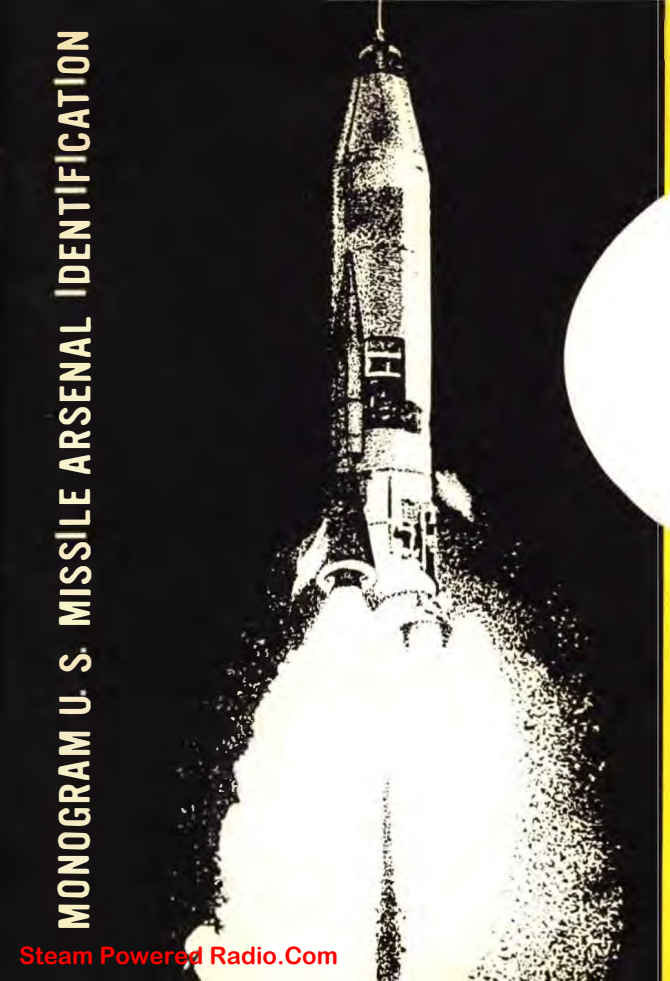
MONOGRAM U. S. MISSILE ARSENAL IDENTIFICATION



Know the Missiles!

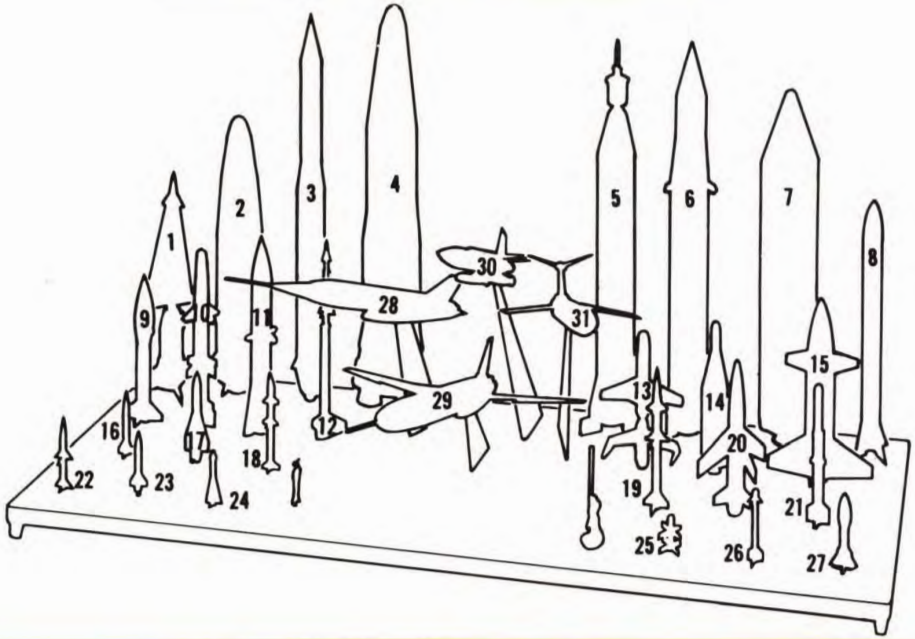
Introduction by **Willy Ley**

Photo-rendering:

Air Force firing of Convair ATLAS

Contents:

Numbers refer to key at right



— WILLY LEY

Born in Berlin in 1906 and now a citizen of the U. S., Willy Ley is known as an outstanding expert on rockets, missiles, and space travel. Mr. Ley became interested in rockets and in 1927 was one of the founders of the German Rocket Society. Mr. Ley has been a contributor to LOOK, COLLIER'S, ORDNANCE, AERONAUTICAL ENGINEERING REVIEW, is author of a syndicated newspaper column; author of more than ten books on scientific subjects, and has recently been appointed to a full professorship in the Science Dept., Fairleigh Dickinson Univ. Mr. Ley is a member of many outstanding scientific groups such as Institute of Aeronautical Sciences, Amer. Soc., for Advancement of Science, American Rocket Soc., New German Rocket Soc. (Hon.) and British Interplanetary Society (Fellow).

