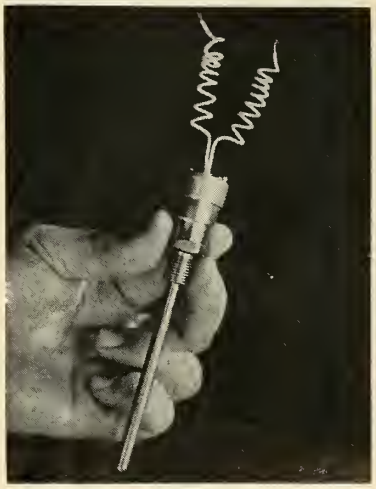
This potentiometer, designed for operation with an AC or DC input, provides, without amplification, outputs as great as 350 volts/inch of displacement.

The capability of the Model 111 to detect a motion as small as 0.000005 in., coupled with its life rating of up to 30,000,000 strokes, depending on circuitry, will make it of prime interest to those involved in the design of programed machine tools or other devices requiring precise knowledge of linear position.

Circle No. 228 on Subscriber Service Card.

Thermal Switch

Hermetically-sealed by employing a ceramic seal that is resistant to high temperatures, Control Products Inc. has designed a special purpose super-high temperature thermal switch which can be calibrated up to 1800°F. The switch is a probe type unit with a special cap that is locked in place after the final calibration has been made.



Contacts may be arranged for either close-on-rise or close-on-fall in temperature. Temperature tolerance is 6°F; temperature differential and repeatability for a given switch is ±1°F, while overshoot to 2200°F or an undershoot to −100°F can be tolerated without damage to the unit.

Circle No. 229 on Subscriber Service Card.

Swash-Plate Engines

A family of swash-plate engines and high-pressure pumps is available for general application from Clevite Ordnance.

The engines can be driven from any source of pressurized gas or vapor, including steam, cold gases such as

. . . products & processes

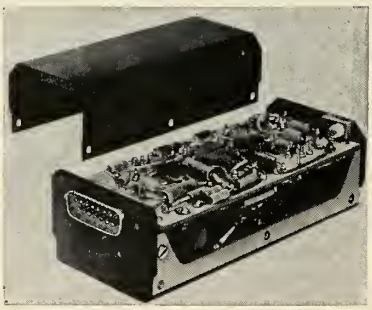
CO_2 and nitrogen, or solid and liquid rocket propellants. Engines deliver as much as 60% of input energy, and torque depends solely on pressure furnished. With input gas temperatures of 2150°F and pressures of 2000 psi, one hot-gas design delivers 100 horsepower at shaft speeds between 4000 and 5000 rpm. It weighs 30 lbs., and is 12 in. long and 6½ in. in diameter.

Pumps are available in wet and dry swash-plate design. Wet swash-plate models are suited to pumping a variety of noncorrosive liquids, including low-lubricity problem fluids like kerosene and hydraulic fluid. Dry swash-plate units are designed for pumping corrosive compounds such as nitric acid, hydrogen peroxide and hydrazine.

Circle No. 230 on Subscriber Service Card.

Strain Gage Oscillator

A transistorized strain-gage subcarrier oscillator is available from Electro-Mechanical Research, Inc. The instrument, designated the Model 179A, is intended for highly accurate conversion of strain-gage bridge signals into FM subcarrier signals on IRIG channels 1 to 14 and A.



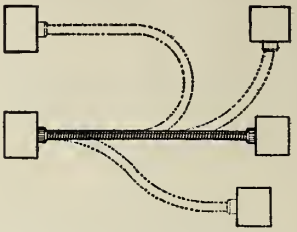
The subcarrier oscillator operates with a four-arm strain-gage bridge consisting of elements having 100 to 150 ohms resistance. There is no necessity for reactive balancing since internal oscillator circuitry automatically compensates for up to 1000 uuf capacitance across one arm.

Circle No. 231 on Subscriber Service Card.

Tapoffs, Splitters & Baluns

Blonder-Tongue Laboratories, Inc. has announced a complete line of advanced line splitters, tapoffs, and baluns. This advanced series of splitters and tapoffs can satisfy all installation requirements of large and small antenna systems in strong, intermediate and weak signal areas. A complete line of tapoffs and splitters is available for 75 ohm, 300 ohm, or mixed impedance systems.

FLEXIBLE SHAFTING OFFERS NEW FREEDOM OF DESIGN



Before the innovation of Flexible Shafting, it was necessary to transmit power from a drive unit to its driven unit by means of a solid shaft which utilized expensive and cumbrous gearing. Today the Flexible Shaft alone provides a means of transferring this power from one unit to another by going around, over, and under obstacles. This allows you more space in your design, and eliminates the age old problem of having to have perfect alignment of the shaft and its drive or driven unit in order to make a connection. Flexible Shafts are simply curved towards the unit and connected by means of a ferrule, or an end fitting. If you have any application, now or in the future, which will require control from remote places, you owe it to yourself to write F. W. Stewart Corporation, 4311 Ravenswood Ave., Chicago 13, Illinois, for complete information on Circle Ess Flexible Shafting.

Circle No. 75 on Subscriber Service Card.

Coaxial cable may be plugged directly into a new type of solderless fitting and may be used with a quick disconnect. Flat 300 ohm transmission line need not be stripped, but is inserted directly into "no-strip" connectors and secured in place by tightening two screws.

Circle No. 232 on Subscriber Service Card.

Low Level Commutators

A line of low level, all solid-state electronic commutators for use in severe missile environments is available from General Devices, Inc.

