

Aerospace Glossary

**Research Studies Institute
Air University**

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Preface

THIS GLOSSARY of aerospace terms does not represent the official opinion, interpretation, or prescribed term usage of the Department of Defense, the United States Air Force, the Air Research and Development Command or its subsidiary organizations, nor does it carry their sanction. It is a product of Air University designed for internal distribution and student use only.

The word list has been arrived at by noting words and phrases spoken by people engaged in aerospace research, development, and operations, and also by noting terms found in the current periodical and book literature of missiles, astronautics and related fields. A large number of quotations have been extracted from aerospace literature, each quotation illustrating a manner in which a particular term is used. As a result, the definitions are based upon an analysis of both spoken and written usage, fortified by consultations with knowledgeable persons in residence at Air University, in missile industry, and at AF research and development and test centers.

This glossary attempts only to describe and explain usage not to prescribe it. Students should use it as a guide to the specialized vocabulary that deals with aerospace missiles and vehicles, their employment and the physical laws that govern them.

No attempt has been made to cover the aerospace vocabulary already set forth in the United States Air Force Dictionary. The Dictionary, published in 1956, covered many hundreds of the older aerospace terms, particularly in the field of aeronautics. These terms are not repeated here in this glossary except for added material. Thus, the user of the glossary should refer to the Dictionary for terms not found in this glossary.

The vocabulary in the aerospace field is undergoing rapid change. It follows, then, that many new terms will not be found in this glossary. An effort has been made, however, to overcome this by setting forth the basic vocabulary upon which new locutions are built.

Many individuals have assisted the editor in preparing this glossary. The editor, however, is personally responsible for the phrasing of most definitions.

April 1959

A

A-4. The German V-2.

The designation 'A-4' was given this missile at the beginning of its research and development in the 1930's, indicating that it was to be the fourth missile in the *Aggregat* (or *Apparat*) series undertaken by the weapons department of the German Army. Its designation of 'V-2' appears to have been first used after the V-1 had been launched across the English Channel in June 1944. See V-2.

AA (*abbr*). 'Antiaircraft.'

AA-20. A French liquid-rocket air-to-air missile, used as armament for the Mystère.

The AA-20 has a range of 1 mile, a speed of mach 1.5.

AAC (*abbr*). 'Alaskan Air Command.'

AAFB (*abbr*). 'Auxiliary Air Force Base.'

AAL (*abbr*). 'Ames Aeronautical Laboratory.'

AAM (*abbr*). 'Air-to-air missile.'

AAOC (*abbr*). 'Antiaircraft operations center.'

AAS (*abbr*). 'American Astronautical Society.'

ablate, *v. tr.* To carry away; *specif.*, to carry away *heat*, as generated by friction, from a vital part by arranging for its absorption in a nonvital part, which may melt or vaporize, then fall away taking the heat with it. Hence, **ablation**, *n.* Cf. *heat sink*.

ablating material. A material that will absorb or carry away heat or some other form of energy.

This material may be vaporized or melted, for example, to use up unwanted heat, as in reentry. For hypersonic reentry bodies, ablating materials must handle temperatures in surrounding air up to 15,000° F.

ablating nose cone. A nose cone designed to prevent heat transfer to its internal structure by the use of an ablating material.

ablation, *n. Specific*. The melting or vaporizing of an outer surface so as to keep an inner part cool.

Able, *n.* 1. A code word for the letter 'A,' formerly and sometimes now used in transmitting messages. 2. A name given to the 7-pound female rhesus simian which made a 300-mile flight into space in the nose cone of a Jupiter missile, 28 May 1959, returning alive to earth and rescued some 1,500 miles from point of launch takeoff. 3. A designation used as a second element in the names of a

booster vehicle signifying a booster vehicle made up of a basic vehicle plus a second stage considered as a first modification, as in 'Thor-Able' or 'Atlas-Able' (which see). 4. Used with a roman numeral 'I' as short for Atlas-Able I or Thor-Able I, with 'II' as short for Atlas-Able II or Thor-Able II, etc.

In sense 2, Able died 1 June 1959 not from ill effects of her flight into space, but from a reaction to an anesthetic administered after the flight while a physician was trying to remove instruments attached to her. These had been used to detect and report back physiological reactions during flight. See *bioastronautics*, *n.*, *Jupiter*, *n.*, note.

ABMA (*abbr*). 'Army Ballistic Missile Agency.'

abn (*abbr*). 'Airborne.'

abort, *n. Specif.* 1. In research and development: An uncompleted missile flight or an uncompleted hold-down test resulting from a failure of equipment or of a system other than one undergoing test. 2. In a tactical operation (simulated or real): A missile failure either on the ground or in flight; an instance of such failure; a missile that fails to begin or complete a programmed flight. 3. An aircraft sortie, mission, or flight that has been aborted.

In sense 1, cf. *test failure*.

abort, *v. intr.* 1. Of a rocket missile: To become an abort. 2. Of an action: To fail, as in 'the blastoff aborted.'

This verb was well established in WW II in senses pertaining specifically to aircraft operations: 1. *intr.* Of airborne persons or aircraft: To turn back from an aerial mission before its completion, esp. for reasons other than enemy action. 2. *tr.* To cause an air *mission*, *sortie*, or *operation* to fall short of success for reasons other than enemy action.

absolute zero. The temperature at which all thermal motion or heat action ceases, approximately -273.16° C, -459.69° F, 0° K, or 0° R.

AC (*abbr*). 'AC Spark Plug.' See **ACSP** (*abbr*). See **USAF Dictionary** for other uses.

acceleration, *n.* 1. The process of velocity increase; the rate of this velocity increase. 2. In physics, any velocity change, either increase or decrease.

aceto-carmine smear. *Medicine*. A glass-slide smear used with a red pigment to differentiate

cellular structure for examination under a microscope.

acid trailer. A trailer used to transport acid fuels or oxidizers.

acquisition and tracking radar. A radar set that locks onto a strong signal and tracks the object reflecting the signal.

ACSP (abbr). 'AC Spark Plug' of General Motors Corporation, an associate missile contractor, as for the guidance system of the Thor. Cf. **AC (abbr).**

The 'AC' in this usage stands for Albert Champion (1878-1927), founder of two spark plug companies, i.e., the Champion Company of Toledo, Ohio, in 1905, and the Champion Ignition Company of Flint, Michigan, in 1908, the latter renamed the AC Spark Plug Company in 1922.

actuating system. A system in a guided or ballistic missile that supplies and transmits energy for the operation of mechanisms or other devices within the missile.

This system may be electrical, hydraulic, pneumatic, or mechanical.

AD (code). 'Aero Design & Engineering Company, Bethany, Oklahoma.'

ADA (abbr). 'Air defense area.'

adapter skirt. A flange or extension of a missile stage or section that provides a ready means for fitting some object to the stage or section.

ADC (abbr). 'Air Defense Command.'

ADDC (abbr). 'Air defense direction center.'

additive, n. Specif. A substance added to a propellant to achieve some purpose such as a more even rate of combustion.

ADL (abbr). 'A. D. Little,' a company of Cambridge, Massachusetts, that does industrial research for the armed forces.

ADPS (abbr). 'Automatic data processing system.' Cf. **EDPS (abbr).**

ADSID (abbr). 'Air Defense Systems Integration Division.'

This division is under joint control of the Air Defense Command and ARDC.

Advanced Research Projects Agency. (ARPA) A Defense Department Agency established in February 1958 to initiate, coordinate, control, and stimulate projects for development of antimissile missiles, space vehicles, and other related technical equipment.

ARPA is to be phased out, according to announcement of 23 Sep 1959, with the USAF taking over its responsibilities. See *Discoverer, n.*, *Midas, n.*, *National Aeronautics and Space Administration*, note, *Sentry, n.*

AEC (abbr). 'Atomic Energy Commission.'

AEDC (abbr). 'Arnold Engineering Development Center.'

aerial torpedo. 1. A torpedo designed to be launched from a low-flying aircraft into water.

2. A self-propelling device that carries an explosive through the air; a guided missile. *Obs.*

This term in sense 2 was used as early as 1909 and was common in the latter part of WW I and in the twenties for a type of pilotless aircraft carrying an explosive. See *bomb, n.*, note, *guided missile*, note, *Kettering aerial torpedo*.

aero-astro-medicine, n. Aerospace medicine.

Hence, **aero-astro-medical, a.**

aeroballistic missile. A missile the flight of which is confined to the atmosphere.

aeroballistics, n. The ballistics of projectiles or vehicles as they pass through any part, or through the layers, of the atmosphere.

The problem of reentry, for example, is a problem of aeroballistics.

Aerobee, n. A research sounding-rocket originally developed by the Applied Physics Laboratory, and produced for the Navy, AF, and Army by Aerojet. Also called the AJ10-25. See **sounding rocket**.

The Aerobee is a two-step rocket, the first a booster unit, the second a liquid rocket. Its overall length with booster is 26 feet, its diameter 1.25 feet, its weight 1,655 pounds. Unguided but stabilized by a tail fin, it reaches 70 miles altitude at a speed of 2,900 mph with a payload of 150 pounds.

Aerobee 75. The Aerobee Hawk.

Aerobee 150. An advanced version of the Aerobee developed by Aerojet, capable of reaching 160 miles altitude with a payload of 150 pounds. Formerly called 'Aerobee-Hi.'

Aerobee 150 uses an 18,000-pound-thrust booster, developed for use by the USAF and the Navy.

Aerobee 300. A sounding rocket that uses the Aerobee 150 as the first stage and the Sparrow I as the second stage. It carries a 50-pound payload to 300 miles. Also called 'Spaerobee.'

Aerobee Hawk. A modified Aerobee for Army use. Also called 'Aerobee 75.'

This Aerobee is powered by a dual thrust solid rocket motor that carries a 90-pound payload to 75 miles.

Aerobee-Hi. n. The Aerobee 150.

aeroduct, n. A ramjet type of engine designed to scoop up ions and electrons freely available in the outer reaches of the atmosphere or in the atmospheres of other spatial bodies, and by a metachemical process within the duct of this engine, expell particles derived from the ions and electrons as a propulsive jet stream.

The aeroduct is theoretical, but according to the physicist, Professor F. Zwicky (1898-), it promises a source of jet power potentially great. See *Journal of American Rocket Society*, Mar 1951, p 14. Cf. **free radical**.

aerodynamically guided missile. A missile

guided all the way to target by means of controls reacting with air.

The Goose and Snark are examples of this type missile.

aerodynamic heating. The heating of a missile, aircraft, or other object due to friction of air, significant at high speeds as during reentry.

aerodynamics, *n.* That field of dynamics concerned with the motion of air and other gaseous fluids, or of forces acting on bodies in motion relative to such fluids.

aerodynamic weapon system. A weapon system in which the weapon vehicle flies entirely through the atmosphere, and is subject to aerodynamic guidance and control as it flies toward target. ●

The B-58 or the Snark are examples of an aerodynamic weapon system. Cf. **ballistic weapon system.**

aeroembolism, *n.* The formation of gas bubbles (principally nitrogen) in body tissues after exposure to conditions of low atmospheric pressure, as in high-altitude flying without benefit of a pressure suit or pressurized cabin; the illness brought on by the presence of these bubbles.

Aeroflot, *n.* The commercial airline of Russia.

Aerojet, *n.* Short for 'Aerojet-General Corporation,' a subsidiary of The General Tire & Rubber Company, and missile powerplant contractor, as for the Titan, Dyna-Soar, Sparrow, Bullpup, Polaris, Aerobee, and Vanguard.

Aeromedical Laboratory. (AML) A laboratory at Wright-Patterson AFB for conduct of research in aerospace medicine.

aeromedicine, *n.* A branch of aerospace medicine concerned with the health of persons who fly within the earth's atmosphere, exposed to different altitudes and gravity forces. Cf. **space equivalent.**

Aeronautical Systems Center. (ASC) An AMC center at Wright-Patterson AFB concerned with the acquisition and delivery of aeronautical weapon and support systems.

aeronautics, *n.* The art, science, or business of designing, manufacturing, and operating vehicles that move through the air.

aeronomy, *n.* A science that treats of the earth's atmosphere, or of the atmosphere of other spatial bodies, esp. in respect to its properties, motions, reactions, and changes in reaction to radiation bombardment from outer space, or to its relation to its primary body.

Aeronutronic, *n.* Short for 'Aeronutronic Systems, Inc.' of Ford Motor Company, missile contractor, as for Project Farside.

aeropause, *n.* An upper region of the atmosphere in which the atmosphere ceases to function for manned or unmanned flight.

The lower limits of the aeropause vary according to the use to which the atmosphere is put; its upper limits tend to recede as man advances in knowledge of aeromedical and aeronautical design. In it the air particles are so tenuous as to provide almost no support for man's physiological requirements, and practically no support for vehicles that depend upon air for oxidizing fuel or for aerodynamic reaction.

Aerophysics, *n.* Short for 'Aerophysics Development Corporation,' a Santa Barbara, California, missile contractor, as for the Dart.

'Aerophysics' is preferred to 'ADC.'

aeroplane, *n.* The early form of the word 'airplane,' now used chiefly in Great Britain.

This word is of two senses and of two origins:

1. A supporting surface of an airplane, such as a wing or horizontal tail surface. Now *obs.* In this sense, the word was coined in 1866 by F. H. Wenham, a member of the Aeronautical Society of Great Britain. He obtained the word by combining the Greek *aero* meaning 'air' with the Latin *planum* meaning 'flat surface' or 'plane.' This sense caught on at once, and was widely used in England and the United States until the end of the century. Its widespread use delayed the acceptance of sense 2, and made the use of other locutions, such as 'flying machine' and Langley's 'aerodrome,' more or less acceptable for the aircraft as a whole.

2. The winged aircraft as a whole. In this sense, the word is of French origin, coined in 1871 by Alphonse Pénaud, and applied first to his model airplane. He obtained the word by combining the Greek *aero* with the Greek *planos* meaning 'wandering,' the same antecedent as that of the word 'planet,' i.e., *aeroplane* meant something that wandered in the air. This sense became known in England very soon, as indicated by evidence as early as 1873, where it vied for acceptance with the established Wenham sense. Although not at first adopted, it did exert influence on both British and American speakers. When F. W. Lanchester invented the word *aerofoil* in 1907, the new word tended to displace the word *aeroplane* in the British sense, leaving the French meaning for general acceptance. Sense 1 is now almost forgotten.

Aerosonic, *n.* Short for 'Aerosonic Instrument Corporation.'

aerospace, *n.* 1. The earth's envelope of air and the space above it, the two considered as a single realm for activity in the flight of air vehicles and in the launching, guidance, and control of ballistic missiles, earth satellites, dirigible space vehicles, and the like. 2. Used principally as an attrib. or adjective, as in *aerospace activity*, *aerospace vehicle*, *aerospace war*, etc.

The upper limits of the aerospace recede upward as technology and science bring it under greater control. Three kinds of flying vehicles are adapted to its ex-

ploitation—the aircraft that flies within the atmosphere, the space-air vehicle, such as Dyna-Soar, that flies both within and above the sensible atmosphere, and the true spacecraft that flies principally in space either in orbit or under directional control.

aerospace, *a.* The attrib. use of *aerospace*, the noun.

aerospacecraft, *n.* An aerospace vehicle.

aerospace medicine. A branch of medicine concerned with the study, prevention, cure, or alleviation of diseases or other bodily ailments arising from conditions encountered in, or brought on by, flight through the atmosphere or through space.

This term is considered more explicit than the term 'aviation medicine,' although for some years the latter term has been used in the same sense.

The branch of medicine covered by the term deals with the selection, maintenance, and treatment of the flyer or space traveler; with the design of aircraft, spacecraft, and related equipment to meet human requirements; with the adaptations of man to the conditions of flight; with ailments resulting from different kinds of flight; and with the evacuation of the sick and wounded by air.

See *aero-astro-medicine, n.*, *aviation medicine*, and *space medicine*.

aerospace power. A power of man derived from his ability to fly vehicles in the air and in space, and to exploit the complex relationships that obtain from this ability in political, diplomatic, military, cultural, and economic affairs. See *airpower, n.*, sense 1.

aerospace vehicle. Any vehicle that may be operated either in the atmosphere or in space.

This category of vehicles includes the aircraft, the spacecraft, and the space-air vehicle.

aerospatial, *a.* Of or pertaining to the aerospace, esp. to materials or equipment used in aerospace operations.

aerothermochemistry, *n.* A branch of thermochemistry as it pertains to the earth's atmosphere, esp. in regard to the reaction, influence, or use of thermochemical phenomena in the aeronautical sciences. Cf. *aeroduct, n.*, *metachemistry, n.*

The dissociation and recombination of atomic particles in the ionosphere is, for example, a phenomenon for study in aerothermochemistry.

aerothermodynamic border. An altitude border at about 100 or less miles, above which the particles of air are so rare that the skin of an object moving through them at high speeds generates no significant heat.

aerothermodynamics, *n.* A branch of thermodynamics that treats of the mechanical action or relations of heat generated by friction between air particles and a moving body.

AEW (*abbr.*). 'Airborne early warning.'

AFAC (*abbr.*). 'Air Force Armament Center.'

AFBMC (*abbr.*). 'Air Force Ballistic Missile Committee.'

AFBMD (*abbr.*). 'Air Force Ballistic Missile Division.'

AFBMTTC (*abbr.*). 'Air Force Ballistic Missiles Training Center.'

AFCRC (*abbr.*). 'Air Force Cambridge Research Center.'

AFDAT (*abbr.*). 'Air Force Directorate of Advanced Technology.'

AFFTC (*abbr.*). 'Air Force Flight Test Center.'

AFMDC (*abbr.*). 'Air Force Missile Development Center.'

AFMTC (*abbr.*). 'Air Force Missile Test Center.'

AFOSR (*abbr.*). 'Air Force Office of Scientific Research,' in Headquarters USAF.

AFPTRC (*abbr.*). 'Air Force Personnel and Training Research Center.' *Hist.* since 15 April 1958.

AFSWC (*abbr.*). 'Air Force Special Weapons Center.'

AFSWP (*abbr.*). 'Armed Forces Special Weapons Project.' *Hist.* since 6 May 1959.

afterbody, *n.* 1. A companion body that trails a satellite. 2. A section or piece of a ballistic missile that reenters the atmosphere unprotected behind the nose cone or other body that is protected for reentry. 3. An aft part of a missile, esp. of a nose cone.

afterburning, *n.* *Specif.* Irregular burning of fuel left in the firing chamber of a rocket after fuel cutoff.

AFWB (*abbr.*). 'Air Force Weapons Board.'

AGARD (*abbr.*). 'Advisory Group for Aeronautical Research and Development.' Part of NATO.

Agna, *n.* The ARPA name for the orbiting upper stage of a Discoverer vehicle, the stage built by Lockheed and powered by the Bell-Hustler liquid rocket.

agravic, *a.* Of or pertaining to a condition of no gravitation. See *weightlessness, n.*, *zero-gravity, n.*

AICBM (*abbr.*). 'Anti-intercontinental ballistic missile.'

AIEE (*abbr.*). 'American Institute of Electrical Engineers.'

aimed missile. A missile aimed on its launcher so as to attain a desired trajectory, but not

guided during flight. Cf. **unguided missile**, **Zuni**, *n*.

aiming error. In missilry, an error that results from a miscalculation in such matters as longitude or latitude, distance, speed, reentry deflection, or the like. Cf. **circular probable error**.

AIP (*abbr*). 'American Institute of Physics.'

air, *n*. 1. The mixture of gases in the atmosphere. 2. The element that gives lift to aircraft, or offers resistance to objects that move through it. 3. a. The region above and around the earth, including the atmosphere and the space beyond, subject to control by air, space-air, or space vehicles, in contradistinction to land and sea; the aerospace (which see). b. *Restrictive*. That part of this region that includes the atmosphere up to its effective upper limits, but not outer space. See **effective atmosphere**.

A strong trend has set in to restrict the word *air* in many contexts of sense 3 to the meaning set forth in sense 3b. This leads to considerable ambiguity in combined forms already in use, such as *air attack*, *air control*, *air force*, *air power*, *air vehicle*, *air warfare*, and *air weapon*, which carried broad meanings reasonably understood so long as the capability for space travel had not made it necessary to distinguish between flight through the air (i.e., the atmosphere) and flight through outer space. Space capability, however, has automatically given restricted meanings to these terms, making it necessary to avoid ambiguity by introducing changes in phraseology. See, for example, the definition of **Continental Air Defense Command**, wherein the necessity is clear for using *air attack* in a restricted sense. See also **airpower**, *n*.

air attack. 1. An attack by aircraft or by aerodynamically controlled missiles, esp. against a surface target. 2. An attack from above the surface, either by aircraft or by missiles trajectoryed through the air or through space.

The ambiguity of this term is noted under **air**, *n*.

airborne, *a*. (*abn*) 1. Of an aircraft: Supported in the air by aerodynamic, aerostatic, or reaction forces. 2. Of a person or thing: Riding in an aircraft. 3. Of equipment or other materiel: Carried or transported, or designed to be carried or transported, by aircraft. 4. Of an operation or action: Carried out with aircraft.

See **flightborne**, *a*.

air breakup. The breakup of a test reentry body after reentry into the atmosphere.

Air breakup is sometimes provided for, as by the firing of a cartridge inside the reentry body, so as to retard the fall of certain pieces and increase the chances of their recovery. Cf. **blowoff**, *n*.

air-breather, *n*. A missile, like the Snark, propelled by fuel oxidized by intake from the atmosphere; an air-breathing vehicle.

air-breathing, *a*. Of a missile vehicle or other vehicle: That takes in oxygen from the atmosphere to oxidize its fuel.

aircraft, *n*. (*acft*) Construed either as *singular* or *plural*. 1. In a broad sense, any machine or craft designed to fly through the air, or through both the air and space, given lift by its own buoyancy (as with airships), or by dynamic reaction of air particles over and about its surfaces, or by reaction to a fluid jet; esp. such a machine or craft considered as a vehicle, subject to directional changes in the air during flight. 2. *Restrictive*. A powered fixed-wing airplane. 3. A model or miniature of an aircraft. 4. *transf*. The pilot or crew that flies an aircraft, as in 'the aircraft was informed of bad weather.'

In sense 1, the word 'aircraft' is broad enough to be applied to rigid and nonrigid airships, gliders, helicopters, kites, fixed-wing powered airplanes, balloons, powered aerial targets, and winged guided missiles that operate essentially in the air or in the rarified atmosphere where space merges with the air. The term, properly used, is not applied to true spacecraft designed to operate outside the envelope of the earth's atmosphere. It is, however, sometimes applied to the space-air vehicle, like the Dyna-Soar. See **aerospace**, *n*., note, **air vehicle**, **space-air vehicle**, **spacecraft**, *n*. See also **guided missile**, **pilotless aircraft**.

aircraft rocket. A rocket missile specially designed to be carried by, and launched from, an airplane. Cf. **guided aircraft missile**, note.

air defense. Defense against flightborne attacks by aircraft or missiles upon an area defense area; the sum total of all measures undertaken for this purpose; an organization or activity providing this defense.

Air Defense is regarded by most authorities as comprising two categories: Active air defense and passive air defense.

Three fundamental tasks inhere in air defense: (1) *Warning* to alert military forces in time to take action prior to attack, and to implement civil defense measures. (2) Continuous *surveillance* and *control* of friendly aircraft and missiles so as to deploy them on courses compatible with defense operations. (3) A *capability* to destroy enemy attackers.

These tasks are performed by a forward defense, centralized control, and a mixture of weapons.

Air Defense Command. (ADC) An AF major air command established on 1 January 1951, responsible for providing air defense of the United States. Cf. **Continental Air Defense Command**.

air defense force. An air force charged with air defense.

air drag. The drag exerted by air particles upon a moving object, as upon an aircraft or rocket moving through the air, or upon an earth satellite that comes within the earth's atmosphere during orbit. See *drag, n.*

air environment. 1. The environment that surrounds and affects an airborne system or piece of equipment. 2. The aggregate of equipment, facilities, personnel, and conditions that make up an airborne system or part of an airborne system. Cf. *flight environment, ground environment.*

AiResearch, n. Short for 'AiResearch Manufacturing Division' of The Garrett Corporation.

AiResearch has designed auxiliary power and other systems for missiles, and manufactures liquid oxygen for use in missiles.

Air Force Ballistic Missile Division. (AFBMD) A division of Headquarters ARDC, established as a field organization at Inglewood, California, to command and control the development of operational ballistic missiles and space-air vehicles.

AFBMD, established in June 1957, is the successor organization of the Western Development Division.

Air Force Cambridge Research Center. (AFCRC) An ARDC center at Lawrence G. Hanscom Field near Bedford, Massachusetts.

AFCRC conducts basic and applied research in electronics, geophysics, radio-chemistry, and radio-biology for military purposes in aerospace operations.

Air Force Directorate of Advanced Technology. (AFDAT) A directorate under the Deputy Chief of Staff, Development, Headquarters USAF, concerned with rocket and missile technology.

Air Force Flight Test Center. (AFFTC) An ARDC center at Edwards Air Force Base at Muroc, California.

AFFTC accomplishes functional flight tests of complete, manned aircraft weapon systems, conducts engineering evaluation flight tests of aircraft and power plants, and makes static firing tests of missile power plants. Cf. *Rocket Engine Test Laboratory.*

Air Force Missile Development Center. (AFMDC) An ARDC center at Holloman Air Force Base near Alamogordo, New Mexico.

AFMDC is concerned esp. with development of short-range guided missiles, as well as with electronic and upper atmosphere research. It conducts tests for development purposes, but not for acceptance or operational purposes.

Air Force Missile Test Center. (AFMTC) An ARDC center with headquarters at Patrick AF Base, Florida.

The AFMTC is responsible for the maintenance and operation of the Atlantic Missile Range (including Cape Canaveral) and its supporting facilities for use by the AF, and by the Army and Navy when directed; for the support of AF contractors and other governmental testing agencies; for evaluating tests performed by the AF or AF contractors; and for the conduct of missile testing and missile operational training.

Air Force Office, PMR. An AF office at Headquarters Pacific Missile Range.

This office is a field extension of ARDC.

Air Force Special Weapons Center. (AFSWC) An ARDC center at Kirtland Air Force Base in Albuquerque, New Mexico.

The AFSWC studies, designs, develops, and tests the most acceptable, feasible, and suitable combinations of aerospace vehicles and nuclear weapons. Cf. *Defense Atomic Support Agency.*

airframe, n. The assembled structural and aerodynamic components of an aircraft, missile, or rocket vehicle that support the different systems and subsystems integral to the vehicle.

The airframe includes the framework and outer skin, but neither the nose cone nor the combustion chambers. In a staging vehicle, the airframe diminishes in length.

The word 'airframe,' a carryover from aviation usage, remains appropriate for rocket vehicles since a major function of the airframe is performed during flight within the atmosphere.

airglow, n. The visible light that appears at night in the upper atmosphere that results from energy released by dissociated molecules and ionized atoms which during the daytime had absorbed energy from solar radiation.

Airglow limits the effectiveness of photography of celestial objects from terrestrial observatories.

air law. The law that governs the use of a given airspace, determined by the laws or conventions that obtain for the geographical area below it, or by international agreements.

Until the use of outer space became possible, air law was considered applicable to an indefinite height, but projected space law may limit its applicability. See *space law*, and see *airspace, n.*, sense 1.

airlift force. A military force trained and equipped to airlift personnel, equipment, and supplies, in support of war or peace plans.

This force in the USAF may be augmented by the Civil Reserve Air Fleet in time of emergency.

airlog, n. A device in an air vehicle or airborne missile for measuring distance flown.

Such a device was used in the Kettering aerial torpedo as early as 1916.

Airone, n. An Italian solid-rocket surface-to-surface missile, with a range of about six miles.

airplane, n. 1. In a broad sense, any heavier-than-air aircraft supported by the aerodynamic flow of air over fixed or rotating surfaces, including the conventionally powered winged craft, the glider, helicopter, gyroplane, and

certain winged guided missiles. 2. In a restricted sense, the conventional winged aircraft (including the STOL and VTOL), powered by jet or piston-driven engines.

The word 'airplane' is preferred to 'aeroplane' in American usage, although up through WW I 'aeroplane' was commonly preferred. 'Airplane,' however, appears to have been of British origin. The first evidence known is cited in the O.E.D. as of 1907. But the British have preferred to use 'aeroplane' to the simpler form, despite the fact that W. W. Skeat (1835-1912), Professor of Anglo-Saxon at Cambridge University, recommended 'airplane' to his countrymen. See USAF Dictionary for further analysis. See also *aeroplane, n.*

airpower, n. Also written *air power*. 1. Aerospace power. See note. 2. *Restrictive*. That part of aerospace power that derives from the ability to fly air vehicles only and to exploit the relationships that obtain from this ability. Distinguished from *spacepower*. 3. An instance of this power (sense 1 or sense 2) as it exists in a particular country, as determined by the knowledge, inventiveness, financial support, industrial backing, military coordination, and diplomatic skill of the people of that country. 4. *Restrictive*. This power (sense 3) as it resides in a particular branch or in all branches of a nation's armed services. 5. Military aircraft or units of an air force, as in 'airpower was assembled for the strike.' 6. The air arm, or the aerospace arm, of a nation, as in 'airpower carried the attack to the enemy first.' 7. A nation having predominant strength in airpower or in airpower and spacepower, as in 'the United States is an airpower in the councils of nations.'

'Airpower' as used in sense 1 is usually in contexts where a ready term is needed to cover both air and space power, the two being considered as essentially inseparable. In this usage, however, the word 'airpower' is giving way, among many users, to the term 'aerospace power.' When a distinction is desired between the power deriving from the use of air vehicles and the power to penetrate space, 'air power' is used restrictively, as in sense 2. See *spacepower, n.*

Air Proving Ground Center. (APGC) An ARDC center at Eglin Air Force Base near Valparaiso, Florida, charged with developing and testing AF weapons and armament equipment.

The Air Proving Ground Center was the successor designation of the Air Proving Ground Command as of 1 Dec 1957.

airspace, n. 1. Space in the air, esp. such space above a particular surface of the earth, as in 'American airspace is defended by a network of radar, fighter aircraft, and interceptor mis-

siles.' 2. Space in the air as occupied by an aerial formation or by a single aircraft; space in which an airplane or airplanes maneuver.

air-space, a. Of or pertaining to both the atmosphere and space.

Because this adj. is pronounced as the noun 'airspace' is, it is subject to misunderstanding. 'Aerospace,' the attributive or adj. is commonly used instead. See also *space-air, a.*

air start. An ignition sequence of an engine while the engine is flightborne in the air. Cf. *inflight start*.

air-to-air missile. (AAM) A missile launched from an aircraft at an air target.

air-to-surface missile. (ASM) A missile launched from an aircraft at a surface target.

This missile may be a guided missile or an ALBM.

air-to-underwater missile. (AUM) A missile launched by an aircraft toward an underwater target. See *Petrel, n.*

air-transportable, a. Of a missile: Subject to ready transport by aircraft. Said of the Thor, Sergeant, etc.

air vehicle. An aircraft considered as the carrier of something.

When regarded as vehicles, missiles with trajectories confined to the atmosphere fall in the category of air vehicles. See *aerospace vehicle, space-air vehicle*.

air weapon. 1. A weapon used by an air force, employed above the earth, either within the atmosphere or in outer space. 2. *Restrictive*. Such a weapon essentially used within the confines of the atmosphere.

Use of the term *space weapon* as a differentiating term automatically gives a restrictive meaning to *air weapon*. See *air, n., note*.

AJ (abbr). 'Aerojet,' short for 'Aerojet-General Corporation.'

Alaskan Air Command. (AAC) An AF major air command with the mission of organizing and conducting the air defense of Alaska with appropriate support. Cf. *Continental Air Defense Command*.

albedo, n. The ratio of light reflecting from an unpolished surface to the light falling upon it.

This term is used esp. in reference to light reflected from the moon or the planets. See *weigh, v., note*.

Albert, n. The name of one or other of two rhesus monkeys used as test animals at Holloman AFB.

Albert I, launched in a V-2 to an altitude of 37 miles on 18 Jun 1948, was not recovered because of parachute failure. *Albert II*, launched in a V-2 to an altitude of 83 miles on 14 June 1949, was likewise not recovered, but he was considered to have suffered no apparent ill effects from weightlessness or cosmic radiation.

ALBM (abbr). 'Air-launched ballistic missile.'

An ALBM, under design by Douglas from concepts by Lockheed, Convair, and Martin, is to be a two-stage rocket, expected to be adapted to launch at supersonic speeds by the B-70 and B-58, and at subsonic speeds by the B-52 or by a nuclear-powered aircraft. If launched by a nuclear-powered craft (either airborne or spaceborne) the weapon would obtain the same advantages that attach to the Polaris in that the launch platform could be both mobile and continuously flightborne, yet not subject to a ready fix by a defender.

alcohol, *n.* Ethyl alcohol (C_2H_5OH), methyl alcohol (CH_3OH), or an analogous compound, used with liquid oxygen as a bipropellant.

Ethyl alcohol and liquid oxygen were used in the German V-2. See *specific impulse*, note.

alert status. The status of a person or thing ready for immediate action on command; *specif.*, the status of a missile at the launch pad or missile shelter, readied for launch except for the loading of propellants. Cf. *reaction time*, *ready status*.

alga, *n.* Usually plural *algae*. Any plants of a group of unicellular and multicellular development that include the Chlorella, Scenedesmus, and other low genera.

The green algae and blue-green algae, for example, provide a means of photosynthesis in a closed ecological system, also a source of food.

algorithm, *n.* The art or system of calculating with any species of notation, as in arithmetic with nine figures and a zero. Sometimes called 'algorithm.'

Different algorithms have been used in the design of computing machines.

Allegany Ballistics. Short for 'Allegany Ballistics Laboratory' of the Hercules Powder Company, Cumberland, Maryland, power plant contractor, as for Little John and Terrier.

'Allegany' is sometimes misspelled 'Allegheny.'

Allied World. The group of nations that have created alliances among themselves against communist aggressors.

This term applies to the nations of Nato, Seato, Anzus, the Baghdad Pact, and of other defense pacts, as those of Japan or South Korea with the US. See *free world*, *western world*.

all-inertial guidance. The guidance of a missile vehicle entirely by use of inertial devices.

Allison, *n.* Short for 'Allison Division' of General Motors Corporation, an associate contractor esp. for power plants, as for the Mace, Matador, and Regulus I.

Alpha, *n.* Short for '1957 Alpha,' '1958 Alpha,' etc., each the first earth satellite placed in orbit during the indicated calendar year.

Use of this term is by way of extending a system of nomenclature used by astronomers to identify newly

discovered natural objects such as comets and asteroids. Under this system, the first satellite of the year is called 'Alpha' with the year date prefixed, the second is called 'Beta' with the year date prefixed, and so on.

Under the same system, suffix arabic numbers are also used when the satellite is accompanied in orbit by other objects, such as by a nose cone or rocket. These numbers indicate the relative apparent brightness of each member of the group. Thus, the rocket of Sputnik I was called '1957 Alpha 1'; the satellite itself was called '1957 Alpha 2'; and the nose cone was called '1957 Alpha 3.' With Sputnik II, only one object was in orbit; consequently it was simply called '1957 Beta.'

These terms are often written in Greek letters, as in 1957 α_2 (or 57 α_2), 1957 β , 1958 α , 1958 β , 1958 γ , 1958 δ . Sometimes the year date is dropped if understood in context as in α_2 and β .

The 1957 Alpha was Sputnik I; the 1958 Alpha is Explorer I; the 1959 Alpha is Vanguard II.

The system is not applied to lunar probes like Mechtla.

Alpha Centauri. A star in the constellation Centaurus, seen in the southern hemisphere, which is about as near to our sun as Proxima Centauri, some 4.3 light years distant.

Alpha Centauri is the third brightest star (excluding the sun) in the heavens. Proxima Centauri is a faint star. See *Canopus*, *n.*, *Sirius*, *n.*

alpha particle. A particle, with a positive charge of 2, ejected at high speed from certain radioactive elements or isotopes, and identical with the nucleus of helium. Cf. *radiation*, *n.*

Alpha particles produce harmful physiological effects.

alveolar air. *Medicine*. The respiratory air in the sacs of the lungs.

American Interplanetary Society. An astronomical society founded in 1930 in New York City by G. Edward Pendray (1901—) and David Lasser (1902—), its name being changed in 1934 to the 'American Rocket Society.'

American Rocket Society. (ARS) The successor organization (since 1934) of the American Interplanetary Society. See *rocket society*.

The ARS is affiliated with various local rocket societies, as in Los Angeles and Washington, D. C. It is also affiliated with Reaction Motors, Inc. Its publication is the *Journal of the American Rocket Society*.

Ames Aeronautical Laboratory. (AAL) A NASA laboratory at Moffett Field, California.

amino acid. Any one of the acids containing the group NH_2 .

Amino acids are the chief components of proteins. These acids have been produced in the laboratory by subjecting a mixture of gases thought to have been in the earth's primitive atmosphere to electrical charges. Cf. *primitive atmosphere*.

AML (*abbr.*). 'Aeromedical Laboratory.'