Introduction . .

Rockets are not new! The first records of their use date to 1232 A.D. when the Chinese used them against invading Mongolians. These "flaming fire arrows" were hollow bamboo tubes filled with gunpowder. Their effect was to frighten and demoralize the enemy. The use of rockets in warfare spread westward and in the late 1700's, they were used against the British in India. The British began the study of rockets for use by their army.

During the Napoleonic wars, rockets were used extensively by the British. These rockets, developed by Colonel William Congreve in the early 1800s, weighed about 32 pounds and had a range of about 2000 yards. They were stabilized in flight by means of a 15-foot guide stick, very similar to those on our Fourth-of-July Skyrockets. These rockets were used by the British against American forces at the battle of Fort McHenry, and immortalized in our National Anthem's "... the rocket's red glare".

The U. S. Army organized its first rocket battery in 1846. The rockets used were greatly improved by the substitution of canted fins for a stabilizing stick; a development by William Hale. These forerunners of the modern rocket were used in the Mexican War with promising results. However, by 1860 artillery accuracy had been greatly improved with the development of the rifled cannon and once again rockets fell into disuse as a military weapon.

Shortly after World War I Dr. Robert H. Goddard of Clark University began experiments with modern rockets, and successfully launched a rocket using liquid oxygen and gasoline as fuel. This rocket reached an altitude of 7,500 feet with a maximum velocity of 550 m.p.m. Many of Dr. Goddard's developments are used today on our modern missiles and Dr. Goddard is considered the father of modern Rocketry.

During World War II, two outstanding weapons were developed using rocket power. The American "Bazooka" is actually a rocket launcher. The German V-1 "Buzz-Bomb" and later V-2 were tremendously effective in the battle of Britian and almost succeeded in changing the outcome of the war. The German Peenemunde rocket research effort has been ranked in importance with the American Manhattan Project which created the atom bomb. Today, many of the original German scientists from the Peenemunde project are actively working in the United States on the American Missile program.

Although not generally known, the U.S. had a guided missile program well under way before the end of World War II, and by the end of 1943 the Army had established a Rocket Branch, charged with the responsibility of developing the Army's whole new family of rockets and guided missiles. Missile batteries have been in active service with the Army since the first guided missile unit was activated in October, 1945.

In the period after World War II, America placed great emphasis on the development of rocket powered missiles and the names Hermes, WAC Corporal, Viking and others began to be seen in the news. These were early experimental rockets that helped pave the way for todays missiles and tomorrows space ships.

The missiles in the following pages are now in service or are in late development stages. We have a successful ICBM in the Snark, which has flown over 5000 miles. We have launched guided missiles from a submarine (Regulus II), have satellites in orbit around the earth and are readying a rocket for a shot at the moon! Responsible scientists have said we can have a manned missile in orbit by the middle of 1960! Space travel is now a probability rather than a wild dream!

Information in the following pages is based on the most authoritative sources, however, specific data as to the exact size, performance and characteristics has not been released on some missiles.

VANGUARD

Satellite Vehicle
U. S. Navy
—Martin

U. S. Navy Vanguard leaving its launching pad at Cape Canavarel. Tower at left holds fueling lines and electrical connections.

Vanguard is an advanced design, 3-stage rocket designed to put the United States' satellite into orbit. The satellite program was undertaken at the request of the National Academy of Sciences as the U. S. contribution to the International Geophysical Year (IGY)

A three-stage rocket, Vanguard must raise itself in several stages of flight, powered and coasting, to an initial satellite orbiting altitude of 300 miles. The first stage is powered by a G. E. rocket engine using a liquid fuel and raises the entire vehicle to about 36 miles.

The second stage, also a liquid fueled rocket, raises the satellite to orbiting altitude, and with the first stage, has given the satellite about half of its orbiting velocity.

The third stage is a solid propellant rocket, unguided but maintained on course by a spinning motion. This stage, fired at orbital height, provides the remaining required velocity to put the satellite into orbit.

Because of its extremely advanced design, difficulties were encountered on several attempts at launching, but with the "bugs" overcome, Vanguard successfully launched the Satellite Vanguard I, March 17th, 1958.