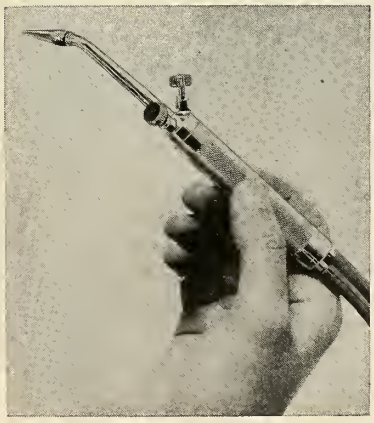
Designed for airborne sampling of low level differential instruments such as strain gauges and thermocouples, the units contain up to 90 differential channels in high density packages. The 30 channel unit weighs only 2.5 oz. and is less than 1 in. in volume per channel. In addition, the units contain all necessary power converters and programing circuitry.

Circle No. 233 on Subscriber Service Card.

Miniature Torch

A miniature torch which uses gas or acetylene to produce intense pinpoint flames for delicate and close tolerance work is now available from Microchemical Specialties Co.

The Misco torch is only 7 inches long from tip to gas connection and weighs just three ounces. It features finger tip mixer controls for fine adjustment of flame and is furnished with three tips, .008″, .015″, and .020″ bore diameter. Other tips ranging from .004″ to .030″ are available.



Circle No. 234 on Subscriber Service Card.

Vibration Tester

A simplified portable vibration tester for quality control analysis which can be operated by factory personnel is being marketed by Rototest Laboratories.

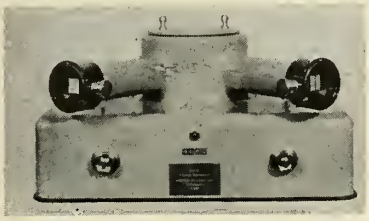
In addition to its portability and low initial cost, other features of Rotocon (R) are: low operating and main-

tenance, excellent sound proofing, and simple data take-off. In operation there is less than 75 db of noise measured six feet away from the machine. The tester provides a fundamental output vibration at 50 cps and overtones at predetermined multiples.

Circle No. 235 on Subscriber Service Card.

Scanning Monochromator

A McPherson Model 235 is a 50cm vacuum ultraviolet scanning monochromator that guarantees a vacuum of better than 1 x 10^{-5}mm Hg is available from McPherson Instruments Corp. This compact table model



consists of a vacuum chamber, bilateral entrance and exit slits, a 50cm radius of curvature grating with 600 lines per millimeter, and a screw-driven scanning mechanism with 12 reversible speeds. A counter reads actual wavelengths in Angstrom units from Central Image through 6000A, and is accurate to ± 1A.

Circle No. 236 on Subscriber Service Card.

Copper Clad Laminates

A complete line of thin copper clad laminates is available from the Plastic Products Division of International Resistance Co.

The materials involved include the complete range of insulation, from vinyl and polyethylene to teflon and glass reinforced teflon.

Available now is 1 or 2 ounce copper bonded to 0.005 Kel-F, 0.005 teflon-FEP, 0.007 teflon-glass cloth, 0.005 linear polyethylene and 0.006 mylar.

Circle No. 237 on Subscriber Service Card.

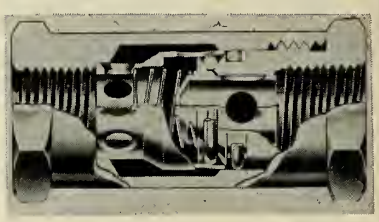
Environmental Room

Labline, Inc. is marketing a line of walk-in environmental rooms with two temperature ranges: ambient to 140°F and 0° to 140°F. Accuracy is maintained within plus-minus 1°F. The test rooms are constructed in convenient panel form, shipped knocked down to permit easy access through narrow doorways.

Circle No. 238 on Subscriber Service Card.

Surge Flow O-Ring

An engineering development positively assures O-ring reliability against high pressure split-second surge flows, in the latest from Circle Seal Products. Faster acting solenoid and other rapidly actuated valves in higher pressure systems have created new problems which the Circle Seal 200 Series Check Valve has successfully eliminated. Fool-proof



O-ring retention is assured by an ingenious cage device which positively restrains the O-ring from washout. Heavier, more rugged construction of the body provides additional protection against abuse and failure.

Circle No. 239 on Subscriber Service Card.

Four Pin Holders

Supplementing its line of three-pin transistor holders, Sealectro Corp. is producing a four-pin transistor holder. Designated as TC-400T, the new hold-

ers feature the "Press-Fit" technique which permits fast and economical chassis insertions. Both the TC-200T (3 pin-holder) and TC-400T (four-pin holder) are constructed with extra-long terminals which act as a heat sink and permit soldering of transistors in place with greatly reduced danger of damage to the transistor elements.

Circle No. 240 on Subscriber Service Card.

High Pressure Regulators

Grove Valve and Regulator Co. has designed a new line of small volume high pressure regulators.

The regulators, or "loaders," can handle a wide range of pressures. The interior construction is highly resistant to corrosion. All metal parts in contact with line fluid are stainless steel including the filter. The regulators are designed using a minimum number of parts to reduce maintenance problems and boost repeatable accuracy.

Circle No. 241 on Subscriber Service Card.

Transistor Welder

An automatic transistor welder has been developed by National Electric Welding Machines Co.

A 3 ft. x 4 ft. table, 32-inches high, forms the top of the unit's base and is designed specifically to accommodate a standard dry box. An operator, seated at the console and hand-loading a six-station dial, can produce 2000 transistors an hour, according to National Electric engineers.