AMM (*abbr.*). 'Antimissile missile.'

anacoustic zone. The space above the hypoaoustic zone (some 75 miles altitude) in

which sound is not propagated because of a scarcity of air particles.

'Anacoustic' is coined from the Greek *an* 'not' plus *acoustic*. Cf. *hypoacoustic zone*.

AMR (*abbr*). 'Atlantic Missile Range.'

AMTC (*abbr*). 'Army missile test center.'

analeptic drug. A drug that invigorates the central nervous system.

analogue computer. A computing machine that works on the principle of measuring, as distinguished from counting, in which the input data is made analogous to a measurement continuum, such as voltages, linear lengths, resistances, light intensities, etc., which can be manipulated by the computer to produce sought-after answers. See **digital computer**.

Analogue computers range from the relatively simple devices of the slide rule or airspeed indicator to complicated electrical machines used for solving mathematical problems. Radar and gun directors lean heavily upon this type of computer. See **model**, *n*.

angstrom, *n*. A unit for measuring the wave length of light, equal to one ten-millionth of a millimeter, or 10^{-8} centimeter.

Anhydrone, *n*. A trade name for magnesium perchlorate used as a water absorbent.

aniline, *n*. A liquid compound, $C_6H_5NH_2$, used as a rocket fuel.

Aniline is a hypergolic fuel when oxidized by nitric acid.

anoxia, *n*. *Medicine*. An absence of oxygen in the blood, cells, or tissues of the body. Often confused with hypoxia (which see).

antiatom, *n*. An elemental particle theoretically considered to exist, consisting of a negative nucleus with positive electrons in orbit.

The atom of the known world consists of a positive nucleus with negative electrons.

antiballistic-missile missile. A surface-to-air missile launched, or designed to be launched, to intercept and destroy a ballistic missile. Cf. **Nike-Zeus**, *n*.

antigravity, *n*. A hypothetical effect that would arise from some energy field's cancelling out the effect of the central force field of the earth or other body.

antimatter, *n*. Matter theoretically considered to exist, consisting of antiatoms.

antimissile missile. (AMM) 1. An explosive missile launched to intercept and destroy another missile in flight. 2. A weapon system (including detection, tracking, and analysis of data) built about such a missile.

Cf. **ballistic missile interceptor**, **interceptor missile**.

antipodal bomber. A bomber capable of striking at a target on the opposite side of the world from the point of takeoff.

This term was used in reference to a projected rocket-propelled vehicle considered as early as 1933. Its summit altitude was projected to be 155 miles, its range some 14,600 miles. Cf. **Dyna-Soar**, *n*.

antisatellite missile. A missile designed to follow a course so as to strike or strike near an orbiting satellite.

APGC (*abbr*). 'Air Proving Ground Center.'

aphelion, *n*. That point on an orbit about the sun most distant from the sun. Cf. **ellipse**, *n*.

The earth's aphelion is about 94,500,000 miles from the sun.

APL (*abbr*). 'Applied Physics Laboratory' of Johns Hopkins University.

apogee, *n*. 1. That point in an elliptical orbit of an earth satellite at which the distance is greatest between the orbiting body and the earth. Cf. **aphelion**, *n*., **perigee**, *n*. 2. The point of greatest distance from the earth in the trajectory of a ballistic missile, or in the flight path of a piloted orbital glider.

Since the orbit of an earth satellite is elliptical, its apogee (sense 1) is 180° from the perigee through the center of the earth. See **ellipse**, *n*.

'Apogee' is derived from the Greek *apo* away from, and *gaia* earth.

apogee, *v. intr*. Of a satellite or missile: To reach its apogee, as in 'the Vanguard apogees at 2,460 miles.'

apogee speed. The speed of an orbiting body when at apogee. Cf. **perigee speed**.

The apogee speed of Sputnik I was 16,200 mph; of Sputnik II, 15,100 mph; of Explorer III, 13,450 mph. The apogee speed of Explorer I is 13,700 mph; of Vanguard I, 12,400 mph; of Sputnik III, 14,637 mph; of Vanguard II, 13,041.

Applied Physics Laboratory. (APL) A laboratory of Johns Hopkins University located at Silver Springs, Maryland.

The APL was established in 1942; it helped develop the Tartar and Aerobee, for example.

applied research. Research directed toward using knowledge, principles, and techniques already understood so as to advance the state of the art, to make something new, or to create a particular situation, each to the end of serving a practical or utilitarian purpose.

Applied research, for example, has made use of the third law of motion, discovered by Galileo (1564-1642) and Newton (1642-1727), in the invention of a reaction engine. Cf. **basic research**, **research**, *n*.

APS (*abbr*). 'American Physical Society.'

apse, *n*. *Line of apsides*, a line of indefinite length that passes through the foci of an el-

lipse, the major axis being a segment of this line. See *Mercury, n.*, note.

APU (*abbr.*). 'Auxiliary power unit.'

Aral'sk, n. A Russian town some 70 miles southwest of a space-probe launch site.

Arcas, n. A sounding rocket developed for the Navy, carrying a 40-pound payload to 70 miles. The Arcas uses a solid propellant.

Arcon, n. A Navy sounding rocket, with solid motor, that carries 100 pounds to 200 miles.

ARDC (*abbr.*). 'Air Research and Development Command.'

ARDC center. One of the several major subdivisions of ARDC directly subordinate to Headquarters Air Research and Development Command.

The ARDC centers are the Wright Air Development Center, the Arnold Engineering Development Center, the Air Force Cambridge Research Center, the Rome Air Development Center, the Air Force Flight Test Center, the Air Proving Ground Center, the Air Force Missile Development Center, the Air Force Missile Test Center, and the Air Force Special Weapons Center.

area defense. A defense against air or missile attack organized to protect an entire area as distinguished from a point or line.

The AF is responsible for the development, procurement, and manning of land-based surface-to-air missile systems, as well as aircraft, for area defense. Cf. *point defense*.

ARGMA (*abbr.*). 'Army Rocket and Guided Missile Agency.'

argon, n. A colorless, odorless, and inert gaseous element, constituting nearly 1 percent of air.

Argus, n. *Project Argus*, a Defense Department project for obtaining data related to problems of global surveillance.

Under this project, for example, atomic bombs were exploded above the earth's atmosphere in August and September 1958 to obtain data on radio and radar reactions under conditions of nuclear-burst particles being trapped for a time within the earth's magnetic field. Argus was a hundred-eyed hero of Greek mythology set by Hera to watch Io, a maiden loved by Zeus. See *Explorer IV*.

Argus theory. A theory that a shield of radiation, if placed above the earth's atmosphere, would burn up incoming nuclear warheads or make infrared targets of them.

ARL (*abbr.*). 'Applied Research Laboratory' of Johns Hopkins University.

Arma, n. Short for 'American Bosch Arma Corporation,' an associate contractor for guidance systems, as for the Titan.

Armed Forces Special Weapons Project. (AFSWP) The former designation of the Defense Atomic Support Agency.

Army Ballistic Missile Agency. (ABMA) An Army research agency for development of ballistic missiles, located at Huntsville, Alabama.

This agency was established 1 Feb 1956.

ArmyOrd (*abbr.*). 'Army Ordnance.'

Army Rocket and Guided Missile Agency. (ARGMA) An Army research agency for development of rockets and guided missiles, located at Huntsville, Alabama.

Arnold Engineering Development Center. (AEDC) An ARDC center at Tullahoma, Tennessee, named for General of the Air Force Henry H. Arnold (1886-1950).

AEDC provides facilities for static testing and evaluating supersonic aircraft, guided missiles, and aircraft engines.

ARPA (*abbr.*). 'Advanced Research Projects Agency.' Used attrib., as in *ARPA policy*, *ARPA project*.

Arrow, n. A Canadian all-weather twin-jet supersonic delta-wing fighter, developed by Avro Aircraft. Also called the CF-105.

ARS (*abbr.*). 'American Rocket Society.'

artificial asteroid. A manmade object placed in orbit about the sun. See *asteroid, n.*

artificial earth satellite. A manmade earth satellite, as distinguished from the moon. Usually called 'earth satellite.'

artificial gravity. A simulated gravity set up within a space vehicle, as by rotating a cabin about the longitudinal axis of a spacecraft, the centrifugal force generated being similar to the force of gravity.

artificial satellite. A satellite placed in orbit by man, esp. an earth satellite.

This term is broad enough to include satellites placed in orbit about the moon or about a planet.

artillery guided missile. A rocket missile of comparatively short range guided to target by wire or radio command.

The Dart and Lacrosse are examples of this missile. Cf. *rocket artillery*.

artillery rocket missile. A rocket missile of short range used as artillery in ground operations.

The missiles may be unguided except by the launcher, or guided.

ASA (*abbr.*). 'American Standards Association.'

ASBCA (*abbr.*). 'Armed Services Board of Contract Appeals.'

A-series, n. *Specif.* A designation for a series of ten rockets undertaken in research and development by the German Army, the object being to produce long range rockets for military use. Now *hist.*

The A-series, short for 'Aggregat (or Apparat) series' was begun in 1929. The best known of the rockets was the A-4, also known after June 1944 as the V-2.

ASM (abbr). 'Air-to-surface missile.'

ASofAF (abbr). 'Assistant Secretary of the Air Force.'

Asp, n. A Navy sounding rocket, with solid motor, that carries 25 pounds to 38 miles.

Aspan, n. A two-stage Navy sounding-rocket that carries 50 pounds to 160 miles.

The second stage is the Asp; the first stage is powered by the solid Nike jato M-5.

Asroc, n. A Navy rocket missile in research and development, being designed as a sub-seeker at longer ranges than 10 miles.

assemble, v. (asbl) tr. To put together a *missile, rocket*, or the like from component parts; to put together component *parts*.

assembly, n. (assy) 1. The process or action of putting together a missile, aircraft, or the like. *Attrib.*, as in *assembly line, assembly team*. **2.** That which is assembled; *specif.*, a combination of assembled parts or subassemblies that may be taken apart and reassembled without destruction, and providing (when assembled) a self-contained unit that functions as an essential part of a subsystem or system. See *subsystem, n.*, note.

assembly inspection. An inspection of an assembly performed at a launch site.

This inspection is against damage during shipment. In its performance mechanical, electrical, and hydraulic connections are hooked up so as to test all subsystem operations. Cf. *hangar test*.

associate contractor. A contractor responsible for developing and producing one part of the equipment essential to a complete weapon system, space probe, or the like, who has a contract directly with the government.

This contractor must coordinate his development and production with the developments and products of other contractors associated with him. See *integrating contractor, Space Technology Laboratories, Titan, n.*, note.

asteroid, n. Specif. 1. One of the small planets that revolve about the sun between the orbits of Mars and Jupiter. **2.** Also applied to a man-made probe that establishes an orbit about the sun, such as Pioneer IV and Mechta.

Walter Baade (1893–), astronomer, estimates the number of asteroids at 30,000. More than 1,500 have been catalogued. Of these Ceres is the largest, with a diameter of 488 miles, and Vesta is the brightest. The combined volume of the known asteroids is less than one-twentieth the volume of the moon.

ASTIA (abbr). 'Armed Services Technical Information Agency.'

ASTM (abbr). 'American Society for Testing Materials.'

ASTOR (abbr). 'Antisubmarine torpedo ordnance rocket.'

Astor, n. A submarine missile for launch against an enemy submarine.

Under development by Westinghouse, Astor can carry a nuclear warhead.

astrionics, n. The art or science of adapting electronics to space flight.

Avionics (which see) is a broader term than *astrionics*.

ASTRO (abbr). 'Air Space Travel Research Organization,' a division of Marquardt.

astro (prefix). [Greek *astron* star.] A combining form, as in *astrobiology, astronautics*, etc. Sometimes compressed, as in *astrionics*. See *star, n.*

astrobiology, n. A branch of biology concerned with the discovery or study of life on planets or satellite bodies.

astrodynamics, n. A branch of dynamics treating of the motions of spatial bodies (including artificial satellites) or of the forces acting on these bodies in motion.

Astro dynamics embraces those parts of celestial mechanics, geophysics, aerodynamics, electromagnetic theory, etc., that bear upon the motions of a spatial body.

Astrodyne, n. Short for 'Astrodyne, Inc.,' a missile contractor, as for the propulsion system of Teal. Term no longer used.

Astrodyne was jointly organized in Jan 1958 by Phillips Petroleum Company and North American Aviation, Inc., fully owned by the latter since Aug 1959.

astrogate, v. [See next.] intr. To plot and direct the movements of a spacecraft from within the craft.

astrogation, n. Contraction of 'astronavigation.'

astrometry, n. A branch of astronomy concerned with the measurements of celestial bodies and the determination of their movements and positions. See *weigh, v.*

astronaut, n. 1. One concerned with flying through space, or one who actually navigates and flies through space. See *astronautics, n.*, note. **2.** Also applied to an animal that flies through space. See *dog, n., monkey, n., rabbit, n.*

astronautic centrifuge. Medicine. A laboratory facility for achieving centrifugal acceleration so as to test the ability of animals or men to withstand stresses of space flight.

astronautics, n. 1. The art, skill, or activity of operating space vehicles. **2.** In a broader

sense, the art or science of designing, building, and operating space vehicles.

Because the prefix *astro* means 'star,' this word is not of a parallel coinage with 'aeronautics,' but *spationautics* has not caught on. It appears that the French pioneer aviator, Robert Esnault-Pelterie (1881–), gave currency to the French equivalent of the word in 1930, when he published *L'Astronautique*. Esnault-Pelterie had himself used the term, however, on 8 June 1927 when he read a paper before the Societe Astronomique de France; but he eschewed the distinction of having coined the word, for he said it had already been invented by the French novelist, J. H. Rosny the Elder (1856–1940). He gave no indication as to where or when Rosny had used it. A search through the more likely of Rosny's published works has not revealed it.

astronavigate, v. 1. *tr.* To guide and direct a spacecraft from within the vehicle. 2. *intr.* Of a person: To travel by spacecraft under guidance by a pilot within the vehicle.

astronavigation, n. The plotting and directing of the movement of a spacecraft from within the craft by means of observations on celestial bodies. Sometimes contracted to 'astrogation' or called 'celestial navigation.'

Astronavigation may be achieved entirely by instruments within the spacecraft, whereby sightings are made on celestial bodies and a flight path selected. See **celestial guidance**.

astronomical unit. (A.U.) A unit of distance equal to the earth's mean distance from the sun, 93,000,000 miles or 150,000,000 kilometers.

The value of 93,005,000 miles for this unit was announced in 1944 by the English Astronomer Royal, H. Spencer Jones (1890–).

astronomy, n. The science that treats of the location, magnitudes, motions, and constitution of celestial bodies and structures.

astrophysics, n. A branch of astronomy that treats of the physical properties of celestial bodies, such as luminosity, size, mass, density, temperature, and chemical composition.

The spectrograph and other apparatuses in the late 19th century helped to change astronomy from an exclusive study of positions to a broader study including composition.

astrotracker, n. A star tracker.

ASW (abbr). 'Antisubmarine warfare.'

ATAR (abbr). 'Antitank aircraft rocket.'

Atlantic Missile Range. (AMR) A 5,000 to 6,000 mile instrumented range for testing ballistic and guided missiles, located between Cape Canaveral, Florida, and a point beyond Ascension Auxiliary Air Force Base near the middle of the South Atlantic. Formerly called 'Florida Missile Test Range.'

Twelve stations are established along this range. These are: Cape Canaveral AAFB, Jupiter AAFB, Grand Ba-

hama AAFB, Eleuthera AAFB, San Salvador AAFB, Mayaguana AAFB, Grand Turk AAFB, Dominican Republic AAFB, Mayaguez AAFB, St. Lucia AAFB, Fernando de Noronha AAFB, and Ascension AAFB. Ocean-going vessels gather data between St. Lucia AAFB and Ascension AAFB, and at points beyond Ascension.

The test range is under the operational control of the Air Force Missile Test Center. Cf. **Pacific Missile Range**.

See **Joint Long Range Proving Ground** for early history.

Atlas, n. 1. An AF surface-to-surface long-range, strategic, liquid-rocket missile; also the vehicle of this missile. Also called the SM-65 and WS 107A-1. 2. The ballistic missile undertaken for development by Convair under MX-774. Now *hist*.

The Atlas (sense 1), an ICBM 81 or more feet long and 10 feet in diameter (plus the fairings of the booster engines), with a gross takeoff weight in excess of 120 tons, a range that extends to more than 6,000 miles, and a speed of more than 17,000 mph, was developed by Convair (responsible for airframe and assembly), General Electric and Burroughs (for guidance), Rocketdyne of North American (for propulsion), General Electric (for the nose cone), and Space Technology Laboratories (for systems engineering). The propulsion system provides for a sustainer engine and two booster engines (all liquid) and two vernier engines, but the A-series of the missile (essentially a test vehicle) was equipped with only the two boosters and verniers. Each booster develops a thrust of 150,000 pounds, the verniers 1,000 pounds each. The B-series with both sustainer and boosters develops a thrust increment in excess of 360,000 pounds. The nose cone is designed to carry a nuclear warhead. Guidance is radio-inertial or all-inertial.

The Atlas was flight-tested repeatedly in 1957 and 1958. The first of these (for the A-Series) was in June 1957. On 19 Jul 1958, the B-Series began to be flight-tested, with successive tests reaching out for greater ranges. A test of 28 Aug 1958 sent the nose cone to a distance of 3,000 miles; and on 28 Nov 1958, the distance reached was 6,325 miles over the Atlantic Missile Range. On 9 Sep 1959, an operational squadron at Vandenberg fired an Atlas D; on the same day, an Atlas rocket fired a Mercury capsule, which was recovered on the Atlantic Missile Range. See **Atlas satellite, Big Joe, Centaur, n., Score, n.**

The name 'Atlas' was officially assigned to the missile in Sep 1951. This name, after the Greek mythological divinity who bore the heavens on his head and hands, also appeared in the name of Atlas Corporation, a holding company of Consolidated Vultee Aircraft at that time.

Atlas-Able, n. A rocket test vehicle consisting of the Atlas as a first stage, a Vanguard second stage as a second stage, with other upper stages added when required.

The second stage of this test vehicle is the Aerojet liquid rocket with 7,500 pounds of thrust; the third stage is an Allegany Ballistics solid rocket with 2,500 pounds of thrust. The first Atlas-Able was called Atlas-Able I.

Both the USAF and NASA support this vehicle.

Atlas-Hustler, n. A rocket research vehicle under development to consist of the Atlas

rocket as the first stage, the Bell Hustler as the second.

The Atlas-Hustler is expected to be powerful enough to put a 3,000-pound satellite into a low orbit.

Atlas satellite. An earth satellite launched from Cape Canaveral at 1802 (EST) on 18 December 1958, consisting of the entire vehicle of the Atlas, except for its two booster engines. See **Score, n.**

This satellite, launched under Project Score, weighed between 8,700 and 8,800 pounds with a payload of about 150 pounds. At achieving orbit, it was reported to apogee at 625 miles, with its perigee at 118 miles, its initial orbital time at 100 minutes, and its inclination at about 32 degrees. During flight to achieve orbit, its engines delivered power for 4 minutes 30 seconds. Its expected life was set at 20 to 25 days. It actually fell back to earth on 21 January 1959, plunging into the atmosphere and burning up over the Pacific.

Several ground-to-satellite and satellite-to-ground communications were made with this satellite, including voice broadcasts from the satellite of Christmas messages recorded by President Eisenhower.

Atlas-Score vehicle. The rocket vehicle used to launch the Atlas satellite under Project Score.

Atlas squadron. A missile squadron that employs the Atlas.

The first Atlas squadron is scheduled to become operational at Vandenberg AFB in 1959; another is to be deployed at Warren AFB in Wyoming. Some 9 Atlas squadrons are programmed.

ATM (abbr). 'Antitank missile.'

atmosphere, n. (atm) 1. The body of air which surrounds the earth, defined at its outer limits by the actual presence of air particles but in such few numbers that collisions between them are so rare as to make the force of gravity the only means of keeping them associated with air particles at lower altitude. 2. The effective atmosphere (which see). 3. A body of gas, air, or other mixture of gases that envelops, or is conjectured to envelop, a spatial body other than the earth. Cf. **primitive atmosphere.**

In sense 1, the atmosphere is usually considered to consist of different strata or spheres, the last extending to 1,000 miles or more above the earth. From one standpoint these are the troposphere, the stratosphere, and the ionosphere; from another, the lower atmosphere, the middle atmosphere, and the upper atmosphere. But these same spheres, or other spheres differently conceived, may have properties that make for use of other names, as those of *chemosphere*, *isothermal region*, *ozonosphere*, *exosphere*, *ecosphere*, *homosphere*, *heterosphere*, *mesosphere*, and *thermosphere*. See separate entries.

Temperatures vary in the atmosphere from a standard of 59° F at sea level to 40° F at 5,000 feet, 23° F at 10,000 feet, -13° F at 20,000 feet, -39° F at 30,000 feet, -68° F at 40,000 to 100,000 feet, etc., to an estimated 4,000° F at 2,112,000 feet or 400 miles. These temperatures, sometimes reported by the Rankine scale

(which see), are relative to the air particles or other objects in the strata that absorb heat. Empty space between particles is without heat.

Sonic speeds also vary with altitude—1,120 ft/sec at sea level, 1,040 ft/sec at 20,000 feet, 973-975 ft/sec in the stratosphere, 1,430 ft/sec at 400,000. Above this (75 miles), sonic speed is without practical meaning because of the rarity of air particles. See **anacoustic zone.**

In sense 3, the atmosphere may include methane gas (as with Jupiter or with Saturn's satellite Titan), or ammonia (as with Jupiter), or other gases suited to the gravity forces and temperatures of the spatial bodies concerned.

atmospheric braking. The action of slowing down an object entering the atmosphere of a spatial body from space, by using the drag exerted by air or other gas particles in the atmosphere; the action of the drag so exerted.

atmospheric flare. A projection of atmosphere like a flare beyond the upper limits of the normal atmosphere. Comparable to a solar flare.

atmospheric plume. An atmospheric flare.

atmospheric refraction. Refraction of light from a distant point by the atmosphere, caused by its passing obliquely through varying air densities.

atomedics, n. The art and science of practicing medicine by full use of the technologies developed and available through electronics and atomic sciences. Hence **atomedic, a.**

This term, coined in 1956 by Dr. Hugh MacGuire of Montgomery, Alabama, is sometimes capitalized, esp. in reference to the specific operations of the Atomedic Research Center of Montgomery, Alabama.

atomic, a. 1. Of or pertaining to nuclear energy, either by fissionable or by fusionable process. 2. *Restrictive.* Of or pertaining to fissionable energy, as in the 'atomic bomb' distinguished from the thermonuclear bomb.

atomic clock. A device for measuring time utilizing a radioactive source with a precisely known decay constant.

This clock sent into space may, it is considered, be compared with a similar clock on earth, and used as a means of testing the general theory of relativity. Earth-bound clocks ought theoretically to run slower than a clock in a less strong gravitational field.

atomic particle. One of the particles of which an atom is constituted, as an electron, neutron, or a positively charged nuclear particle.

atomic rocket. A projected rocket engine in which the energy for the jet stream is to be generated by atomic fission or fusion.

This projected rocket may utilize fissionable or fusionable matter to heat and generate some substance such as liquid carbon dioxide into a hot and expanding gas, or it may itself be the source of ionized atomic particles.

atomic weapon. A bomb, shell, guided missile,

or the like in which the warhead consists of nuclear-fissionable, radioactive material, as uranium 235 or plutonium 239, as the explosive charge.

ATLAN (*abbr.*). 'Automatic terrain recognition and navigation' guidance system.

ATLAN (the RAN pronounced as 'ran') uses a radarscope film, which when matched by the missile's radar in flight, gives guidance. It is used on the TM-61B Matador or TM-76A Mace. ATLAN, effective over land only, is used for extremely low-level penetration. See map-matching guidance.

attitude, *n.* The inflight position of a missile or other flying body described by reference to its inclination about one or two of its three axes, and referred to a given datum plane or line, as that of the earth.

attitude control system. A system within the flight control system that functions to direct and maintain the desired attitude in the missile or vehicle.

attitude jet. A jet stream used to correct or alter the attitude of a flying body either in the atmosphere or in space; the nozzle that directs this jet stream.

The jet may be continuous or intermittent. A vernier engine is sometimes used to produce it.

AUM (*abbr.*). 'Air-to-underwater missile.'

auntie, *n.* Also anti. Slang for 'antimissile missile.'

aurora, *n.* Either of two displays of lights in the sky, one near the north magnetic pole, the other near the southern, which results from the impingement upon the earth's atmosphere of streams of electrically charged particles emitted by the sun.

The charged particles from the sun are attracted to the magnetic poles. Solar flares increase the intensity of the radiation and thus increase auroral activity.

automate, *v. tr.* To subject a process of manufacture to automation; to make supervision a product of automation.

automatic data processing system. (ADPS) An electronic system that includes an electronic data processing system plus auxiliary and connecting communications equipment.

automatic firing. The firing of a rocket engine or motor, esp. during flight, by use of an automatic device.

automation, *n.* 1. The means by which the production, movement, and inspection of manufactured articles are supervised and controlled by electronic or self-operating mechanical devices. 2. The means by which an item of supply or equipment is requisitioned and im-

mediately located for delivery by use of electronic equipment.

automaton, *n.* A computing machine, such as Univac, Maniac, or an IBM data-handling machine.

Autonetics, *n.* A division of North American, concerned with guidance systems.

autopiloted, *a.* Of a flying vehicle: Under continuous guidance by an automatic pilot.

Auxiliary Air Force Base. (AAFB) A site with its installations and facilities under AF control and used as an auxiliary to an AF base, as in the case of Cape Canaveral Auxiliary Air Force Base, auxiliary to Patrick Air Force Base. See Atlantic Missile Range.

auxiliary system. A system, as in a ballistic missile, that serves as an aid or adjunct in the performance of functions by other systems.

Systems for recovering a missile part, for missile self-destruction, for jettisoning, for heating or cooling, or for pressurization are considered auxiliary systems.

availability, *n.* An aspect of a device or system that indicates whether it can be obtained in desired quantity.

Availability, measured by objective tests (the state of the art, the absence or presence of factories, trained personnel, etc.), is a consideration apart from capabilities or reliability.

Avco, *n.* Short for 'Avco Manufacturing Corporation,' missile contractor, as for the nose cone of Titan.

aviation medicine. 1. Aeromedicine. 2. More broadly, aerospace medicine. See aerospace medicine, note.

avionics, *n.* [From *aviation electronics*.] A field of applied research in which electronic devices are adapted to use in aviation, missilery, and astronautics. Hence, **avionic, *a.*** Cf. **astrionics, *n.***

Avro, *n.* Short for 'Avro Aircraft Limited,' a Canadian aircraft manufacturer.

A-weapon, *n.* 1. An atomic weapon. 2. Any one of the German missile weapons developed under the A-series (which see).

azon, *n.* [Azimuth only.] A WW II bomb fitted with control surfaces in the tail to provide some radio control over the bomb's movement, but in azimuth only. Hence, **azon bomb, azon missile.**

The azon and razon (which see) were used with moderate success in the CBI theater.

Azusa system. A tracking system at a launch site developed by Convair for measuring missile velocity and position during the early flight of a missile.

This system, by use of ground equipment in conjunction with a transponder in the missile equipment, provides exact measurements that permit control and guidance of the missile until thrust cutoff.

B

B-36. A Convair developed heavy bomber powered in its later versions by six Pratt & Whitney reciprocating engines and by four General Electric turbojets. Also called the 'Peacemaker.'

The B-36 has a range of 10,000 miles, a speed of 435 mph, a ceiling of 45,000 feet. Its span is 230 feet, its gross weight 370,000 pounds. The B-36 is obsolete, replaced in SAC by the B-52.

B-47. A Boeing medium bomber powered by six General Electric J47 turbojets. Also called the 'Stratojet.'

The B-47 has a range of over 3,000 miles (with an added inflight refueling capability), a ceiling of 40,000 feet, and a speed of 600 mph. Its span is 116 feet, its gross weight 200,000 pounds. It has been modified for use in refueling, reconnaissance, training, radar pickup, and the launch of the Rascal.

B-52. A Boeing heavy bomber powered by eight Pratt & Whitney J57 turbojets. Also called the 'Stratofortress.'

The B-52 has a range of 6,000 miles with an added inflight refueling capability, a ceiling of over 50,000 feet, and a speed of more than 600 mph. Its span is 185 feet, its gross weight 400,000 pounds. It can carry the Hound Dog under its wings.

B-57. A Martin light bomber powered by two Wright J75-5 turbojets. Also called the 'Canberra.'

The B-57, a USAF version of the English Electra Canberra, has a range of over 2,000 miles, a ceiling of 45,000 feet, and a speed of 600 mph. Its span is 64 feet, its gross weight 50,000 pounds.

B-58. A supersonic medium jet bomber developed by Convair in conjunction with ARDC. Popularly called the 'Hustler.'

The B-58, powered by four General Electric J79 turbojets, is a delta-wing, needle-nose bomber with pinch waist, test-flown on 11 Nov 1956. Its ceiling is over 50,000 feet, its speed about 1,500 mph. Its span is about 57 feet, its gross weight 150,000 pounds. Its crew numbers three.

B-61. A name sometimes given the TM-61 or Martin Matador.

B-66. A Douglas light bomber, powered by two Allison J71-13 turbojets. Also called the 'Destroyer.'

The B-66 has a range of over 1,500 miles, a ceiling of over 45,000 feet, and a speed of from 600 to 700 mph. Its span is about 73 feet, its gross weight up to 83,000 pounds.

B-70. A strategic jet bomber under development by North American, expected to achieve

speeds of mach 3. Also identified as the WS-110A, and called the 'Valkyrie.'

The B-70 is to be powered by 6 GE J93-3 turbojets burning hydrocarbon fuel (boron fuel for a programmed J93-5 was cancelled in Aug 1959). Its range may be over 7,000 miles, its ceiling may be 80,000 feet, and its speed may be over 2,000 mph. Its span is over 185 feet, its gross weight 600,000 pounds. Cf. *Navaho*, *n.*, note.

Baby, *n.* A Japanese solid rocket research vehicle.

This rocket vehicle is reported as about 5 feet long, 3 inches in diameter, 20 pounds in weight, with a speed of 900 mph.

background research. An aspect of basic research considered to provide a foundation for subsequent research.

Background research is usually considered to involve systematic observation, collection, and organization of facts to provide adequate data upon which to project the analysis and experimentation required for the discovery or testing of new facts, principles, or hypotheses.

backout, *n.* An undoing of things already done during a countdown, usually in reverse order. Used in contexts where the countdown has been discontinued.

backup, *a.* Of a missile system or project: Designed to come along closely behind some other missile system or project so as to complement the latter or to take advantage of techniques and processes learned in the development of the earlier system or project, as in 'the Titan is a backup ICBM to the Atlas.'

backup item. An item under development intended to perform the same general functions that another item also under development performs.

A backup item may be secondary to its primary, or it may be parallel to it so as to enhance the probability of achieving an item with the desired capabilities. A backup item may be for any part or system. See preceding entry.

Baker, *n.* The name given the 1-pound monkey which accompanied the monkey Able on the Jupiter flight of 28 May 1959. See *Able*, *n.*, sense 2.

'Baker' was formerly authorized as a code word for the letter 'B.'

ballistic body. A body free to move, behave, and be modified in appearance, contour, or texture by ambient conditions, substances, or forces, as by the pressure of gases in a gun, by rifling in a barrel, by gravity, by temperature, by air particles, or by the target.

Bullets, conventional bombs, arrows, grenades, and the like are considered ballistic bodies; a guided missile or a missile with a self-contained propulsion unit is not considered a ballistic body during the period of its guidance or propulsion.

ballistic condition. A condition affecting the behavior of a missile or vehicle in flight.

Ballistic conditions include the velocity, weight, shape, and size of the missile or vehicle; likewise the density and temperature of the ambient element, and the rotation of the earth.

ballistic missile. 1. *Specif.* Any missile or missile vehicle guided during powered flight in the upward part of its trajectory that becomes, usually after a successive loss of fallaway sections, a free-falling or ballistic body after thrust cutoff; esp. such a missile that apogees above the sensible atmosphere. 2. That part of this missile (usually the nose cone with warhead) that reenters the atmosphere and heads toward the target area. 3. Generically, a missile that is subject to ballistic conditions during flight without benefit of continuous propulsion.

A ballistic missile (sense 1) is a different object at launch from that which reaches target. During flight large quantities of fuel are consumed, with a resultant and continuing change in the center of gravity, and sections of the vehicle usually fall away with resultant changes in size and shape, so that what flies toward the target after reentry may be only the nose cone (with warhead) of the original vehicle. Thus, context must be depended upon to determine what object is being referred to by the term.

At launch, the ballistic missile is an assembly of a number of interconnected and interacting systems and subsystems. The propulsion is developed through a propulsion system; attitude stability during powered flight is maintained through a control system; velocity and direction during powered flight is regulated by a guidance system so as to achieve a correct trajectory before thrust cutoff; electric power for use during flight is provided by an accessory power subsystem; means of furnishing data from test flights is provided by a monitoring system; the airframe is built to support everything in the missile; and a warhead is incorporated for detonation at a predetermined target by a fuzing system housed with the warhead in the nose cone. The missile, at every stage in its performance, is dependent upon a precisely calculated interaction of the systems it incorporates.

The ballistic missile is often differentiated from the guided missile in the restricted sense of the latter term. See *guided missile*.

Ballistic Missile Division. Short for 'Air Force Ballistic Missile Division.'

ballistic-missile early warning system. (BMEWS) A system to detect enemy ballistic missile firings and to give early warning.

This system makes use of radar stations in the northern latitudes and a central computer and display facility. Cf. *early-warning satellite*.

ballistic missile interceptor. (BMI) An interceptor, esp. an explosive rocket missile, designed to home upon, and destroy, a ballistic missile in flight.

This term is sometimes used as a synonym of 'anti-

missile missile.' The latter term, however, is a broader term. Cf. *antiballistic-missile missile, interceptor missile*.

Ballistic Missiles Center, AMC. (BMC) An office of Headquarters Air Materiel Command established at Inglewood, California, so as to provide a streamlined logistics system for IRBM's and ICBM's. Formerly called 'Ballistic Missiles Office.'

Note the plural use of 'Missiles' in this name. Cf. *Ballistic Missile Division*.

Ballistic Missiles Office. (BMO) A former name for the Ballistic Missiles Center, AMC.

Ballistic Research Laboratories. (BRL) An Army research laboratory at Aberdeen Proving Ground, Maryland.

ballistics, *n.* The science or art that deals with the motion, behavior, appearance, or modification of missiles acted upon by propellants, rifling, wind, gravity, temperature, or any other modifying substance, condition, or force; the art of designing missiles so as to give them efficient motion and flight behavior within the limitations set up by their purpose. See *exterior ballistics, internal ballistics*.

ballistic trajectory. That part of a missile's trajectory traced after the cutoff of propulsive force and guidance, the missile being acted upon only by the force of gravity, its momentum, and the properties and conditions of the element through which it passes.

The ballistic trajectory of a bullet or shell is its entire trajectory beginning at the muzzle of the gun; that of a free-falling bomb is from the point at which it separates from the bomber; that of a ballistic missile is from the point at which its fuel is cut off. A missile guided all the way to target has no ballistic trajectory.

The ballistic trajectory of a ballistic missile normally spans both the free-flight trajectory and the reentry trajectory. If the missile picks up guidance at reentry, however, the trajectory ceases to be ballistic. See *trajectory, *n.**

ballistic vehicle. The vehicle of a ballistic missile; a vehicle that follows a ballistic trajectory.

ballistic weapon. A ballistic missile; a weapon that reaches target like a ballistic missile.

ballistic weapon system. A weapon system in which the weapon carrier takes the warhead above the sensible atmosphere and puts it on a ballistic trajectory toward target. Cf. *aerodynamic weapon system*.

balloon-type missile. A missile, such as Atlas, that requires the pressure of its propellants (or substitute gases) within it to give it structure integrity.

Baralyme, *n.* A trade name for a carbon-dioxide absorbent, a mixture of calcium hydroxide and borium hydroxide.

barium oxide. A chemical compound, BaO, used as a water vapor absorbent.

base complex. The property, installations, and facilities that constitute a base: *specif.*, an air base with its landing strips or runways, its supporting facilities, its interior lines of communication, and a surrounding area of sufficient size for local security.

basic research. Research carried out by use of those techniques and disciplines relevant or appropriate to the discovery, testing, and marshaling of evidence as it bears upon a fact or hypothesis; research concerned with adding to man's knowledge, conducted under the direction of an hypothesis, or under the guidance of a discipline already established.

Basic research is conducted by applying the laws of evidence; a search for primary evidence is therefore a sign of basic research. Such research is applicable to anything—to phenomena, to the facts upon which a science is developed, to the principles or laws of a science, to the facts that contribute to the biography of a man, to the facts that explain an historical event, to the structures of mathematics, to the criteria of the disciplines, or to the manifestations of philosophy, religion, or aesthetics. It may be conducted in a laboratory, in the field, or in a library. This research is often done in phases, or by different people, each working on a part of the total effort, in which case any part of the activity is considered basic research.