Photo Courtesy Martin Company

U. S. Army Jupiter C in launching position. Huge Gantry crane is at right. Crane can be rolled up to missile for servicing and fueling.

JUPITER C

Satellite Vehicle
U. S. Army
—Chrysler

The Jupiter C is a four-stage research test vehicle developed in connection with nose-cone re-entry problems arising when a ballistic missile nose-cone leaves outer space and encounters the relatively heavy atmosphere near the earth. The first stage is the proven REDSTONE ballistic missile engine using liquid fuel.

Upper stages consist of solid-propellant rocket motors which boost the satellite into required speed for orbiting. The 4th stage actually fires the satellite into orbit, and when spent, continues in orbit with the satellite.

The Jupiter C was built at Redstone Arsenal, the Army's Ballistic Missile Agency at Huntsville, Alabama, and as early as 1956 reached a range of more than 3,300 miles during test flights.

Not originally intended as a satellite launching vehicle, it was adapted for this purpose in less than 3 months and successfully launched the satellite Explorer I on January 31st, 1958. Subsequently, Jupiter C missiles launched other Explorers

Official U. S. Army Photo

REGULUS II

Surface-Surface
U. S. Navy
—Chance-Vought

Photo Courtesy Chance-Vought Aircraft

U. S. Navy Regulus II Missile leaving its portable launcher in test flight. Note booster rocket beneath missile, which will drop off after launch.

The U. S. Navy's Regulus II is a surface-to-surface missile designed for launching from submarines and surface vessels as well as from land installations. It is a winged, air-breathing missile, 57 feet long and weighing 12 tons. Powered by a G. E. J79 turbojet with afterburner it has a range of about 1500 miles with a top speed approaching Mach 2. A solid-fuel rocket booster assists in launching. The Regulus II is controlled in flight either by a command or inertial guidance system. Capable of carrying a nuclear warhead, Regulus II is in production and is scheduled to replace the earlier sub-sonic Regulus I which has been in service.