Circle No. 242 on Subscriber Service Card.

Fast Microwave Switch

A fast acting, high-power microwave switch that can be closed in tenths of a microsecond has been developed by Electric Products Inc.

The new microwave switch uses a gas discharge, similar to that in a thyratron, to create a fast acting and relatively high power switch for a microwave line. In addition to closing in tenths of a microsecond, the switch can be reopened in a few microseconds.

Circle No. 243 on Subscriber Service Card.

High Purity Gold

Gold, 99.999% pure, is available in powder and sheet form from High Purity Metals, Inc.

The gold offers semiconductor manufacturers excellent wetting to silicon at relatively low temperatures (in the order of 700°C). The gold exhibits high thermal conductivity and vapor pressure, along with superior resistance to corrosive acids.

Circle No. 244 on Subscriber Service Card.

new literature

TEST AND SENSING GUIDE—Alden Products has published a Vest Pocket Guide and Wall Chart to help the design engineer choose the right test and sensing component. This chart contains complete specs on Alden panel lights, switches, fuseholders, test prods and jacks and molding materials.

Circle No. 200 on Subscriber Service Card.

BASICS IN THE MACHINING OF TEFLON—An informative 12-page booklet released by the Plastic Products Division of Raybestos-Manhattan contains R/M suggestions for stress relieving; tools and coolants to use; speeds and rates of feed; rakes, angles and clearances; burrs and chips; turning, boring, drilling, tapping, reaming, counterboring, grinding; fly-cutting; surface finishes; tolerances, etc.

Circle No. 201 on Subscriber Service Card.

STRAIN GAGES—A line of subminiature, free-filament wire strain gages, designed for accurate strain measurement on any test surface or material in a wide variety of applications including high temperature, are discussed in a 4-page, 2-color new product data sheet released by the Electronics & Instrumentation Division of Baldwin-Lima-Hamilton Corp. Product Data Sheet 4330 contains line drawings, graphs and tables to support the data and specifications concerning this strain gage, Type HT. Microminiature built-in thermocouples are also available if desired.

Circle No. 202 on Subscriber Service Card.

TRANSFEROBOT—USI Robodyne Division of U.S. Industries, Inc., has published literature describing its "TransfeRobot." It explains the concept of flexible and versatile automation equipment and how it is embodied in this member of USI Robodyne's family of automation products. The literature describes the design and operation of the "TransfeRobot" as well as the simple means of programing and set-up, which permits it to be switched from job to job in one-half hour.

Circle No. 203 on Subscriber Service Card.

CONTROL COMPONENTS—Over 2500 components for control of gas or liquid over a temperature range of −320° to 1500°F, and pressures to over 3500 psig are covered in a new catalog published by The Garrett Corp.'s AiResearch Manufacturing division. Major items available for aircraft, missile or process industry applications include: fuel control systems, pneumatic and electrical valves, actuators, air motors and thermostats.

Circle No. 204 on Subscriber Service Card.

ZIRCONIUM OXIDES—The Zirconium Corp. has available a well-illustrated four-page brochure on zirconium oxides and high-temperature materials. The brochure lists materials and describes the processes Zircoa uses in manufacturing their high-temperature refractories. Pictures showing plant facilities, standard and custom refractory shapes are included.

Circle No. 205 on Subscriber Service Card.

PRESSURE REGULATOR CATALOG—Now available from OPW-Jordan, an 8-page Catalog gives up-to-date information on the complete line of Sliding Gate Pressure Regulators. The brochure describes in detail the OPW-Jordan self-operated, pilot-operated, solenoid operated and back pressure Regulators.

Circle No. 206 on Subscriber Service Card.

HIGH ALUMINA TECHNICAL CERAMICS—Diamonite Products Manufacturing Co. has available a brochure covering data and the application of high alumina technical ceramics to the electronics industry. Off the shelf service for standard rods, tubes and cylinders are listed with prices in various quantities. The six-page brochure contains a chart of comparative properties of Diamonite materials for electronic applications. A graph of dielectric loss factors of Diamonite material on a comparative scale is also shown.

Circle No. 207 on Subscriber Service Card.

WIND TUNNEL DATA—How the National Aeronautics and Space Administration reduces high-speed wind tunnel data at their Langley Field, Va., test center is the subject of an application information bulletin just released by the Systems Division of Beckman Instruments, Inc. In addition to a description of the data system installation and its function, the bulletin includes system specifications, block diagram, operation explanation and photograph.

Circle No. 208 on Subscriber Service Card.

FACILITIES BROCHURE—A Research, Engineering, and Manufacturing Facilities brochure has been released here by the Gabriel Electronics Division of The Gabriel Company. The brochure depicts the new, ultramodern facilities at Millis and illustrates the utilitarian design of the structure for the engineer, research specialist, and for electronics component manufacturing.

Circle No. 209 on Subscriber Service Card.

NUCLEAR LAB INSTRUMENTS—A 64 page catalog of nuclear laboratory instruments and related accessories is now available from Tracerlab. The new "General Catalog F" contains complete descriptive information and specifications on all Tracerlab products for nuclear research, education and clinical applications. Among the instruments described are scalers, ratemeters, spectrometers, geiger, proportional, and liquid scintillation detectors, manual and automatic sample changers, data printers, high voltage power supplies, radiation research equipment, sample preparation and handling equipment, and personnel and safety protection equipment.

Circle No. 210 on Subscriber Service Card.