This activity includes background research (which see), which is not so much a phase of basic research as it is an aspect, for basic research involves continuous reappraisal of fact and hypothesis. See **applied research, evidence, *n.*, primary evidence, and research, *n.***

basketball project. A popular name for the IGY satellite project announced from the White House on 29 July 1955. See **IGY satellite.**

BATO (*abbr.*). 'Balloon-assisted take-off.'

battleship stand. A test stand for carrying out a battleship tank test.

battleship tank test. A hot propulsion system test using propellant tanks of a thickness and strength approximating that of a battleship fuel tank to permit repeated pressurization of the tanks in simulating the acceleration pressures of an actual rocket flight. See **propulsion system test.**

battleship test. A battleship tank test.

BB-10. A French guided bomb, radio controlled, with an annular shroud wing and canard surfaces.

BDM (*abbr.*). 'Bomber defense missile.'

beacon tracking. The tracking of a moving object by means of signals emitted from a beacon within the object by dovap.

beam riding. The maneuver of a missile vehicle or other craft as it follows a radar or radio beam.

beast, *n.* A familiar term for a large rocket.

bel, *n.* [After A. G. Bell (1847–1922).] A unit used for the logarithmic expression of ratios of power, voltage, or current in wire or radio communication.

Bell, *n.* Short for 'Bell Aircraft Corporation,' aircraft manufacturer, as for the X-2, and prime contractor for missile systems, as for the Rascal or Shrike. Cf. **BTL (*abbr.*)**.

Beltsville Space Center. The Space Projects Center of NASA at Beltsville, Maryland.

Bendix, *n.* Short for 'Bendix Aviation Corporation,' missile contractor, as for Talos.

bends, *n.* 1. A painful cramping in the joints caused by aeroembolism. 2. Popularly used synonymously with 'aeroembolism.'

Beta, *n.* Short for '1957 Beta,' '1958 Beta,' etc. See **Alpha, *n.*, note.**

'1957 Beta' is the IGY name for Sputnik II; '1958 Beta' is the IGY name for Vanguard I; '1959 Beta' is Discoverer I.

beta particle. An electron originating within and emitting from a radioactive substance, often producing harmful physiological effects.

betatron, *n.* A device that accelerates electrons in a changing magnetic field, used chiefly to produce very hard X-rays.

The betatron, for example, is used for X-ray examination of solid propellant rocket motors.

Big A. The Atlas.

Big Brother. An early name for Sentry.

Big Joe. A test vehicle for the Mercury capsule using Atlas as the booster, first used on 9 September 1959 from Cape Canaveral.

Big T. The Titan.

bioastronautics, *n.* Astronautics considered for its effects upon animal or plant life.

See **Able, *n.*, sense 2, dog, *n.*, Jupiter, *n.*, note, man-in-space program, monkey, *n.*, mouse, *n.*, rabbit, *n.***

biodynamics, *n.* The study of the motions of bodies and of the forces acting upon bodies in motion, or in the process of changing motion, as these motions or forces affect life.

biomedical, *a.* Of or pertaining to biomedicine.

biomedicine, *n.* A combined discipline of biology and medicine directed toward analyzing human tolerances to environmental variances

and providing protection and maintenance when such tolerances are exceeded.

biosatellite, n. A satellite designed to carry an animal or plant, or a satellite that carries an animal or plant.

The word *animal* as used here includes man.

biosphere, n. That part of the earth and its atmosphere in which animals and plants live.

Cf. *ecosphere, n.*, sense b.

bipropellant, n. A liquid rocket propellant that consists of a mixture in the combustion chamber of a liquid fuel and a liquid oxidizer; also either the fuel or the oxidizer before being brought together in the combustion chamber.

bird, n. A figurative name for a missile, earth satellite, or other inanimate object that flies.

This term, used as early as 1918 in reference to the Liberty Eagle, is common among technicians who handle missiles. See *guided missile*, note.

Bird Dog. An early name for Genie.

BIS (abbr). 'British Interplanetary Society.'

black box. Any unit, as a robot pilot, that may be mounted in, or removed from, a missile, aircraft, or the like as a single package. Cf. *module, n.*

black-box operation. A maintenance action that consists of replacing one black box that is not functioning properly with another that does function properly.

Black Knight. A British rocket test vehicle under development and first used to launch a missile several hundred miles on the Woomera Rocket Range in Australia, 7 September 1958.

The Black Knight is a development of the Royal Aircraft Establishment associated with the contractors Saunders-Roe, Ltd. and Armstrong Siddeley Motors. The rocket is expected to be developed into the carrier of an ICBM.

blast, n. Specif. 1. The brief and rapid movement of air or other fluid away from a center of outward pressure, as in an explosion. 2. The characteristic instantaneous rise in pressure, followed by a sudden decrease, that results from this movement, differentiated from less rapid pressure changes.

This term is commonly used for 'explosion,' but the two terms are to be distinguished. In space, an explosion could take place, but no blast would follow.

blast, v. To *blast off*, to take off from a launching pad or stand. Said of a rocket in reference to the blast effects caused by rapid combustion of fuel as the rocket starts to move upward.

This usage is popular in press accounts, but seldom used in the Air Force.

blast furnace. A rocket engine. *Slang.*

blastoff, n. A missile launch. *Slang.*

bleed, v. tr. 1. With *off*: To take off a part or all of a *fluid* from a tank or line, normally through an escape valve or outlet, as in 'to bleed off excess oxygen from a tank.' 2. To let a fluid, such as air or liquid oxygen, escape from a *pipe, tank*, or the like.

blockhouse, n. Also written *block house*. 1. A reinforced concrete structure, often built underground or half underground, and sometimes dome-shaped, to provide protection against blast, heat, or explosion during rocket launchings or related activities; *specif.*, such a structure at a launch site that houses electronic control instruments used in launching a rocket. 2. The activity that works in such a structure.

At a launch site, the blockhouse actually controls the rocket for a few seconds at the time of launching before control reverts to Central Control (which see). Its distance from the launch pad varies according to the particular site. The Atlas blockhouse at Cape Canaveral is 750 feet distant from the pad, built to withstand a 50,000-pound blast at 50 feet; the Vanguard blockhouse is 175 feet from the pad.

A blockhouse, as a structure, is a facility, not a part of the GSE. See *ground support equipment*, note.

Bloodhound, n. A British surface-to-air supersonic missile, powered by ramjets and rocket boosters.

blowoff, n. The action of applying an explosive force and separating a package section away from the remaining part of a rocket vehicle or reentry body, usually to retrieve an instrument or to obtain a record made during early flight. Cf. *fallaway section*.

Blue Streak. A British surface-to-surface missile reported in development, with de Havilland, Rolls-Royce, and Sperry as associate contractors.

Blue Streak, some 60 feet long, 10 feet in diameter, is an IRBM with ranges up to 2,000 miles, and with a nuclear capability. The carrier rocket is liquid-propelled.

BMC (abbr). 'Ballistic Missiles Center, AMC.'

BMD (abbr). 'Ballistic Missile Division.' In full, AFBMD.

BMEWS (abbr). 'Ballistic missile early warning system.'

BMI (abbr). 'Ballistic missile interceptor.'

BMIC (abbr). 'Ballistic Missile Indoctrination Course.'

BMMG (abbr). 'Ballistic Missiles Management Group (AMC).'

BMO (abbr). 'Ballistic Missiles Office.' Now *bist*.

BMOC (*abbr.*). 'Ballistic Missile Orientation Course.'

BMWS (*abbr.*). 'Ballistic Missiles Weapon System.'

BO4. A Swedish air-to-surface solid rocket missile developed by Bofors. Also called the 'Jaktrobot.'

This missile is reported as having a speed up to 1,000 mph, a range up to 50 miles, an infrared guidance. Also called the 304.

boattail, n. The rear section of a ballistic body, sometimes tapered but squared off at the end, and serving as the base of the missile during launch.

Bobbin, n. A British ramjet test vehicle.

Boeing, n. Short for 'The Boeing Airplane Company,' a missile and aircraft contractor, as for the assembly and airframe of the Bomarc, or for the B-47.

Boeing 707. A Boeing-built passenger airliner, powered by four turbojet engines in four separate and interchangeable pods, two under each wing. Also called the 'Stratoliner.'

An advanced version, called the 707-321, made a record nonstop flight from New York to Moscow on 23 Jul 1959 in 8 hours, 53 minutes. See KC-135, VC-137.

boiling, n. The action that takes place in a liquid when its vapor pressure equals an opposing gas pressure (as that of the atmosphere); *specif.* in medicine, the bubbling of body fluids that occurs when atmospheric pressure drops to 47 mm of mercury or less.

boiloff, n. The vaporization of a liquid, such as liquid oxygen or liquid hydrogen, as its temperature reaches its boiling point under conditions of exposure, as in the tank of a missile being readied for launch.

Bold Orion. A projected AF ballistic missile designed to be launched from an airplane; the project of this missile. Also called WS-199. Cf. **ALBM** (*abbr.*).

This missile, expected to have a 1,000-mile range, is reported as powered by a solid rocket. It is a Martin project.

Bomarc, n. An AF surface-to-air clipped delta-winged air-breathing missile developed by Boeing for long-range air defense interception. Also called IM-99.

The Bomarc's dimensions are approximately 47 feet long, 18 feet in span, and 3 feet in body diameter. Gross takeoff weight is 7½ tons or more. An area defense missile, its range is up to 400 miles, its speed 2.5 to 3.5 mach. It takes off vertically, powered in its advanced version by an external booster solid rocket and by two ramjet engines mounted beneath the wings which take over when speed of mach 1 is attained. Its

guidance system is by radio command and radar homing. The airframe is by Boeing, the ramjets by Marquardt, the booster by Aerojet, and the guidance by Westinghouse.

The Bomarc A, scheduled for operational use at McGuire AFB, for example, has a 200-mile range. Bomarc B has a 400-mile range.

The Bomarc is tied in with the air defense systems, and has been fired on orders of a SAGE control center nearly 1,500 miles from the launch site.

Bomarc squadron. An AF or allied squadron equipped with Bomarcs, and normally tied in with a SAGE center.

bomb, n. 1. An explosive or other lethal agent (including its container or holder) that is planted or thrown by hand, dropped from an aircraft, or projected at low speed (as by lobbing from a mortar), and used to destroy, damage, injure, or kill; a thing similar to this object in appearance, operation, or effect, as a leaflet bomb, smoke bomb, etc. 2. *Specif.* Such an explosive dropped from an aircraft. 3. Also applied in WW II to a guided explosive or guided missile. Used esp. as the second element in combinations, as in *azon bomb, buzz bomb, flying bomb, jet bomb, and robot bomb*. Chiefly *hist.*

Although the word 'bomb' was used in sense 3 by natural extension, esp. in reference to azon and razon bombs, its use in this sense was short-lived when the missiles became self-propelled. The connotation of an object dropped from an aircraft, as in sense 2, was too strong. The term soon gave way to 'guided missile' (which see, esp. note).

boost, n. An extra propulsion or momentum given a flying vehicle during liftoff, climb, or other part of its flight, as with a booster rocket.

boost, v. tr. To give added thrust to an *aircraft* or *missile* by means of a ratio unit or other booster rocket.

booster, n. Short for 'booster engine' or 'booster rocket.'

booster engine. An engine, esp. a booster rocket, that adds its thrust to the thrust of the sustainer engine, or provides propulsion for a special phase of flight, as in the Navaho. See **sustainer engine**.

booster rocket. 1. A rocket motor, either solid or liquid, that assists the normal propulsive system or sustainer engine of a rocket or air vehicle in some phase of its flight. 2. Also applied to a rocket used to set a missile vehicle in motion before another engine takes over, as in the Aerobee or the Navaho.

A booster rocket (sense 1) may be incorporated into a rocket stage to give added power, or it may be a unit externally attached, as with a ratio unit. In the development of a given missile, the booster rocket may serve

temporarily without its sustainer engine, as in the Atlas A-series.

In sense 2, the booster rocket provides the power for takeoff so as to conserve the fuel of the main propulsion unit for later use. It is not considered a regular stage (although it somewhat functions as a stage) because it does not constitute an inherent part of the missile's propulsion system before separation. Cf. **ground start**.

booster vehicle. A rocket vehicle used to carry a payload object to a desired altitude at a desired velocity before separation.

boostglide vehicle. A projected space-air vehicle (half aircraft, half spacecraft) designed to fly to the limits of the sensible atmosphere, then be boosted by rockets into the space above so as to orbit the earth once or more times, returning to earth by gliding under aerodynamic control. See **Dyna-Soar, n.**, **orbital glider**.

bootstrap, v. intr. Of a rocket: To lift off and ascend rapidly. *Slang*.

boron-based fuel. A chemical fuel using boron, capable of about 4% more energy than hydrocarbon fuels. See **B-70**.

brains, n. The guidance system of a missile.

breadboard, n. 1. A flat sheet of metal that serves as a board on which the different parts of an assembly (as of a radio set) may be laid out, fixed to the board, connected together, and left uncased so that their operation may be checked or demonstrated. 2. The assembly on such a sheet of metal, as in 'breadboards are undergoing tests.'

breadboard, v. tr. To test an *instrument* by laying out its parts on a breadboard.

breakoff feeling. A feeling experienced by some flyers at high altitudes of being suddenly separated and detached from the earth and human society.

breakout, n. A process in missile production through which missile components, once stabilized, are taken away from the prime contractor and contracted for with independent suppliers. Principally an *Army* term.

breakthrough, n. A sudden advance in science or technology that opens the way to a new and greater capability, as in 'the breakthrough of Einstein in his $E = mc^2$.'

bremsstrahlung, n. [German 'brake radiation.'] The radiation of energy from charged particles after they have been decelerated or retarded, as in the case of atomic particles entering the earth's atmosphere, slowed down by collision with air particles. See **thindown, n.**

brennschluss, n. [German 'end of burning.'] Burnout in a rocket engine or motor.

BRL (abbr). 'Ballistic Research Laboratories.'

BSED (abbr). 'Ballistic Systems Education Division' of Air University. Also written BSED/AU.

BTL (abbr). 'Bell Telephone Laboratory,' guidance contractor, as for the Titan. Cf. **Bell, n.**

BuAer (abbr). 'Bureau of Aeronautics.'

bubble colony. A colony of persons placed upon the moon or other spatial body provided with individual or group environmental capsules.

bucket, n. A fanciful name for the bucket-like container of the second, third, and fourth stages of Jupiter C. See **tub, n.**

Bug, n. 1. A name given the Liberty Eagle of WW I. See **Liberty Eagle**. 2. A guided missile similar to the Liberty Eagle, but improved and developed by General Motors, flight-tested in December 1941.

The term 'Bug' (sense 1) is used in General H. H. Arnold's *Global Mission* (1949), pp. 74-75.

In sense 2, the Bug had a range of 200 miles and was under radio control. It was never used operationally.

buildup, n. The process of a force building up its strength in missiles, aircraft, stores, supplies, personnel, etc., so as to launch an operation.

Bulldog, n. A Navy air-to-surface solid rocket missile undergoing development by Martin, similar to the Bullpup but with a greater expected range.

Bull Goose. An early name for the Goose.

Bullpup, n. A Navy air-to-surface solid rocket guided missile undergoing development by Martin. Also called ASM-N-7.

The Bullpup's dimensions are approximately 11 feet by 2.7 feet, with a body diameter of 1 foot. Gross launch weight is 571 pounds. Its range is up to 5 miles, its speed from mach 1 to 2. It is mounted under the wings of an airplane, zeroed in on target by the flight of the airplane, and guided by visual reference radio command. Its warhead is non-nuclear, normally a 250-pound bomb. It is operational.

Bumblebee Program. A Navy supported program undertaken in January 1945 by the Applied Physics Laboratory of the Johns Hopkins University, which led to development of Talos, Tartar, Terrier I and II, and Triton.

Bumper, n. A two-step high-altitude research rocket consisting of the German V-2 with the Wac Corporal, the first missile to be launched from Cape Canaveral, 24 July 1950.

The Bumper underwent 6 flight tests at White Sands before 2 others at Cape Canaveral. In a flight of 24 Feb 1949 at White Sands it reached the then record altitude of 241.71 miles, with an end speed up to 5,100

mph. At Canaveral, the tests were for range, not altitude. See **Hermes, n.**, **Wac Corporal**.

BuOrd (*abbr.*). 'Bureau of Ordnance.'

Bureau of Aeronautics. (**BuAer**) A Navy bureau, created in 1921, 'charged with matters pertaining to naval aeronautics as may be prescribed by the Secretary of the Navy.'

The BuAer, working with different prime contractors, is charged with procuring, producing, testing, and maintaining certain guided missiles, such as the Sparrow II and Regulus II.

Bureau of Weapons. (**BuWeap**) A Navy bureau authorized and readying to merge the Bureau of Aeronautics and the Bureau of Ordnance on or about 1 January 1960.

Bureau of Ordnance. (**BuOrd**) A Navy bureau, organized under statutes of 1842 and 1862, responsible for design, procurement and development of offensive and defensive arms and armament, including rockets and certain guided missiles.

The BuOrd, working with different prime contractors, is responsible for such missiles as the Sidewinder, Petrel, Talos, Tartar, and Terrier II.

burner, n. A thing that burns; *specif.*, a rocket fuel.

burnout, n. 1. The event or action in a rocket or other reaction engine that marks the final combustion or oxidation of a fuel, either through fuel exhaustion or fuel shutoff. 2. The moment that this event takes place. 3. The point in a trajectory at which it takes place.

burnout velocity. The velocity of a rocket missile or vehicle at the moment of burnout. Cf. **end velocity**.

BuShips (*abbr.*). 'Bureau of Ships, U. S. Navy.'

button, n. 1. A knob, disk, or the like, connected electrically or mechanically with some working device that reacts when the knob or disk is depressed. 2. *To press* (or *push*) *the button*: a. To start a chain of reactions that launches, or is intended to launch, a rocket. See **T-time, n.** b. To execute a destruct.

In sense 2, 'the button' signifies the control button or switch on a console. See **console, n.**

buyer, n. *Specif.* In contracting, an unofficial representative of a procuring contracting officer, not empowered to commit the government except when so authorized.

buzz bomb. An early name for the V-1.

C

C-7. An Italian solid-rocket air-to-air missile, guided by infrared.

C-119. A twin-engine, twin-boom, transport aircraft, developed by Fairchild. Popularly called the 'Packet' or the 'Flying Boxcar.'

The C-119 is used in the effort to recover Discoverer capsules. See **Discoverer VI**.

C-124. A four-engine transport developed by Douglas, with a main hold 77 feet long, 12 feet 10 inches high, and 13 feet wide, capable of air-transporting the Thor. Popularly called the 'Globemaster II.'

C-133. A four-engine turboprop transport developed by Douglas, with a main freight hold of 90 feet in length, almost 12 feet in width, and over 12 feet in height, capable of air-transporting the Titan. Popularly called 'Car-gomaster.'

CAF (*abbr.*). 'Complete assembly for ferry.'

CAFB (*abbr.*). 'Cooke Air Force Base.' *Hist.*

CAL (*abbr.*). 'Cornell Aeronautical Laboratory.'

CAMAL (*abbr.*). 'Continuously airborne missile launching and low-level.'

CAMAL program. A program for development of a nuclear powered aircraft.

Cambridge Research Center. Short for 'The Air Force Cambridge Research Center.'

can, n. *Specif.* A shield or container for an entire missile, by which environment can be controlled. See **controlled environment**.

canard, n. 1. 'An airplane having its stabilizer and elevators forward of the wing' (USAF Dict.). 2. An aerodynamic control surface on the nose of a missile, as on the Bullpup or the projected Bold Orion.

In sense 2, the canard may be used for control during reentry.

Canaveral, n. Short for 'Cape Canaveral.'

Canberra, n. The B-57.

Canopus, n. The second brightest star in the heavens, a star in the constellation Argo. Cf. **Alpha Centauri**.

capability, n. A power or capacity to do something.

Capabilities belong to people, organized forces, or things. The capabilities of a force refer to the things it can do in both offensive and defensive operations; the capabilities of a missile refer to its range, speed, accuracy, and the like. Cf. **characteristic, n.**

capability in-being. The capability of a military force as it actually exists, ready to be used in immediate reaction to command.

Cape Canaveral. 1. A cape on the east coast of Florida, the site of Cape Canaveral Auxiliary Air Force Base, used as a laboratory for launching missiles or space vehicles. 2. The

launching site located on this cape. 3. Short for 'Cape Canaveral Auxiliary Air Force Base.'

The Air Force Missile Test Center operates the launching site. See **Bumper**, *n*.

Cape Canaveral Auxiliary Air Force Base.

An auxiliary AF base located on Cape Canaveral, Florida, the site of rocket launchings on the Atlantic Missile Range.

capsule, *n*. Any closed, neatly adapted, movable container, receptacle, or chamber that provides for special handling, emergency use, or special environmental control.

The capsule may be a specially pressurized and oxygen-supplied receptacle for carrying an animal above the sensible atmosphere; it may be an airtight, ejectable airplane cockpit or cabin; or it may be any other container that provides a special environment or protection. When adapted to space or high altitude flight, it is built to provide a particular environment. See **data capsule**, **environmental chamber**, **manned capsule**, **pressurized capsule**, **recovery capsule**, **sonar capsule**.

captive test. A hold-down test esp. of a propulsion subsystem, rocket engine or motor. Distinguished from a flight test.

The captive test is designed esp. to verify or demonstrate the integration of propulsion subsystems with the propulsion system, also the operation of the flight control subsystem under full thrust conditions. Cf. **flight readiness firing**, **static testing**.

capture, *n*. The act or event of a central force field capturing a passing or colliding body or particle.

capture, *v. tr.* Of a central force field, as of a planet: To overcome the velocity or centrifugal force of a passing or colliding *body* or *particle* and bring its behavior under its own control or integrate its mass into its own.

A spacecraft on a transfer orbit, for example, would be captured by the planet at the point of rendezvous.

carcinogenesis, *n*. The origination of cancer, as by contact with certain types of radiation.

CARDE (*abbr*). 'Canadian Armament Research and Development Establishment.'

cardiovascular reactivity. The response and behavior of the heart and blood vessels to various types of stress, such as exercise, extreme cold or heat, or acceleration.

Cargomaster, *n*. The C-133.

carrier rocket. A rocket vehicle used to carry something, as in 'the carrier rocket of the first artificial earth satellite.'

CAS (*abbr*). 'Complete assembly for strike.'

CASF (*abbr*). 'Composite Air Strike Force.'

cat, *n*. The domesticated feline, used in bio-astronautic experiments.

The cat is esp. suited to tests in weightless experiments because of its unique vestibular apparatus, which gives it a special ability in orienting itself.

celestial body. 1. A spatial body that exists in the heavens. 2. *Restrictive*. Any such body exclusive of a manmade space vehicle.

This term (sense 1) includes the sun, the stars, planets, meteors, the moons, the manmade space vehicles. It also includes the earth from the standpoint of a detached observer. It does not always and necessarily include the earth, however, since the term is essentially one used by an observer on the earth of the earth's *caelum* or sky. See **spatial body**.

Technically *celestial body* covers nebulae, but *celestial structure* is also applied to them. The term is also generic for the terms *astronomic body*, *planetary body*, *satellite body*, and *meteoric body*.

celestial guidance. The guidance of a missile vehicle or other vehicle by reference to celestial bodies.

The missile vehicle is equipped with gyroscopes, telescopes, mechanically or electrically recorded navigational tables, computers, and other instruments and devices that sight stars, calculate positions, and direct the missile. The Snark, for example, is equipped with celestial guidance.

celestial mechanics. That branch of mechanics concerned with mathematical development of postulates treating of the motions of celestial bodies.

celestial navigation. The plotting of a moving vehicle's position and the directing of it from within the vehicle by means of sightings on celestial bodies. Cf. **celestial guidance**.

This term is normally used in reference to aircraft navigation. In reference to spacecraft navigation, the term *astronavigation* (which see) is also used.

celestial sphere. An imaginary sphere of infinite radius assumed for navigational purposes, the center of which coincides with the center of the earth, and its spherical surface bearing the celestial bodies as they appear in the sky.

The equator of this sphere is an extension of the plane of the earth's equator.

celestial structure. Any group of celestial bodies, or any aggregate of dust or gas in space, that move together as of one system.

The term applies to a nebula, a planet and its satellites, a solar system, a galaxy, etc.

Centaur, *n*. A projected rocket test vehicle to consist of a modified Atlas as the first stage, a liquid oxygen and hydrogen second stage, and a storable liquid third stage.

This vehicle is of interest to both ARPA and NASA. It is programmed by NASA as an advanced man-carrying spacecraft, also as a vehicle for launching communications satellites and for soft landings on the moon. Its payload may be as high as 8,000 pounds. Cf. **man-in-space program**.

center of mass. That point in a given body, or in two or more bodies that act together in respect to another body, which represents the

mean position of the matter in the body or bodies.

The center of mass in the earth about which the moon revolves is not at the same point as the center of mass of the moon and earth together as the two bodies revolve about the sun. In the first case, the center of mass is at about the center of the earth; in the second case, the center of mass is about 1,000 miles under the earth's surface on a line connecting the center of the moon with the center of the earth. As the moon revolves about the earth, the center of mass of the two bodies moves.

central control. 1. Control exercised over an extensive and complicated system from a single center. 2. Usually *capitalized*. The place, facility, or activity from which this control is exercised; *specif.* at Cape Canaveral or at Vandenberg AFB, the place, facility, or activity at which the whole action incident to a test launch and flight is coordinated and controlled, from the make-ready at the launch site and on the missile range, to the end of the rocket flight downrange. 3. A similar facility on a downrange station that exercises central control from the standpoint of the station.

For a few seconds during the actual launch, control of a missile is exercised from the blockhouse, but it almost immediately reverts to Central Control for guidance and tracking, with two men in essential control. One of these is the supervisor of range operations, the other is the range safety officer. See separate entries.

central force field. The gravitational or electromagnetic field that attracts and limits the behavior of surrounding objects or particles.

The sun or a planet is a central force field, for example; likewise the nucleus of an atom. Cf. *primary body*, *quantum*, *n.*

centrifugal force. 1. A force exerted upon a rotating object (or upon its parts), or upon a revolving object, in a direction outward from the center of rotation or revolution. 2. As applied to an object constrained to follow a curved path, the force equal and opposite to the centripetal force, having the value of mv^2/r , in which m is the mass of the object, v its velocity, and r the radius of the path's curvature.

This force explains why a body revolving about another does not fall. Centrifugal force opposes the force of gravity.

centrifuge, n. A machine with a long arm which, when rotated at different speeds, simulates the accelerations encountered in high-performance aircraft or rocket vehicles. See *astronautic centrifuge*.

CEP (abbr). 'Circular probable error' or 'circular error probability.'

CF-105. The Arrow.

CFP (abbr). 'Contractor-furnished property.'

CG or cg (abbr). 'Center of gravity.'

C. G. S. (abbr). 'Centimeter—gram—second.'

This abbreviation designates a system in which the unit of length is the centimeter, the unit of mass is the gram, and the unit of time is the mean solar second. Used, for example, in defining the constant of gravitation.

CH-10. A Russian rocket vehicle used for the launch of a sputnik, as of Sputnik II.

Its powerplant is reported as a one or two-stage liquid rocket, thrust unknown outside Russia, its propellants kerosene and liquid oxygen. Its overall length is reported at 118 feet, its guidance by radio and gyro, its payload 1,120 pounds.

chamber pressure. The pressure of gases within a firing chamber.

The designer of a missile has some freedom in choosing a chamber pressure to achieve a desired thrust-time program.

Chance Vought. Short for 'Chance Vought Aircraft, Inc.,' an aircraft and missile contractor, as for Regulus I.

characteristic, n. (char) Specif. A disposition inherent in a piece of equipment that tends to make it perform in a certain way.

The characteristics of a ballistic missile, for example, refer to such matters as its responsiveness to control, its tendency to remain stable as the center of gravity changes, its sturdiness under the impact of heavy pressures, etc. Cf. *capability, n.*, *feature, n.*, *operational characteristic*.

characteristic velocity. The velocity of a body at the earth's surface that would allow the body to reach a given orbit without further expenditure of energy.

checkout, n. 1. A sequence of actions taken to test or examine a thing as to its readiness for incorporation into a new phase of use, or for the performance of its intended function. 2. The sequence of steps taken to familiarize a person with the operation of an airplane or other piece of equipment.

In sense 1, a checkout is usually taken at a transition point between one phase of action and another. To shorten the time of checkout, automation is frequently employed.

checkout GSE. Ground support equipment used to make a checkout on equipment. Cf. *test GSE*.

chemical bomber. 1. A bomber that uses a chemical for fuel. Distinguished from a nuclear bomber. See *chemical fuel*, sense 1. 2. A jet bomber that uses exotic fuel, esp. as introduced into the afterburner.

chemical fuel. 1. A fuel that depends upon an oxidizer for combustion or for development of thrust, such as liquid or solid rocket fuel, jet

fuel, or internal-combustion-engine fuel. Distinguished from nuclear fuel. 2. An exotic fuel that uses special chemicals, such as the fuel once projected for the afterburner of the B-70. Cf. J93.

chemosphere, *n.* A stratum of the atmosphere considered to begin at approximately 20 miles and to extend to 50 miles above the earth, marked for its photochemical activity.

By some meteorologists, the chemosphere is considered to be an extension of the stratosphere.

Chlorella, *n.* A genus of unicellular green algae, considered to be adapted to converting carbon dioxide into oxygen in a closed ecological system. See **closed ecological system**.

chromosomal aberration. *Medicine.* A change in the chromosomes of a reproductive cell.

Chrysler, *n.* Short for 'Chrysler Corporation,' a prime contractor, as for the Redstone or Jupiter.

circle, *v. tr.* To orbit the *earth* or other spatial *body*; to go around a *thing*.

circuitry, *n.* The system of electric or electronic circuits used in a missile system or subsystem.

circular probable error. (CEP) 1. In missilery a probable error that results from peculiarities inherent in a particular missile system (as those of ballistic differences) expressed in terms of the radius of a circle centered on the desired mean point of impact (DMPI), the circle including one half the missile strikes, excluding gross errors. 2. In bombing, a probable error expressed in similar terms.

The probable error for any given missile is obtained statistically by testing, and may be used to assess probable damage to a target. Gross errors resulting from malfunctioning equipment or from mislocation of a target are excluded from the calculation. See **gross error**.

This term is understood by some people to be the radius of a circle centered on the mean point of impact (MPI) of missiles aimed at the same point, the circle including half the missile strikes. This, in effect, describes the distribution of the missile impact group without reference to distance from the desired mean point of impact.

circular velocity. Orbital velocity.

circumplanetary space. The space relatively close by a planet, esp. the space close by the earth including the outer reaches of the upper atmosphere.

cislunar, *a.* [Latin *cis* 'on this side.'] Of or pertaining to phenomena, projects, or activity in the space between the earth and moon, or between the earth and the moon's orbit.

cislunar space. 1. Space between the earth and the moon, shaped like a frustum (with its base a great circle of the earth equal in diameter to the earth's diameter) and moving like the hand of a clock as the moon revolves about the earth. 2. Space between the earth and the moon's orbit.

CIT (*abbr.*). 'California Institute of Technology.'

Civil Reserve Air Fleet. The aircraft belonging to airlines, private firms, and individuals, considered as a reserve available in a national emergency for airlift esp. of persons.

closed-circuit TV. A television sending and receiving system in which the cameras or the film reproductions are linked directly to the receiving sets by coaxial cables so that picture transmission is never broadcast by normal radiation.

closed ecological system. *Space medicine.* A system that provides for the body's metabolism in a spacecraft cabin by means of a cycle wherein exhaled carbon dioxide, urine, and other waste matter are converted chemically or by photosynthesis into oxygen, water, and food. Cf. **controlled leakage system**, **open system**.

The closed system is projected for space flights enduring several days, weeks, months, or years. Cf. **alga, *n.***, **Chlorella, *n.***

closed system. *Specif.* Short for 'closed ecological system.'

close satellite. A satellite that orbits close to its primary.

closest approach. 1. The event that occurs when two planets or other bodies are nearest to each other as they orbit about the sun or other primary. 2. The place or time of such an event.

See **Mars, *n.***, **Venus, *n.***

cloud chamber. A container for holding a gas, esp. air supersaturated with water vapor, designed to make the paths of particles moving through the gas visible.

For example, the passage of alpha particles through air supersaturated with water vapor will cause pairs of ions to form, on which drops of water will condense, the drops indicating the path of the alpha particles.

cluster, *n. Specif.* Two or more rocket motors bound together so as to function as one propulsive unit.

coast, *v. intr.* Of a missile: 1. To continue forward movement after thrust cutoff without benefit of gravity force. 2. To continue

forward movement on a curved trajectory after thrust cutoff, the total movement having a component due to gravity force.

In technical contexts, sense 1 is the sense usually meant.

coasting flight. 1. The flight of a rocket missile or vehicle between burnout or thrust cutoff of one stage and ignition of another, or between burnout and summit altitude or maximum horizontal range. 2. The curved flight of a rocket missile after thrust cutoff.

In sense 1, coasting flight is one of two components in the movement of the missile; the other is flight due to gravity. In sense 2, coasting flight includes the component due to gravity force.

coffin, n. A missile shelter for a horizontally positioned missile. See *hangar, n.*, sense 2.

cold-flow test. A test of a liquid rocket without firing it to check or verify the efficiency of a propulsion subsystem, providing for the conditioning and flow of propellants (including tank pressurization, propellant loading, and propellant feeding).

combustion chamber. *Specif.* A firing chamber (which see).

Comet, n. 1. One or other of two Russian rocket missiles, submarine-to-surface, called 'Comet I' and 'Comet II.' 2. A British turbojet airliner or transport, developed by de Havilland.

The Comet (sense 1) is reported as having a speed of 3,000 to 4,000 mph.

command, n. An electronic or electrical signal that activates a control mechanism in a guidance system so that the vehicle carrying the mechanism may be guided; the control exercised by such a signal. See *radio command*.

See *USAF Dictionary* for other senses.

command destruct. A system that destroys a flightborne test missile, actuated on command of the range safety officer whenever missile performance degenerates enough to be a safety hazard.

command destruct signal. A radio signal that detonates an explosive in a rocket test missile or vehicle so as to destroy it.

command guidance. The guidance of a missile or vehicle by radio command or by wire.

common item. An item of supply used in two or more systems, subsystems, or pieces of support equipment, including related components and spares.

communications satellite. A satellite designed to reflect radio or other communications waves

or to receive radio messages, then to relay them after a time lapse. See *Courier, n.*, *Score, n.* **companion body.** A nose cone, last-stage rocket, or other body that orbits along with an earth satellite. Cf. *afterbody, n.* See *sputnik rocket, note*.

comparator, n. An electronic processing instrument that compares one set of data with another.

compatibility, n. 1. A disposition ascribed to a major subsystem that indicates it functions well in the overall missile system. Often modified by an adjective to show its extent, as in 'the guidance system has good compatibility.' 2. Also applied to the overall system with reference to how well its various subsystems work together, as in 'the missile has good compatibility.'

compatible, a. Of a missile subsystem: Suited for smooth operation in the overall missile.

complex, n. Short for 'launch complex,' as in 'Complex 25B at Cape Canaveral.'

component, n. (comp) One of the parts of which a thing is composed; *specif.*, a self-contained part that constitutes a distinct entity (as the wing of an airplane or a vernier engine of a propulsion system) and performs a function necessary to the proper operation of the module, subsystem, or system of which it is a part.

A component may itself be an assembly, or it may be a single piece not subdividable without destruction. The same object may also be a component of two different systems, as with the vernier engine which functions with the guidance system as well as the propulsion system.

composite, a. Of a force: a. Having or operating different kinds of equipment, as bomber aircraft and ballistic missiles. b. Made up of dissimilar elements, as of two or more services.

Composite Air Strike Force. (CASF) A special task force of the USAF Tactical Air Command, normally deployed in the US, but ready for immediate deployment to any area of the world, carrying with it a certain logistic capability.

Elements of this force were deployed in 1958 to the Lebanon area and to Taiwan.

ConAD (abbr). 'Continental Air Defense Command.' Cf. *NorAD (abbr)*.

concurrency, n. As used in such phrases as 'concept of concurrency' or 'process of concurrency': The meeting together at one time of several different scientific, technological, training, and other developments so as to re-

duce the amount of lead time in achieving a given capability.

For example, in February 1954 the AF made the decision to design the Atlas ICBM around a lightweight, high-yield nuclear warhead, although such a warhead existed only in theory at that time. By the time the Atlas was developed, however, the projected warhead was also actually available, together with launch sites, trained crews, etc. Had the Atlas program been delayed until the warhead became available, the fruition of the program would have been postponed.

cone, *n.* *Specif.* A nose cone.

configuration, *n.* 1. The relative disposition and makeup of a thing's component parts; the internal and external contours that result from this disposition; the shape of a thing at any given time. See *hot configuration*. 2. The thing itself, as in 'the Titan and other configurations are now being tested'; a type or model of a thing.