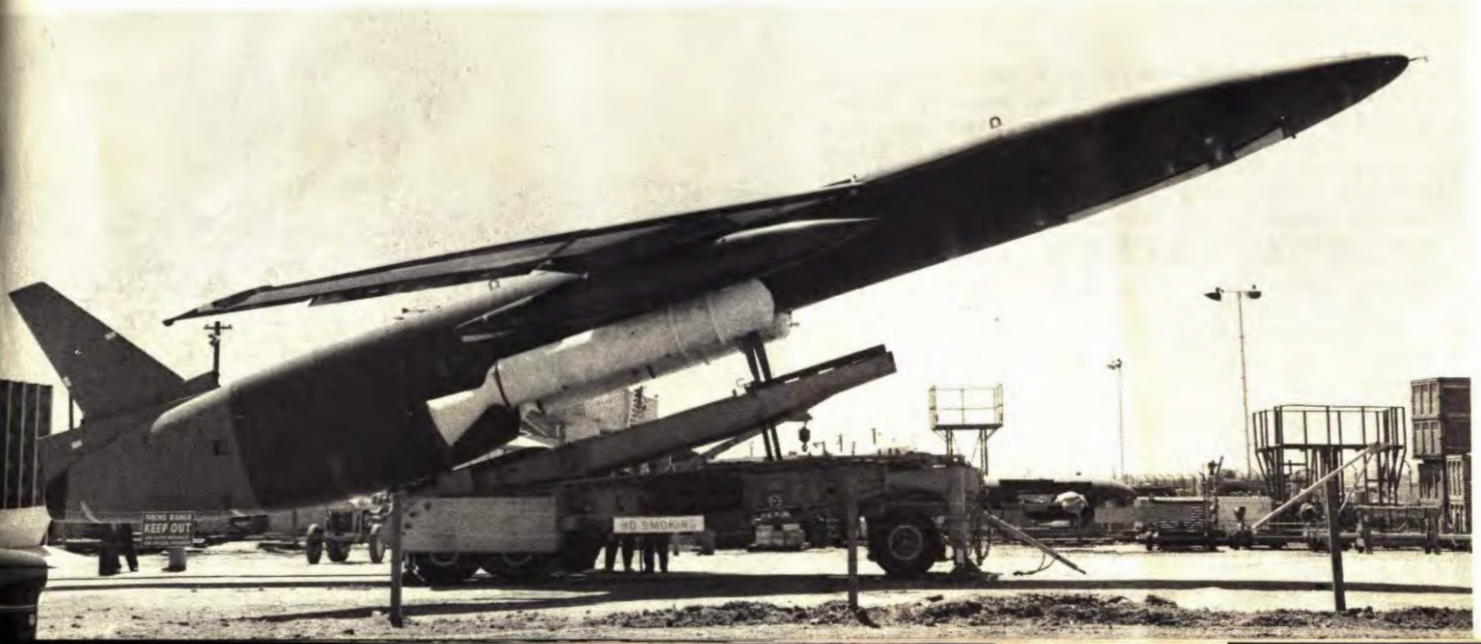
SNARK

Surface-Surface
U. S. Air Force
—Northrop

Snark is the Air Force intercontinental guided missile powered by an air-breathing Pratt & Whitney J-57 turbojet engine, plus two solid-fuel rocket boosters to aid in launching. A surface-to-surface missile, it has a range of about 5000 miles with a top speed of Mach 0.94. The Snark can be "zero" launched from a mobile launcher in a relatively small area. Missile and launcher can be air-lifted to any point in the world. The Snark is controlled in flight by means of inertial and celestial guidance equipment. The Snark is now in service and is the only intercontinental guided missile in the free world. It carries a nuclear warhead.

USAF Snark on portable launcher. Note booster rockets on each side of fuselage. Launcher is towed by high speed tractor.

Photo Courtesy Northrop Aircraft



MATADOR

Surface-Surface

U. S. Air Force

—Martin

The first operational missile with the Air Force, the Matador has been in service in Germany for the past four years. The Matador is powered by an Allison J-33 air-breathing turbojet and uses a solid fuel rocket booster in launching. Overall length is 45 feet; range is over 600 miles at a speed of Mach 0.9. The Matador is controlled by an MSQ Radar guidance system, but other guidance systems are interchangeable. The missile is capable of carrying a nuclear warhead weighing up to 3000 lbs.

USAF Matador being readied for test flight from its portable transporter - launcher. Solid-fuel booster has not yet been mounted beneath the tail of the missile.

CORPORAL

Surface-Surface

U. S. Army

—Firestone

U. S. Army Corporal Missile on portable launcher. Crane at right is used for servicing the missile.

The Army's Corporal was the first ballistic missile developed by this country. It is powered by a liquid-fuel rocket engine and carries either a high explosive or nuclear warhead. A surface-to-surface missile, 46 ft. long, Corporal is fired from a launching pad, where it is placed by a self-propelled, electrically powered transport-erector. Control is by command guidance system. Basic firing data is computed and entered as "dial settings" before the missile is launched. After firing, minor corrections are made to the trajectory to insure accuracy. Range is about 50 miles at a velocity of about Mach 3.

Official U. S. Army Photo

JUPITER

Surface-Surface
U. S. Army
—Chrysler

Designed by the Army's Ballistic Missile Agency, Jupiter is intended to carry a nuclear warhead approximately 1500 miles. Powered by a Rocketdyne liquid-fuel rocket engine developing approximately 150,000 lbs. of thrust, Jupiter attains a velocity of 10,000 mph and reaches altitudes up to 300 miles. Overall length of the missile is 58 feet and it weights approximately 105,000 lbs. Jupiter is now in initial production status. Control is supplied by an inertial guidance system.

U. S. Army Jupiter begins its rise from the launching pad in a successful test flight at Cape Canaveral, Florida.

Official U. S. Army Photo

REDSTONE

Surface-Surface
U. S. Army
—Chrysler

Redstone is the Army's medium range missile (200-300 miles) and was designed by the Wernher von Braun team of former German Scientists at the Army Ballistic Missile Agency. It is powered by a liquid-fuel rocket engine burning liquid oxygen (LOX) and alcohol, developing 75,000 lbs. of thrust. The guidance system is entirely self-contained. Target data is fed into a program device which plays back the information to the various components of the control system in flight. Redstone is approximately 69 feet long and weighs 45,000 lbs. It is capable of carrying a nuclear warhead.

U. S. Army Redstone missile being fueled. Frost band on outer shell is caused by Alcohol and Liquid Oxygen fuel.

Official U. S. Army Photo

ATLAS

Surface-Surface
U. S. Air Force
—Convair

Atlas is America's largest missile and the first intercontinental ballistic missile project. It is 75 ft. long and weighs about 243,000 lbs. It is currently in the final phase of its development program. Powered by a sustainer engine and two boosters, all of liquid-fuel type by Rocketdyne, and developing a total of 360,000 lbs. of thrust, its maximum velocity is 15,000 mph. Flight control is by Radar Command guidance system. Atlas carries a nuclear warhead over a range of 5000 to 6000 miles.

USAF Atlas ICBM towers aloft on its launching stand at Cape Canaveral as the gantry service tower is moved away.