DIGITAL VOLTMETERS—A new 20-page, two-color bulletin on NLS SERIES 20 transistorized digital voltmeters, ratiometers and ohmmeters has been produced by Non-Linear Systems, Inc. The booklet covers the premium models in the NLS line. They include the M24 Multi-Purpose Instrument for measuring DC voltage, voltage ratio and resistance; the V24 Volt-Ratiometer for measuring DC voltage and voltage ratio; and the R24 Ratiometer for measuring DC voltage only.

Circle No. 211 on Subscriber Service Card.

INERT-GAS WELDING—A revised edition of Air Reduction's catalog on its complete line of manual, semi-automatic and automatic Heliwelding (Airco's tungsten-inert-gas welding process) equipment has just been published. The booklet also contains information on accessory equipment, tungsten electrodes, and filler wires used in conjunction with this welding process.

Circle No. 212 on Subscriber Service Card.

POTENTIOMETER TRANSDUCERS—A bulletin consisting of 4 pages filled with specification data for potentiometer transducers is available from H. E. Sostman & Co. Designed to serve as an assistance for the specifying engineer concerned with industrial instrumentation, the bulletin is thorough, yet concise in its treatment of transducer specifications as applied to pressure, motion, altitude, weight, flow, indicating, recording, systems and controlling.

Circle No. 213 on Subscriber Service Card.

FLUOROSCOPY—A new 4-page folder, describing Fluoroscopy with high-speed movies is available from Philips Electronic Instruments. The text discusses the new method for inspection of components and assemblies under actual operating conditions. The folder describes how units under test can be evaluated during functional conditions such as simulated high frequency vibration. Reliability diagnostic testing during preproduction evaluation and production non-destructive testing of critical components are also covered.

Circle No. 214 on Subscriber Service Card.

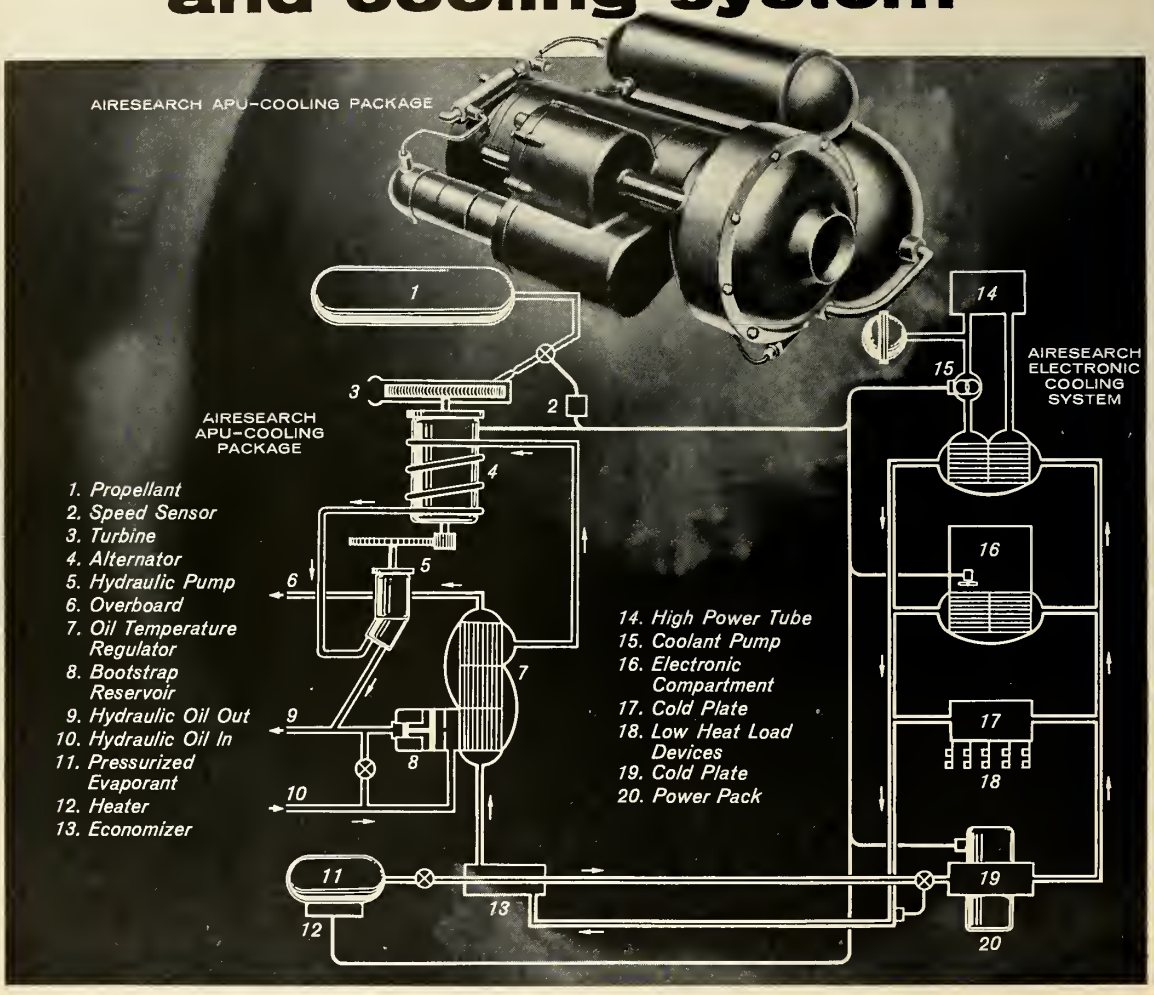
RARE EARTHS—Vitro Chemical Co. has issued a new brochure, containing complete technical information about various chemicals, metals and alloys of the rare earth group of elements, Thorium, scandium and yttrium. In addition to potential uses, it describes manufacture and lists detailed properties and chemical analysis of more than 50 products, several of which are now available for the first time on a commercial scale.