Applied in sense 2 either to a missile or aircraft as a whole or to the airframe or other component part.

configure, *v.* [Back formation of 'configuration.'] *tr.* To give *something* a particular configuration.

Congreve rocket. Any of several rocket motors invented by the British Army Colonel, Sir William Congreve (1772–1828), during the years 1805 to about 1817 for use in artillery bombardment, flaring, or incendiary action.

Congreve's rockets included one capable of sending a 9-pound spherical bomb to a range of 3,000 yards.

conic section. A curve formed by the intersection of a plane and a right circular cone.

The conic sections are circular, elliptic, parabolic, or hyperbolic—curves that are used to describe the paths of bodies moving in space.

conjunction, *n.* The passing of two or more celestial bodies in the same degree of the zodiac.

Conjunction of inferior planets are of two kinds, *inferior conjunction* when the planet is between the earth and sun, *superior conjunction* when the sun is between the earth and planet. Cf. *opposition, n.*

console, *n.* An array of controls and indicators for the monitoring and control of a particular sequence of actions, as in the checkout of a missile, a countdown action, or a missile launch procedure.

A console is usually designed around desklike arrays. It permits the operator to monitor and control different activating instruments, data recording instruments, or event sequencers. See *launch monitor console, master console*.

constant of gravitation. (G) The acceleration that results from the attraction of a unit of mass at unit distance, determined by Heyl and Chrzanowski in 1942 to be $6.673 \times 10^{-8} \pm$

0.003 in C.G.S. units. See *C.G.S. (abbr), gravitation, n., note*.

Expressed in C.G.S. units, this means that two small spheres of one gram mass each with their centers one centimeter apart attract each other with a force of $6673/100,000,000,000$ of a dyne; that is, they will accelerate toward each other at a rate of $6673/100,000,000,000$ of a centimeter per second per second. See *dyne, n.*

constellation, *n.* 1. Any one of the arbitrary groups of fixed stars—some 90 now recognized. 2. A division of the heavens in terms of any one of these groups.

continental air defense. A coordinated defense of the continental United States against air or missile attack. Cf. *air, n., note*.

The defense is coordinated as among the ground, sea, and air forces, and civil defense authorities.

Continental Air Defense Command. (ConAD) A joint command established in the summer of 1954 to coordinate the operations of the three services in defense of the continental United States and Alaska against air and ballistic missile attack.

The Air Force, through its Air Defense Command, its Alaskan Air Command, its units in Greenland and Newfoundland, has primary responsibility in ConAD. Cf. *North American Air Defense Command*.

contract, *n.* (contr) *Specif.* An agreement between the government and a contractor whereby the contractor commits himself to render specified services or to furnish specified articles to the government for recompense; a document attesting to or certifying such an agreement, including applicable changes and amendments, supplements, and exhibits.

contracting officer. *Specif.* 1. Any officer or civilian employee of a military department who, in accordance with departmental procedures, is designated a 'contracting officer' with authority to enter into and administer contracts and to make determinations and findings with respect thereto, or to any part of such authority. 2. An authorized representative of a contracting officer acting within the limits of authority given him by the contracting officer. Cf. *buyer, n.*

contractor, *n.* (contr) 1. Any person, partnership, company, corporation, or combination thereof that enters into a contract with the government. 2. *Specif.* Such a one who enters into a contract with a contracting officer; a prime contractor or an associate contractor.

In some official contexts, and usually by specific definition, the word 'contractor' may mean both the contractor and the subcontractor.

contractor-furnished property. (CFP) All property, except government property, that is used by the contractor in the performance of his contract.

contract status report. A report normally issued by an office or agency of the government which contains brief technical, operational, logistical, and managerial information for use in the management, guidance, and evaluation of a contract; any report issued by the government or by the contractor on the status of a given contract.

contractual coverage. The coverage of a legally binding document which requires the contractor to satisfy Air Force requirements for supplies or services defined by such document.

controlled environment. The environment of any object, such as an instrument, a man, or an unlaunched missile, in which matters such as humidity, pressure, temperature, etc. are under control.

controlled leakage system. *Aviation or space medicine.* A system that provides for the body's metabolism in an aircraft or spacecraft cabin by a controlled escape of carbon dioxide and other waste from the cabin, with replenishment provided by stored oxygen and food. Cf. **closed system**.

control of space. 1. A control over the use of space, esp. circumplanetary space, exercised through astronautics and the possession of skills, techniques, and equipment that permit exploration, movement, and travel into and through space. 2. Such control exercised by one nation or by a group of nations with effective denial of such control to a rival nation or group of nations.

control rocket. A vernier rocket, retrorocket, or other such rocket, used to guide, accelerate, or decelerate a ballistic missile, spacecraft, or the like.

control system. Short for 'flight control system.'

Convair, n. [*Consolidated Vultee Aircraft.*] A division of General Dynamics Corporation (since April 1954), aircraft contractor (as for the B-58), and missile contractor and associate contractor (as for Tartar, Wizard, and Atlas).

Cooke Air Force Base. The former name (January 1957–October 1958) of Vandenberg Air Force Base. *Hist.*

Originally an Army training post for an armored division, this base was called Camp Cooke by the Army between 1942 and 1953 in honor of Philip St. George Cooke (1809–1895), noted soldier, explorer, and author.

coordinating responsibility. *Office of coordinating responsibility* (OCR), the office or organization designated by competent authority to assume responsibility for supporting the office of primary responsibility by technical or administrative advice and assistance so as to ensure integration and compatibility of a mission segment with overall objectives. Cf. **primary responsibility**.

The office of coordinating responsibility is the lowest echelon agency commensurate with the level of the mission segment. See **mission segment**.

coriolis force. An apparent force exerted upon an object in motion relative to the earth's coordinate system, so called in explanation of horizontal deflection of the object to the right of its velocity in the Northern Hemisphere, or to its left in the Southern.

This force is named after the French mathematician who detected it, Gaspard Gustave de Coriolis (1792–1843).

Its effect, in cases of motion containing a north or south component, is due to the different rotational speeds of the earth's surface in an eastward direction, the speed being greatest at the equator and least at the poles. For example, a missile launched due north from a site on the equator has an eastward velocity initially the same as the eastward surface velocity at the equator. As it moves northward, however, the surface velocities successively become less, so that the impact point of the missile will be east (or to the right) of the line connecting the launch site with a point due north of it. On the other hand, if the missile is fired due south from a site in a north latitude, eastward initial velocity will be less than the eastward velocity of the surface at the impact point, so that the impact will be to the west (or to the right) of the line connecting the launch site with a point due south of it. If the missile is fired at the North Pole, it does not participate in the earth's rotation; its apparent westward deflection is due to the earth's rotating beneath it.

In case of a missile fired due east or west, the missile travels due east or west for only an instant except at the equator. Its flight path is actually on a plane that describes a great circle. Thus, in the northern hemisphere, the missile's velocity has a southward component, with a resultant deflection to the right.

At the equator, coriolis force is exerted on objects moving north or south, the deflection increasing with distance from the equator; the deflection, however, is zero for objects moving due east or west on the equator.

In the southern hemisphere, the same deflective force is exerted, but toward the left of velocity.

Cornell, n. Short for 'Cornell Aeronautical Laboratory' of Cornell University, missile contractor, as for Lacrosse.

Corporal, n. An Army surface-to-surface liquid rocket ballistic missile developed by Firestone and Gilfillan. Formerly called the

XM4E1 or the SSM-A-17. Called the M-2.

This missile is 30 inches in body diameter and some 46 feet long; it reaches a speed of several mach, and has a maximum range of 100 miles. It is operational and in hands of overseas forces, but is expected to be replaced by Sergeant. It is launched vertically, its launcher a light-metal takeoff pedestal. A mobile erector places the missile on the launcher. Its guidance is by radio command.

The Corporal is primarily for use against tactical targets at ranges of 75 miles and over.

corpuscle, *n.* A minute radiation particle.

corpuscular cosmic ray. A cosmic ray considered to consist of a particle, the atomic nucleus of hydrogen or helium.

corpuscular radiation. 1. The emission and propagation of elementary material particles (corpuscles), esp. atomic particles. 2. The particles that are radiated. Cf. *radiation, n.*

cortical activity. The activity of the brain in areas controlling consciousness and awareness in response to sensory excitation.

Corvus, *n.* A Navy air-to-surface liquid rocket missile undergoing research and development by Temco. Also called XASM-N-8.

This missile, designed so it may be launched from carrier-based aircraft, may be used against surface ships or heavily defended areas as a standoff missile. It homes on enemy radar.

cosine jitter. In a tracking device, a cosine factor that repeatedly moves back and forth, plus or minus, of its true value.

cosmic flight. The flight of a space vehicle or probe through space.

cosmic ray. Either a highly penetrative quantum of energy or a highly penetrative particle—depending upon the applicability of theory to explain each particular phenomenon connected with the ray—which, according to tentatively accepted theory, is produced by transmutations of atoms in interstellar space.

When behaving as a quantum of energy, the cosmic ray is considered to be of a wave length in the order of 0.001 angstrom; when behaving as a particle, it is considered to be the nucleus of hydrogen, helium, or some other element less heavy than the nucleus of iron. The ray bombards the earth and other objects in space in great quantity, and in the atmosphere causes ionization. See *corpuscular cosmic ray*, *heavy cosmic ray primary*.

Because of new data obtained from space probes, a single theory on the nature of cosmic rays is theoretically evolving.

cosmos, *n.* The totality of the observed and postulated physical whole, conceived as an orderly and harmonious system.

The Greek word *kosmos* means order or harmony.

COTAR (abbr). 'Correlated orientation tracking and ranging' system.

cotar, *n.* A system generally using a parabolic antenna for the analysis of a narrow band of radar energy for tracking and ranging purposes. Attrib., as in *cotar antenna*.

count, *v. intr.* To proceed from one point to another in a countdown or plus count, normally by calling a number to signify the point reached; to proceed in a countdown, as in 'T minus 90 and counting.'

countdown, *n.* 1. A step-by-step process that culminates in a climactic event, each step being performed in accordance with a schedule marked by a count in inverse numerical order; *specif.*, this process as used in leading up to the launch of a large or complicated rocket vehicle, or in leading up to a captive test, a readiness firing, a mock firing, or other firing test. 2. The act of counting inversely during this process.

In the launch of a ballistic missile or space vehicle, the countdown normally takes considerable time to effect, because the process involves checking on each system and subsystem with the interruptions of holds and recycling.

In sense 2, the countdown ends with T-time; thus, 'T minus 60 minutes' indicates there are 60 minutes to go, excepting for holds and recycling. The countdown may be in hours, minutes, or seconds. At the end, it narrows down to seconds, 4-3-2-1-zero. See *plus count*.

courier, *n.* 1. *Project Courier*, an ARPA project to develop a capability for a delayed communication repeater for use in a satellite. 2. A satellite used in this project.

The Courier with a magnetic recorder is programmed to receive messages from the ground as it passes over a transmitting station, then to release the messages over a receiving station. The capability would be equivalent to the handling each minute of 20 messages of 100 words each. Courier is a follow-on of Score.

CRAF (abbr). 'Civil Reserve Air Fleet.'

critical mass. The minimum mass of a fissionable material necessary, when related to a particular shape and environment, to sustain a nuclear chain reaction.

critical vendor item. Any piece of material, or any article, to be incorporated into a piece of equipment, system, or subsystem considered by the AF to be currently or potentially in such limited supply as to affect adversely the delivery of the end item.

Crossbow, *n.* An AF air-to-surface winged missile developed by Radioplane, designed to home on enemy radar.

Weighing about 1 ton, subsonic, and with a range of 200 miles, the Crossbow is powered by a small turbojet.

cruise missile. A powered missile, esp. a guided missile, that flies at a moderate speed and at

an approximately constant altitude normally within the atmosphere.

The Bomarc, Snark, and Quail are examples of cruise missiles.

cryogenic fuel. A rocket fuel that either is itself kept at very low temperatures, or combines with an oxidizer kept at very low temperatures.

Nonhypergolic fuels are usually cryogenic fuels. 'Cryo' comes from the Greek *kryos* icy cold.

C. T. 20. A French rocket-boosted, turbojet target drone.

This drone is reported as having a speed of 560 mph, a range of 125 miles, a ceiling of 40,000 feet, with takeoff weight of 1,470 pounds.

cutoff, *n.* The action of sharply stopping a process, as in shutting off the flow of fuel or stopping the application of a propulsive force; the event or time of this action.

Cf. **fuel shutoff**; see also **ballistic trajectory** for an example of usage.

In a large rocket engine, a significant impulse may take place from fuel cutoff to zero thrust. Cf. **afterburning, *n.***

CYA (*abbr.*). 'Keep your skirts clean.' Pentagon slang.

cycle checkout. The periodic action of giving a complete physical checkout on missiles held in alert status. See **recycling inspection**.

cycle-checkout van. A van with checkout equipment used in making a cycle checkout. Cf. **missile checkout trailer**.

cyclic testing. Repeated testing of a thing at regular intervals to be assured of its reliability.

Cyclic testing is used on electronic tubes, combustion chambers, and other components of a rocket before the countdown for launching.

D

Dart, *n.* An Army low-altitude surface-to-surface solid rocket missile of short range, developed by the Aerophysics Development Corporation. Also called the XSSM-A-23.

Powered by a smokeless rocket propellant, the Dart is wire-guided to target by a ground operator in line of sight with the target. Its speed is mach 1, its range about 6,000 feet, effective against tanks and bunker installations. Its length is 5 feet, its diameter 8 inches, its span (with fins) 3 feet, its gross weight 100 pounds. It is launched nonvertically.

data analysis. *Specif.* An analysis of flight test data reduced to usable form, as on the Flight Test Report. See **data collection**.

data capsule. A capsule in which data is recorded on tape during the flight of a research vehicle, the capsule being later recovered after ejection.

data collection. *Specif.* The action or process of collecting data on a rocket test flight, normally by means of cameras and telemetry.

On the Atlantic Missile Range, for example, about one-fourth of the data is collected by cameras at Cape Canaveral and on the downrange stations; the other three-fourths is obtained by telemetry from instruments inside the vehicle reporting on such matters as altitude, attitude, battery condition, vibration, acceleration, and temperature. See also **decibel, *n.***, note.

The testing process has three steps in it, data collection, data reduction, and data analysis.

data link equipment. Electronic equipment that coordinates data collection, data reduction, and data analysis.

data reduction. *Specif.* The action or process of reducing data collected on a test flight to usable form, usually by means of electronic computers and other electronic equipment.

See **data collection**, **Flight Test Report**, **Radio Corporation of America**.

Davy Crockett. An Army light pentomic missile, with nuclear capability (subkiloton yield), under development by Martin.

DB (*abbr.*). 'Director bomber,' as in the DB-47 used to launch the Rascal.

debug, *v. tr.* To take the bugs or defects out of a *missile* or other piece of equipment.

deceleration, *n.* The process of velocity decrease; the rate of this velocity decrease.

decibel, *n.* (db) 1. A unit for measuring the relative loudness of sounds, being the smallest degree of difference ordinarily detectable by the human ear. 2. In wire or radio communication, one-tenth of a bel.

The decibel is used to measure the sounds of a rocket as it ascends. These vary as they bounce off of, or are absorbed by, clouds.

declination, *n.* In astronomy and celestial navigation, the angular distance of a celestial body from the celestial equator measured through 90° and named 'north' or 'south' as the body is north or south of the celestial equator measured on an hour circle.

deep, *a.* Extending far beyond the upper limits of the atmosphere, as in 'to penetrate into deep space.' Hence, **deep, *adv.***

deep space probe. A probe that penetrates deep into space.

Defense Atomic Support Agency. (DASA) An Armed Forces agency organized to carry out special functions concerned with the military use of atomic energy not delegated to the Atomic Energy Commission.

The 'Defense Atomic Support Agency' is a redesignation of the Armed Forces Special Weapons Project as

of 6 May 1959. The field command of the agency is at Sandia Base, Albuquerque, New Mexico.

deflector, n. Short for 'flame deflector.'

Deimos, n. The outer of the two moons of Mars.

Deimos, named after a Greek word meaning 'terror,' revolves in an orbit 14,600 miles from the center of Mars (some 12,500 miles from the surface), its orbital period being 30 hours 18 minutes. Its diameter is about 5 miles. See **Martian satellite**.

delivery capability. The capability of a nation or force to deliver destructive missiles or bombs upon an enemy, normally measured by the quality, quantity, and deployment of suitable carriers, such as aircraft and ballistic missile vehicles, together with their supporting systems.

Delta, n. Short for '1958 Delta,' the IGY name for Sputnik III. See **Alpha, n.**

Delta Dagger. The F-102.

Delta Dart. The F-106.

deluge collection pond. A facility at a launch site into which water used esp. to cool the flame deflector is flushed as the rocket begins its ascent. Also called a 'skimmer basin.' See **flame deflector**.

deploy, v. tr. To send or move a *missile* to an operational launch site, and to place it in alert or ready status; to move different *missiles* to different launch sites and make ready for immediate or instant use.

See USAF Dictionary for other definitions.

depot-level maintenance. With special reference to missiles: The repair, modification, major overhaul or rebuilding of an assembly, subassembly, or other end item by an air depot or by an air depot mobile team.

This maintenance serves to support organizational maintenance by providing technical assistance and facilities beyond the capability or responsibility of the missile squadron. It is applicable in a training or combat situation. The maintenance, sometimes also provided by a contractor, tends to eliminate field maintenance, as such, from the operation. See **organizational maintenance**.

Destroyer, n. The B-66.

destruct, n. The deliberate action of detonating or otherwise destroying a rocket missile or vehicle after it has been launched, but before it has completed its course. Said of friendly missiles esp. during test flights.

Destructs are executed when the missile gets off its plotted course or functions in a way so as to become a hazard. See **command destruct**.

destructible target. A target drone designed to be destroyed if hit. Cf. **recoverable target**.

destruct line. On a missile test range, a bound-

ary line on each side of the downrange course beyond which a missile cannot fly without being destroyed under destruct procedures.

destructor, n. An explosive or other agent for destroying a missile or one of its components under destruct procedures.

deterrence, n. An objective of a military force in which a potential aggressor nation is constrained to avoid general or total war.

The three factors that contribute to deterrence are (1) sufficient *force* to prevail over an enemy nation, (2) manifest *determination* to use that force, and (3) the potential aggressor's *belief* that such force and determination exist.

deterrent, n. That which deters, esp. a force in-being recognized by an aggressor nation to have such retaliatory power as to make the cost of aggression unacceptable. Said of a bomber force or a missile force. Hence, **deterrent force, deterrent posture**.

deuterium, n. The hydrogen isotope of mass number 2 (symbol H² or D); heavy hydrogen.

development, n. In the prototype manufacture of a rocket, weapon system, or other complicated object: That phase or aspect of the process in which a basic concept or design is carried through to the production of an acceptable physical object. See **research, n., note**.

development missile. A missile used to test equipment or procedures relevant to the development of an operational missile.

device, n. (dv) A mechanism that works to serve a particular purpose. Used esp. as the second element in combinations, as in *rocket device, satellite device, or atomic device*.

DEW (abbr). 'Distant early warning.'

Diamondback, n. A Navy air-to-air missile under research and development through the Bureau of Ordnance and the prime contractor, Philco.

The Diamondback, developed out of Sidewinder, is reported to have infrared guidance.

digital computer. A computer that works on the principle of counting, as distinguished from measuring. See **analogue computer**.

Digital computers make up a family of computers, ranging from the abacus to the business-office adding machine, to electrical relay computers as used in telephone exchanges, to the complex electronic calculators, such as Eniac. Electronic computers use either a decimal or binary system of notations. See **model, n.**

digitalizer, n. An instrument that consists essentially of a digital computer but adapted to some particular use.

Ding Dong. An early name for Genie.

direct manhour. A manhour readily and directly identifiable as spent on a given product, operation, or project. Cf. **indirect manhour.**
dirigible space vehicle. A space vehicle that is subject to some directional control from within the vehicle during flight.

Discoverer, n. 1. A project of the Advanced Research Projects Agency for the launching of a series of earth satellites esp. from the Vandenberg Air Force Base, the satellites intended, in some instances, for orbit over the earth's poles for discovery of new data on radiation and other space phenomena and for development of satellite general data. 2. One of the satellites of this project. See following entries. See also **Sentry, n.**

The Thor and Atlas rockets are normally used as the first stage of the carrier rockets for these satellites. A liquid-fuel rocket is to serve as the second stage.

Discoverer I. The first satellite launched under the Discoverer project at Vandenberg Air Force Base. Also called '1959 Beta.'

Launched at 1349 (PST) 28 Feb 1959, Discoverer I was the first earth satellite to achieve a polar orbit. The satellite vehicle, made of magnesium, was in effect the second stage of the rocket vehicle, some 18.8 feet long and 5 feet in diameter at the engine end. Its own second-stage launch weight (including fuel) was about 7,100 pounds; its orbital weight was about 1,300 pounds, of which 40 pounds were payload instruments. The satellite was built by Lockheed; it was powered in its second stage by the Bell-Hustler rocket, the first stage having been the Thor.

Discoverer I was programmed to perigee at 146 miles, to apogee at 558 miles, with a projected lifetime of about two weeks. Because of malfunction in its radio-transmitting equipment, the satellite was difficult to track, and much of the expected scientific data was not received.

Discoverer II. The second satellite launched under the Discoverer project, consisting of the entire second stage of the carrier rocket.

Launched on 13 Apr 1959, the satellite was reported in a north-south polar orbit with an orbital period of 90.5 minutes, an apogee of 220 miles, a perigee of 152 miles. Its weight of 1,600 pounds included the weight of a special nose cone designed for ejection and recovery, the recovery capsule weighing 160 pounds. Announcement was made 23 Apr 1959 that the satellite had fallen. The satellite was called '1959 Gamma.'

Discoverer III. The third satellite launched 3 June 1959, under the Discoverer program, considered doubtful as having achieved an orbit.

Powered by the Thor rocket as the first stage and by the Bell-Hustler rocket as the second, this 1,600-pound satellite carried a nose cone of 195 pounds, in which were housed 4 mice. The cone was programmed for return to earth on 4 June, to be snared by aircraft as it parachuted downward. Tracking stations at Kodiak

Island and the Hawaiian Islands, however, received no signals.

Discoverer IV. An instrumented satellite launched from Vandenberg 25 June 1959 that failed to reach orbit.

Discoverer V. A polar satellite launched from Vandenberg at 1200 (PST), 13 August 1959.

Powered by a two-stage Thor-Hustler rocket vehicle (the 1,700-pound second stage becoming the satellite), Discoverer V was launched, in part, to test procedures for recovering a capsule precisely ejected. It reached orbit with apogee at 450 miles, perigee at 136 miles, and an orbital period of about 94 minutes. Efforts on 14 August to recover the capsule failed. See **Agena, n.**

Discoverer V is also called '1959 Epsilon.'

Discoverer VI. A 1,700-pound polar satellite launched from Vandenberg at 1220 (PST), 19 August 1959, intended, in part, to test out recovery techniques and to obtain space data direct from recovered instruments.

Discoverer VI, similar in configuration to Discoverer V, apogees at 537 miles, perigees at 138 miles, with an initial orbital period of 95 minutes, and an expected lifespan of at least 30 days. It is called '1959 Zeta.'

The satellite ejected a 300-pound capsule (chiefly instruments) at 1727 (EST) 20 August as programmed, but the 8 C-119's deployed to increase the possibility of its being snared as it parachuted to the Pacific Ocean were unable to find it.

diversionary missile. A missile decoy.

DMPI (abbr). 'Desired mean point of impact.'

documentation, n. 1. The procedure or means by which substantiation is provided for any statement of fact, theory, or interpretation. 2. The evidence, in the form of documents, bona fide copies, exhibits, or references, that supply this substantiation.

DOD (abbr). 'Department of Defense.'

dog, n. The domesticated canine used in bioastronautic experiments.

See **Laika, n.**, **Otvazhnaya, n.**, **Znezhinka, n.** Cf. **Able, n.**, sense 2, **bioastronautics, n.**

doghouse, n. A protuberance or blister that houses an instrument or instruments on an otherwise smooth skin of a rocket. *Slang.*

dome, n. A roof or covering shaped like a hemisphere, often made of plastic. See **radome, n.**

doodle bug. A V-1. British *slang*.

Doppler, n. [After Christian *Doppler* (1803-1853), German mathematician and physicist.] Used in combination, as in the following entries. See **Doppler principle**, note.

'Doppler' is commonly spelled without the capital.

Doppler drift. The drift of a missile or other object as indicated by Doppler radar.

Doppler effect. The apparent change in the frequency of vibrations, as of sound, light, or

radar, when the perceived and perceiver are in relative motion to one another.

Doppler-Fizeau principle. The Doppler principle as applied to a source of light: When the distance between the observer and the source of light is diminishing the lines of the spectrum are displaced toward the violet, and when the distance is increasing they are displaced toward the red, the displacement being proportional to the relative velocity of approach or recession. See **Doppler principle**, note.

Doppler principle. A principle of physics that, as the distance diminishes or increases between a perceiver and a source of constant radiations (as of sound, light, or radio), the frequencies appear to be greater or less.

Doppler in 1842 correctly explained this principle as it applied to the pitch of sound, and realized that the principle was applicable to light. He incorrectly inferred, however, that a rapidly receding star would be red and an approaching one blue. The correct application of the principle in astronomy was made in 1848 by the French physicist, Armand Fizeau (1819-1896). See **Doppler-Fizeau principle**.

Doppler radar. A radar that measures the velocity of a moving object by measuring the shift in carrier frequency of the return signal, the shift being proportional to the velocity with which the object approaches or recedes from the radar station.

Doppler shift. The apparent shift in the lines of a luminous body's spectrum as the body approaches, or recedes from, an observer, the shift being in accordance with the Doppler-Fizeau principle.

Douglas, n. Short for 'Douglas Aircraft Company, Inc.,' a missile and aircraft contractor, as for the assembly and airframe of Thor, the design and airframe of Genie, the airframe of Nike-Zeus, the development of the B-66, etc.

DoVAP (abbr). 'Doppler velocity and position.' Hence **dovap, n.**

This term is used in reference to a beacon tracking system, wherein radio impulses are sent from the tracking station to a receiver in the missile or other object, then returned to the station on a different frequency.

Dove, n. A high-angle aerial bomb equipped with an infrared seeker, developed for the Navy by Eastman.

downrange, adv. In a direction away from the launch site and along the line of a missile test range. Hence, **downrange, a.**

downrange station. A station set up along a missile test range, used for tracking or other missile monitoring services.

A downrange station typically consists of a Central Control, a powerhouse, a weather building, a maintenance area, an air strip, a fuel area, water tanks, barracks and dining hall.

drag, n. A force exerted upon a moving object in a direction opposite to the direction of motion; *specif.*, air drag (which see).

drone, n. An unmanned airborne vehicle, esp. an aircraft, guided by remote control, as by a mother airplane, and used to test out equipment, defense procedures, and the like. See **target drone**.

dry emplacement. A launch emplacement that has no provision for water cooling during launch. Cf. **wet emplacement**.

dry-fuel rocket. A solid rocket that uses a mixture of fast-burning powder. Used esp. as a booster.

dry run. A practice exercise or rehearsal esp. observed in preparation for a rocket launching, usually several times.

dry weight. The weight of a rocket vehicle without its fuel. Cf. **takeoff weight**.

This term, appropriate esp. for liquid rockets, is sometimes considered to include the payload.

dual thrust. A rocket thrust derived from two propellant grains using the same propulsion section of a missile. See **dual-thrust motor**.

The dual-thrust technique is considered to provide what is in effect a two-stage propulsion system without the disadvantages of jettisoning the booster unit or of sequential ignition of the sustainer grain, and with the advantages of lower weight, shorter length, and lower cost. The Navy's Teal (XKDT-1), used as a target drone, has been used to test the dual-thrust principle.

dual-thrust motor. A solid rocket motor built to obtain dual thrust.

In a single chamber unit the booster propellant grain may be bonded to the sustainer grain, with the thrust level regulated by mechanically changing the nozzle throat area or by using different grain compositions or configurations. In a dual-chamber unit, the separate chambers may be arranged in tandem or concentrically.

Duck, n. An AF air-to-air missile in research and development by Fairchild.

Dumbo, n. An experimental atomic rocket engine.

dynamics, n. A branch of mechanics that treats of the motion of bodies and of the forces acting upon bodies in motion or in process of changing motion.

Dyna-Soar, n. A projected manned orbital glider or bomber under study by the AF.

Dyna-Soar, with a projected range between 12 and 25 thousand miles, would be rocket-boosted to an altitude of 100 to 150 miles and sustained in flight by small sustainer rocket engines. Boeing and Chance Vought are one team doing development work; Martin and Bell are another. Cf. **T-4A**.

dyne, *n.* A unit of force that will accelerate a particle having a mass of one gram one centimeter per second per second.

E

EAD (*abbr.*). 'Induced (*sic*) aerial detonation.'

Eagle, *n.* A Navy long range air-to-air guided missile under early development at the end of 1958, with nuclear capability. See **long range. early-warning satellite.** A reconnaissance satellite used to detect enemy ballistic-missile firings early enough to give warning. See **reconnaissance satellite.**

earth, *n.* 1. The planet we inhabit including its atmosphere. 2. This planet without its atmosphere, 7,900 miles in diameter at the poles, 7,927 at the equator, 3,959 miles mean radius.

The earth's mass (sense 1) is 6×10^{21} metric tons; its density (sense 2) is 5.52 as compared to water; its orbital speed (sense 1) averages 18 miles per second; its escape velocity (sense 1) is slightly less than 7 miles per second; the eccentricity of its orbit is 0.016751; its albedo is about 0.29; its age is estimated at more than 3,000 million years.

Data obtained from Vanguard satellites indicate the earth is somewhat pear-shaped, of greater spherical circumference in the Southern Hemisphere than in the Northern. See **Vanguard I.**

earthlight, *n.* The sunlight reflected by the earth's surface, as upon the moon or other object above the earth.

earth-moon orbit. An orbit of an earth satellite that would describe an ellipse about both the moon and earth.

Because the moon is itself orbiting about the earth, the earth-moon orbit would be achieved irregularly, unless its size, shape, and inclination were matched with a given orbital velocity so as to bring it regularly to the back side of the moon, or to place the perigee above the moon's orbit.

earth-moon satellite. A manmade satellite that would orbit in an ellipse about both the moon and earth. See preceding entry.

earth satellite. A body that orbits about the earth; *specif.*, such a body placed in orbit by man, i.e., an artificial earth satellite.

The first four earth satellites placed in orbit by man are, or were, of different sizes, shapes, and performances, as shown below (*IOT* initial orbit time, *IPEE* inclination of the orbit's plane to the plane of the earth's equator):

	<i>Sputnik I</i>	<i>Sputnik II</i>	<i>Explorer I</i>	<i>Vanguard I</i>
<i>launched</i>	4 Oct 57	3 Nov 57	31 Jan 58	17 Mar 58
<i>weight</i>	184 lbs	1,120 lbs	30.8 lbs	3.25 lbs
<i>shape</i>	sphere	cylinder	cylinder	sphere
<i>diameter</i>	22.8"	48"	6"	6.4"
<i>length</i>		19'	6' 8"	
<i>payload</i>	cells & radios	dog & instruments	11 lbs instruments	cells & radio

<i>thrust at takeoff</i>	280,000	400,000	80,000	25,000
<i>IOT</i>	96.2 min	103.7 min	114.5 min	134 min
<i>apogee</i>	560 mi	1,056 mi	1,587 mi	2,466 mi
<i>perigee</i>	145 mi	150 mi	219 mi	405 mi
<i>IPEE</i>	65°	65°	34°	33-34°
<i>lifespan</i>	3 months	5 mo 11 da	5-10 yrs	5-10 yrs

In this table, the initial orbit time, apogee, and perigee are given as of the time immediately after launching. These performances normally deteriorate with passage of time if the satellite dips into the atmosphere at the perigee. In the case of *Sputnik II*, its overall weight (including the third-stage rocket) was 3 tons.

See **Atlas satellite, Discoverer I, Explorer I, Explorer II, Explorer III, Explorer IV, Sputnik I, Sputnik II, Sputnik III, Vanguard I, Vanguard II**; also **Discoverer II, Discoverer III, Discoverer IV, Discoverer V, Discoverer VI, Explorer VI.**

See also **apogee speed, perigee speed.**

earth weight. The static weight of a given object as measured at the surface of the earth.

The static weight of a given object varies at different points of latitude and elevation. Variations are especially marked as between points on the surface and extreme altitudes.

ebullism, *n. Medicine.* The formation of water vapor bubbles in the tissues brought on by boiling of body fluids.

eccentric, *a.* Of an orbit: Deviating from the line of a circle.

eccentricity, *n.* The state or degree of being eccentric, expressed for an ellipse by dividing the distance between the foci by the length of the major axis.

The eccentricity of a circle is zero; of an ellipse less than one; of a parabola exactly one; of a hyperbola greater than one. The eccentricity of the orbit of *Mercury* is 0.206; of *Venus* 0.007; of the *earth* 0.017; of *Mars* 0.093; of *Jupiter* 0.048; of *Saturn* 0.056; of *Uranus* 0.047; of *Neptune* 0.009; of *Pluto* 0.249; of the *Moon* 0.056; of *Explorer I* 0.139.

ecliptic, *n.* That great circle on the celestial sphere which describes the apparent path of the sun in the course of the year.

The plane of the ecliptic is the plane in which the center of mass of the earth and moon revolves about the sun. It is inclined to the plane of the equator at an angle of about 23° 27'. Cf. **zodiac, *n.***

ecosphere, *n.* A spherical extent inhabited by living organisms or suitable for the life of such organisms: **a.** A layer of space about the sun extending from, and including, Venus through Mars. **b.** The biosphere of the earth.

In sense a, the ecosphere need not provide the same conditions as found on earth for support of life; indeed, the linking of carbon or silicon molecules to form a living organism is considered to be chemically possible without the presence of oxygen. In sense b, 'biosphere' is the preferred term.

ECP (*abbr.*). 'Engineering change proposal.'

The ECP is a formal proposal by a contractor for engineering changes affecting safety, deviation from contract specifications, service bulletins, etc.

EDPE (*abbr.*). 'Electronic data processing equipment.'

EDPS (*abbr.*). 'Electronic data processing system.' Cf. **ADPS** (*abbr.*).

Edwards Air Force Base. An AF base near Muroc, California, originally known as Muroc Air Force Base, renamed for Captain Glen W. Edwards, a test pilot killed in 1948.

Edwards AFB is the site of the Air Force Flight Test Center, the Rocket Engine Test Laboratory, and the NASA High Speed Flight Station.

Edwards Rocket Base. An early name for the Missile Static Test Site.

effective atmosphere. That part of the atmosphere which effectively influences a particular process or motion, its outer limits varying according to the terms of the process or motion considered. Cf. **sensible atmosphere**.

For example, an earth satellite orbiting at 250 miles altitude remains within the ionosphere, but because the air particles are so rare at this altitude as to cause no appreciable friction or deflection, the satellite may be considered to be outside the effective atmosphere. For movement of air vehicles the effective atmosphere ends at the aeropause (which see).

effective exhaust velocity. The velocity of an exhaust stream after the effects of friction, heat transfer, nonaxially directed flow, and other conditions have reduced it.

effectiveness, *n.* A measured capability that expresses a performance rate of a person, organization, thing, or method in repeatedly achieving a desired result or objective.

effector, *n.* Any device used to maneuver a missile in flight, such as an aerodynamic surface, a gimbaled motor, or a jet.

EGADS (*abbr.*). 'Electronic ground automatic destruct sequencer.' See next.

egads button. [See prec.] A button used by the range safety officer to destroy a missile in flight if its course, as plotted during flight, is predicted to go beyond the destruct line. Cf. **impact predictor system**.

electrical engine. *Specif.* An ion or plasma engine, so-named because of the separation of charged particles.

electromagnetic wave. The form in which radiant energy travels, being produced by the oscillation of an electric charge, and including the waves of radio, infrared, visible light, ultraviolet light, the X-ray, the gamma ray, and the cosmic ray (when considered as a quantum of energy). See **radiation *n.***, sense 2.

electron, *n.* 1. A very light particle with a mass 1/1845 that of a proton, having either

a negative or positive charge. 2. *Restrictive.* Such a particle with a negative charge.

Electrons are constituents of all atoms, but in some situations they are free, sometimes knocked out of the atom by bombardment.

See **ionize, *v.***, **negation, *n.***, **positron, *n.***

electronic, *a.* Of or pertaining to electronics.

electronic countermeasure reconnaissance.

Electronic reconnaissance carried out to locate radar or other electronic installations.

This reconnaissance may be carried out by aircraft, orbital rockets, or earth satellites. See **electronic reconnaissance**.

electronic data processing. (EDP) The processing of data so as to interpret the data and put it into usable form.

electronic data processing center. An installation, together with personnel and automatically operated equipment (including computers), that serves as a center for simplifying and interpreting data gathered by instrumentation or by information collection agencies.

electronic reconnaissance. Reconnaissance conducted with the aid of electronic devices.