Official U. S. Air Force Photo

THOR

Surface-Surface

U. S. Air Force

—Douglas

Thor is the Air Force IRBM and is also being used as a test vehicle in the "Thor-Able" re-entry problem tests and in the forthcoming lunar probes. Powered by a Rocketdyne liquid-fuel rocket engine developing 165,000 lbs. of thrust the Thor reaches a maximum velocity of 10,000 mph. It has an overall length of 62 ft. and weighs approximately 100,000 lbs. Its range is 1500 to 2000 miles with a nuclear warhead. Control is by inertial guidance.

USAF Thor leaving its launching pad in a test launching. Thor is intermediate range ballistic missile developed by Douglas Aircraft Co.

Photo Courtesy Douglas Aircraft

SERGEANT

Surface-Surface
U. S. Army
—Sperry

Latest addition to the Army family of guided missiles, Sergeant will eventually replace the four-year old Corporal. Highly mobile, Sergeant has been greatly simplified, both in handling and guidance controls, to minimize maintenance requirements and handling procedures. Sergeant is 30 ft. long and is powered by a solid-fuel rocket engine of 50,000 lbs. thrust. Its range is about 100 miles with a nuclear warhead. It is controlled by an inertial guidance system.

U. S. Army Sergeant missile elevated to launching position at White Sands Proving Ground.

Official U. S. Army Photo

U. S. Army Dart missile mounted for display purpose on a standard Jeep. In use it can be fired from a launcher mounted on a Jeep or truck.

DART

Surface-Surface
U. S. Army
—Aerophysics Development

The Army's Little (5 ft.) Dart is an anti-tank, anti-placement weapon used by infantry or armored units. Powered by a solid-fuel rocket motor, it has a range of about 6000 ft. It is launched from a portable launcher mounted on a standard army vehicle and can be fired by one man. Guidance is optical and an automatic computor transmits signals to the flying rocket through a wire trailing from the rocket. Dart carries a high-explosive warhead.

U. S. Army Lacrosse on launcher mounted on standard Army truck. Wings and fins are removable for transporting and snap into fuselage slots.

Lacrosse is an Army surface-to-surface guided missile with a range of about 20 miles. It is an artillery type weapon designed for use from immediately behind combat areas and is controlled by radar from forward positions or from the air. Lacrosse uses a solid-fuel rocket engine; is 19.5 ft. long; and is launched from a portable launcher mounted on a standard Army truck.

LACROSSE

Surface-Surface
U. S. Army
—Martin

HONEST JOHN

Surface-Surface
U. S. Army
—Douglas

The Army's Honest John is a free-flight or unguided missile having no electronic controls. It is an artillery type weapon designed for close support of ground troops. Propelled by a solid-fuel rocket, it is fired from a mobile, self-propelled launcher and carries an atomic or high explosive warhead. 27 ft. long, it has a range of 20 miles.

U. S. Army Honest John missile on portable transporter-launcher. Missiles will replace heavy artillery for field use.

LITTLE JOHN

Surface-Surface
U. S. Army
—Douglas

Designed by Redstone Arsenal to supplement the Honest John, Little John is an unguided or free flight missile with a range equal to medium field artillery. Powered by a solid-fuel rocket motor and launched from a portable launcher, it is highly mobile. The missile and launcher can be transported by helicopter. Only 12 ft. long, Little John uses several types of high explosive warheads.

U. S. Army Little John missile on display stand. In use the Little John is launched from a rail launcher which can be towed behind a Jeep.

NIKE-AJAX

Surface-Air
U. S. Army
—Bell Telephone

U. S. Army Nike-Ajax missile being raised to launching position at White Sands Proving Ground.

Already obsolete and undergoing replacement by Nike-Hercules, Nike Ajax is the U.S. first surface-to-air missile. The original Nike program was begun in 1945 and over 10,000 Nike-Ajax missiles are now in service at over 100 sites in 15 defense areas within the U. S. A two-stage missile, Nike-Ajax is accelerated to supersonic speeds by a solid-fuel booster, which drops off, and the 2nd stage liquid-fuel rocket takes over. Guidance is by Radar Command and maximum range, 35 miles. Total length, with booster, is 35½ feet.

Official U. S. Army Photo

U. S. Army Nike-Hercules in launching position at White Sands Proving Ground. Tubes in bottom half of missile are booster rockets.

NIKE-HERCULES

Surface-Air

U. S. Army

—Western Electric

Nike-Hercules, now replacing Nike-Ajax missiles, has many times the destructive power of the older missile and more than twice the range (75 miles). Hercules is a two-stage missile with the booster stage made up of four solid-fuel rockets with a single solid-fuel rocket for the 2nd stage. The guidance system employs three radars, a computer, automatic plotting boards, power generators and other equipment in the ground support system. Overall length is 41½ feet with booster. Hercules makes full use of the Nike-Ajax launching equipment already installed around the country.