Circle No. 215 on Subscriber Service Card.

TELEMETER SIGNAL CONDITIONER CIRCUITS—Descriptions of the designs of signal conditioner units suitable for processing many types of outputs prior to transmission are included in this brochure by Texas Instruments, Inc. The more important designs, evaluated for missile use and which are available as off-the-shelf items are listed.

Circle No. 216 on Subscriber Service Card.

Integrated accessory power and cooling system



meets the most advanced missile and space vehicle requirements

AiResearch has developed a *single* system package for missiles and space vehicles to meet increasing accessory power and cooling load requirements in the face of decreasing size and weight allowances.

This integrated accessory power and cooling system supplies hydraulic power for actuating systems, 3200 or 400 cycle three-phase electric power for guidance and control, and at the same time provides cooling both for the APU and all electronic equipment operating in the missile or space vehicle.

The cooling system in the example shown here uses liquid ammonia as the expendable evaporant, and each heat load area has a separate temperature control valve. Alternator and controls, turbine assembly and APU liquid propellant fuel tank are patterned after operationally proven components.

World leader in the design and manufacture of cooling and accessory power systems, AiResearch has delivered more missile APUs than any other company, and is the leader in advanced electronic cooling systems for aircraft, missiles and spacecraft.

AiResearch design and manufacturing experience in these two fields includes: liquid and solid propellant APUs; hydraulic and hot gas actuators and control systems; 3200 and 400 cycle alternators; cold plates; expendable and closed cycle gas and liquid cooling systems; cryogenic cooling systems.

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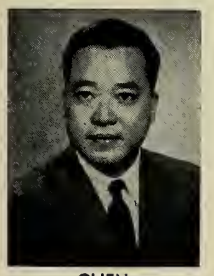
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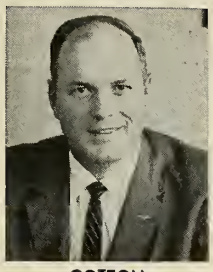
COTTON


GREYSON


KULLAS

B. S. Chen: Former assistant director of engineering at the space communications division of Radiation, Inc., joins Dynatronics, Inc. as manager of the design engineering division.

Dr. Isidor I. Rabi: Chairman of the President's Science Advisory Committee for the past 15 years and advisor to the Atomic Energy Commission and the Departments of State and Defense, named technical consultant to Loral Electronics Corp.

H. C. Cotton: Former sales manager for the Army's *Pershing* program at The Martin Co.'s Missile and Electronics Division, appointed to the newly created post of manager-advanced systems at Ryan Aeronautical Co.

William L. Greyson: Former director of research and development at Hitemp Wires, Inc., joins Dilectrix Corp. as director of research and development and chief of a "New Horizon" design and development department.

A. J. Kullas: Named technical director of The Martin Co.'s rocket booster portion of the Air Force *Dyna-Soar* program. He joined the firm in 1940 as a structures analyst and subsequently served as structures manager, chief engineer, manager of flight vehicle design engineering and manager of technical development.

Dr. Solomon L. Miller: Elected head of the research section of the research and development department of Rheem Semiconductor Corp. Was previously manager of the device analysis section in the semiconductor research department of IBM's Research Laboratory and prior to that a research physicist at Bell Telephone Laboratories working on semiconductor devices.

William Fitzwater, Jr.: Former senior design specialist with North American Aviation's Autonetics Division, joins Epsco-West as senior design specialist.

Arthur G. Wimer, Jr.: Named to the newly established position of chief scientist for the Air Research and Development Command (ARDC), the top civilian advisor to **General Bernard Schriever.**

Thomas LeSueur Hardy: Appointed senior systems engineer to head Arnoux Corp.'s new Huntsville, Ala., office. Previously served as design engineer for Martin-Orlando and as field engineer for both Col-Ins-Co., Inc. and Murphy Cota Co.

Myron A. Tracy: Manager of The Garrett Corp.'s Washington sales office, appointed manager of military relations responsible for conducting all prime military sales and contract negotiations for Garrett and its AiResearch Manufacturing divisions.

Peter W. Cummins: Supervisor of market research for the Continental-Diamond Fibre Corp., a subsidiary of The Budd Co., promoted to manager of product planning and market research.

Dr. Peter Fortescue: Who will continue to act as chief research and development engineer for the General Atomic Division of General Dynamics Corp., appointed chief research and development engineer of the newly organized General Atomic Europe.

Prof. Thomas Gold: Chairman of Cornell University's department of astronomy and director of its center for radiophysics and space research, elected special consultant to the National Research Corp. on projects relating to the direct conversion of solar energy to electric power.

Emory W. Farr: Special projects engineer for Statham Instruments, Inc., and **Joseph C. Sanchez,** lead engineer in the Structures Laboratory of North American Aviation, join Electro-Optical Systems, Inc., as project engineers in the Transducer Laboratory of the Solid State Division.

Donald P. Vaughan: Former director of sales for the Trimpot Division of Bourns, Inc., joins Spectrol Electronics Corp. as marketing manager.

Joseph Robert Lewis: Appointed director of engineering for the Sierra Electronic Division of Philco Corp.

Sam Cravitt: Joins Del Electronics Corp. as a senior research project engineer. Was formerly with Farrand Optical Co. as a research project engineer working in the field of infrared instrumentation, components, fire control and navigation systems.