Electronic reconnaissance includes radar reconnaissance and electronic countermeasure reconnaissance. It may be carried out by aircraft, missile vehicles, earth satellites, or fixed stations. Telemetering, photoscope, tape recording, and miniradio broadcasting are devices used in its conduct.

electronics, *n.* (*elct*) That branch of physics that treats of the emission, transmission, behavior, and effects of electrons.

Practical application of electronics is made through such devices as vacuum tubes, cathode-ray tubes, photoelectric cells, transistors, and the like.

elephant ear. A thick plate on a missile's skin that reinforces a hatch or hole. *Slang*.

ellipse, *n.* A plane curve described about two fixed points (the foci) so that the sum of the distances between any point on the curve and the foci is equal to the sum of the distances between any other point on the curve and the foci.

The orbit of a planet or satellite describes an ellipse. One of the fixed points is the center of the primary body (the sun or a planet) so that the point of greatest nearness in the orbit is 180° from the point of greatest distance through the major axis of the ellipse.

elongation, *n.* 1. An increase in angular distance of an inferior planet from the sun, the angle measured from the center of the earth; the maximum of such angular distance. 2. A similar increase in angular distance as applied to the relative positions of other spatial bodies, as of the moon and sun, with the earth as the reference point.

In sense 1, the elongation of Venus extends to 47°, that of Mercury to 28°.

Emerson, n. Short for 'Emerson Electric,' a missile contractor, as for Little John.

EMSS (abbr). 'Experimental man space station.'

encapsulated seat. A seat in an aircraft or space vehicle that is placed inside a capsule so as to obtain a desired environment for the seat's occupant.

This seat is sometimes designed to be ejected, capsule and all.

end velocity. The velocity of a rocket vehicle, rocket stage, projectile, satellite, or space probe at the time of thrust cutoff.

engine, n. (eng) Specif. The powerplant of a missile vehicle, aircraft, space-air vehicle, or spacecraft.

The type engine used in a missile may be the turbojet (as in the Goose), the ramjet (as in the Bomarc), the pulsejet (as in the V-1), the liquid rocket (as in the Atlas), the solid rocket (as in the Polaris), or more complicated arrangements (as in a nuclear-powered vehicle).

See entry in USAF Dictionary for normal usage. See also ion engine, photon engine, rocket engine.

engineer, n. (engr) A person professionally competent to design, construct, or operate something, esp. as used in such phrases as 'missile engineer,' 'rocket engineer,' or 'scientists and engineers.' See **scientist, n.**

engine spray. That part of a pad deluge that is directed at cooling the missile's engine or engines during launch.

Entac, n. A French short-range wire-guided, solid rocket missile, which can be launched from a jeep, tank, or aircraft.

envelope diameter. A dimension of an opening or hole, as in a tube or missile airframe, that describes the extent to which an object irregularly shaped may be accommodated as it rests in the opening or as it slides into the opening either at an angle or straight.

The term is used esp. in reference to accommodating rocket engines within the airframe of a missile.

environment, n. 1. The aggregate of conditions and influences that surround and affect a thing, either artificially created or natural. Cf. **hyperenvironment.** **2.** The special condition that differentiates one system or piece of equipment from another, as in 'the computer environment' or 'the data environment of SAGE,' or 'the airborne environment for a radar antenna.'

Cf. **air environment, controlled environment, flight environment, ground environment.** Cf. **can, n.**

environmental capsule. A capsule that provides the necessary environment for the support of life or for the functioning of a piece of equipment. Cf. **bubble colony.**

environmental chamber. A chamber in which humidity, temperature, pressure, fluid contents, noise, and movement may be controlled so as to simulate different environmental conditions.

This chamber may be used on the ground for conduct of experiments, or it may be fashioned as a capsule to provide a given environment in space or in the upper atmosphere. Cf. **capsule, n.**

environmental engineer. An engineer responsible for the daily inspection and maintenance of a piece of electronic equipment, such as a computer or a data-reduction machine.

Epsilon, n. Short for '1958 Epsilon,' the IGY name for Explorer IV or for another satellite named under the same system. See **Alpha, n.**

ERB (abbr). 'Edwards Rocket Base.' *Hist.*

erector-launcher, n. A mobile piece of equipment that erects a missile into launching position, then serves as a launcher.

erosion gauge. An instrument for measuring the effect of dust and micrometeors on an earth satellite's outer surface.

escape, v. intr. 1. Of a particle or larger body: To achieve an escape velocity and a flight path outward from a primary body so as neither to fall back to the body nor to orbit it. **2.** Of a person: To get out of a confining place at a time of peril.

escape orbit. One of various paths that a body or particle escaping from a central force field must follow in order to escape.

This orbit must have an eccentricity of not less than one as on a parabolic curve or hyperbolic curve.

escape velocity. The minimum velocity at which a molecule, rocket, or other body must move outward from an attracting central force field in order to escape this field on a parabolic orbit. Also called 'velocity of escape.'

The escape velocity for the *earth* is 6.95 mi/sec; for the *moon* 1.49 mi/sec; for the *sun* 384.30 mi/sec; for *Mercury* 1.99 mi/sec; for *Venus* 6.51 mi/sec; for *Mars* 3.22 mi/sec; for *Jupiter* 38.04 mi/sec; for *Saturn* 23.53 mi/sec; for *Uranus* 14.40 mi/sec; for *Neptune* 12.95 mi/sec; for *Pluto* unknown.

As an escaping body moves outward from the central force field, its velocity diminishes because of gravity; at the same time, however, the pull of gravity diminishes with distance. Escape velocity is, therefore, that initial velocity which, though diminished at each successive point on the orbit, will provide enough remaining velocity at each successive point to overcome the pull of gravity at that point. Cf. **Pioneer, n.**

eshp (*abbr*). Also **e.s.h.p.** 'Equivalent shaft horsepower.'

ESV (*abbr*). 'Earth satellite vehicle.'

evidence, *n.* An outward sign or manifestation that an hypothesis is true, obtained through perception or testimony and applied to the hypothesis through reason.

Evidence is that which is seen or testified to; proof is an effect of evidence as realized through reason.

exact orbit. A projected orbit that an earth satellite must reach and follow if sought-after data is to be obtained from the satellite.

exerciser, *n.* A machine that simulates the strains and vibrations to which a rocket vehicle or a rocket component is subjected, and used to test the vehicle for structural integrity. Cf. **motion simulator**.

exhaust deflecting ring. A type of jetavator consisting of a ring so mounted at the end of a nozzle as to permit it to be rotated into the exhaust stream.

exhaust stream. *Specif.* The stream of gaseous, atomic, or radiant particles that emit from the nozzle of a rocket or other reaction engine. Usually called a 'jet stream,' esp. in reference to a jet engine.

exhaust velocity. The velocity of gaseous or other particles that exhaust through the nozzle of a reaction engine or motor relative to the nozzle. See **thrust**, *n.*

The exhaust velocity of a rocket engine may be obtained by multiplying the specific impulse by gravity 32.2. See **specific impulse**.

exosphere, *n.* The outermost fringe or layer of the atmosphere, where collisions between molecular particles are so rare that only the force of gravity will return escaping molecules to the upper atmosphere.

exospheric, *a.* Of or pertaining to the exosphere.

exotic fuel. A fuel considered to be unusual, as liquid hydrogen with a fluorine oxidizer.

expenditure, *n.* *Specif.* The loss of a rocket vehicle or missile by launching it or otherwise using it up, as in 'the expenditure of an Atlas in a flight test at Canaveral.'

experimental vehicle. An aircraft or missile vehicle undergoing development and test, not yet proved for operational use. See **X** (*prefix or letter*).

exploratory rocket. A rocket built and equipped to explore the upper atmosphere or outer space.

Explorer, *n.* Any of the earth satellites

launched under the research and development program of the Army Ballistic Missile Agency or under one of the programs of NASA, each differentiated from the other by a numeral, as in Explorer I, Explorer II, etc.

The term *Explorer* was once considered to be generic to be applied to any American earth satellite, but when Vanguard I was launched, it became known as Vanguard I, not as Explorer II. Cf. **Alpha**, *n.*

Explorer I. The first American earth satellite to reach and remain in orbit, launched at 2248 hours (EST), 31 January 1958. Also called 'Alpha' or '1958 Alpha.'

Launched by the Army Jupiter C at Cape Canaveral, Explorer I consists of an outer skin (that of the last rocket stage) 80 inches long, 6 inches in diameter, which contains a 30-inch long steel shell weighing 7.5 pounds, inside of which is an 11-pound package of complex gauges, meters, wires, and miniradio transmitters. The satellite does not tumble as Sputnik II is reported to do, but spins on its longitudinal axis at 700 rpm. Its initial orbital period was 1.14 minutes (approximately), its initial apogee some 1,573 miles, its perigee was some 224 miles. It orbits in a plane at 33.50 to the earth's equator at a velocity of about 18,000 mph. See **apogee speed**.

Dr. James A. Van Allen (1915-), Professor of Physics at the State University of Iowa, designed the instruments for Explorer I. See **radio transmitter**, note.

See **earth satellite** for other details.

Explorer II. A projected earth satellite launched on 5 March 1958 by the carrier rocket Jupiter C, but failing to achieve an orbit.

Launched from Cape Canaveral, it plunged into the South Atlantic 1,900 miles southeast of its launch site. It was similar in size and shape to Explorer I.

Explorer III. An earth satellite launched by Jupiter C on 26 March 1958, which fell back to earth between 27-29 June 1958. Also called '1958 Gamma.' Cf. **Explorer II**.

Launched from Cape Canaveral at 1239 (EST), Explorer III went into orbit equipped with magnetic tape to record and report the intensity of cosmic rays encountered. See **magnetic tape**. Cylindrically shaped with a cone nose, it was 31 pounds in weight, 6 inches in diameter, 80 inches long. Rocket thrust at takeoff was 84,000 pounds; initial orbital period was 115.7 minutes; it apogeed at 1,741 miles, it perigeed at 117 miles. Its perigee speed was 18,860 mph; its apogee speed was 13,450 mph. The inclination of its orbital plane was 33.37°. Its lifespan was about three months. For comparative data, see **earth satellite**, note.

Explorer IV. An earth satellite launched by Jupiter C on 26 July 1958. Also called '1958 Epsilon.'

Launched from Cape Canaveral at 1000 (EST), Explorer IV is 38.43 pounds in weight (including the rocket casing), bullet-shaped, 6 feet 8 inches long, 6 inches in diameter, and carrying 18.26 pounds of instruments for measuring corpuscular radiation. Its initial orbit time was 110.2 minutes, its apogee 1,373.3 miles, its perigee 162.9 miles; its inclination to the earth's equator 50.8°, its expected lifetime 2 years.

One of the purposes of Explorer IV was to provide a means for checking the Argus tests of 27 and 30 Aug and of 6 Sep 1958.

Explorer V. A projected earth satellite launched on 24 August 1958 by the carrier rocket Jupiter C, but failing to achieve an orbit.

Press reports of a statement by Dr. Wernher von Braun indicated that the first stage booster rocket had separated after burnout, but that residual gases and liquids in it expanded in the vacuum of space, gave it extra thrust, and caused it to overtake and collide with the other stages to knock them off into a wrong direction.

Explorer VI. A 142-pound earth satellite launched from Cape Canaveral at 0923 (EST), 7 August 1959, placed in orbit by a three-stage Thor-Able under auspices of the AF and the NASA. Called '1959 Delta.'

Explorer VI, called a paddlewheel satellite from its appearance with 4 solar vanes extending from its spheroid body, measures 26 by 29 inches. The solar vanes, positioned so as to obtain maximum sunlight, are each 20 inches long. These vanes popped out from the main body just prior to the ignition of the third stage.

The satellite is instrumented for different purposes—to obtain data on radiation and radiation belts; to scan the earth's cloud cover and surface by viewers; to chart the earth's magnetic field with magnetometers; to measure density of micrometeoroids; to obtain data on the behavior of radio waves in deep space; to test out the practicability of using solar energy; to transmit by radio signal data obtained; and to test out a kick rocket at perigee if desired.

Clear signals from the satellite were picked up in England within four minutes after launch. In 47 minutes after launch a signal was sent from Jodrell Bank to the satellite that turned off one of the 3 transmitters, and 20 minutes later the transmitter was turned on again by another signal.

The satellite apogees at about 26,401 miles, and perigees at 157 miles. Its orbital period is 12 hours, 46 minutes, traveling 91,140 miles, its maximum speed at perigee is 22,957 mph; its minimum speed at apogee, 3,111 mph. Its inclination is 48°. Its life expectancy is more than a year.

exterior ballistics. That branch of ballistics concerned with the behavior of a missile during flight, influenced by conditions of air density, temperatures, velocity, and the like. Sometimes called 'external ballistics.'

extragalactic, *a.* Outside the Galaxy.

extrapolate, *v. intr.* To reason by extrapolation.

extrapolation, *n.* 1. A process of making inferences about an unknown or not-understood thing by reference to something known and understood and assumed to correspond in some way with the thing unknown or not understood. 2. The inference or inferences made by this process.

Extrapolations on techniques of space flight are made from knowledge of techniques of air flight.

F

F-100. A North American supersonic day fighter, powered by the Pratt & Whitney J57 turbojet. Also called the 'Super Sabre.'

The F-100A, powered by the J57-7, has been superseded by advanced versions. The F-100D has an autopilot and auto-fire-control system added, and has an in-flight refueling capability. The F-100F is a two-place fighter-bomber, powered by the J57-21, with ceiling over 50,000 feet. The F-100D and the F-100F are designed to carry the GAR-8 (the Sidewinder).

F-101. A McDonnell jet fighter, powered by two Pratt & Whitney turbojets. Also called the 'Voodoo.'

The F-101A is an all-weather, multipurpose aircraft with a nuclear capability and an in-flight refueling capability. On 12 Dec 1957 it set an official speed record of 1,207.6 mph. It carries the Falcon missile.

The F-101B is an all-weather interceptor, capable of carrying the MB-1 Genie.

F-102. A Convair supersonic interceptor, powered by a Pratt & Whitney turbojet, carrying Falcon missiles. Also called the 'Delta Dagger.'

F-104. A Lockheed supersonic day fighter, powered by a General Electric turbojet. Also called the 'Starfighter.'

The F-104A established an altitude record of 91,249 feet, set on 7 May 1958; also a speed record for operational aircraft of 1,404.19 mph, set on 16 May 1958. See X-2.

The F-104B is a 2-place version, tandem seating.

F-105. A Republic supersonic day fighter-bomber, powered by a General Electric J75-5 turbojet. Also called the 'Thunderchief.'

Advanced versions of this aircraft are expected to be powered by the General Electric J75-10. Armament includes the Sidewinder.

The F-105E, a 2-place configuration, was cancelled in May 1959 in favor of the 1-place F-105D.

F-106. An all-weather supersonic jet fighter interceptor developed by Convair. Also called the 'Delta Dart.'

This is a completely redesigned F-102, powered by a Pratt & Whitney J75-9 turbojet. Its performance is classified. Its armament includes the Sidewinder, the Genie, and the Falcon missiles.

F-108. A fighter interceptor under development by North American, programmed for speeds of mach 3. Contract cancelled Sep 1959.

The F-108's projected ceiling was 70,000 feet, range about 1,100 miles. It was to be powered by two General Electric J93-3 turbojets, its armament to include the GAR-9, and capable of carrying a nuclear warhead. Its crew was to be two.

FAGMS (*abbr.*) 'Field artillery guided missile.'

The abbreviation sometimes has a suffix to indicate the particular missile, as in FAGMS-R the Redstone, FAGMS-S, the Sergeant.

FAI (*abbr.*). 'Fédération Aéronautique Internationale.'

Fairchild, *n.* Short for 'The Fairchild Engine and Airplane Corporation,' missile contractor, as for the Goose and Petrel.

Fairchild divisions (Aircraft Division, Engine Division, Guided Missiles Division, Stratos Division, and Electronics Division) undertake development and manufacture of different missile systems.

Fairchild Air Force Base. An AF base near Spokane, Washington, named for General Muir S. Fairchild, WW I bomber pilot, first commander of Air University, and Vice Chief of Staff, USAF, who died in March 1950. Designated as a site for ICBM's.

Falcon I. An AF air-to-air solid rocket, radar-guided missile developed by Hughes for use in such defense weapon systems as the F-89, F-102, and F-106. Also called GAR-1.

Falcon I, in its GAR-1D version, is 6.5 feet long, ½ foot in diameter, and weighs 100 pounds. Its range is 5 miles, and speed mach 2. Its 6,000 pound-thrust solid motor is made by Thiokol. See **GAR** (*abbr.*).

Falcon II. A guided aircraft rocket similar to Falcon I, but provided with an infrared detector as a target homing device. Also called GAR-2.

Falcon II (GAR-2A) rounds out the armament used on the F-89, F-102, and F-106. See **GAR** (*abbr.*).

fall, *n.* The action of the verb 'fall.'

fall, *v. intr.* Of a spacecraft or spatial body: To drop toward another spatial body under the influence of the latter's gravity.

For example, the moon falls toward the earth, but its tangential velocity compensates for this motion, and keeps it in orbit; or an earth-originated spacecraft could be made to fall toward the sun, once outside the gravitational influence of the earth, by killing a part of its velocity.

fallaway section. Any section of a rocket vehicle that is cast off and falls away from the vehicle during flight, esp. such a section that falls back to the earth. Cf. **blowoff**, *n.*, **companion body**.

fallback area. At certain missile sites, an area to which technicians and others fall back once the missile is readied for firing.

Farnsworth Electronics. A division of International Telephone and Telegraph Corporation, missile guidance contractor.

Farside rocket. A four-stage solid research rocket launched from an unmanned plastic balloon as a part of AF Project Farside.

The rocket, suspended nose upward from the balloon, is fired at an altitude of 20 miles. It tears through the balloon to climb to altitudes up several thousand miles. Cf. **rockoon**, *n.*

FBM (*abbr.*). 'Fleet ballistic missile'; *specif.*, the Polaris.

fbn (*abbr.*). 'Flightborne.'

feature, *n.* Any form, shape, substance, or part that distinguishes a missile or other piece of equipment.

Features refer to such things as the size of a fuel tank, the hardness of a nose cone, the combination of booster rockets with a sustainer engine, etc. Cf. **capability**, *n.*, **characteristic**, *n.*

Federal, *n.* Short for 'Federal Telecommunications Laboratory,' a division of International Telephone and Telegraph Corporation, a missile guidance contractor, as for Talos, Terrier I, and Lacrosse.

fence, *n. Specif.* 1. A line of readout or tracking stations for pickup of signals from an orbiting satellite. 2. A line or network of radar stations for early warning.

ferret, *n.* An aircraft or spacecraft equipped to detect, locate, record, and sometimes to analyze electromagnetic radiation.

ferret surveillance. Surveillance by means of electronic equipment.

final mass. *Specif.* Remaining mass.

final trim. That action in the flight of a ballistic missile that adjusts it to the exact direction programmed for its flight.

Final trim of a rocket missile is normally accomplished by use of vernier engines.

fire, *v. tr.* 1. To ignite a rocket engine or motor. 2. To launch a missile.

Firebee, *n.* A target drone developed by Ryan. The AF version is either the Q-2A or the later Q-2C. The Navy version is the KDA-4.

The Firebee, 17.6 feet long and 11.2 feet in span, is powered by a turbojet engine. Its guidance is by radio command or in the AF versions, by radio and radar.

Fireflash, *n.* A British air-to-air solid rocket missile fire-tested in 1953.

This missile, 9 feet 4 inches long, 28 inches in diameter, has wrap-around type of boosters. The missile separates from the boosters at maximum speed and coasts to target. It is used as a training weapon in the Fighter Command, but is carried as armament by the Hawker Hunter and the Supermarine Swift Mark 7.

Firestreak, *n.* A British air-to-air solid rocket missile.

This missile is reported as 10 feet in length, 1 foot in diameter, with a ceiling above the altitude of the launching fighter plane at 40,000 feet. Its range is about 8 miles. Its guidance is by infrared. It is carried underwing by the Gloster Javelin and the de Havilland Sea Vixen.

firing, *n.* The action or event of igniting a rocket engine or motor.

firing chamber. That part of a rocket engine or motor that consists of a chamber in which

the fuel and oxidizer are ignited, and in which pressure of gases is built up to provide an exhaust velocity sufficient for thrust.

In a liquid engine the fuel and oxidizer are separately induced into the chamber by lines running from the tanks. In a solid engine, the grain is suspended within the chamber. See **thrust chamber**.

firing position. The position of a missile or of a missile stage from which it is fired.

This position is vertical and at rest for the booster stage of ballistic missiles; it may be at an angle for successive stages or for short-range missiles.

firing table. A platform upon which a rocket engine is ignited; a launch pad.

This usage is not recommended, because of possible confusion with the same term as used in artillery, i.e., a table or chart that provides data for aiming a gun on target under standard conditions as well as corrections for winds, temperature, etc., under special conditions.

firing time. The amount of time required to fire a missile on alert or ready status once action has been taken to do so, as in 'the firing time will be reduced with the Minuteman.' Cf. **reaction time**.

fissionable, a. Subject to, or involving, nuclear fission.

fixed satellite. An earth satellite that orbits the earth from west to east at such a speed as to remain fixed over a given place on the earth's equator. See **stationary orbit**.

flame bucket. A deep cavelike construction built beneath a launcher (as for the Atlas or Thor), open at the top to receive the hot gases of the rocket positioned above it, and open on one or three sides below, with a thick metal fourth side bent toward the open sides so as to deflect the exhausting gases. See **flame deflector**.

flame deflector. 1. In a vertical test launch, any of variously designed obstructions that intercept the hot gases of the rocket engine so as to deflect them away from the ground or from a structure. See note. 2. In a captive test, an elbow in the exhaust conduit or flame bucket that deflects the flame into the open.

In sense 1, the flame deflector may be a relatively small device fixed to the top surface of the pad surrounded by the framework of the launcher, or it may be a heavily constructed piece of metal mounted as a side and bottom of a flame bucket. In the latter case, the deflector may be perforated with numerous holes connected with a source of water, bending at an angle of about 45° into the line of the exhaust stream. During thrust buildup and the beginning of the launch, a deluge of water (in some cases 30,000 gallons per minute) pours from the holes in such a deflector to keep it from melting.

flat pad. A launch pad that remains untilted

and steady. Distinguished from a ship's launch platform that rolls, pitches, and heaves.

flight, n. (flt) 1. The movement of a man-made object through the atmosphere or through space, sustained by aerodynamic, aerostatic, or reaction forces, or by centrifugal force; esp. the movement of a man-operated or man-controlled device, such as a missile, a space probe, a space vehicle, or aircraft. 2. An instance of such a movement.

The USAF Dictionary sets forth several other meanings of the word 'flight' not directly related to the astronautic science.

flight bird. A missile awaiting flight test. Sometimes designated by number, as in *flight bird No. 1*, *flight bird No. 2*, etc.

flightborne, a. (fbn) 1. Of an aircraft, missile, space-air vehicle, or spacecraft: Supported in the air or in space by aerodynamic or aerostatic forces, by reaction to a jet stream, or by velocity. 2. Of a person or thing: Riding in an aircraft, space-air vehicle, or spacecraft. 3. Of equipment or other materiel: Carried or transported, or designed to be carried or transported, by aircraft, space-air vehicles, or spacecraft. 4. Of an operation or action: Carried out with aircraft, space-air vehicles, or spacecraft or with any combination of them.

This term is coined to avoid the limiting connotations of the word 'airborne' and the word 'spaceborne.' See **guidance system**, note, for example of use. Cf. **flightworthy, a.**

flight control system. A system in a ballistic or guided missile that consists of actuating devices or mechanisms that control the thrust units, and impart movement to jet vanes, swiveling engines, aerodynamic surfaces (when applicable) or the like, so as to maintain attitude stability, to correct deflections caused by gusts or other disturbances, and to make the missile respond to commands of the guidance system.

Although distinguished from the guidance system (which see), and the responsibility of a separate research and development group, the control system in one of its functions is an integral component of the guidance system. See **thrust, n.**, note.

flight environment. 1. The environment surrounding and affecting a flightborne system or piece of equipment. 2. The system itself or the equipment itself that is, or is to be, flightborne.

This term is applicable to space vehicles as well as to aircraft. Cf. **air environment**.

flight path. 1. The line or way connecting the continuous positions occupied, or to be oc-

cupied, by an airplane, missile, or the like as it moves through the air or through space, without reference to the vertical or horizontal planes. 2. Less exactly, the trajectory of a guided or ballistic missile. See *trajectory, n.*, sense 2.

flight profile. A graphic portrayal of a missile's, aircraft's, or space probe's line of flight as seen from the side, indicating the various altitudes along the route. Cf. *trajectory, n.*

flight readiness firing. (FRF) A brief test firing of a missile's propulsion system with the missile secured to and restrained by the launcher.

This firing is to determine, to the extent possible, the readiness of the missile system and of the launch facilities prior to flight test.

flight space. Space above and beyond the earth's surface now used, or potentially to be used, for flight of aircraft, spacecraft, space-air vehicles, or missiles.

flight test. 1. A test by means of actual or attempted flight to see if and how a thing intended to fly flies. This is a test of an aircraft, spacecraft, space-air vehicle, or missile. 2. A test of a component part of a flying vehicle, or of an object carried in such a vehicle, to determine its suitability or reliability in terms of its intended function, by making it endure actual flight.

In sense 1, the flight-test is of a vehicle usually highly instrumented to provide information on the performance not only of the vehicle as a whole, but of its component systems that function in the total vehicle. In sense 2, the test has no bearing upon the capability of the vehicle to fly, but it tests a system or thing within or on the vehicle. See *test objective*, *test vehicle*.

Flight Test Report. A report prepared at a missile test center on each flight test incorporating all available data on the flight test for study by scientists and technicians.

At the AFMTC, some 450 technicians employed by the Radio Corporation of America reduce the data to usable form, the Flight Test Report. See *data reduction*.

flight test vehicle. (FTV) A test vehicle for the conduct of flight tests, either to test its own capabilities or to carry equipment requiring flight test. Cf. *research vehicle*.

flightworthy, a. Of an aircraft, missile, space-air vehicle, or spacecraft: Ready and sufficiently sound in all respects to meet and endure the stresses and strains of flight. Cf. *flightborne, a.*

Florida Missile Test Range. (FMTR). The

early name for the Atlantic Missile Range (up to June 1958).

See *Joint Long Range Proving Ground*.

flyaway cost. The cost of a completed aircraft capable of actual flight.

flying bomb. A name once applied to a pilotless aircraft or other self-propelled device carrying an explosive warhead. Cf. *bomb, n.*, note.

This term was used in 1918 in reference to the Kettering aerial torpedo, and in 1944 in reference to the V-1. Cf. *aerial torpedo*, sense 2.

follow-on, n. Any object, group of objects, technique, or procedure considered to be a second or subsequent generation in the development of the object, group of objects, technique, or procedure. See *generation, n.*

The Atlas, for example, is a follow-on to the MX-774.

forbidden line. A line in a spectrum that represents a transition within an atom which in ordinary sources is not found, but which may be conspicuous in very large bodies of rarefied gas where the time interval between collisions of atoms is long.

Forbidden lines of oxygen appear, for example, in the polar aurora.

force structure. The composition of the Air Force or other armed service in terms of the kinds of major combat and support units and of their relation to one another. Cf. *objective force structure*.

Ford Instrument. Short for 'Ford Instrument Company,' a division of Sperry Rand Corporation, missile contractor, as for the guidance of Redstone and Jupiter.

forward defense. In air defense, a capability to attack enemy aircraft or missiles at points remote from the target area.

fps (abbr). 'Feet per second.' Cf. *ft/sec (abbr)*.

freedom, n. *Medal of Freedom*, a decoration given by the President for service to mankind, considered to be the highest decoration awarded to a civilian.

The Medal of Freedom is of bronze (an inch and a quarter in diameter) suspended from a red, white, and blue ribbon. Authorized in 1946, it had been awarded 13 times up through May 1959, Ex-Secretary of State John Foster Dulles being the last recipient. Others receiving the award include Genevieve de Gallard-Terraube (French nurse of Dien Bien Phu fame), Lewis L. Strauss, Robert B. Anderson, and Charles E. Wilson.

free fall. The drop or fall of a ballistic missile or other body from summit altitude without

being guided and without being retarded by retrorockets or other devices.

The free fall comes to an end as the body strikes the surface, or at a point where a retarding force other than air particles become effective.

free-flight rocket. A rocket without electronic control or guidance.

Honest John, for example, is a free-flight rocket.

free-flight trajectory. That part of a ballistic missile's trajectory that begins with thrust cutoff and ends at reentry. See **reentry trajectory**.

This trajectory includes the coasting flight projected to a vertical plane plus the trajectory of the free fall up to the point of reentry.

free radical. An atom or group of atoms broken away from a stable compound by application of external energy, and, although containing unpaired electrons, remaining free for transitory or longer periods.

Interest centers on three radicals, atomic hydrogen (H), atomic nitrogen (N), and the imine radical (NH). In their free state, they are highly active, combining with each other or with other substances to form other stable molecules, and yielding in the process energies well in excess of those available from conventional chemical fuels. Their use in propulsive systems, now theoretical, depends upon their being isolated and available in bulk, either in pure form or dissolved in a desired concentration in another fuel. Cf. **aeroduct**, *n*.

free space. Space unoccupied by matter except by occasional meteoroids; space not used by an orbiting body. Cf. **flight space**.

free world. That part of the world not under communist control or domination.

This term is not always used precisely. In some contexts it includes the uncommitted nations; in others it refers esp. to those nations actively resisting communist aggression. See **Allied World**, **western world**.

FTCC (abbr). 'Flight Test Coordinating Committee.'

FTL (abbr). 'Federal Telecommunications Laboratory.'

ft/sec (abbr). 'Feet per second.' Cf. **fps (abbr)**.

FTV (abbr). 'Flight test vehicle.'

fuel, n. 1. A substance that may be oxidized in a rocket motor or engine so as to produce heat or a rapid expansion of gases. 2. Also applied to atomic matter used to produce heat through fission or fusion, or used to eject atomic particles, as in a nuclear rocket.

In sense 1, fuel is an ingredient of a propellant. See **propellant**, *n*. See also **cryogenic fuel**, **hypergolic**, *a*. In sense 2, see **nuclear rocket**.

fuel shutoff. The action of shutting off the flow of liquid fuel into a combustion chamber

or of contriving to stop the combustion of a solid fuel; the event or time marking this action. Cf. **cutoff**, *n*.

full flow. The flow of liquid propellants into a rocket's combustion chamber at a maximum or near-maximum rate.

fuming nitric acid. A highly concentrated solution of nitric pentoxide (N₂O₅) in water, red or brown in color and more active than the clear nitric acid.

This is sometimes used as an oxidizer in a rocket engine.

fusionable, a. Of or pertaining to nuclear fusion.

G

G (abbr). 'The constant of gravitation.' See **gravitation**, *n*., note.

g, n. Often written G. 1. The measure or value of the gravitational pull of the earth as modified by the earth's rotation, equal to the acceleration of a freely moving body at the rate of 32.16 feet per second per second. 2. The force equal to this value, as in 'he experienced three g's during the turn.' Sometimes called 'g-force.'

g (abbr). 'Gravity.'

galactocentric, a. 1. Of concepts: Formed or postulated upon the notion that the Galaxy is the center of things. 2. Of movements: That move about, or in relation to, the Galaxy as the center of things.

Cf. **geocentric, a.**, **heliocentric, a.**

galaxy, n. 1. *Capitalized.* The group of several billion suns, star clusters, nebulae, etc., to which the earth's sun belongs. Also called the Milky Way. 2. Any of several similar groups of stars forming isolated units in the universe.

The Galaxy (sense 1) is generally considered by astronomers to be shaped like a great disk, with stars irregularly dispersed in clusters. Its diameter is 30,000 parsecs, its thickness 1,000 to 2,000 parsecs except at the center, where it is 5,000 parsecs or more. Outside the central plane other classes of objects are dispersed in spheroidal distribution extending to 5,000 parsecs beyond the central periphery and 10,000 parsecs distant from the galactic plane. The spherical diameter of the globular clusters surrounding the center is 30,000 parsecs.

The earth's sun is from 8,000 to 10,000 parsecs from the central part of the disk, with a rotational velocity about the central mass of from 150 to 200 miles per second, taking 200 million years to complete one revolution.

GALCIT (abbr). 'Guggenheim Aeronautical

Laboratory of the California Institute of Technology.' Sometimes written 'Galcit.'

GAM (*abbr*). 'Guided aircraft missile.'

This abbreviation is used with a number to designate a particular guided aircraft missile, as in GAM-63 the Rascal, GAM-72 the Green Quail, and GAM-77 the Hound Dog.

Gamma, n. Short for '1958 Gamma' or the like. See **Alpha, n.**, note.

'1958 Gamma' was Explorer III; '1959 Gamma' is Discoverer II.

gantry, n. A frame structure that spans over something, as an elevated platform that runs astride a work area, supported by wheels on each side; short for 'gantry crane' or 'gantry scaffold.'

gantry crane. A large crane mounted on a platform that usually runs back and forth on parallel tracks astride the work area.

gantry scaffold. A massive scaffolding structure mounted on a bridge or platform supported by a pair of towers or trestles that normally run back and forth on parallel tracks, used to assemble and service a large rocket as the rocket rests on its launching pad.

This structure is a latticed arrangement of girders, tubing, platforms, cranes, elevators, instruments, wiring, floodlights, cables, and ladders—all used to attend the rocket. At Cape Canaveral, one of the gantries stands 150 feet high.

gapa (*abbr*). 'Ground-to-air pilotless aircraft.'

GAR (*abbr*). 'Guided aircraft rocket.'

The GAR-1D is Falcon I; the GAR-2A is Falcon II; the GAR-3 is an advanced version of GAR-1; the GAR-4 of the GAR-2. The GAR-8 is the Sidewinder. The odd-numbered GAR's are radar-guided, the even-numbered are heat-guided.

GAR-9. A guided aircraft rocket under development by North American, Hughes, and Aerojet.

This rocket is an advanced version in the Falcon family, with accurate guidance and nuclear capability.

Gaslight, n. *Project Gaslight*, a project of the Army aimed at solution of the reentry problem.

gasoline, n. (gas) A hydrocarbon fuel used as a bipropellant with liquid oxygen. See **specific impulse**, note.

GB-4 missile. A WW II glide bomb with a mounted television camera and transmitter, controlled in azimuth and range by radio, and guided from a mother aircraft by use of the television. Also called the 'GB-4'. *Hist.*

This missile was first used in July 1944 against U-boat pens at Le Harve.

GCI (*abbr*). 'Ground-controlled interception.'

GCR (*abbr*). 'Ground-controlled radar.'

GDOP (*abbr*). 'Geometrical dilution of precision.'

GE (*abbr*). 'General Electric' Company.

Geiger counter. [Hans Geiger (1882–1947), German physicist.] An instrument for detecting and measuring radioactivity. In full, 'Geiger-Müller counter.'

This counter, essentially a thin-walled gas-filled metallic tube with a needle electrode projected within, detects the radiating particle indirectly. The particle penetrates the thin wall and ionizes the gas; a current is momentarily set up, which is detectable and measurable. Cf. **scintillating counter**.

The Geiger counter is used to detect and measure radiation encountered by earth satellites.

General Electric. Short for 'General Electric Company,' missile contractor, as for the guidance of Polaris, or for the power plant of Green Quail.

general war. A war in which several nations are participants, esp. involving the major powers.

generation, n. In any technical or technological development, as of a missile, jet engine, or the like, a stage or period that is marked by features or performances not marked, or existent, in a previous period of development or production, as in 'the first generation of rockets used liquid propellants.'

Current development in rocket missiles is usually considered to be entering the second generation.

Genie, n. An AF air-to-air solid rocket missile. Also known as the MA-1 and the MB-1. Formerly called 'Ding Dong,' 'Bird Dog' and 'High Card.'

Originally designed by Douglas in 1956, and flight-tested in 1957, the Genie was at first unguided, but a guided version is being developed. It has a range of 1.5 miles and may carry a nuclear warhead. The MA-1 carries an inert warhead; the MB-1, a nuclear warhead.

geocentric, a. 1. Of an idea or concept: Formed or postulated upon the notion that the earth is the center of things. 2. Of or pertaining to the earth as the center of something. 3. Of or pertaining to the earth's center of mass.

geocentric diameter. The diameter of a celestial body measured in seconds of arc as viewed from the earth's center.

Geophone, n. A trademark name for a listening instrument that picks up sounds transmitted through the earth.

geophysical constant. A quantity that expresses a fixed value for a law or magnitude that applies to the physics of the earth.

The constant of gravitation and the constant of nutation are examples of a geophysical constant.

geophysical rocket. A rocket vehicle designed to carry instruments or organisms into the upper atmosphere or space so as to obtain data on agents that modify the earth.

geophysics, *n.* The physics of the earth, esp. in respect to its modification by motion, radiation, and other agents.

George Washington. The name of a projected nuclear submarine for carrying the Polaris, expected to be commissioned in 1960.

German Rocket Society. One or other of the rocket societies organized in Germany.