Official U. S. Army Photo

BOMARC

Surface-Air

U. S. Air Force

—Boeing

Bomarc is an Air Force supersonic, pilotless interceptor powered by two ram-jet engines using liquid fuel. Initial launching is accomplished by means of a liquid-fuel rocket engine in the tail which accelerates the missile to a speed sufficient to make the ram-jet engines operational. The Bomarc is 46.7 feet long and weighs about 15,000 lbs. It has a range of about 250 miles and reaches a speed approaching Mach 2.5. Launching is from a permanent launcher-shelter installation. Guidance is GCC/Radar Homing. The Bomarc carries a nuclear warhead.

USAF Bomarc interceptor missile at the moment of vertical launch. Arm at right is used to raise missile to vertical and is dropping away.

TALOS

Surface-Air
U. S. Navy
—Bendix

A surface-to-air missile, Talos is designed to destroy enemy aircraft at ranges up to 65 miles. It is launched from the deck of naval ships and now forms the major armament of the light cruiser Galveston. Powered by a ramjet engine, it is launched by means of a booster rocket using solid fuel. Initial guidance to the target area is by radar beam, after which the missile homes on the target by means of radar homing equipment in the missile. Talos is 30 feet long including the booster.

U. S. Navy Talos missiles on the Navy's "U.S.S. Desert Ship" at White Sands Proving Ground. Installation is similar to that aboard ship.

Official U. S. Navy Photo

TERRIER

Surface-Air

U. S. Navy

—Convair

Terrier is an anti-aircraft surface-to-air missile powered by a solid-fuel rocket engine and designed for use from destroyers and other naval ships. In launching, it uses a solid-fuel booster rocket and its total length with booster is 27 feet. Guidance is by radar beam, directed from shipboard. Terrier is now in service with the fleet and is scheduled to be replaced in 1961 by Tartar.

U. S. Navy Terrier missiles in their launching mount on the deck of a Navy cruiser. These missiles replace traditional deck guns.

Photo Courtesy Convair

TARTAR

Surface-Air

U. S. Navy

—Convair

Official U. S. Navy Photo

U. S. Navy Tartar photos have not been released, but this picture of Terrier missiles illustrates the general shape of the Tartar which is a smaller version of the Terrier.

Tartar is a surface-to-air anti-aircraft missile for use from destroyers and other small naval vessels. Similar to Terrier in appearance, it is about three-fourths the size. Tartar uses, in addition to initial beam-rider guidance, a homing guidance device which takes over as the missile enters the target area. Propellant is a solid-fuel.

HAWK

Surface-Air

U. S. Army

—Raytheon

Designed as a defense weapon against low-flying aircraft, the Hawk is a versatile and highly mobile missile. It uses a solid-fuel rocket motor and is controlled by a radar system that covers the "blind" spots of radar used to detect high-flying aircraft. The portable launcher carries three missiles which can be fired in rapid sequence. Launcher and missiles can be transported by truck or helicopter. The Hawk can also be used in permanent installations to supplement the Nike system. Missile is 17 feet long, weighs about 1200 lbs. and has a range of 22 miles in a low level trajectory.

U. S. Army Hawk missiles on portable launcher as used in field. Launcher is towed by truck. Missiles are also used from fixed installations.

Photo Courtesy Raytheon Corp.

BULLPUP

Air-Surface
U. S. Navy
—Martin

Official U. S. Navy Photo

U. S. Navy Bullpup missiles being loaded under wing of FJ Fury fighter at U. S. Naval Air Missile Test Center.

Bullpup is the Navy's efficient air-to-surface missile designed to provide fire support to ground troops. It is powered by a solid-fuel rocket motor and its warhead is a 250 lb. bomb. Total length is 11 feet and range is about 5 miles. It is guided from the launching aircraft, which can carry four of the missiles slung beneath the wings.

RASCAL

Air-Surface
U. S. Air Force
—Bell Aircraft

The Rascal is a liquid-propellant rocket missile of the Air Force. In use, it is carried on an outrigger pylon on the right side of a DB-47 Stratojet bomber to within 100 miles of the target where it is launched, permitting the bomber and crew to avoid the defending interceptors. It is guided by radar command and has a velocity of Mach 1.5. Gross weight is 13,000 lbs. with its nuclear warhead.

USAF Rascal on transporter-loader. This unit lifts the missile up for attaching to the fuselage of a DB-47 Stratojet bomber.