F. Robert Walker: Former field sales manager of closed circuit TV equipment with General Electric, joins Gulton Industries, Inc. in the newly created position of manager of marketing.

Dr. Bernhard H. Goethert: Director of Engineering for ARO, Inc., contract operator for the USAF's Arnold Engineering Development Center, elected a member of a special scientific panel in the North Atlantic Treaty Organization's Advisory Group for Aeronautical Research and Development.

Charles E. Hunter: Special assistant to the president of Thiokol Chemical Corp., has temporarily been assigned to the West Coast area in connection with the corporation's rocket activities.

Louis H. Aricson: President and general manager of Daystrom, Inc.'s Transicoil Division, appointed vice president, human relations, in charge of executive development, industrial relations, public relations and advertising. He succeeds **L. E. Minkel,** who resigned to join Studebaker-Packard Corp.

Theodore Grant: Elected western office manager for the Aerospace Industries Association in Los Angeles, replacing **Capt. Leland D. Webb (USN-ret.)** retiring.

C. Wesley La Blanc: Former assistant to the president of the Magnavox Co., joins the United Industrial Corp. as assistant to the president.

Philip L. Sommer: Formerly with Chrysler Corp., where he was responsible for customer relations activities in Washington, appointed a Washington representative for Boeing Airplane Co.

John Mihalic: A vice president of Avco Corp. and president of its Nashville Div., named president of the Crosley Div., succeeding **F. C. Reith,** deceased.

Fred L. Schwab: Former sales manager of Phillips Control, appointed sales manager of Relay Sales, Inc.

——contracts——

NAVY

$1,400,000—Melpar, Inc., Falls Church, Va., for target detection devices and systems.

$304,415—Stanford Research Institute, Menlo Park, Calif., for design, development and manufacture of a parabolic antenna.

$82,211—Convair Division of General Dynamics Corp., San Diego, for design and development of a magnetic tape system.

$68,984—Lockheed Electronics Co., Plainfield, N.J., for design and construction of masts and stabilized platform.

$55,000—Microwave Electronics Corp., Palo Alto, Calif., for research on traveling wave amplifiers.

$31,560—AiResearch Mfg. Co. of Arizona, for research on the matching of propulsion systems to the ground effect machine.

$25,815—Dage Television of Thompson Ramo Wooldridge, Inc., Michigan City, Ind., for research on *ARCAS* videosonde.

AIR FORCE

Cook Technological Center, Morton Grove, Ill., for study, design and fabrication of a supersonic parachute sled test vehicle. Amount not disclosed.

$247,000,000—Boeing Airplane Co., for research and development connected with the hardened and dispersed concept in which the solid-propellant *Minuteman* will be placed in blast-resistant underground silos, ready for launching.

$15,625,000—General Electric Co.'s Heavy Military Electronics Dept., for AN/FPS-24 frequency diversity search radars.

$5,279,083—RCA Service Co., Division of RCA, for the complete management and operation of "White Alice" project.

$1,000,000—Space Electronics Corp., for fabrication of the electronic systems for the *AbleStar* upper stage booster. Subcontract from Aerojet-General.

$154,000—General Precision, Inc.'s Kearfott Div., Little Falls, N.J., for necessary personnel, facilities, materials and supplies to conduct an engineering study on the techniques and applications of recursive logic.

$136,000—General Instrument Corp.'s Advanced Development Laboratory, Westbury, N.Y., for development of a new type of airborne "telemetry" radio transmitter which will automatically beam back to earth data on conditions of the upper atmosphere.

$108,600—Lieb-Jackson, Inc., Columbus, Ohio, for fabrication, delivery and installation of a complete diffuser section and heat exchanger.

$100,000—The Martin Co., Baltimore, for providing a 15-year master plan of checkout systems for manned and unmanned weapons.

ARMY

Servomechanisms, Inc., Research Division, Goleta, Calif., for development and fabrication of a 560-watt thermoelectric generator. Amount not disclosed.

Piasecki Aircraft Corp., Philadelphia, has received a subcontract for the complete airframe manufacture of a new missile. Amount not disclosed.

Redstone Machine & Tool Corp., Huntsville, for fabrication and assembly of missile components, tooling and equipment—*Saturn*. Amount not disclosed.

$7,199,262—Convair, Division of General Dynamics, Pomona, for development of the *Mauler* missile system. (Two contracts.)

$6,597,644—Western Electric Co., Inc., New York City, for engineering services on the *Nike-Hercules*.

$4,069,000—Western Electric Co., Inc., New York City, for components of the Missile Monitor system.

$3,393,601—General Electric's Missile Production Section, for safing, arming and fuzing systems for advanced surface-to-surface missiles. (Two contracts.)

$3,159,303—Syivania Electric Products, Inc., Needham, Mass., for a large-scale mobile digital computer.

$1,434,000—Morrison-Knudsen Co., Inc., Honolulu, for construction of a *Nike-Hercules* project, Oahu, Hawaii.

$1,160,000—Sylvania Electric Products, Inc.'s Electronic Defense Laboratories, Mountain View, Calif., for design, fabrication, installation and field support of specialized electronic warfare equipment.

$1,000,000—Hallamore Electronics, division of The Siegler Corp., for special test equipment for the *Titan*.

$620,187—Brown Engineering Co., Inc., Huntsville, Ala., for engineering and manufacturing services—*Saturn*.

$297,955—Edward R. Marden Corp., Brookline, Mass., for construction of additional facilities, satellite tracking station, New Boston, N.H.