The first German rocket society was the *Verein für Raumschiffahrt* (Society for Space Travel), founded 5 June 1927. Known as the VfR, its early members included Johannes Winkler, Max Valier, Willy Ley, Hermann Oberth, Walter Hohmann, the Russian Nikolai A. Rynin, and the Frenchman Robert Esnault-Pelterie. By 1928 the society had more than 500 members, by 1930 more than 1,000. The VfR came to an end in 1934.

In 1937 a successor rocket society was organized but its existence was tenuous up to the time of and during WW II. In 1948 it started up again with vigor, newly named the *Gesellschaft für Weltraumforschung* (Society for Space Exploration). In November 1956, it changed its name to *Deutsche Gesellschaft für Raketen-technik und Raumfahrt* (German Society for Rocket Engineering and Space Travel).

GFAE (*abbr.*). 'Government-furnished aeronautical equipment.'

GFE (*abbr.*). 'Government furnished equipment.'

g-force, *n.* A force having the value of one *g*.

GFP (*abbr.*). 'Government-furnished property.'

giant planets. The planets Jupiter, Saturn, Uranus, and Neptune. Cf. **Jovian planet.**

Gilfillan, *n.* Short for 'Gilfillan Brothers,' missile guidance manufacturers, as for the Corporal.

gimbal, *n.* A contrivance with two mutually perpendicular and intersecting axes of rotation on which a mounted engine or other object may be inclined in one direction or another.

gimbal, *v. tr.* 1. To move a reaction engine about on a gimbal so as to obtain pitching and yawing correction moments. 2. To mount an engine on a gimbal.

gimbaled motor. A rocket motor mounted on a gimbal, so as to obtain pitching and yawing correction moments.

Gimlet, *n.* An air-launched rocket under research and development by the Navy.

glide bomb. (GB) A WW II bomb fitted with lifting or control surfaces, carried and released toward a target by an airplane, and sometimes guided by radio command or by a

radiation homing device. Also called a 'glider bomb.'

The first American glide bomb, the GB-1, was used against Cologne, Germany, on 25 May 1944. See **GB-4 missile**, Henschel 293.

glide rocket. A rocket missile or vehicle kept within or near the sensible atmosphere so as to assume a flat gliding attitude within the atmosphere after power shutoff.

Globemaster II. The C-124.

GM (*abbr.*). 'Guided missile.'

gnatobiotics, *n.* The study of germ-free animals for use in space probes.

Goddard, Robert H. An American rocket pioneer.

Dr. Goddard (5 Oct 1882—10 Aug 1945) was a professor of physics at Clark University. In a 60-page pamphlet 'A Method for Reaching Extreme Altitudes' (1919) he discussed the use of rockets for exploring the upper atmosphere and the problems of reaching the moon by rockets. In 1920 he embarked on experiments to test liquid fuels, and on 16 Mar 1926 succeeded in flying the first liquid oxygen and gasoline rocket. In 1930, with a grant from the late Daniel Guggenheim, he set up a laboratory near Roswell, New Mexico, and proceeded to a series of rocket tests that advanced knowledge on fuels and stabilizers. With another grant in 1934, he continued his experiments. During WW II he designed takeoff rockets for Navy aircraft.

Goddard Space Flight Center. (GSFC) A research center being established by NASA near Beltsville, Maryland, for the development of satellites, space probes and vehicles, tracking, communications, and data reduction systems. Cf. **Space Projects Center.**

Named for Robert H. Goddard (1882-1945).

Goldstone Tracking Facility. A radio telescope located at the Army Camp Irwin in Barstow, California. Cf. **Jodrell Bank.**

This radio telescope has an 85-foot diameter antenna.

Golem 1. A Soviet underwater-to-surface liquid-rocket missile, adapted from a German prototype.

Golem 1 is reported as having a range of 400 miles. It is launched from a special chamber towed by a submarine.

This missile appears to be named for the automaton of the 16th century, created by the cabalist rabbi Löw of Prague.

Golem 2. A Soviet two-stage rocket IRBM to be launched from underwater, with a range of about 1,200 miles.

This missile is under development.

Golem 3. A Soviet anti-aircraft, solid-rocket missile, with a range of eight miles.

This missile may be launched from underwater.

go-no-go, *a.* Of a rocket missile launch: So controlled at the end of the countdown as to permit an instantaneous change in decision on whether to launch or not to launch.

Goodyear, *n.* Short for 'Goodyear Aircraft Corporation,' missile guidance contractor, as for the TM-76A Mace and Subroc.

Goose, *n.* An AF surface-to-air delta-winged diversionary missile developed by Fairchild. Also called SM-73. No longer in production.

Goose is designed primarily as a missile decoy launched in advance of attacking bombers, but is itself capable of carrying a lethal load. With a range in excess of 2,000 miles, a high subsonic speed, and a ceiling of 50,000 feet, it is some 60 feet in length, over 4 feet in diameter, and 32 feet in span. It is launched by a solid propellant jato and powered at cruise speeds by a turbojet engine. Its guidance is inertial. See **Bull Goose**.

government, *n.* *Specif.* The government of the United States, esp. as represented by the Department of Defense.

government-furnished aeronautical equipment. (GFAE) That part of government-furnished property that, under the terms of an Air Force contract, is procured by the Air Force and furnished direct to aircraft equipment or missile manufacturers for inclusion or incorporation into aircraft, missiles, or other vehicles.

government-furnished property. (GFP) Property in the possession of, or acquired directly by, the government, and delivered or otherwise made available to the contractor.

gox (*abbr.*). 'Gaseous oxygen.'

grain, *n.* The body of a solid propellant used in a rocket, fashioned to a particular size and shape so as to burn smoothly without severe surges or detonations.

A grain may be very long (40 or 50 inches, for example), shaped to fit the requirements of the rocket, and referred to by its shape, as in *tubular grain*, *cruciform grain*, *triform grain*, etc.

Grand Central. Short for 'Grand Central Rocket Company,' missile contractor, as for the power plant of Dart.

gravipause, *n.* The boundary at which the dominant gravity of a particular spatial body ends, and is matched by the counter-gravity of another spatial body.

gravireceptor, *n. Medicine.* A nerve ending that responds to the mechanical stimulation of gravity.

gravisphere, *n.* The spherical extent in which the force of a given celestial body's gravity is predominant.

gravitation, *n.* The universal phenomenon of every particle of matter being attracted by every other particle, the force of attraction varying inversely as the square of the distance

between them and directly as the product of their masses; the attraction that inheres in this phenomenon.

By formula the force of gravitation is usually expressed as $f = Gm_1m_2/d^2$, where f is the force of attraction, G the constant of gravitation (which see), m_1 the mass of the first body, m_2 the mass of the second body, and d the distance between the masses.

Sir Issac Newton (1642-1727) formulated or deduced the law of universal gravitation. The exact value of G , however, was not known to him.

gravity, *n.* (g) 1. The resultant effect, at the earth's surface, of the earth's gravitation and of the centrifugal force of the earth's rotation upon a free-falling body, measured by the acceleration produced in the free-falling body toward the center of the earth. **2.** The measure of this effect. **3.** A like effect of the gravitational force of another spatial body upon an object falling toward it.

The acceleration due to gravity is 32.17 feet per second per second at latitude 45°; that is, a body starting at rest falls 16.085 feet in the first second, 48.255 feet in the next, 80.425 in the next, etc.

The value of gravity or g varies with latitude. At the poles, the surface is nearer the center of the earth than at the equator, and the centrifugal force of the earth's rotation is small as compared to what it is at the equator. Expressed in weight, an object of 190 pounds at the poles would weigh 189 pounds at the equator (if a spring balance is used). Cf. **weight, *n.***

great circle. A circle on the surface of a sphere, the plane of which passes through the center of the sphere and divides it into two equal parts; *specif.*, such a circle on the surface of the earth, the earth being assumed to be spherical. See **earth, *n.***, note.

Green Quail. An early name for the Quail.

Green Room. *Specif.* A room of the Cape Canaveral Central Control that serves as the command center.

gross error. 1. A missile strike at such distance from the target as to do no useful damage, the resultant of errors outside the missile system itself. **2.** Such a strike beyond an arbitrarily determined distance from the desired point of impact.

In sense 1, if the coordinates of the aiming point are not accurately known, as in the case of a far-distant point, a gross error may result. See **circular probable error**.

ground, *n.* 1. The earth's surface, esp. the earth's land surface. Used in combination to form adjectives, as in *ground-to-air*, *ground-to-ground*, and *air-to-ground*. Cf. **surface, *n.* 2.** The domain of nonflight operations that normally take place on the earth's surface or in a vehicle or on a platform that rests upon

the surface. Used attrib., as in *ground control*, *ground system*, etc., distinguished from *flightborne control*, *flightborne system*, etc.

See USAF Dictionary for other common meanings in military contexts.

ground environment. 1. The environment that surrounds and affects a system or piece of equipment that operates on the ground. 2. That system or part of a system, as of a guidance system, that functions on the ground; the aggregate of equipment, conditions, facilities, and personnel that go to make up a system, or part of a system, functioning on the ground. See *environment, n.*, *SAGE (abbr)*.

ground-handling equipment. Equipment on the ground used to move, lift, or transport a missile, rocket vehicle, or component parts.

Such equipment includes the gantry, the missile transporter, and the forklift.

ground start. An ignition sequence of a rocket's main stage, initiated and cycled through on the ground. Cf. *air start*, *inflight start*.

In large rockets, the ground start is commonly fueled from pressurized tanks external to the rocket, permitting takeoff with the rocket's own internal propellant load intact.

ground support equipment. (GSE) That equipment on the ground, including all implements, tools, and devices (mobile or fixed), required to inspect, test, adjust, calibrate, appraise, gauge, measure, repair, overhaul, assemble, disassemble, transport, safeguard, record, store, or otherwise function in support of a rocket missile, vehicle, or the like, either in the research and development phase or in an operational phase, or in support of the guidance system used with the missile, vehicle, or the like.

The GSE is not considered to include land or buildings; nor does it include the guidance station equipment itself, but it does include the test and checkout equipment required for operation of the guidance station equipment. Cf. *test GSE*.

ground-to-ground, a. Of a missile: Launched from the surface to strike at a target on the surface. See *ground, n.*

Strictly speaking, a ground-to-ground missile is one launched from a land surface to strike at a target on a land surface. This restriction, however, is seldom implied. See *land-based, a.*, *surface, n.*

ground trace. The theoretical mark traced upon the surface of the earth by a flying object, missile, or satellite as it passes over the surface, the mark being made vertically from the object making the trace.

growth potential. The potential of a rocket

missile or vehicle for future development as indicated by the adaptability of its basic design and structure.

The Thor, for example, is considered to have good growth potential, indicated, for example, by its use as the first stage of a moon rocket. See *Discoverer, n.*

GSE (abbr). 'Ground support equipment.'

GSS (abbr). 'Global surveillance system.'

GSV (abbr). 'Guided space vehicle.'

g-tolerance, n. A tolerance in a person or other animal, or in a piece of equipment, to g-force of a particular value.

guidance, n. The resultant effect upon a missile or vehicle that moves it in a desired direction, the effect being in response to controls exercised by a person inside the vehicle or by a preset or self-reacting device within the missile or vehicle, or as exercised by a device within the missile or vehicle reacting to outside command or signals.

See *celestial guidance*, *command guidance*, *homing guidance*, *inertial guidance*, and *map-matching guidance*.

guidance station equipment. The ground-based part of the radio-guidance system for a flightborne vehicle, specifically including the tracking radar, the rate-measuring equipment, the data link equipment, and the computer.

The guidance station equipment is not considered a part of the ground support equipment (which see).

guidance system. A system for a missile guided all the way to target or for a ballistic missile, both developing targeting data so as to achieve the desired trajectory or flight path, and communicating this data in the form of commands to the missile's flight control system. See *control system*.

With an all-the-way guided missile, the input of targeting data is continuous from launch to target; with a ballistic missile, the data input places the missile on the desired trajectory at desired velocity prior to thrust cutoff.

The guidance system may be self-contained within the missile (as with celestial guidance) or it may consist of a combination of ground and flightborne components.

guided aircraft missile. (GAM) A self-propelling missile launched, or designed for launching, from an aircraft, and guided to a surface target or used as a decoy. Cf. *Quail, n.*, *Hound Dog* and *Rascal, n.*

Although a GAM may be rocket-propelled, as with the Rascal, it differs from a GAR in that its normal target is on the surface. See *GAM (abbr)*.

guided aircraft rocket. (GAR) A rocket-powered guided missile designed to be launched

from an aircraft in flight against an airborne target. Cf. *Falcon I*, *Falcon II*.

The GAR is normally carried by a fighter aircraft. See note under *guided aircraft missile*.

guided missile. (GM) 1. A missile or missile vehicle guided all the way, or substantially all the way, to its target while in flight or motion through the atmosphere or through space, or through any other medium. Distinguished from the ballistic missile (which see). See also *unguided missile*. 2. In a broader sense, any missile given direction in any part of its flight path or trajectory, including the ballistic missile and the missile of sense 1. 3. Also applied in a literal sense to the aimed missile.

As normally used in the Armed Services, the term 'guided missile' does not apply to such missiles as bullets, hand grenades, artillery shells, and aerial bombs, although these missiles are actually 'guided' in the sense of being given initial guidance at launch. Rather the term applies, except when used generically, only to missiles given continuous guidance during flight, like the guidance given an airplane or automobile. This restriction in meaning—a restriction that evolved as early as 1941—thus differentiates the guided missile as defined in sense 1 from the ballistic missile, which is not 'guided' in the greater part of its flight.

The guided missile (sense 1) may be aerodynamically guided, if in the atmosphere; or it may be guided by directional jets or by vanes in the jet stream, if above the atmosphere. Its flight path is determined either by a preset or self-reacting device within the missile, or by a device within the missile reacting to command or signal outside the missile. Its guidance depends either on applied power, or on the exchange of altitude for momentum under aerodynamic conditions. See *guidance*, *n*.

Guided aircraft missiles (GAM's) and guided aircraft rockets (GAR's) technically are guided missiles in sense 1, but are sometimes referred to as aircraft armament.

Sense 2 is a generic sense, and is used, for example, in AFR 55-5, dated 15 May 1958. See also *guided missile insignie*, *guided missile unit*.

In its early history, *guided missile* vied with other terms for acceptance. *Aerial torpedo*, *flying bomb*, *robot bomb*, and *jet bomb* were common in WW II. By 1947, however, *guided missile* had generally won out, except for a time *pilotless aircraft* was an alternate locution for a missile with wings. See *aerial torpedo*, *bomb*, *n*., note, *buzz bomb*, *flying bomb*, *jet bomb*, *pilotless aircraft*, *radio torpedo*, *robot bomb*, and *rocket bomb*. See also *bird*, *n*., *Bug*, *n*.

guided-missile insignie. An insignie worn above the left breast pocket of a coat, jacket, or shirt (if an outer garment) signifying that the wearer is assigned to a guided missile unit, an R&D unit, or a staff position, in each case with duties directly and distinctively associated with guided missiles.

Eligibility for this insignie is set forth in AFR 35-5, dated 23 May 1958. Manner of wear is prescribed by AFM 35-10, dated 15 July 1957.

guided-missile ship. A naval vessel designed to carry and launch a guided missile. Cf. *Halibut*, *n*., *missile submarine*.

guided-missile unit. An AF unit employing tactical, strategic, reconnaissance, or interceptor surface missiles.

Units employing guided aircraft missiles (GAM's) or guided aircraft rockets (GAR's) only are not considered guided missile units. The missiles employed by guided-missile units include the SM-62 Snark, the SM-65 Atlas, the SM-68 Titan, the SM-73 Goose, the SM-75 Thor, the SM-78 Jupiter, the TM-61 Matador, the TM-76 Mace, the IM-99 Bomarc, and the Minute-man.

GAM's and GAR's are considered, for this purpose, to be aircraft armament.

guided space vehicle. (GSV) A space vehicle under directional control.

Directional control may be effected through radio command, through preset mechanisms, through inertial guidance, celestial guidance, or theoretically through control by a pilot.

guided weapon. (GW) A guided missile. *British*.

GW (*abbr*). 'Guided weapon.'

H

half stage. A booster unit in a stage-and-a-half rocket, as in the Atlas.

Halibut, *n*. USS *Halibut*, a nuclear-powered missile submarine of the US Navy, adapted esp. to the launch of Regulus II.

The USS *Halibut* is the first of the missile submarines of the Navy. Cf. *Patrick Henry*.

hangar, *n*. *Specif*. 1. A typically constructed building (as for aircraft) with space inside open to the roof, equipped with overhead tracks, hoists and pulleys, used esp. at a launching base to provide facilities for the assembly and checkout of a rocket vehicle previously transported by air or truck to the base. See *hangar test*. 2. A missile shelter at a launch point in which the missile rests on its side ready to be raised into firing position.

In sense 2 the hangar rolls back out of the way or the missile moves forward, to clear the hangar.

hangar test. At a launching base hangar, an inspection and test of a rocket missile or vehicle that consists of inspecting for possible damage to the missile incurred during transport to the base, of hooking up all mechanical, electrical, and hydraulic connections followed by a test of their operation, and of a test of all subsystems with applicable checkout equipment. Cf. *assembly inspection*.

hard base. A hardened launching base adapted,

designed, or built to withstand a specific amount of overpressure, esp. against that of a nuclear attack. Cf. *soft base*.

The facilities of a hard base may include hardened launch emplacements, natural or manmade tunnels, silos reinforced with concrete, hardened blockhouses, and other facilities protected against overpressure.

harden, *v. tr.* To make a *launch site*, *launch pad*, *base*, or other *installation* hard or strong against heat or blast by reinforcing it with concrete, or by providing it with a shield of heavy concrete or earthwork. Cf. *semi-harden*, *v.*

A hardened launch pad, for example, may consist principally of a hole in the ground, deep enough to take a given missile, reinforced to guard against caveins, and covered over by concrete doors.

hardened, *a.* Of an installation: Made hard, as with concrete or earth, to withstand overpressures of nuclear or other blast.

Hawk, *n.* An Army and Marine Corps surface-to-air, two-stage solid-rocket missile designed primarily against low altitude targets, developed by Raytheon. Also called XM-3.

Expected to complement Nike defenses, the Hawk is about 17 feet in length and weighs about 1,275 pounds. With a solid booster it is launched at different angles from a special launcher (fixed or mobile) and homes upon target by radar. Its range is about 22 miles, its speed supersonic.

heat exchanger. A device for transferring heat from one substance to another, as by regenerative cooling (which see).

heat of vaporization. The heat absorbed by a liquid when it vaporizes; the quantity of heat required at a given temperature to convert a unit mass of liquid into vapor.

heat shield. Any device that protects something from heat. See *heat sink*.

heat sink. A contrivance for the absorption or transfer of heat away from a critical part or parts, as in a nose cone where friction-induced heat may be conducted to a special metal for absorption. Cf. *ablate*, *v.*

For example, the GE nose cone surface for the Atlas is of very smooth copper, plated with a thin film of nickel and specially fabricated to provide for laminar flow and for heat diffusion. The stagnation temperatures at the front of the cone are diffused before the melting point is reached.

heavy cosmic ray primary. A cosmic ray considered to consist of a particle, the nucleus of an element heavier than the nucleus of helium, but less heavy than the nucleus of iron.

HedUSAF (*abbr.*). 'Headquarters United States Air Force.'

HEF (*abbr.*). 'High-energy fuel.'

heliocentric, *a.* 1. Of or pertaining to the sun's center of mass. 2. Of or pertaining to the sun as the center of the solar system.

helium, *n.* A lighter-than-air, nonflammable gaseous element, inert and colorless, having an atomic number of 2, and an atomic weight of 4.003. *He* (symbol).

Helium is found in nature on the earth; it is also transmuted from heavy hydrogen, as in the explosion of a hydrogen bomb, or as in the sun. It is used to pressurize liquid rocket engines, as well as to lift balloons and airships.

Henschel 293. (Hs 293) A WW II German glide bomb initially propelled by a rocket engine. *Hist.*

Early models of the Hs 293 were called Hs 293 V-1, Hs 293 V-2, Hs 293 V-3, etc., in which the 'V' stood for *Versuchsmuster*, an experimental model. Cf. V-1, etymological note.

Hercules, *n.* 1. Short for 'Hercules Powder Company.' See *Allegany Ballistics*. 2. Short for 'Nike Hercules.'

Hermes, *n.* *Hermes Project*, a missile project begun in 1944, but with flight tests delayed until 1950, the objective being to develop an artillery type missile. *Hist.*

Captured V-2's were used in the first firings. The Bumper firings at Cape Canaveral were also a part of the Hermes Project. Cf. JB-2.

heterosphere, *n.* That part of the upper atmosphere wherein the relative proportions of oxygen, nitrogen, and other gases are unfixed, and wherein radiation particles and micro-meteoroids are mixed with air particles. See *homosphere*, *n.*

HETS (*abbr.*). 'High environment test system.'

Project HETS is a USAF project for developing a solid propellant rocket to test inertial guidance systems and aerodynamic shapes for advanced vehicles. The project is a joint development with NASA's Scout.

hidyne, *n.* Variant of 'hydyne' (which see).

High Card. An early name for Genie.

High Speed Flight Station. A small NASA station at Edwards AFB.

Hiller, *n.* 'Short for 'Hiller Aircraft Corporation.'

hold, *n.* A delay or pause, as in the launching or testing sequence, or in the countdown, of a rocket vehicle.

Holds may be scheduled so as to meet liftoff time; they may be unscheduled because of weather, equipment malfunction, or the like.

hold, *v. intr.* During a countdown: To stop counting and to wait until an impediment has been removed so that the countdown can be resumed, as in 'T minus 40 and holding.' Cf. *count*, *v.*, *recycle*, *v.*

hold-down test. The testing of some system or subsystem in a rocket missile or vehicle while the rocket is firing but restrained in a test stand.

Holy Moses. The popular name of the HVAR of WW II.

home, *v.* 1. *intr.* Of a guided missile: To direct itself toward a target by guiding on heat waves, radar echoes, radio waves, or other radiation emanating from the target. 2. *tr.* To cause a *missile* to go toward an object emitting radiation.

homing guidance. The guidance of a missile or vehicle by means of a receiver within the missile or vehicle that is sensitive to radiation emitted at the objective, such as infrared, radio signal, or radar.

homosphere, *n.* That part of the atmosphere made up, for the most part, of atoms and molecules found near the earth's surface, and retaining through the entire extent the some relative proportions of oxygen, nitrogen, and other gases.

The homosphere lies below that part of the atmosphere where radiation particles and micrometeoroids freely mix with air particles. See **heterosphere, *n.***

Honest John. An Army surface-to-surface solid rocket artillery projectile developed by Army Ordnance with Douglas and Emerson. Also called the M-31.

With a weight of 3 tons, a length of 27 feet, a diameter of 2½ feet, Honest John has a range of about 18 miles, a reported supersonic speed, and a nuclear capability. Its launcher is self-propelled and mobile. It is a free-flight rocket with no guidance after launch.

Honeywell, *n.* Short for 'Minneapolis-Honeywell Regulator Company,' missile contractor, as for guidance components of Titan, Thor, Atlas, and Polaris.

hot, *a.* Of a systems test, esp. of a propulsion system test: Conducted by actually firing the propellants. Cf. **cold-flow test.**

A hot test may be live or static, or conducted in a confined place. See **battleship tank test**, **live testing**, **static testing**.

hot configuration. Said of a test missile: Equipped and ready for firing, either static or live.

Hound Dog. An AF air-to-surface guided aircraft missile under development by North American. Also called the GAM-77 or WS-131B.

Hound Dog is reported as of 40 feet in length, with a turbojet or ramjet powerplant, inertial or Doppler radar guidance, and for use with the B-52. Its power-

plant is by Pratt & Whitney; its guidance by Auto-netics.

Hound Dog was first flight-tested on 23 Apr 1959, launched from a B-52 down the Atlantic Missile Range. The B-52 had taken off from Eglin.

Hound Dog, replacing Rascal, is considered an interim weapon until an ALBM becomes operational.

hour circle. Any great circle on the celestial sphere that passes through both celestial poles.

The hour circle is used as a line of angular distance or of time measured eastward from the vernal equinox.

HTV (*abbr.*) 'Hypersonic test vehicle.'

Hughes, *n.* Short for 'Hughes Aircraft Company,' missile contractor, as for Falcon I and Falcon II.

human engineering. The art or science of designing, building, or equipping an aircraft, space-air vehicle or space vehicle to the anthropometric, physiological, or psychological requirements of a person.

Hustler, *n.* 1. A liquid rocket engine developed by Bell that generates approximately 15,200 pounds of thrust. 2. The popular name of the B-58.

In sense 1, the Hustler was used to power the second stage of Discoverer I. Its fuel system is helium-preserved. It uses JP-4 as a fuel and inhibited red fuming nitric acid as an oxidant, the combination achieving a specific impulse of about 268. See **Atlas-Hustler, *n.***, **Thor-Hustler, *n.***

HVAR (*abbr.*) 'High velocity aircraft rocket.' See **Holy Moses.**

This term is applied specifically to a WW II aircraft rocket that was in production until fiscal year 1955. Six feet long, 5 inches in diameter, it weighs about 140 pounds, and has a velocity of about 1,500 feet per second (about 1,000 mph).

hydrazine, *n.* A liquid base, NH_2NH_2 .

Hydrazine may be used as a monopropellant, or, more commonly, as a fuel combining with an oxidizer. With liquid oxygen, it gives a theoretical specific impulse of 259 seconds at sea level; with fluorine a specific impulse of 299 seconds; with nitrogen tetroxide 249 seconds. With nitric acid, hydrazine is hypergolic.

hydrogen, *n.* (H) An element, flammable and lighter than any other chemical element, a colorless, tasteless, and odorless gas in its uncombined state. **a.** Used in its liquid state as a rocket fuel. See **liquid hydrogen**. **b.** Subject in the isotope deuterium (H^2) or tritium (H^3) to nuclear fusion.

Hydrogen's atomic weight is 1.0080, its atomic number is 1. The ordinary isotope (H^1) consists of a single proton in the nucleus and a single electron.

hydrophone, *n.* An instrument for listening to sound transmitted through water.

hydrosphere, *n.* That part of the earth that consists of the oceans, seas, lakes, and rivers; a

similar part of any other spatial body if it so exists.

hydyne, n. Also **hidyne**. A hydrazine-based liquid rocket fuel developed by Rocketdyne, and used as a propellant, as in Jupiter-C.

Hydyne (the word coined from *hi* plus *dyne* or power) is reported as a 60-40 mixture of unsymmetrical dimethyl hydrazine and diethylene triamine.

hyperbola, n. The curve of a right-circular conic section made by an intersecting plane that forms a greater angle with the base than the cone's side forms.

The hyperbola consists of two infinite branches, with eccentricity greater than one. Of different shapes (between that of the near parabola to a near straight line) it has an eccentricity approaching infinity as its curve approaches a straight line.

hyperenvironment, n. A natural or induced environment encountered at altitudes of 75,000 feet or above.

hypergol, n. [From a WW II German code word.] 1. A rocket fuel or propellant that ignites spontaneously upon contact with the oxidizer. 2. A propulsion system that utilizes such a fuel.

In sense 1, cf. **pyrophoric fuel**.

hypergolic, a. 1. Self-igniting. Said of a fuel, propellant, or propulsion system. 2. Of ignition: Occurring spontaneously when a fuel comes in contact with the oxidizer.

See **aniline, n.**, **hydrazine, n.**

Hypergolic fuels are normally liquid.

hypergolicity, n. A property of a fuel that self-ignites upon contact with an oxidizer.

hypersonic, a. Of or pertaining to the speed of an object moving at mach 5 or greater relative to surrounding fluid.

hypoacoustic zone. A zone or level above the earth (from above 60 to 75 miles altitude) in which the air particles are so reduced in number that sound is transmitted with less volume than at lower levels.

'Hypoacoustic' is coined from the Greek *hypo* 'less than ordinary' plus *acoustic*. See **anacoustic zone**.

hypobarism, n. Medicine. A condition in which the gas pressure within the body tissues, fluids, or cavities is greater than ambient gas pressure.

hypoxia, n. Medicine. Oxygen deficiency in the blood, cells, or tissues of the body in such degree as to cause psychological and physiological disturbances.

Hypoxia may result from a scarcity of oxygen in the air being breathed, or from an inability of the body tissues to absorb oxygen under conditions of low barometric pressure. In the latter case, water vapors from body fluids increase in the sacs of the lungs, crowding out the oxygen.

I

I (abbr). 1. 'Interceptor,' used as a prefix letter in missile designations, as in **IM** or **ITM**. 2. 'Impulse.'

In sense 2, the 'I' is modified by an inferior letter 's' or 't' to indicate specific impulse (*I_s*) or total impulse (*I_t*).

IAF (abbr). 'International Astronautical Federation.'

IAS (abbr). 'The Institute of the Aeronautical Sciences.'

IAWR (abbr). 'Institute of Air Weapons Research.'

IBM (abbr). 'International Business Machines.'

ICAO (abbr). 'International Civil Aviation Organization.'

ICAS (abbr). 'International Council of the Aeronautical Sciences.'

ICBM (abbr). 'Intercontinental ballistic missile.'

ICBMS (abbr). 'Intercontinental ballistic missile system.'

ice frost. A thickness of ice that gathers on the outside of a rocket vehicle over surfaces supercooled as by liquid oxygen inside the vehicle.

This ice frost is quickly shaken loose and falls to the ground once the rocket vehicle begins its ascent.

ideal exhaust velocity. The exhaust velocity of an ideal rocket.

ideal rocket. A theoretical rocket postulated for parameters that may be corrected in practice.

An ideal rocket assumes a homogeneous and invariant propellant, an observance of perfect gas laws, a no-heat-transfer condition, a steady and constant propellant flow, an axially-directed velocity of all exhaust gases, a uniform gas velocity across every section, and a chemical equilibrium established in the combustion chamber.

igniter, n. A squib or pyrotechnic device used to ignite a rocket engine.

Igor, n. The ME.

IGY (abbr). 'International Geophysical Year.'

IGY satellite. One or other of the artificial earth satellites developed for purposes of the International Geophysical Year (which see).

One of these satellites, for example, is a 20-inch sphere, with a thin magnesium skin coated with a highly polished silicon monoxide, designed to measure the Lyman-Alpha radiation in the outer ultraviolet band of sunlight, and to transmit its measurements by means of a miniature transmitter. Another is a 13-inch sphere designed to carry an inflatable subsatellite.

IM (abbr). 'Interceptor missile.'

This abbreviation is used with a number to designate a particular missile, as in *IM-99* for Bomarc.

impact, *n.* *Specif.* The action or event of a bomb, ballistic missile, or the like striking the surface or striking another object; the time of this event, as in 'from launch to impact.'

impact, *v.* 1. *tr.* To strike a *surface* or an *object*. Said of a missile. 2. *intr.* Of a missile or fallaway section: To make impact with a surface or object, as in 'the missile impacted ten minutes after launch.'

impact area. The area on which a missile makes impact, esp. such area on the earth's surface. Used specifically in reference to the impact area of a missile range.

impact line. An imaginary line on the outside of a destruct line and running parallel to it, which marks the outer limits of impact for a missile destroyed under destruct procedures.

impact microphone. An instrument that picks up the vibration of an object impinging upon another, used esp. on space probes to record the impact of small meteoroids.

impact predictor system. An electronic system that follows the powered flight of a missile predicting at regular fractions of a second where the missile would fall if its engine thrust failed at any given instant.

The system consists of a transponder carried in the missile that receives signals from a ground antenna, then sends signals to the impact predictor station, where they are analyzed by the computer which, in turn, plots the course on a board in Central Control.

impulse, *n.* (I) 1. The product of a force's average value and the duration in which it acts, equal to the change in momentum produced by the force. 2. Short for 'total impulse.' See I (*abbr.*), **specific impulse.**

inclination, *n.* The angle between one line and another or one plane and another, as the angle between the plane of the moon's orbit and the ecliptic, or the angle between the plane of an earth satellite's orbit and the plane of the earth's equator.

indirect manhour. A manhour expended in support of, but not identifiable with, a given product, operation, or project.

Hours expended in essential services, management, or administration are considered indirect manhours.

industry team. A group of two or more industrial firms working together in the development and production of a weapon vehicle or other vehicle.

inertial force. The force produced by the reaction of a body to an accelerating force, equal

in magnitude and opposite in direction to the accelerating force.

Inertial force endures only so long as the accelerating force endures.

inertial guidance. A kind of guidance for a missile or the like, effected by means of mechanisms that automatically adjust the missile after launching to follow a given flight path, the mechanisms measuring inertial forces during periods of acceleration, integrating the data obtained with already-known position and velocity, then signaling the controls to effect the desired direction, altitude, etc.

inertial space. Any segment of space considered to have fixed coordinates in respect to a particular object moving within it.

inferior planet. A planet that orbits nearer the sun than does the earth, i.e., either Mercury or Venus.

inflight start. An ignition sequence of a rocket, jet or other engine after takeoff during flight. Cf. **air start**, **ground start**.

This term includes starts both within and above the sensible atmosphere.

infrahuman, *n.* A live animal other than a man used instead of a man in life science experiments.

infrared detector. A device that is sensitive to infrared radiation.

This detector in a guided missile locks on the source of radiation and guides the missile to target. Cf. **Falcon II**, **Sidewinder, *n.***

infrared light. Light in which the rays lie just below the red end of the visible spectrum. Often shortened to 'infrared,' and sometimes called 'black light.'

Infrared light is emitted by a hot nonincandescent source, such as a running aircraft engine. The wave lengths of infrared light range between those of visible light at 7,800 angstroms (.000078 centimeters) to those of radio at 4×10^6 angstroms (less than 1 centimeter).

infrared surveillance. Surveillance by means of instruments sensitive to infrared light. See **surveillance, *n.***

inhibitor, *n.* Anything that inhibits; *specif.*, a substance bonded, taped, or dip-dried onto a solid propellant to restrict the burning surface and to give direction to the burning process. Cf. **restricted propellant**.

in-house, *a.* *Specif.* Of research, development, or other activity: Done within the Air Force, not by contract.

initial mass. *Specif.* The takeoff mass of a rocket.

initial operational capability. (IOC) The

capability achieved by a weapon system or installation undergoing development when it meets the requirements of operational employment and is assigned to an operational unit.

The Thor has an IOC, for example, likewise Vandenberg Air Force Base has an IOC.

initial orbital period. The orbital period of an earth satellite or other orbiting body during its first time around, or during its first few times around.

An earth satellite that dips into the atmosphere at perigee slows down, leading to a longer orbital period.

inspection and repair as necessary. (IRAN)

A phrase that identifies depot-level inspection and repair as necessary, distinguished from complete disassembly and overhaul.

instantaneous readout. Readout by a radio transmitter instantaneous with the computation of data to be transmitted. Cf. *readout station*, *real time*.

Institute for Air Weapons Research.

(IAWR) An institute at the University of Chicago concerned with air weapons research.

IAWR works under contract with ARDC. It is housed in the Chicago Museum of Science and Industries.

instrument, *v. tr.* To provide a *vehicle* or *component* with instrumentation.

instrumentation, *n.* 1. The installation and use of electronic, gyroscopic, and other instruments for the purpose of detecting, measuring, recording, telemetering, processing, or analyzing different values or quantities as encountered in the flight of a missile or spacecraft. 2. The assemblage of such instruments in a rocket missile, spacecraft, or the like, each instrument designed and located so as to occupy minimum space, achieve minimum weight, yet function effectively. 3. A special field of engineering concerned with the design, composition, and arrangement of such instruments.

In sense 1, instrumentation applies to both flight-borne and ground-based equipment.

instrumentation site. A site, either on the earth or theoretically on the moon or other space platform, used as a place to install instruments for observing, guiding, or controlling missiles, aircraft, space-air vehicles, or spacecraft.

instrumented range. A range for missiles, rocket vehicles, artillery projectiles, or bombs with designated targets or objectives, and with optical, electronic, and sonic instruments

for programmed guidance, control, observation, and recording of data.

instrumented vehicle. A test sphere, earth satellite, or other packaged vehicle that carries instruments to detect and report on conditions encountered as the vehicle moves along its course. Cf. *Lyman-alpha radiation*.

integral tank. A fuel or oxidizer tank built within the normal contours of an aircraft or rocket vehicle and using the skin of the vehicle as a wall of the tank, as in the case of Thor or Atlas.

integrating contractor. An AF contractor, usually an associate contractor, to whom the AF has assigned the additional responsibility of resolving interface problems as they occur in the development of a complete weapon system, space probe, or the like, so as to ensure proper operation and timely phasing.

See *concurrency, n.*

interceptor missile. (IM) A missile designed to intercept and destroy another missile or an aircraft during flight; *specif.*, a surface-to-air guided missile. See *antimissile missile*. Cf. *Bomarc, n.*, *Talos, n.*

intercontinental ballistic missile. (ICBM). A ballistic missile with sufficient range to strike at strategic targets from one continent to another.

The ICBM minimum range is 5,000 or 5,500 miles. The Atlas and Titan are designed as ICBM's.