PETREL

Air-Underwater
U. S. Navy
—Fairchild

U. S. Navy Petrel missiles mounted beneath wings of Lockheed P2V6-B.

Petrel is an air-to-underwater missile used by the U.S. Navy as an anti-submarine weapon. It is 24 feet long with a wing span of 13 feet and weighs 3800 lbs. It is powered by a J-44 turbojet engine. In use, it is carried beneath the wings of a carrier-based aircraft and launched in the general direction of an enemy submarine. It employs a radar homing system for final guidance.

POLARIS

Underwater-Surface
U. S Navy
—Lockheed

Polaris, the Navy's top-priority IRBM, is designed to be fired from surface ships as well as from submerged submarines. Smaller and lighter than other IRBMs, a sizeable number of the missiles can be carried by a single submarine. In use, Polaris would be fired at enemy shore installations from beneath the surface of the sea at distances up to 1500 miles. Polaris is powered by a solid-fuel rocket engine, plus a solid-fuel booster. The missile is fired from the submerged submarine, into the air where its inertial guidance system takes over. The missile is 26½ feet long and weighs about 28,000 lbs.

U. S. Navy Polaris test vehicle clears the surface seconds after being fired from a submerged launching cylinder. When operational, the Polaris will be launched from submerged submarine.

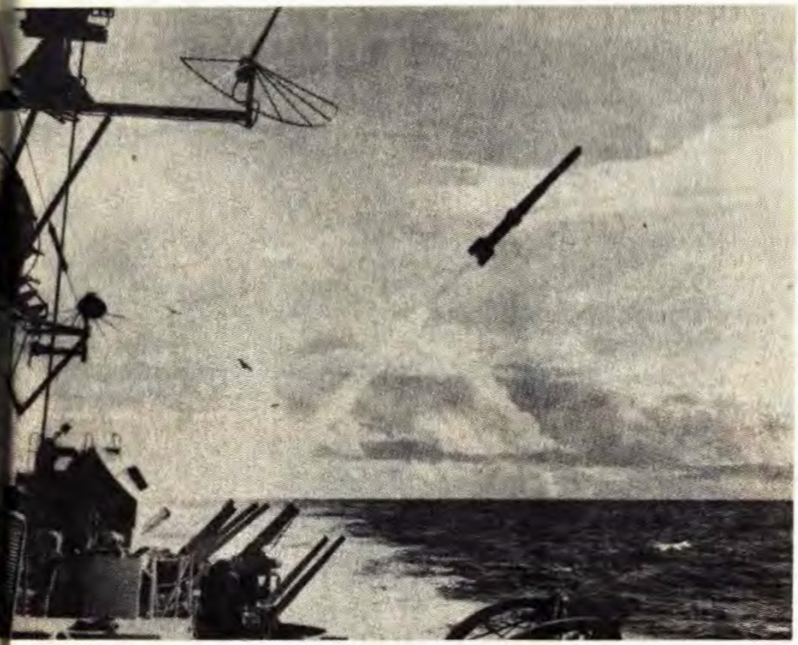
Official U. S. Navy Photo

RAT

Surface-Underwater

U. S. Navy

—Naval Ordnance



U. S. Navy Rat being launched from a destroyer. At the end of its flight path, two parachutes lower the torpedo into the water.

The Rat (rocket assisted torpedo) is a Navy missile launched from a destroyer through the air in the general direction of an enemy submarine. As the missile nears its target, it is lowered to the surface by a parachute. Entering the water, the parachute is discarded and the torpedo portion continues to the target by sonar guidance. Rat uses a solid-fuel rocket for the first part of its flight and a standard torpedo engine for the underwater portion. It is 16 feet long and weighs about 450 lbs.

SPARROW

Air-Air

U. S. Navy

—Raytheon

Official U. S. Navy Photo

U. S. Navy Sparrow missiles mounted beneath wings of Navy fighter aircraft. Four missiles provide plane with tremendous firepower.

Sparrow is a Navy air-to-air guided missile and the most advanced of its type. In use it is carried beneath the wings of carrier-based aircraft and guided to its target by a radar homing device. The missile is 12 ft. long and weighs 350 lbs. Up to four can be carried at one time. It uses a solid fuel rocket engine and carries a high explosive warhead.

The Sidewinder is a simple air-to-air homing missile using an infra-red system which usually guides the missile up the tailpipe of the target aircraft. The missile is 9 feet long and weighs 55 lbs. It utilizes a solid-fuel propellant and carries a high-explosive warhead.