$250,000—Temco Aircraft Corp., Dallas, for manufacture of aluminum outer shells for the guidance and warhead sections of the *Hawk*. Subcontract from Raytheon Co.'s Missile Systems Div.

$235,000—Lockheed Aircraft Corp., Marietta, Ga., for fabrication and assembly of miscellaneous components for *Saturn*.

$234,000—Century Tool Co., Camden, N.J., for electro-mechanical guided missile tool kit for *Hawk*.

$172,147—Parkhill-Goodloe Co., Jacksonville, Fla., for dredging a channel and turning basin to accommodate *Saturn* unloading facilities at Cape Canaveral.

$155,500—Rothwell Construction Co., Ltd., Honolulu, for construction of a *Nike-Hercules* maintenance shop.

$101,075—U.S. Amalgamated Constructors, Inc., Tampa, for construction of a 2800-sq.-ft. concrete frame and block building to house ground-air transmitter-receiver equipment at MacDill AFB.

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editorial . . .

Douglas Gives Our Defense Position

For some time there has been a strong conviction that the Department of Defense should outline for the defense industry its policies and plans, as near as possible, for the future. Some months back, on this page, we pointed out the need for guidance in such important matters as diversification, consolidation and reduction.

In a recent statement directed at the industries responsible for the development of most of the nation's missile/space products, James H. Douglas, Deputy Secretary of Defense, has done just that. Although he hedges with cautious admissions that forecasting even a year or two ahead is subject to a considerable margin of error, the former Air Force Secretary plants several clear sign posts for the road ahead. Some of them are:

That for the big primes in the aircraft and missile/space industry there has been a decline of 50% in the floor space requirements since 1957—with a further contraction of another 50% probable in the next three years.

That the defense industry must be increasingly alert to the possibilities of foreign sales. While he did not specify, this is particularly true in the field of small missiles and rockets, both for military use and for space exploration.

That if consolidations and mergers become necessary to maintain skills and capacities, DOD will be interested in exploring the possibilities with industry.

Mr. Douglas pointed out that in formulating the '61 budget the Pentagon made it clear there was no bright prospect ahead that world tensions would relax, and indicated the '62 budget would reflect the same thinking. Specifically in the missile/space field, he listed the following probabilities:

That there are "persuasive reasons" for believing the missile-carrying B-70, or a weapon system with similar capabilities, will be built.

That the nuclear-powered aerial platform for both air-to-air and air-to-ground ballistic missiles will not be in the inventory for a number of years.

That missile expenditures in '62 seem likely to be about the same as '61, a program designed to give us an "immense mixed capability" by the end of calendar 1963.

Our present liquid missiles and the solids under development will be followed by improved versions or by "a new family of missiles," he said.

He saw a continuing demand for rocket boosters for both our military and our civil space programs.

And finally, Mr. Douglas forecast that the dollar volume of business, although perhaps changing in character and more widely spread, would continue to be "very large" in aviation products, missiles and space products.

While the Secretary's statement may contain little that is new or startling, it is an analytical summation of DOD thinking and attitude quite in keeping with Mr. Douglas' cautious but lucid approach to the problem. It is a paper the defense industry welcomes.

Clarke Newlon

THE HYCON AN/ART-27 RADIO BEACON

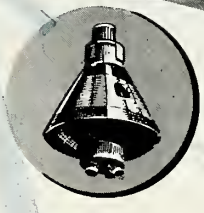
IN SPACE

Automatic set-up and data transmission from celestial bodies.

Solid Propellant

GAS GENERATORS

for Bag Inflation



PROJECT MERCURY PARACHUTE EJECTION

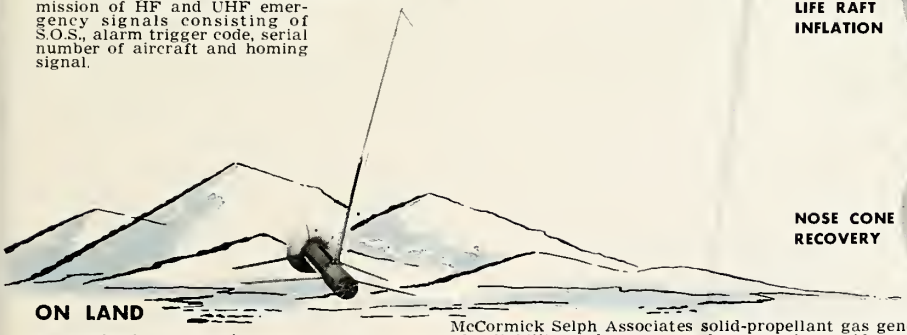
HELICOPTER FLOTATION

LIFE RAFT INFLATION

NOSE CONE RECOVERY

AT SEA

On sea as on land, completely automatic operation and transmission of HF and UHF emergency signals consisting of S.O.S., alarm trigger code, serial number of aircraft and homing signal.



ON LAND

A completely automatic rescue beacon, automatically ejects itself from downed aircraft and sets up on any type terrain. The electronic life line between crash and rescue.

Note: For beacon information contact Hycon Mfg. Company, Pasadena, Calif.