By memorandum of 28 Feb 1958, the Department of Defense made the USAF responsible for future research and development of land-based IRBM's and ICBM's; by memorandum of 26 Nov 1956, operational control of the ICBM was made an AF responsibility.

interface, *n.* 1. In a rocket vehicle or other system, a common boundary between one component and another. Used esp. when parts require mating. 2. Also applied to a juncture of nonmaterial things, as between two or more signal levels, power levels, impedance, or the like, where matching is required.

interferometer, *n.* *Physics.* An instrument for the analysis of a narrow band of radiant energy.

intergalactic space. That part of space conceived as having its lower limit at the upper limit of interstellar space, and extending to the limits of space. See *galaxy, n.*, *space, n.*

Like the term *interstellar space*, this term is defined from an earthbound standpoint. From the standpoint of a detached observer, it is that space between the galaxies, or the space in which the galaxies move.

interior ballistics. That branch of ballistics

concerned with the behavior, motion, appearance, or modification of a missile when acted upon by the ignition and burning of a propellant. Sometimes called 'internal ballistics.'

In rocketry, interior ballistics deals with the missile's behavior in reaction to gas pressures inside the rocket, escapements, shift in the center of gravity as propellants are consumed, etc.

intermediate range ballistic missile. (IRBM)

A ballistic missile with the range of an intermediate range missile, used in performing the strategic bombing mission. See next.

By DOD memorandum of 26 Nov 1956, operational control of land-based IRBM's is an AF responsibility.

intermediate range missile. A ballistic missile or a missile guided all the way to target, each with a range considered to be between short range and long; *specif.*, such a missile with a range between 200 and 1,500 miles.

The limitations of range on either end may change with new concepts of weapons employment, but a range of 200 miles (as in a battle area) is considered within the limits of short range. See **intermediate range ballistic missile**.

internal ballistics. Interior ballistics.

International Astronautical Congress. An international congress made up of members or delegates of various rocket societies in various nations, organized to promote the interests of interplanetary navigation.

The first Congress met in Paris from 30 Sep to 2 Oct 1950. The Congress has been variously described as a union or federation.

International Geophysical Year. (IGY) See note.

The IGY, beginning 1 Jul 1957 and ending 31 Dec 1958, was a period scheduled by the world's scientists for a concerted and cooperative effort to advance scientific knowledge of the world, esp. in respect to cosmic rays, meteorology, latitude and longitude determinations, solar activity, geomagnetism, glaciology, oceanography, seismology, ionospheric physics, aurora, and gravity measurements. Some 55 nations supported the program, the US Congress appropriating \$39 million, and the National Academy of Sciences undertaking to plan, direct, and execute the US program. Prior to the IGY, preliminary work had been done by different scientific groups to provide facilities and bases from which to carry out the program. After the IGY, organized work was carried on for analyzing and publication of data obtained.

interplanetary space. That part of space conceived, from the standpoint of the earth, to have its lower limit at the upper limit of trans-lunar space, and extending to beyond the limits of the solar system, some several billion miles.

This term is one of distance from the earth, not one of planetary influence. In this space the sun is the dominant attraction except in the proximity of a planet body or of a planet's satellite.

interplanetary travel. Travel in a spacecraft from the earth to one or other of the planets in the solar system, esp. to Venus or to Mars.

Travel to Venus is considered to be feasible by spacecraft following the general rotation of the solar system, by escaping from terrestrial influence, then killing velocity by retrorocket expenditure of fuel, and falling toward the sun to reach the orbit of Venus. Travel to Mars would be achieved by escape velocity and the expenditure of fuel to achieve the orbit of Mars. The timing of the arrival at either orbit would have to be exact so as to coincide with the arrival of the planet at a given point. In each case, fuel would be expended initially to escape the gravitational pull of the earth, some 500,000 miles out. The return trips from the planets would be scheduled in the same way, except that in case of a return from Venus, fuel would be expended to reach the earth's orbit (once the gravity of Venus had been overcome); in the case of Mars, the spacecraft would expend fuel to kill velocity so as to fall toward the sun until it reached the earth's orbit. Cf. *fall, v.*

Because takeoff from the earth of a spacecraft destined for Venus or Mars must be pinpointed in terms of the flight path to be followed and the achievement of a rendezvous, the duration of travel may be calculated for different routes. A one-way trip to Venus considered feasible would take 146 days. A waiting period of 470 days would be required either on Venus or in orbit about Venus, with a return trip of 146 days. A round trip to Mars would take 258 outgoing days plus 455 waiting days plus 258 return days.

interstage section. A section of a missile that lies between stages. see *section, n.*

interstellar space. That part of space conceived as having its lower limit at the upper limit of interplanetary space, and extending to the lower limits of intergalactic space.

This term, as defined, is from the standpoint of an observer on the earth. From the standpoint of a detached observer, it is that part of space within the Galaxy (which see).

inverted silo. A silo (which see). So named from its being underground.

invulnerability, n. Specif. That aspect of a device or system that indicates its probability of surviving as it moves toward target.

A nuclear airplane, for example, has a high degree of invulnerability because of its comparative freedom from a fix. The same is so of ALBM's launched by a nuclear airplane. See **nuclear airplane**.

IOC (abbr). 'Initial operational capability.'

ion engine. A projected species of reaction engine in which thrust is to be obtained from a stream of ionized atomic particles supplied by atomic fission, atomic fusion, or solar energy. Cf. *aeroduct, n., photon engine*.

This engine, designed for interplanetary travel in space where air particles offer no resistance to motion, is projected to have relatively low thrust but sufficient to build up to speeds of 100,000 mph.

ionic propulsion. Propulsion of a spacecraft

in reaction to a stream of ionized atomic particles.

ionize, v. tr. To make an *atom* or *molecule* lose an electron, as by X-ray bombardment, and thus be converted into a positive ion, the freed electron then attaching itself to another molecule to form a negative ion; to convert *air* into ions as by X-ray bombardment.

ionized fluid. A fluid of ionized particles.

ionosphere, n. An outer stratum of the atmosphere consisting of layers or zones of ionized air particles.

As conceived by some meteorologists, the ionosphere begins at approximately 25 miles above the earth, by others at approximately 50 miles. It varies in height with the season of the year and the time of day. By some, it is considered to extend to the outermost fringe of the atmosphere beyond 1,000 miles; by others, it is considered to be bounded at its upper limits by the exosphere, or by a sphere called the mesosphere. It reflects certain radio waves and reaches temperatures of several thousand degrees. It is divided into the *D layer*, *E layer*, *F layer*.

IOT (abbr). 'Initial orbit time.'

IPEE (abbr). 'Inclination of a plane to the plane of the earth's equator.'

IR (abbr). 'Infrared.' Hence, **IR detector.**

IRAN (abbr). 'Inspection and repair as necessary.'

IRBM (abbr). 'Intermediate range ballistic missile.'

isothermal region. The stratosphere considered as a region of uniform temperature. See **atmosphere, n.**, note.

ITM (abbr). 'Interceptor tactical missile,' i.e., a tactical missile modified to an interceptor configuration.

ivory tower. A vertical test stand. *Slang.*

IWST (abbr). 'Integrated weapon system training.'

J

J (abbr). 'Jet' or 'turbojet' in the designations of aircraft or missile engines, as in *J33-A-41*, *J44*, *J57*, etc.

See USAF Dictionary for other senses.

J-2. A Soviet target-drone pilotless aircraft, subsonic with a range of about 500 miles.

The J-2 is boosted by solid rockets, sustained by an axial-flow turbojet. It is radio-guided.

J-3. A Russian aerodynamic ramjet missile.

This missile is reported as having a speed of 800 mph, a range of 500 miles, a ceiling of 45,000 feet, a length of 35 feet, a wing span of 22 feet. Guided by radio and radar, it is rocket-boosted to cruise altitude.

J33-A-37. A turbojet engine by Allison, with some 4,600 pounds of thrust.

J33-A-41. A turbojet engine by Allison, with some 5,200 pounds of thrust.

J52. A turbojet engine by Pratt & Whitney, with some 7,500 pounds of thrust.

J57. A turbojet engine by Pratt & Whitney, with some 11,000 pounds of thrust.

J85. A turbojet by General Electric, with some 2,000 pounds of thrust.

J93. A turbojet engine designed by General Electric for use in the F-108 and B-70.

The J93-3 burns hydrocarbon fuel, the J93-5 boron-based fuel in the afterburner. See **B-70**.

Jaktrobot, n. The Swedish BO4.

JATO (abbr). 'Jet-assisted takeoff.'

jato, n. 1. A takeoff assist by use of a jet, esp. with the jet of a *rato* unit. 2. The power unit that gives this assist, usually a solid rocket motor.

JB (abbr). 'Jet bomb.'

JB-2. An American version of the German V-1, improved somewhat in speed, range, and guidance. Cf. **Hermes, n.**

The JB-2 went into production in 1945 but was not used operationally. The Navy called it the 'Loon.'

jet, n. 1. Any stream of gas or liquid squirting or flowing rapidly out of a nozzle; *specif.*, the stream expelled by a reaction device, as by a jet engine, a rocket engine, or ion engine. 2. A jet engine. Used attrib., as in 'a jet fighter,' or 'a four-jet bomber.' 3. A jet airplane, as in 'four jets took off without delay.'

jetavator, n. A control surface that may be moved into or against a rocket's jet stream, used to change the direction of the jet flow for thrust vector control. Cf. **exhaust deflecting ring**, **jet vane**.

jet bomb. (JB) A WW II missile, like the V-1 or the JB-2, provided with jet propulsion.

Use of the word 'bomb' in this term is similar to its use in *buzz bomb* and *flying bomb*, all terms of WW II.

jet engine. Specif. A type of reaction engine that takes in air as a fuel oxidizer. Differentiated from a rocket engine.

JetP (abbr). 'Jet-propelled.'

jet propulsion. The propulsion of a missile or vehicle by means of a reaction engine; *specif.*, the propulsion of a jet engine. Cf. **rocket propulsion**.

Jet Propulsion Laboratory. (JPL) A laboratory under the direction of the California Institute of Technology but provided with facilities and equipment by the government, concerned with research on the fundamental

problems of jet propulsion and guided missiles, with emphasis on fuels, high-temperature materials, and electronic instrumentation for telemetering and missile guidance.

JPL, first organized under Dr. Theodor von Kármán in the mid-1930's as a part of the Guggenheim Aeronautical Laboratory (GALCIT), is physically located some 3 miles north of the Pasadena Rose Bowl. Its professional staff of scientists and engineers numbered some 500 in 1958, many of whom are faculty members at the California Institute of Technology. JPL has worked for the military services under contract; its space program is directed by NASA.

jet stream. Exhaust stream.

jet vane. A fixed, adjustable, or movable vane placed directly in a jet stream to improve stability or give guidance. Cf. *jetavator*, *n*.

Jindivik, *n*. A British aerodynamic target drone.

This drone is reported in public sources as having a ceiling of 50,000 feet, a length of 22 feet, a wing span of 19 feet. Its powerplant is a Viper jet turbine.

Jodrell Bank. The site of a large radio telescope, located near Manchester, England.

The radio telescope has a paraboloidal receiver 250 feet in diameter, 60 feet deep. Cf. *Goldstone Tracking Facility*.

Joint Long Range Proving Ground. The earliest predecessor organization and facility of the Atlantic Missile Range, activated at Cape Canaveral 1 October 1949 as a joint undertaking of the Air Force, Army, and Navy under the executive control of the Chief of Staff, USAF. Now *hist*.

This facility became the sole responsibility of the AF on 16 May 1950, and became known as the Florida Missile Test Range. As early as Oct 1947, the need for the long-range facility had been recognized. Negotiations with the United Kingdom for station sites began in 1947, and 1 Sep 1948 the Banana River Naval Air Station was transferred to the AF. See *Atlantic Missile Range*, *Cape Canaveral*, *Florida Missile Test Range*, *Patrick Air Force Base*. Cf. *White Sands Missile Proving Ground*.

Jovian, *a*. [Latin *Jovis*, genitive of *Jupiter*.] Of or pertaining to the planet Jupiter; associated with Jupiter.

Jovian planet. Any one of the giant planets, i.e., Jupiter, Saturn, Uranus, or Neptune. Usually in plural 'Jovian planets.'

Jovian probe. An instrumented vehicle, unmanned or manned, conceived or designed to approach close enough to the planet Jupiter so as to discover and report back to the earth new data upon the planet.

JP (abbr). 'Jet propellant.' Cf. *RP (abbr)*.

JP-4. A liquid fuel for jet and rocket engines, the chief ingredient of which is kerosene.

JPL (abbr). 'Jet Propulsion Laboratory.'

Juno I. The Jupiter C.

'Juno' as the designation of Jupiter C was in use as early as 1956, but gave way for a time to the designation 'Jupiter C.' 'Juno I' is now preferred in some quarters to avoid the suggestion that the Jupiter C is a modification of the Jupiter.

Juno II. An Army four-stage rocket vehicle adapted as the carrier of a lunar probe or space probe. See *Pioneer III*, *Pioneer IV*.

The Juno II consists of the liquid rocket carrier of the IRBM Jupiter used as a first stage, with solid Sergeant rockets in clusters as upper stages. It is 76.5 feet long, 8.8 feet in diameter. Its launching weight is 121,000 pounds. Its Jupiter rocket engine is by Rocketdyne with a rated thrust of 150,000 pounds; its 15 solid rocket engines by JPL are rated at 1,000 pounds each.

Juno II was developed by the Army Ballistic Missile Agency and the JPL in coordination with NASA.

Juno V. The booster vehicle otherwise called Saturn.

Jupiter, *n*. 1. An Army-developed surface-to-surface intermediate range, single-stage, liquid rocket strategic bombing missile. Also called the SM-78. 2. The sun's fifth planet, the largest in the solar system.

The Jupiter (sense 1), an IRBM 60 feet long and almost 9 feet in diameter, with a gross takeoff weight of 52½ tons, a range of 1,500 or more nautical miles, and a speed of 10,000 mph, was designed by the Army Ballistic Missile Agency. Its engineering and production was done by Chrysler, its inertial guidance by Ford Instrument, its powerplant by Rocketdyne. The Jupiter reentry nose cone (capable of carrying a nuclear warhead) was flight-tested by the Jupiter C test vehicle (Juno I) and successfully recovered over a distance of 3,000 miles in 1957. The powerplant, essentially the same as that of Thor, burns liquid oxygen and kerosene.

Operational employment of the Jupiter missile is assigned to the USAF, but use of the missile as an experimental vehicle remains with the Army. On 13 Dec 1958, a small monkey weighing less than 1 pound was placed in the Jupiter's nose cone and sent 1,700 miles off Cape Canaveral. The monkey was not recovered. On 28 May 1959, however, the Jupiter nose cone carried two other monkeys—as well as a selection of yeast, corn and mustard seed, fruit-fly larvae, and human blood—into space to an altitude of 300 miles, and the entire cargo was recovered. The Jupiter nose cone parachuted into the ocean on the Atlantic Missile Range, some 15 minutes and 1,500 miles from the time and point of launch takeoff.

Jupiter is not to be confused with Jupiter-C (which see). See *Juno I*.

The mean distance of Jupiter (sense 2) from the sun is 5.20 astronomical units (about 483,300,000 miles). Its orbital velocity is 8.12 mi/sec. Its eccentricity is .048. Its sidereal period is 11.86 years, its synodic 399 days. Its mean diameter is 87,000 miles, its mass 318 times that of the earth, and its volume greater than the earth's by 1,300 times. Its mean rotation period is rapid, 9 hours and 55 minutes.

Jupiter has a cold atmosphere of methane gas with clouds of ammonia. Its surface temperature has been measured at -130° C.

Jupiter C. An Army-developed four-stage rocket research vehicle, developed to test

Jupiter components, but also used as the carrier rocket of the Explorer satellites. Also called 'Juno I.'

Jupiter C is essentially a modified Redstone with three solid rocket stages added. Its first stage is a liquid rocket that uses a hydrazine-based fuel for satellite launchings; its second and third stages use solid clusters arranged in a single container (see *tub, n.*); its fourth stage is a single rocket that projects from within the container of the second and third stages surmounted by the instrumented satellite. Its overall length is 69 feet.

Assembled by the Army Ballistic Missile Agency, its first stage propulsion is provided by Rocketdyne, its solid stages by the Jet Propulsion Laboratory.

jurisdictional space. That limited space above the sensible atmosphere that may become subject to use in accordance with international agreements or conventions. Cf. *space law*.

K

K (*abbr.*). 1. 'Kilo,' i.e., one thousand. 2. 'Kelvin scale.'

In sense 1, a thrust of 300 K means a thrust of 300,000 pounds.

Kappa III. A Japanese two-stage solid sound- ing rocket.

This rocket is reported as having a speed of 2,880 mph, a range of 16 miles, a ceiling of 80,000 feet. It is 17 feet long, 5.1 inches in diameter, and can carry a payload of 18 pounds.

Kapustin Yar. A town some 60 miles east southeast of Stalingrad on the Akhtuba River, near which the Russians developed launch sites for short-range missiles and later for their *sputniks*.

'Yar,' as used in this place name, is a Turkish word for cliff or crag, or a steep bank of a river.

KC-135. The tanker version of the Boeing 707, built to service the B-58.

KD (*code*). A Navy designation for a pilotless aerial target.

Kellogg, n. Short for 'M. W. Kellogg Co.,' missile contractor, as for the powerplant of Terrier I.

Kelvin scale. ($^{\circ}\text{K}$) [After the first Baron *Kelvin* (1824–1907), English mathematical physicist and inventor.] A temperature scale that uses centigrade degrees, but makes the zero degree signify absolute zero.

Water freezes at 273.16°K , boils at 373.16°K . Cf. *Rankine scale*.

Kepler's laws. The three laws of planetary motion discovered by Johannes Kepler (1571–1630) that explain the movements of planets in terms of the Copernican Concept, and also explain the movements of earth satellites placed in orbit by man. Cf. *laws of motion*.

These laws are: 1. The orbit of every planet about the sun is an ellipse, the sun occupying one focus. 2. A line from each planet to the sun sweeps over equal areas in equal times. 3. The squares of the times required for the different planets to complete their orbits are proportional to the cubes of their mean distance from the sun.

kerosene, n. A liquid fuel used in certain rocket engines.

Kerosene is a mixture of hydrocarbons produced by distillation from petroleum or oil shale. Its specific impulse when oxidized by liquid oxygen is 248 seconds.

Kettering aerial torpedo. One of the small, low-cost pilotless biplanes designed as guided missiles, developed by C. F. Kettering in WW I and immediately after; *specif.*, the Liberty Eagle.

C. F. Kettering (1876–1958), electrical engineer and manufacturer, used his Delco Company in WW I to develop early pilotless aircraft designed as guided missiles; in WW II, as head of General Motors Research Corporation, he contributed much to the development of weapons.

kick rocket. A small rocket engine attached to the base of a satellite or other object, capable of giving additional speed of 50 to 100 mph if desired.

The kick rocket in Explorer VI, to be fired by ground signal, may be used if the perigee comes to within 100 miles of the earth's surface.

kill, n. 1. An act or instance of destroying an enemy aircraft or missile in midair. 2. The thing destroyed.

kill, v. tr. 1. To destroy an enemy *missile* or other vehicle. 2. To cut back the *velocity* of a lunar probe for a soft landing; to cut the *velocity* of any moving object.

kill switch. A control switch used to shut down a missile experiment if something goes wrong. *Slang*.

Kingfisher, n. An Army research target missile of supersonic speed, developed by Lockheed. Also called Q-5.

The Kingfisher is 38 feet long, 10 feet in span, 2 feet in diameter. Its ramjet engine is by Marquardt. Its guidance is by radio command.

Kiwi, n. An experimental, earthbound atomic rocket engine. See *Rover, n.*

Named for a flightless New Zealand bird.

knot, n. (kt) A nautical mile per hour, i.e., 1.1516 statute miles per hour.

This measure of speed is normally used for ships and for subsonic military aircraft. The measure of miles per hour or of miles per second, however, is usually used for the speed of spacecraft; the speed of missiles and of supersonic aircraft is often given in mach numbers.

Kodiak Island. An island in the Gulf of Alaska, the site of a tracking station of the Pacific Missile Range.

L

laboratory test. In special reference to a rocket vehicle: A quantitative test of a subsystem or of checkout equipment carried out in a laboratory to evaluate or confirm functional and operational design.

Lacrosse, n. An Army four-finned artillery rocket missile developed by Army Ordnance, Cornell, and Martin. Also called the SSM-A-12 or the XM-4E2.

About 20 feet long, 1.7 feet in diameter, and 9 feet in span, Lacrosse has a range of 20 miles and a mach 2 speed. Its solid rocket powerplant is by Thiokol, its radio-command guidance by Federal. The missile is guided to target by a forward observer or by an airborne aircraft. It is capable of carrying a nuclear warhead.

Laika, n. The name of the female dog carried as a passenger in Sputnik II.

Laika, of the Husky breed, approximately 45 pounds in weight, about 20 inches high, survived alive in the satellite from the 3rd to the 10th or 11th of November 1957. The Russians announced her alive on the 10th, dead on the 11th.

LAL (abbr). 'Langley Aeronautical Laboratory.'

laminar flow. A nonturbulent airflow over and about a nose cone or other surface, made up of thin parallel layers.

land-based, a. 1. Of a missile: Designed to be, or intended to be, launched from a land or land-supported surface. Distinguished from 'ship-based' (which see). 2. Of an aircraft: Based on, and operating from, a land area. Distinguished from 'carrier-based' or 'water-based.'

Langley Aeronautical Laboratory. (LAL) A NASA laboratory at Langley Air Force Base, Virginia.

latch, n. A device that fastens one thing to another, as a rocket to a launcher, but is subject to ready release so that the things may be separated.

launch, n. 1. The action taken in launching a rocket missile or vehicle from the surface. 2. The resultant of this action, i.e., the transition from static repose to dynamic flight by the missile or vehicle. 3. The time at which this takes place. 4. The action of sending forth a missile, probe, or other object from a moving vehicle, such as an aircraft or rocket spacecraft.

A launch (sense 1) begins, in the case of a ballistic missile, with the beginning of the countdown, and normally ends when the missile begins to move upward or achieve a velocity at which it responds to normal con-

trol through the guidance system. A launch of a less complicated missile may involve very little preliminary action. See **firing time**.

See **liftoff, n.**, note, **vertical launch**.

launch, v. tr. 1. To send off a *rocket missile* or *rocket vehicle* under its own rocket power, as in the case of guided aircraft rockets, artillery rockets, and ballistic missiles. 2. To send off a *missile* or *aircraft* by means of a catapult, as in the case of the V-1, or by means of inertial force, as in the release of a bomb from a flying aircraft. 3. To give a *space probe* an added boost for flight into space just before separation from its booster vehicle.

This term has different connotations than those of *fire* and *shoot*. See **liftoff, n.**, note.

launch complex. The complex of site, facilities, and equipment used to launch a rocket vehicle or missile. See **launch site**, note.

The complex differs according to the type rocket or particular rocket, or according to whether land-launched or ship-launched. The term is sometimes considered to include the missile crew.

launch crew. A crew that prepares a missile for launch and then launches it; *specif.*, a crew of a stipulated number organized according to function and position requirements to prepare and launch missiles authorized a military unit for direct accomplishment of its primary mission.

launch emplacement. A facility built into or on the earth that consists of a launch pad with associated equipment.

The launch emplacement for a missile often incorporates a missile shelter.

launcher, n. Any of several devices used to hold, support, and sometimes to direct, a rocket missile, carrier rocket, or aircraft as it is being launched.

The launcher may incorporate a rail, tube, or the like for giving initial guidance. In the case of a ballistic missile, however, the launcher is usually a supporting and balancing device that rests directly upon, and is secured to, the pad. The launcher may sometimes incorporate a weighing device to measure fuel injected into the tanks.

launching base. A base, such as Cape Canaveral Auxiliary Air Force Base or Vandenberg Air Force Base, that has several launch sites.

launching pad. A launch pad.

launching rail. A rail that gives initial support and guidance to a missile launched in a non-vertical position, as with Little John.

launching site. A launch site.

launch monitor console. A console for monitoring a missile during the period of its launch.

launch pad. The load-bearing base or platform from which a rocket missile or vehicle positioned on its launcher is launched. Usually called 'the pad.' Cf. *flat pad*, *launch stand*.

The launch pad for an uprighted missile or vehicle is normally a permanent structure usually of steel and concrete, and may stand several feet high or be flush with the surrounding area. It provides room on its surface for the missile itself, for attendant workmen, and for mechanisms used to put the missile in balance and ready for firing. The missile balanced on its launcher, normally rests on one edge of the pad. In some cases the pad has a large hole in it, the flame bucket, over which the missile is placed. Under the top of the pad may be a complex of pressurized tanks, pipes, gauges, and other mechanisms that function in various ways during the launch. For test vehicles, the whole pad is normally hardened to withstand blast or explosion, either normal to a launch or accidental.

launch point. The point from which a ballistic missile or other rocket vehicle is launched.

The launch shelter (if used) and the launch pad, together with lox and fuel storage, are considered to be at the launch point.

launch shelter. A shelter at a launch point for a rocket missile or vehicle. See *missile shelter*.

launch site. 1. A defined area from which a rocket missile or vehicle is launched, either operationally or for missile test purposes; *specif.*, at Cape Canaveral or Vandenberg, any of the several areas equipped to launch a rocket. 2. More broadly, a launching base.

In the specific part of sense 1, the launch site is provided with such equipment as a launch pad, a flame deflector, a gantry, a lox transfer and storage unit, mobile support equipment, a block house, a parking area, a guard house, a deluge collection pond, etc. Launch sites differently constructed are used for different missiles. See *Cape Canaveral*, *Vandenberg Air Force Base*, *Kapustin Yar*.

launch stand. A facility or station at which a rocket missile or vehicle is launched, normally incorporating a launch pad with launcher. Cf. *test stand*.

launch vehicle. A rocket or other vehicle used to launch a probe, satellite, nose cone, or the like.

Lawrence Radiation Laboratory. A University of California laboratory at Livermore, California, concerned with basic and applied research in nuclear physics.

This laboratory, founded in 1936, was known until Dec 1958 as the Radiation Laboratory ('Radlab') or the Berkeley Radiation Laboratory. It was renamed for its first director, Ernest O. Lawrence (1901–1958), Professor of Physics.

laws of motion. The three laws of Galileo (1564–1642) and of Sir Isaac Newton (1642–1727) found to be basic to the development of aeronautical or astronautical engineering.

These are: (1) A material body, if left to itself, will maintain its condition of rest or motion unchanged. (2) A change in the motion indicates the presence of a force, and is proportional to the force. (3) Action and reaction are equal, and in opposite directions. Cf. *Kepler's laws*.

L/D ratio. Lift-drag ratio.

Lewis Flight Propulsion Laboratory. (LFPC)

A NASA laboratory at Cleveland, Ohio.

LFPC (*abbr.*). 'Lewis Flight Propulsion Laboratory.'

Liberty Eagle. A small, low-cost, pilotless biplane of WW I designed and developed as a guided missile by C. F. Kettering (1876–1958), Bion J. Arnold 1861–1942), Orville Wright (1871–1948), and others.

Flight-tested in October 1918 and referred to in the tests as 'the bird' (to distinguish it from manned airplanes used to test control devices), the Liberty Eagle was powered by a 2-cycle 40-hp engine equipped with a guidance system that used a gyro and a highly sensitive aneroid barometer. Made of papier-mâché with wood braces, it weighed 300 pounds without payload, and carried 300 pounds of TNT. It was not used operationally, but was in production for the A.E.F. Air Service when the Armistice was signed.

This machine was also called 'the Bug' and 'the Kettering aerial torpedo.' Cf. *Weary Willie*.

lifespan, n. *Specif.* The time duration between a satellite's achieving an orbit and its falling back to the earth or disintegrating.

lift, v. *To lift off*, to take off in a vertical ascent. Said of a rocket missile or vehicle. See *liftoff, n.*, note.

liftoff, n. The action of a rocket vehicle lifting off vertically from its launch pad. Cf. *take-off, n.*

A *liftoff* is applicable only to vertical ascent; a *take-off* is applicable to ascent in any direction. A *liftoff* is action performed by the rocket; a *launch* is action performed upon the rocket.

light, n. A radiant energy that stimulates the organs of sight to perform their function, consisting, according to modern theory, of quanta transmitted at about 186,000 miles a second; by extension, a related radiant energy, such as infrared, that does not affect the retina, but otherwise acts like the same energy.

The λ (lambda) denotes the wave length of light in angstroms. Visible light ranges from 7,800 angstroms (0.000078 centimeters) on the red side to about 3,900 angstroms on the violet side.

light year. The distance over which light can travel in the period of one year's time—some 6,000,000,000,000 miles, i.e., 6,000 billion miles. See *Alpha Centauri*.

limb, n. The outer edge of a celestial body, as of the sun.

limitation, n. An incapacity in a person or

organization, or in an aircraft, missile, or other piece of equipment; a borderline beyond which a person or thing cannot perform effectively.

limited war. 1. A war looked upon by major powers directly or indirectly concerned as not involving their own sovereignty, and as being limited in one respect or another, as, for example, to a particular geographical area, to the employment of only certain resources, or to the number of contestants. 2. A war considered by a detached observer as relatively limited in some respect, esp. with regard to political objectives.

In sense 1, a given war may be limited from one standpoint, yet be a total war from another. For example, in the Korean War, the war was limited from the point of view of the US, but total from that of the Republic of Korea. A limited war may, or may not, be waged with nuclear weapons.

In sense 2, the limitations imposed by political considerations are always relative, because political objectives by their nature are limited.

The term 'small war' is sometimes preferred to limited war.' See war in the USAF Dictionary.

Lincoln Laboratory. Short for 'Lincoln Laboratory of the Massachusetts Institute of Technology,' located at Millstone Hill near Lexington, Massachusetts. Cf. Millstone Hill.

liquid hydrogen. A liquid rocket fuel that develops a specific impulse, when oxidized by liquid oxygen, ranging between 317 and 364 seconds depending upon the mixture ratio.

liquid oxygen. Oxygen supercooled and kept under pressure so that its physical state is liquid. Used as an oxidizer in a liquid-fuel rocket.

Liquid oxygen, supercooled to as low as -297° F and kept under a constant pressure for use in a rocket, is highly explosive and requires special handling. It boils at -297° F at sea-level pressure, has a specific gravity of 1.14, and a heat of vaporization of 91.6 BTU per pound. It is noncorrosive and nontoxic, but cannot be stored for any great length of time because of rapid evaporation. It is usually produced close to the place where used. Cf. alcohol, *n.*, specific impulse.

liquid oxygen transfer system. A system of tanks, pipes, gauges and valves for the transfer of liquid oxygen from a storage tank to a rocket vehicle, or from a rocket vehicle to a storage tank.

liquid propellant. 1. A rocket propellant that consists either of a mixture of two or more liquids (a fuel, oxidizer, and sometimes an additive), or of a liquid chemical compound that provides its own fuel and oxidizer. 2. Also any one of the liquid ingredients that are to go into the mixture, i.e., the fuel, the oxidizer, or the additive, separately.

liquid rocket. 1. A rocket that uses liquid fuel. 2. Short for 'liquid rocket propellant.'

lithosphere, *n.* The solid part of the earth or other spatial body. Distinguished from the atmosphere and the hydrosphere.

Little Joe. 1. A short solid-rocket test vehicle developed by NASA, used esp. to test the Mercury capsule. 2. A WW II ship-to-air solid rocket missile developed by McDonnell for the Navy, with a ceiling of about two miles.

Little Joe (sense 1), supplied by North American, is 44.5 feet long, 6.5 feet in diameter. With eight solid rockets clustered in a cylindrical section, it can boost a full-scale capsule to about 4,000 mph. Cf. Big Joe.

Little John. An Army solid rocket artillery projectile developed by Redstone Arsenal, Emerson, and Allegany. Also called the XM-47.

About 14.5 feet long, 1 foot in diameter, Little John has a range of about 10 miles and a supersonic speed, but is unguided after it leaves the launcher. It is designed for use in pentomic organizations.

live testing. The testing of a rocket engine, vehicle, or missile, by actually launching it. Cf. static testing.

LMSD (*abbr.*). 'Lockheed Missile Systems Division.'

LN₂ (*abbr.*). 'Liquid nitrogen.'

Lobber, *n.* An Army ballistic cargo vehicle under development by Convair, designed to be fired as a rocket from a portable launcher, with a 50-pound payload and a range of 50 miles.

Lobber, a 9-foot vehicle, is to be powered by a solid propellant. Initially, it is expected to carry medical supplies in a battle area.

local velocity. The velocity of a local point on an object relative to its surrounding fluid. See remote velocity.

lock, *n.* 1. The means by which a tracking device fastens onto an object of interest. 2. The condition existent when a tracking device has locked onto an object of interest. Cf. microlock, *n.*

lock, *v.* To lock on. a. Of a radar beam: To pick up a particular object of interest and keep tracking it. b. Of a radar set or antenna: To fasten onto a given object of interest. c. Of a heat-seeking or infrared detector: To react to a particular source of radiation for a continuing time.

Lockheed, *n.* Short for 'Lockheed Aircraft Corporation,' missile contractor, as for Polaris, Sentry, and X-17.

logbalnet, *n.* An AMC electrical network for

transmitting logistical data on ballistic missiles. **long range.** A range considered long for a given type missile, e. g., 5,000 miles for ballistic missiles, 100 for air-to-air guided missiles.

This term is subject to redefinition as new capabilities are developed. The trend is to consider long range as a particular capability of the ICBM and the TCBM.

Longsight, n. A code word for ARPA activities in forwarding advanced innovations and ideas.

long-term value. The value of something as measured in terms of its expected utility or effectiveness in the distant future.

This term is used in reference to assessments made of evolving equipment—missiles, defense systems, etc.

Loon, n. The WW II JB-2. *Navy.*

Los Alamos Scientific Laboratory. A laboratory concerned chiefly with nuclear physics, located at Los Alamos, New Mexico, but under the administration of the University of California.

Lowry Range. A bombing range southeast of Denver, Colorado, scheduled as a launching site for the Titan.

LOX (abbr). Also written L.O.X. 1. 'Liquid oxygen explosive.' 2. 'Liquid Oxygen.' See next.

Those who would restrict the use of this abbreviation to sense 1 (essentially a commercial sense) wage a losing battle. Sense 2 is entirely naturalized among those who handle liquid oxygen for rocket engines.

lox, n. [See prec.] Liquid oxygen. Used attrib., as in *lox plant*, *lox tank*, *lox unit*.

lox, v. tr. To load the fuel *tanks* of a rocket vehicle with liquid oxygen. Hence, **loxing, n.**

lox-hydrogen engine. An engine that burns liquid hydrogen in liquid oxygen.

lox plant. A plant at which liquid oxygen is manufactured.

lox storage. A storage facility at a launch point for storing liquid oxygen until transfer to the rocket vehicle.

lox transfer. Specif. The transfer of liquid oxygen at a launch point from a storage tank to the tank of a rocket vehicle, or from a vehicle's tank to a storage tank.

lox transfer and storage unit. A facility for storage of liquid oxygen and for the transfer of liquid oxygen to and from a rocket's tank.

LP (abbr). 'Liquid propellant.'

lpr (abbr). 'Liquid propellant rocket.'

lunar base. A projected installation on the surface of the moon for use as a base in scientific or military operations.

The word 'lunar' is derived from the Latin *luna* the moon.

lunar landing. A soft landing of a vehicle on the moon; any landing on the moon.

lunar orbit. The orbit of a lunar probe placed in orbit about the moon, or made to circle the moon before return to terrestrial space.

lunar payload. The payload of a lunar probe, consisting chiefly of instruments for detecting and reporting conditions encountered.

The payload of a vehicle that landed on the moon would not include the rockets required for the return launch unless data was to be obtained from it.

lunar probe. A probe for exploring and reporting on conditions on or about the moon. See **Pioneer, n., probe, n.**

lunar satellite. A manmade satellite that would make one or more revolutions about the moon. See **moon satellite, selenoid, n.**

lunar space. Space near the moon. Cf. **terrestrial space, translunar space.**

The gravitational attraction of the moon is predominant in lunar space.

Lunik, n. [Russian *luna* moon.] A lunar probe that orbits or lands on the moon.

Lunik II, an 858.4-pound instrumented capsule, was launched at about 0500 (EST) 12 Sep 1959. With impact velocity of 7,500 mph, it fell on the moon at 1602:24 (EST) 13 Sep 1959, the first probe to do so. Until Mechta by-passed the moon (4 Jan 1959), it was a Lunik.

Lyman-alpha radiation. The radiation of ultraviolet light, hydrogen derived, with a wavelength beginning at $\lambda 1216$.

The Lyman series runs from $\lambda 1216$ to $\lambda 512$.

This radiation has been observed in the laboratory, but has never been observed on the earth in celestial spectra since the earth's atmosphere obstructs it. It is one of the objects of interest to be detected and measured by instruments in space satellites and probes.

Lyman-alpha radiation is named for Theodore Lyman (1874-1951), American physicist, who discovered the radiation in 1914.

M

M (abbr). 'Missile.' Normally used in combination to designate a particular type missile, as in M-31 Honest John, GAM-77 Hound Dog, IM, SM, and TM. See T-1, T-2, T-3.