SIDEWINDER

Air-Air

U. S. Navy

—Philco

U. S. Navy Sidewinder missiles mounted beneath wings of Navy carrier-based fighter plane.

Official U. S. Air Force Photo

USAF Falcon being prepared for mounting beneath the wing of an Air Force fighter aircraft.

FALCON

Air-Air

U. S. Air Force

—Hughes

Falcon is an Air Force air-to-air missile designed for launching from an interceptor for destruction of attacking bombers. Powered by a solid-fuel rocket, it is the smallest missile in operational service. Length is 6 feet and weight is about 100 lbs. It employs a radar homing guidance system.

Artist's conception of the Air Force Genie missile. Missile is shown on type of 4-wheel dolly used to transport missile to waiting plane.

GENIE

Air-Air

U. S. Air Force

—Douglas

The Genie is an Air Force air-to-air missile carried by fighter aircraft. At time of publication specific information has not been released, but it is believed to be approximately 8 feet long. It probably employs a beam-rider type of guidance.

GLOSSARY *of Missile and Rocket Terms*

A.B.M.A.	Army Ballistic Missile Agency, Redstone Arsenal, Huntsville, Alabama
AIR BREATHING	Propulsion method whereby air is taken in and expelled in the form of a jet.
BALLISTIC MISSILE	Vehicle whose flight path after termination of thrust has zero lift and is subject to gravitation and drag.
BOOSTER	An auxiliary propulsion system.
GUIDANCE	The process of determining the path of a missile and maintaining the missile on that path.
GUIDANCE, BEAM RIDER	A guidance system utilizing a beam, usually Radar.
GUIDANCE, COMMAND	A guidance system whereby information is transmitted to a missile from an outside source.
GUIDANCE, HOMING	A system in which the missile steers toward a target by means of reflection (Radar) or emission (infra-red, heat or sound).
GUIDANCE, INERTIAL	A system in which all guidance components are located aboard the missile.
GUIDED MISSILE	An unmanned missile whose flight path can be altered by a mechanism within the missile.
ICBM	Intercontinental Ballistic Missile — range approximately 5000 miles.
IRBM	Intermediate Range Ballistic Missile — range approximately 1500 miles.
MACH NUMBER	Ratio of the velocity of a body to that of sound in the same medium — 762 mph at sea level.
SUSTAINER	The main engine in a rocket.

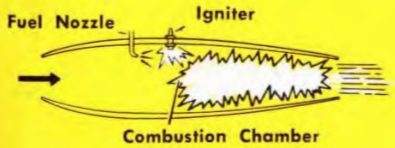
MISSILE ENGINES — *the four basic types used in today's missiles*

RAM JET — The simplest type of Jet engine. Burns gasoline or kerosene mixed with air for fuel. Must be launched by rocket booster to reach high speed in order to "ram" sufficient air into engine for operation.

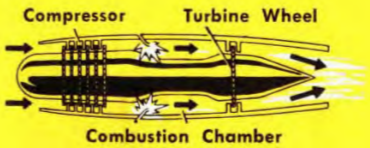
TURBOJET — The engine most commonly used on jet aircraft. Similar to ram jet, but has compressor and turbine to pump air into engine.

SOLID FUEL ROCKET — The earliest type of rocket. Uses a charge consisting of fuel and an oxidizer, hollowed out for faster burning. Proportions of charge can be varied to control rate of burning and thus rate of speed.

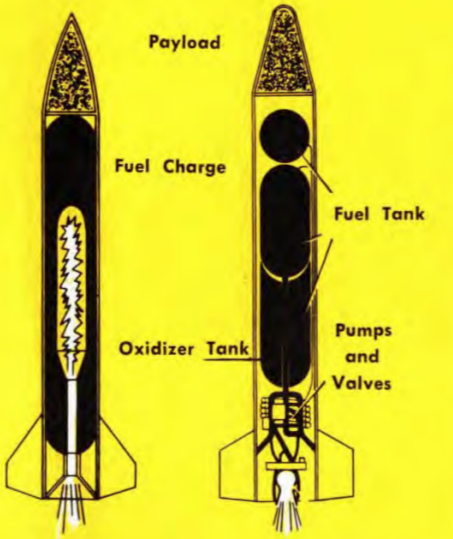
LIQUID FUEL ROCKET — Highly complex, using liquid fuel, usually alcohol plus liquid oxygen as an oxidizer. Requires pumps and valving mechanism to control rate of fuel flow and mixture.



RAM JET



TURBOJET



SOLID FUEL ROCKET

LIQUID FUEL ROCKET

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MISSILES AND ROCKETS MAGAZINE
U. S. ARMY DIGEST • AVIATION WEEK
NAVAL AVIATION NEWS • AIR FORCE
NATIONAL AERONAUTICS

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