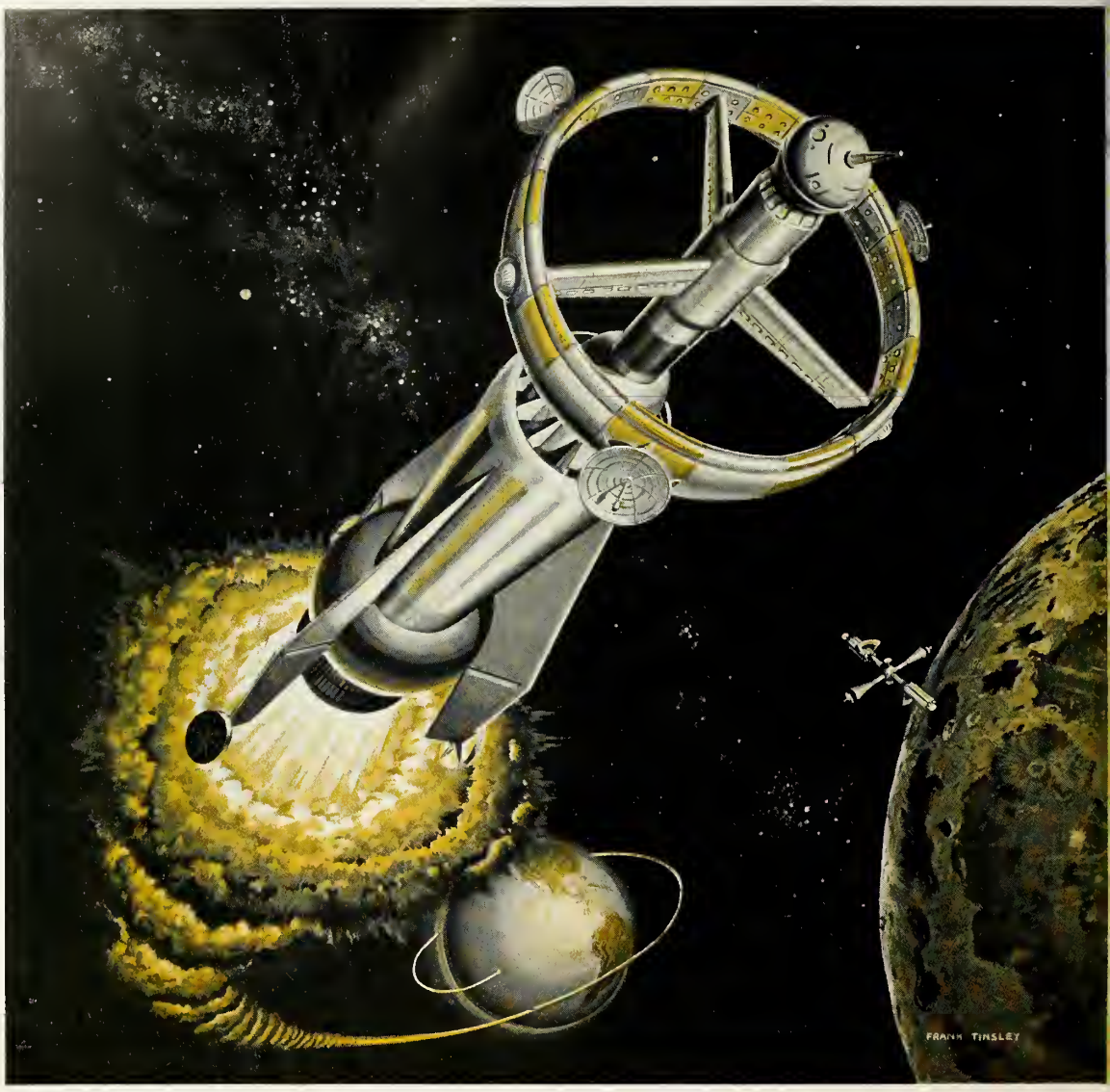
McCormick Selph Associates solid-propellant gas generators have a record of reliability and proven performance in a wide variety of applications. In the AN/ART-27 Radio Locator Beacon, produced by Hycon Manufacturing Co., a Mc/S/A bag inflation system provides flotation in the event of water landings or a shock absorber cushion for land impacts. Inflation is accomplished in 1.25 seconds and units will operate in temperature environments of −65°C to +72°C. These gas generator systems are extremely light, operate in seconds and are rugged and dependable. Other applications include Project Mercury parachute ejection, helicopter flotation, life raft inflation and nose cone recovery. Write Mc/S/A Applications Engineering Dept. for technical details.

EXPLOSIVE ORDNANCE

McCormick Selph Associates

HOLLISTER AIRPORT/HOLLISTER, CALIFORNIA

Circle No. 89 on Subscriber Service Card.



STEPS IN THE RACE TO OUTER SPACE

Atomic Pulse Rocket

This is the Atomic Pulse Rocket, a pot-bellied space ship nearly the size of the Empire State Building, propelled by a series of atomic blasts.

The enormous rocket (weighing 75,000 tons fully loaded) is designed to leave Earth with a thrust of 100,000 tons. Altogether a thousand atomic blasts—each equal to 1,000 tons of TNT—are fired from a low velocity gun into a heavy steel rocket engine at a rate of one per second until the vehicle leaves Earth's atmosphere. Then steam and vaporized steel maintain the thrust. After transit speed is reached, and the propulsion system shut off, power is provided by solar batteries plating the wing and body surfaces.

Inside the rocket, living quarters are situated in the rim of a pressurized wheel-like cabin which revolves to provide artificial gravity. Radio and radar antennae revolve with it. Tubular hydroponic "gardens" on either side of the rim grow algae to produce oxygen and high protein food.

The Atomic Pulse Rocket could transport payload to the Moon at $6.74 per lb., less than one quarter the prevailing air freight charges over equivalent distance.

A similar project is past the pilot-study stage in the Defense Department.

ARMA, now providing the inertial guidance system for the ATLAS ICBM and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, ***ARMA*** needs scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH ARMA CORPORATION