M-2. 1. A Soviet solid rocket antiaircraft missile. 2. The Corporal.

The Soviet M-2 is reported in public sources as having a speed of 1,800 mph, a range of 40 miles, and a ceiling of 40 miles. Its guidance is by radar and infrared homing. It is a surface-to-air missile with two stages.

M-100A. A Soviet air-to-air solid-rocket missile guided by infrared, with a speed of mach 2 or more, a range of about 5 miles.

An early unguided version of the M-100A was used in Korea. The missile is 8 feet long.

Mace, n. A second generation of the AF aerodynamic cruise missile, the Matador, distinguished by a superior guidance system. Also called the TM-76.

About 44 feet long, 4.5 feet in diameter, and wing span of 23 feet, Mace is powered by the J33-A-41. Two guidance systems are used: ATRAN in the TM-76A and inertial guidance in the TM-76B. Martin of Baltimore is the systems contractor. Goodyear is the ATRAN contractor, and AC Sparkplug is the inertial guidance contractor. Common designations of these two versions are 'Mace A' and 'Mace B.'

mach, n. [After Ernst Mach (1838-1916), Austrian physicist.] A unit of speed measurement for a moving object equal to the speed of sound in the medium in which the objects moves.

Thus, *mach .5* is a speed equal to one-half the speed of sound in the medium, *mach 1* is a speed equal to that of sound in the medium. Cf. *remote velocity*, *speed of sound*. At transonic speeds, a body may have a speed less than mach 1 at the same time that local points on the body have speeds greater than mach 1.

Mach speed has no meaning in an element that does not conduct sound. See *atmosphere, n.*, note, *anacoustic, a*. Mach 1 under standard conditions at sea level is equivalent to about 759 mph.

macrocosmos, n. The universe, the world of the stars and galaxies.

'Macrocosmos' is used in contradistinction to 'microcosmos' (which see).

magnetic core. A very small doughnut-shaped ferrite magnetic material that is difficult to magnetize but, once magnetized, lags in values to a changing magnetizing force. Used as a memory device in digital computers.

magnetic tape. A plastic tape covered with a magnetic film, such as iron oxide, used to record variations in electrical quantities as it moves through an electromagnetic field varied in intensity, as by sound received from a microphone, the same tape then being subject to a reverse process in which it reproduces the originally recorded electrical quantities with interpretations in sound, graphic display, or the like.

Magnetic tape is used in telemetering equipment, as in an earth satellite or missile, or in recording signals from a radio transmitter.

In Explorer III, for example, a magnetic tape was designed to work in combination with a Geiger-Müller counter (inclosed in a steel case) and a tuning fork. The tuning fork was designed to record a pulse on the tape every second, except that each time the Geiger counter counted up to 128 cosmic rays as they penetrated its steel case, the tuning fork was to skip a pulse. Every time the satellite would cross the seven-station minitrack fence, the nearest station would signal the tape recorder to play back the record on the tape. This playback of pulses and gaps (a gap occurring about

every 8 to 10 seconds on the average) was to take less than 6 seconds, and in the process wipe the tape clean to start the sequence all over again. The system would tell not only how many cosmic rays were encountered in the orbit, but at what points on the orbit.

magnetic trapping. The trapping of radiation particles by the presence of a magnetic field.

magnetohydrodynamics, n. (MHD) A field of scientific study concerned with the action of superheated deuterium (or some other gas) when subjected to electromagnetic forces.

Experiments are said to indicate that a so-called plasma (electrically charged hot gas) may theoretically be held in 'magnetic bottles' and used to yield a high order of sustained thrust in a reaction engine. The thrust could theoretically be employed for propulsion of spacecraft if problems of weight are solved.

magnetometer, n. An instrument for measuring a magnetic field, or the intensity and direction of trapped charged particles. See *Explorer VI*.

mail rocket. A rocket-powered carrier for a piece, or pieces, of mail.

main stage. 1. In a multistage rocket, the stage that develops the greatest amount of thrust, with or without boosters; the section that houses its propulsion unit. **2.** In a single stage rocket vehicle powered by one or more engines, the period when full thrust (at or above 90 percent) is attained. **3.** A sustainer engine, considered as a stage after booster engines have fallen away, as in 'the main stage of the Atlas.'

maintenance, n. (maint) *Specif.* The servicing, repair, care, modification, or other action taken to keep or to restore materiel or equipment in, or to, such condition as to meet programmed operational requirements.

Maintenance includes the engineering and installation of fixed communications-electronics equipment and facilities, the manufacture, rebuilding, reclaiming, and testing of materiel or equipment, and the classification of materiel or equipment as to its condition status. See *modification, n.*

major subsystem. One of the principal systems in a rocket missile or vehicle, such as a guidance system, control system, propulsion system, communications system, or airframe.

This term is used to indicate that a major system in a rocket is really subordinate to the overall system of the rocket. If, however, this point is already understood, the term 'major system' is often used with the same meaning. See *major system*, *system, n.*, note.

major system. One of the principal systems in a rocket missile or vehicle. Used to distinguish the larger components of the overall system from the subsystems and assemblies.

make-and-buy structure. A composite listing of major parts and/or assemblies of an end

item, showing those to be made on site and those off site, and showing also the research and development studies that support them. See **subcontract structure**.

Details of each make-and-buy structure vary according to the complexity of the end item, and are negotiated on an individual basis.

Man High. 1. An AF project, early known as Project Daedalus and begun at Holloman AFB, the object being to put a man at very high altitudes in a sealed capsule suspended from a large polyethylene balloon for the purpose of scientific observation. 2. The man-carrying sealed capsule used in this project.

Project Man High was approved by ARDC in Mar 1956, after design, fabrication, maintenance, and modification materials had been proved practical by contract (Nov 1955) with Winzen Research of Minneapolis. The first manned ascent (Man High I) was begun at 0623, 2 Jun 1957, by Capt Joseph W. Kittinger, who ascended 96,000 feet and remained at altitude almost 2 hours, the expected 12-hour flight cut short by an oxygen leak. The second ascent (Man High II) was on 19 Aug 1957 by Maj David G. Simons, USAF, who reached 102,000 feet and stayed at approximately 90,000 feet except at night, when the capsule descended to 68,000 feet. This second flight began at 0922 (19 Aug) and ended at 1732 (20 Aug). See account in *Air University Quarterly Review*, Summer 1958.

man-in-space program. Any of several programs aimed at developing a space vehicle provided with the necessary environmental control to allow it to carry a person into space without undue risk to health or life. Cf. **radiation belt**. See also **Mercury**, *n*.

The NASA announced on 9 April 1959 the selection of seven experienced pilots for training in the techniques and arts of astronautics. NASA exercises general supervision over all programs. See **Centaur**, *n*, **Vega**, *n*.

manmade, *a*. Made by man. Said of space vehicles or of celestial bodies made by man.

manned, *a*. Of a vehicle: *a*. Occupied by one or more persons who normally have control over the movements of the vehicle, as in a manned aircraft or manned ship. *b*. Occupied by one of more persons, but not under their control or guidance. See following entries. See also **piloted**, *a*.

manned aircraft. An aircraft that carries one or more persons, each performing a function.

The persons aboard usually operate the aircraft, but they may be limited to observation if the aircraft's flight is controlled or guided by automatic or remote-control devices.

manned capsule. A capsule (which see), esp. a capsule in orbit, that carries one or more persons.

A manned capsule need not be under the control or guidance of the persons within it.

manned interceptor. A manned fighter aircraft used for intercepting enemy aircraft or for launching air-to-air missiles against enemy missiles.

manned orbital vehicle. A vehicle with sufficient velocity to orbit about the earth, carrying a person or persons to make observations, and normally piloted.

manned spacecraft. A spacecraft that carries one or more persons, each performing a function; sometimes *specif.*, a piloted spacecraft. See **spacecraft**, *n*.

A person is considered to be performing a function, in the present state of the art, by merely experiencing flight in a spacecraft. A piloted spacecraft is a species of manned spacecraft.

manned vehicle. An aircraft, space-air vehicle spacecraft, or other vehicle attended by a crew, esp. by a pilot or by a pilot and crew. See **manned spacecraft**.

manufacturer's code. A two-letter code assigned by the AF to each of the rocket or aircraft manufacturers serving as prime contractors.

This code is sometimes used, for example, after the model number or series letter of a weapon system, as in TM-61A-MA. Code letters assigned are as follows: *AD* Aero Design & Engineering Company, Bethany, Oklahoma; *AE* Aeronca Aircraft Corporation, Middletown, Ohio; *AH* American Helicopter Company, Incorporated, Manhattan Beach, California; *BA* Bell Aircraft Corporation, Atlanta, Georgia; *BE* Bell Aircraft Corporation, Buffalo, New York; *BF* Bell Aircraft Corporation, Fort Worth, Texas; *BH* Beech Aircraft Corporation, Wichita, Kansas; *BN* Boeing Airplane Company, Renton, Washington; *BO* Boeing Airplane Company, Seattle, Washington; *BW* Boeing Airplane Company, Wichita, Kansas; *CA* Chase Aircraft Company, Incorporated, West Trenton, New Jersey; *CC* Canadian Commercial Corporation, Toronto, Canada; *CE* Cessna Aircraft Company, Wichita, Kansas; *CF* Consolidated Vultee Aircraft Corporation, Fort Worth, Texas; *CN* Chase Aircraft Company, Incorporated, Willow Run, Michigan; *CO* Consolidated Vultee Aircraft Corporation, San Diego, California; *CS* Curtiss-Wright Corporation, St. Louis, Missouri; *CU* Curtiss-Wright Corporation, Buffalo, New York; *DC* Douglas Aircraft Company, Chicago, Illinois; *DH* de Havilland Aircraft, Toronto, Canada; *DK* Douglas Aircraft Company, Oklahoma City, Oklahoma; *DL* Douglas Aircraft Company, Long Beach, California; *DM* Doman Helicopter, Incorporated, Danbury, Connecticut; *DO* Douglas Aircraft Company, Santa Monica, California; *DT* Douglas Aircraft Company, Tulsa, Oklahoma; *FA* Fairchild Aircraft Division, Hagerstown, Maryland; *FL* Fleetwings, Incorporated, Bristol, Pennsylvania; *FO* Ford Motor Company, Willow Run, Michigan; *FT* Fletcher Aviation Corporation, Pasadena, California; *GA* G & A Aircraft Company, Willow Grove, Pennsylvania; *GK* General Motors, Kansas City, Kansas; *GR* Grumman Aircraft Corporation, Bethpage, L. I., New York; *HE* Helic Aircraft Corporation, Norwood, Massachusetts; *HU* Hughes Aircraft Company, Culver City, California; *KA* Kaman Helicopter Corporation, Windsor Locks, Connecticut;

KE Kellet Autogyro Corporation, Philadelphia, Pennsylvania; KM Kaiser Manufacturing Corporation, Willow Run, Michigan; LK Laister-Kauffman Aircraft Company, St. Louis, Missouri; LM Lockheed Aircraft Corporation, Marietta, Georgia; LO Lockheed Aircraft Corporation, Burbank, California; MA The Martin Company, Baltimore, Maryland; MC McDonnell Aircraft Corporation, St. Louis, Missouri; MH McCulloch Motors Corporation, Los Angeles, California; MO The Martin Company, Omaha, Nebraska; NA North American Aviation, Incorporated, Inglewood, California; NC North American Aviation, Incorporated, Kansas City, Kansas; ND Noordyn Aviation Company, Limited, Montreal, Canada; NF North American Aviation, Incorporated, Fresno, California; NH North American Aviation, Incorporated, Columbus, Ohio; NK Nash-Kelvinator Corporation, Detroit, Michigan; NO Northrop Aircraft, Incorporated, Hawthorne, California; NT North American Aviation, Incorporated, Dallas, Texas; NW Northwestern Aeronautical Corporation, St. Paul, Minnesota; PH Piasecki Helicopter Corporation, Morton, Pennsylvania; PI Piper Aircraft Corporation, Lockhaven, Pennsylvania; PL Platt-LePage Aircraft Company, Eddystone, Pennsylvania; RE Republic Aviation Corporation, Farmingdale, L. I., New York; RP The Radioplane Company, Van Nuys, California; RY Ryan Aeronautical Company, San Diego, California; SA Stroukoff Aircraft Corporation, West Trenton, New Jersey; SE Seibel Helicopter Company, Wichita, Kansas; SI Sikorsky Aircraft Division, Stratford, Connecticut; TG Texas Engineering & Manufacturing Company, Greenville, Texas; TP Texas Engineering & Manufacturing Company, Grand Prairie, Texas; UH United Helicopter Corporation, Palo Alto, California; VE Vega Aircraft Corporation, Burbank, California; VI Canadian Vickers, Limited, Montreal, Quebec, Canada; VL Vertol Aircraft Corporation, Morton, Pennsylvania; VU Vultee Aircraft Corporation, Downey, California; VW Vultee Aircraft Corporation, Wayne, Michigan; WC Waco Aircraft Company, Troy, Ohio.

map-matching guidance. 1. The guidance of a missile or flightborne vehicle by means of a radarscope film previously obtained by a reconnaissance flight over the terrain of the route, and used to direct the missile or vehicle by aligning itself with radar echoes received during flight from the terrain below. 2. Guidance by stellar map matching.

This guidance (sense 1) is effective only over land. See *ATRAN* (*abbr*).

Marco Polo. A nickname for the Viking.

Marquardt, n. Short for 'Marquardt Aircraft Co.,' missile contractor, as for the powerplant of Bomarc. Cf. *ASTRO* (*abbr*).

marriage, n. A relationship between one rocket system and another that makes for smooth and efficient operation; the process of establishing this relationship. Cf. *compatibility, n.*

Mars, n. The sun's fourth planet, its orbit outside the orbit of the earth.

The mean distance of Mars from the sun is 1.524 astronomical units (about 141,500,000 miles). Its closest approach to the earth is 35,000,000 miles, achieved when opposition happens to occur about 25

August (which happens every 15 or 17 years—the next in 1971). Its orbital velocity is 15 mi/sec. Its eccentricity is .093. Its sidereal period is 687 days, its synodic 780 days. Its mean diameter of 4,220 miles is somewhat more than one-half the earth's, and its mass is .108 of the earth's. Its rotation period is 24 hours 37 minutes (the earth's is 23 hours 56 minutes).

Mars has an atmosphere, but one that is much rarer than the earth's, with an oxygen density of less than 1% of the earth's oxygen density. Likewise its water vapor is very small. Its temperatures range from -100° C at the poles to a degree or more above 0° C.

Martian probe. A probe for exploring and reporting on conditions on or about the planet Mars.

Martian satellite. Either of the two moons that orbit the planet Mars—Deimos or Phobos (which see).

The Russian scientist, Dr. L. Shklovsky on 1 May 1959 asserted that the two Martian moons were probably artificial, put in orbit by intelligent beings who lived on the planet Mars some 2,000 to 3,000 million years ago. Dr. E. C. Slipher, Director Emeritus of the Lowell Observatory at Flagstaff, Arizona, and authority on Mars, on 2 May 1959 said that the Shklovsky suggestion was 'scientific fiction nonsense.'

Martin, n. Short for 'The Martin Co.,' missile and aircraft contractor, as for Titan, Lacrosse, Vanguard, and Bullpup, or for the B-57 and Dyna-Soar.

Martin-Vanguard test vehicle. The Vanguard carrier rocket used as a test vehicle.

Maruca, n. A French Navy liquid-rocket, anti-aircraft missile.

This missile is 15 feet long, 5¼ feet in span, with range of 10 miles.

Masalca, n. A French Navy surface-to-air missile with range up to 60 miles.

mass, n. A measure of the quantity of matter in a body, being determined by comparing the resultant changes in velocities when the body impinges upon a standard body.

The unit for determining mass in the US is a piece of platinum kept in Washington, D.C., by the National Bureau of Standards. Mass differs from weight in that the weight of this piece of platinum is the attraction of the earth's force of gravity upon it. In Washington, the mass and weight have equivalent values; at other points the mass remains the same, the weight, however, varies with latitude and elevation.

According to the theory of relativity, however, the mass of a moving body relative to the observer is not constant. The body increases in mass with velocity, i.e., $m = m_0 / \sqrt{1 - v^2/c^2}$, in which m is the mass of the moving body, m_0 its mass at rest, v its velocity relative to the observer, and c the speed of light.

mass production. The production of goods in quantity, sometimes by serial production.

mass ratio. The ratio of one mass to another; *specif.*, the ratio between takeoff mass and remaining mass.

For example, the takeoff mass of the V-2 is 12 tons (the rocket vehicle 3 tons, the payload 1 ton, the fuel 8 tons); its remaining mass is 4 tons (vehicle plus payload). The mass ratio is 3 to 1. The mass ratio of the Juno II rocket when used to launch Pioneer IV was 121,000 to 13.

master console. A console from which overall monitoring and control may be exercised.

Masurca, *n.* A French Navy solid rocket, supersonic, for use against aircraft, with range up to 15 miles.

Matador, *n.* An AF surface-to-surface, turbojet propelled, winged, tactical missile, with a solid booster, developed by Martin with Allison and Thiokol, associate contractors. Also called TM-61 and B-61.

About 40 feet long, 4.5 feet in diameter, and wing span of about 28 feet, the Matador has a reported range of 700 miles and a speed just under sonic speed. Its sustainer engine is the Allison J33-A-37. Its guidance uses the MSQ radar guidance system and the Shanicle system. It is capable of carrying a nuclear warhead.

The Matador made its first flight in 1950, and has since been in quantity production. Matador units are deployed in Germany, Taiwan, and Korea.

The latest version of the Matador, the TM-61B has evolved into the Mace, the TM-76.

Matador Mace. The Mace.

mate, *v. tr.* To fit one *part* into another.

MB (*abbr.*) 'Missile bomb.' See **Genie, *n.***

McDonnell, *n.* Short for 'McDonnell Aircraft Corporation,' missile contractor, as for Quail, Talos, and Triton.

ME. A Soviet, sulphur-based solid antitank missile, effective at about 1,000 yards. Also called 'Igor.'

mechanical border. *Specif.* That layer in the atmosphere where air resistance and friction becomes negligible (from 120 to 140 miles altitude). See **effective atmosphere.**

mechanoreceptor, *n.* *Medicine.* A nerve ending that reacts to mechanical stimuli, as touch, tension, and acceleration.

Mechta, *n.* [Russian 'dream.'] A Russian lunar probe or asteroid launched on 2 January 1959.

Mechta, sphere-shaped and made of aluminum and magnesium, is reported as weighing 796.67 pounds. It traveled 372,000 miles from the earth before radio contact was lost on the afternoon of 5 Jan 1959. Its period is 450 days, with a perihelion of 90,972,960 miles, and an aphelion of 122,540,080. Its orbital plane is inclined at about 8° from the plane of the ecliptic. It was launched from near Aral'sk. See **Lunik, *n.***

megaton, *n.* (mt) 1. One million tons. 2. The explosive power of one million tons of TNT, as in 'a megaton bomb.' Used attrib.

memory, *n.* The faculty of a computer, control system, guidance system, instrumented satellite, or the like to bring out data or in-

structions previously recorded so as to make them bear upon an immediate problem, such as the guidance of a physical object, or the analysis and reduction of data.

This faculty, normally associated with digital computers, depends upon such devices as magnetic drums, delay lines, and manetic cores. See **magnetic core.**

Mercury, *n.* 1. The planet nearest the sun. 2. A man-in-space program of the National Aeronautics and Space Administration. Cf. **man-in-space program.**

The mean distance of Mercury (sense 1) from the sun is .39 astronomical units (about 36,270,000 miles). Its orbital velocity is from 23 to 36 mi/sec. Its eccentricity (greater than that of the other planets except Pluto and some of the asteroids) is .20. Its sidereal period is 88 days, its synodic 116 days. Its diameter is about 3,000 miles; its mass about .056 of the earth's. Its greatest elongation is from 18° to 28°. It is seen better in the southern hemisphere than in the northern.

Mercury is without evidence of an atmosphere. With a rotation period considered to be identical with its revolution period, it is hot (350° C) on its sunlit side, cold (almost -270° C) on its dark side.

Mercury's line of apsides advances at a rate some 43" faster than it should according to Newtonian law. This phenomenon, explained by Einstein's theory of relativity, tends to confirm the theory.

Mercury capsule. A capsule for accommodating a man, under development for the Mercury project, and designed to provide drag and heat dissipation for reentry.

meson, *n.* An elementary particle intermediate in mass between the electron and proton.

Mesons have different properties. Some are positively charged, some negatively, and some are neutral. The pi meson (pion) has somewhat more mass than the mu meson (muon), and other mesons have still more mass.

mesopause, *n.* The upper limit of the mesosphere. See **pause, *n.***

mesosphere, *n.* 1. In the nomenclature of Chapman, a stratum of atmosphere that lies between the stratosphere and the ionosphere, sometimes called the chemosphere. 2. In the nomenclature of Wares, a stratum that extends approximately from 250 to 600 miles, lying between the ionosphere and the exosphere.

In sense 2, the mesosphere is the region of sunlight auroras. Literally, a mesosphere is a sphere that lies between two others.

meta (*prefix*). [Greek 'between, with, beyond.'] A combining form meaning 'along with' or 'beyond what is usual.'

metachemistry, *n.* Chemistry that transcends the normal bounds of the science; the chemistry of subatomic particles. Cf. **aeroduct, *n.***

Metagalaxy, *n.* The entire system of galaxies including the Milky Way.

metastable compound. A chemical compound

of comparative stability which, however, becomes unstable under a particular set of conditions. See next.

Nitromethane (CH_3NO_2) is an example of a metastable compound. See **nitromethane**, *n*.

metastable propellant. A metastable compound used as a propellant.

Nitromethane (CH_3NO_2), for example, may be used as a monopropellant at chamber pressure above 500 psi. At lower pressure, it requires an oxidizer for stable combustion.

meteor, *n*. 1. A body originating in outer space but entering the earth's atmosphere with such velocity as to become incandescent and to appear as a falling star. 2. Such a body encountered or existent outside the atmosphere, normally called a 'meteoroid' or a 'meteorite.'

A meteor (sense 1), incandescent with heat generated by friction with the air, could possibly be mistaken for a ballistic missile. Its body, although no more massive on the average than a pinhead, acquires an envelope of its own vapor much larger than itself, the air along its path becoming ionized. The ionized air reflects radio waves.

The speed of meteors, relative to the earth, ranges between 10 and 40 miles per second as they enter the atmosphere.

meteoric erosion. Erosion on a space vehicle from contact with meteoroids.

meteoric particle. A particle of matter from a meteoroid; a small meteoroid.

meteorite, *n*. 1. One of the countless small solid bodies in outer space encountered by satellites, probes, or other space vehicles. Usually called a 'meteoroid' in prespace-age parlance. 2. A metallic or stony body already fallen to earth from outer space; the remnant of a meteor.

Although the suffix *-ite* in the word 'meteorite' signifies a mineral or rock in or on the earth's crust, as in *anthracite* or *granite*, its presence in the word has not prevented the word's widespread adoption in sense 1. Usage in this sense, however, is not new. It goes back well into the 19th century. See **micrometeorite**, *n*.

meteoroid, *n*. A small body moving through space, which if caught in the earth's atmosphere and becoming visible is known as a meteor. Commonly called a 'meteorite' when encountered by space vehicles.

meteorological satellite. An earth satellite equipped and on orbit so as to provide aid in forecasting weather.

methane, *n*. An odorless and flammable gaseous hydrocarbon, CH_4 , present in the atmospheres of Jupiter, Saturn, and Titan. It condenses into a liquid at -160°C .

MEW (*abbr*). 'Microwave early warning.'

MHD (*abbr*). 'Magnetohydrodynamics.'

mi (*abbr*). 'Mile,' i.e., a statute mile. Cf. **nmi** (*abbr*).

Mia, *n*. The name given one of the mice used in flight tests. See **Thor-Able**, *n*.

Mia is a contraction of 'mouse in Able.' *Mia* I was in the first flight test of 23 April 1958, *Mia* II in the second of 10 July 1958. Neither was recovered.

microcosmos, *n*. That part of the cosmos in which minute particles or organisms move or live; any little system, as in the atom, in which electrons and other minute particles move.

These meanings depart from the traditional meaning of the term, 'the little world of man, as opposed to the larger universe.' Cf. **macrocosmos**, *n*.

microlock, *n*. 1. A lock by a tracking station upon a minitrack radio transmitter. 2. The system by which this lock is effected.

micrometeorite, *n*. A small meteorite, i.e., a micrometeoroid.

micrometeoroid, *n*. A very small meteoroid, esp. as encountered by earth satellites, probes, or the like. Cf. **micrometeorite**, *n*.

microminiature, *n*. A piece made smaller than what is already considered a miniature piece.

Midas, *n*. A project of the Advanced Research Projects Agency and Air Force (Lockheed the contractor), aimed at developing a satellite for detecting ballistic-missile launching by infrared and other techniques.

'Midas' is from *Missile Defense Alarm Satellite*.

Midas satellite. A satellite developed under the Midas project.

Mike, *n*. A word standing for the letter 'M,' used to signify 'missile' in the designation **SAC-Mike** (which see).

mile, *n*. (mi) Unless otherwise stated or implied, a measure of distance equal to 5,280 feet. Also called a 'statute mile.' See **knot**, *n*.

Used esp. in phrase 'miles per hour' (mph). When a nautical mile is meant, it is called a 'nautical mile.'

mile per hour. (mph) A statute mile per hour.

milestone, *n*. In programming, a significant and frequently critical event which, if made to happen, will signify decided progress toward a broader, predetermined goal; such an event already made to happen.

The milestone may be qualitative or quantitative, or both, in character.

Military Assistance Program. (MAP) A program of the US that provides allied nations with military equipment, technical assistance, and military advice.

militology, *n*. Systematized knowledge of military means of influence, their relation to other

means, and to the subjects, objects, and objectives related to the national interest.

Milky Way. The Galaxy to which the earth's sun belongs.

As seen at night from the earth, the Galaxy is a faintly luminous belt of distant stars.

Millstone Hill. The site near Lexington, Massachusetts, at which the Lincoln Laboratory is located.

The 84-foot dish radar antenna mounted atop Millstone Hill weighs 90 tons. Cf. **radar probing**, **radio telescope**.

mini (*prefix*). A contraction of 'miniature' used in combination, as in *minicomponent*, *miniradio*, *minitransistor*; also a contraction of the words thus made, as in *minitrack*, i.e., a minitransmitter track. See following entries.

'Mini' rhymes with 'tinny.'

miniature, *n.* Used attrib. in reference to equipment, such as gimbals, gyroscopes, computers, etc., made small to fit into confined spaces, as within an earth satellite or rocket missile.

miniaturize, *v. tr.* To make a functioning miniature of a *part* or *instrument*. Said of telemetering instruments or parts used in an earth satellite or missile, where room is at a premium.

Hence, *miniaturized*, *a.*, *miniaturization*, *n.*

minitrack, *n.* 1. The track of a miniature transmitting set emitting telemeter-type signals. 2. Short for 'minitrack radio.' Used attrib., as in *minitrack chain*, *minitrack picket*.

minitrack radio. A radio receiving set that tracks an object equipped with a miniature transmitter emitting telemeter-type signals. Used, for example, in tracking earth satellites.

Minuteman, *n.* A USAF multipurpose ballistic missile in research and development by the AF Ballistic Missile Division of ARDC, to be powered by multistage solid propellant rocket motors, and capable of carrying a nuclear warhead.

Designs for solid motors for the Minuteman have been proposed by Thiokol Corporation, Aerojet-General Corporation, Astrodyne, and other firms. See **polyurethane**, *n.* The assembly and test contract is with Boeing; the nose cone with Avco.

The guidance system is to be an outgrowth of the Thor's system. In one configuration, the missile will have intercontinental range (launch weight 40 tons). Its launch is expected to be from underground sites.

missile, *n.* (M) 1. Any weapon object designed to be (or is in fact) thrown at, dropped upon, projected toward, or self-propelled to a target, as through water, air, or space; also an object

that simulates in some manner the performance of such a weapon object, for example, the decoy Quail. 2. *Specif.* A self-propelled missile guided all the way to target or guided part of the way, as is the case with a ballistic missile. 3. A rocket vehicle. See **rocket missile**, *note*.

The usefulness of this term in sense 2 is somewhat nullified by its use in sense 3. In sense 2, it is commonly used as an attrib., as in *missile base*, *missile force*, *missile guidance*, *missile research*, etc.

In sense 2, the missile may be considered to be the entire object as it appears when launched, or it may be considered the remaining body at any point on the trajectory. See **ballistic missile**, **guided missile**.

missile accident. Either an occurrence during missile assembly, checkout, transport, or countdown in which the missile is destroyed or is damaged to the extent that the testing or flight operation is delayed, or an occurrence in which the missile through some abnormal action injures or destroys life or property.

missile base. A military base at which missiles are deployed.

missile carrier. That which carries a missile proper to the point at which it is launched or trajected toward target; the aircraft or the rocket vehicle that makes the missile flight-borne. Cf. **vehicle defense**.

missile checkout trailer. A trailer fitted out with missile checkout equipment. Cf. **cycle-checkout van**.

missile contractor. A contractor, esp. a prime contractor, engaged in developing or manufacturing a missile.

missile decoy. A guided vehicle used to divert and mislead enemy defenses, attracting radar and drawing enemy fire so as to increase the odds for penetration by manned bombers or other weapons.

Missile decoys, like the Quail and the Goose, are normally employed with manned bombers, either flying parallel courses with the bombers or rendezvousing with the bombers in the target area. Adapted to different purposes, the decoy may be converted into a real missile, made to home upon a defending radar or to strike at some other target.

missile division. In SAC, a major unit charged with the strategic employment of missiles. Cf. **strategic missile squadron**.

The First Missile Division is located at Vandenberg AFB.

missile emplacement. A launch emplacement for missiles.

missileer, *n.* Also **missilier**. [Coined by analogy with *bombardier* or *grenadier*.] A person

skilled in launching and controlling a ballistic or other missile.

missile firing laboratory. A launch complex used for obtaining and verifying data on the firing and launching of rockets. Mainly a *Navy* term.

missile gap. A condition that prevails when missile production in one country is measurably ahead of missile production in another country, normally considered in terms of both quality and quantity.

missileman, *n.* A person who works on or handles a missile; *specif.*, an airman or officer in a missile unit.

Missile Master. An Army electronic system that gives early warning of hostile missiles and provides for instantaneous reaction.

The Missile Master is the Army counterpart of the AF SAGE.

missile race. An arms race or contest between nations for the quantity and quality production of ballistic and other type missiles.

missile range. A marked-off course or area over which test vehicles, test missiles, or probe rockets are flown. Usually an instrumented range that provides for programmed observation, guidance, control, and recording of data. See *instrumented range*, *missile test range*.

See also *Atlantic Missile Range*, *Pacific Missile Range*, and *cf.* *Point Mugu*, *White Sands Missile Proving Ground*.

missilery, *n.* Variant-spelling of 'missilry.'

missile shelter. A shelter at a launch point in which a missile on alert status is placed, from which it can be quickly positioned, or in which it is already positioned, for launching. *Cf.* *coffin, n.*, *hangar, n.*, sense 2.

The missile shelter may provide for a horizontal missile attitude, or, in the case of a silo-type installation, for a vertical attitude.

missile squadron. An AF squadron made up of persons with the required skills for servicing, making ready, and launching one or more types of missiles, as in 'the first Snark missile squadron at Patrick.'

Missile Static Test Site. (MSTS) A static test site for missiles near Edwards Air Force Base, California. Also called 'Edwards Rocket Base' and 'Missile Captive Test Site.'

missile strike. 1. An attack upon a target, esp. a surface target, by means of missiles. 2. The action of a missile striking a target. 3. The point of impact at which a missile strikes, as

in 'the number of missile strikes on target may be estimated.'

missile submarine. A submarine built to launch guided or ballistic missiles as its chief offensive armament. See *Halibut, n.*, *Polaris, n.*, *George Washington*, *Regulus II*.

missile system. 1. The weapon system of a particular missile. 2. A component system belonging to a missile, as in 'the guidance unit is to be used as a missile system.'

This term (sense 1) is appropriately applied when the missile is a complicated weapon. See *weapon system*.

missile test range. A missile range, esp. for the test of missiles or their rocket vehicles.

missile threat. The threat of being attacked by means of missiles, esp. long-range missiles.

missile transporter. A vehicle, esp. an air or automotive vehicle, used to transport a missile from one site to another, or from the manufacturing plant to the launch point.

For large missiles, such as the Atlas, the automotive missile transporter consists of a wheeled tractor and trailer, the trailer sometimes provided rear-wheel guidance by a special operator seated at the back wheels of the trailer.

missile unit. A military unit made up of persons with the skills required to service, make ready, or launch ballistic or other missiles, or to train others to do so.

missile vehicle. The rocket or other powered carrier that bears a missile in flight; the missile as a whole regarded as a vehicle.

This term is used to avoid ambiguity in contexts where the word 'missile' used alone could be understood to mean either the missile or the vehicle.

missilry, *n.* The art or science of designing, developing, building, launching, directing, and sometimes guiding a rocket missile; any phase or aspect of this art or science.

This term is sometimes spelled 'missilery,' but is pronounced as a three-syllable word.

mission, *n.* (msn) 1. In missile or rocket testing, the action involved in carrying out a particular test; an instance of such an action, as in 'the test center completed 20 missions during the month.' 2. In missile or rocket development, the aggregate of responsibilities, actions, and objectives involved in developing and producing a particular missile or rocket vehicle.

See the USAF Dictionary for other meanings of this term.

mission segment. Any part of an overall mission; *specif.*, the aggregate of management, skills, manhours, and materials that go to make

up the development and production of a particular component of a rocket system.

That part of the overall mission concerned with the production of a particular assembly, for example, would constitute a mission segment. Likewise that part concerned with production of a major subsystem would constitute a mission segment made up of smaller mission segments.

mixed force. A composite force, esp. one that uses ballistic or guided missiles and combat aircraft as offensive or defensive weapons.

mixture of weapons. The complementary employment of different type missiles, as of missile weapons with fighter and bomber aircraft.

MNORM (abbr). 'Missile not operationally ready—Maintenance.'

MNORP (abbr). 'Missile not operationally ready—Parts.'

mock firing. A complete dry run of the operations connected with the firing and launch of a missile except that the engines are not actually fired, the object being to train personnel, develop procedures, and check out equipment.

mod (abbr). 'Model.'

model, n. Specif. An electronic, mechanical, or other device that functions like something under study or analysis (such as a human brain), or that produces values equivalent to values produced by a mind, organ, or other device.

This term, in the first instance, is applied to devices that incorporate symbols of factors considered to play a part in the functioning of a complex organism, such as a person's body or mind, permitting observation of the symbols direct as a means of studying the remote factors. When the symbols are quantitative in nature, the device may be called a 'mathematical model.'

The term, in the second instance, is applied to devices that in no way simulate the processes of the principal organism or system, but which produce identical answers or results with those of the principal. For example, an analogue computer may come out with answers identical with those of a human mind, without, however, simulating the processes of the mind.

The model of the first kind is usually a research tool, used to study some object or process. The model of the second kind is essentially a working tool.

See the USAF Dictionary for other senses of the term.

modification, n. Specif. Any change or alteration of a rocket missile or vehicle, or of its ground support equipment, that brings about a change in the rocket's capabilities or characteristics.

module, n. 1. The size of some one part of a missile or other structure, as the semidiameter of a missile's base, taken as a unit of measure for the proportional design and construction of

component parts. 2. A one-package assembly of functionally associated parts so arranged as to be mounted together in a missile and to function as a system or subsystem; a black box. See **subsystem, n.**, note.

monitor, v. tr. To keep track of a flightborne aircraft, missile, spacecraft, or other body during the period under which it is controlled, and, if radio command is provided, to transmit to it commands for its safe operation and guidance.

See USAF Dictionary for other meanings.

monkey, n. A small long-tailed animal belonging to the order of primates, used in space research as an animal considered to approximate man in his reactions to like conditions. See **Able, n.**, **Albert, n.**, **Baker, n.**, **bioastronautics, n.**, **Jupiter, n.**, note.

mono-atomic ramjet. A ramjet aircraft engine considered feasible for operation in a narrow altitude band at about 60 miles, its propulsion to be derived from the heat-producing recombination of free oxygen atoms.

monopropellant, n. A rocket propellant, esp. a liquid propellant, in which the fuel and oxidizer make up a single substance before injection into the combustion chamber.

A monopropellant may be a mixture of compounds, such as hydrogen peroxide and alcohol, or a compound in itself, such as nitromethane. The term is normally applied to liquid monopropellants rather than to solid propellants, to distinguish them from the liquid bipropellants.

moon, n. 1. The natural celestial body that orbits as a satellite about the earth. Called 'the moon.' 2. Also applied generically to any one of the manmade earth satellites, or to a satellite of a planet other than the earth.

In sense 1, the moon has a mean diameter of 2,160 miles, a mean distance from the earth of about 238,857 miles, a mass about 1/81.5 that of the earth, and a volume of about 1/49th. Its mean orbital velocity is about 2,337 statute mph, its apogee 252,710 miles, its perigee 221,463 miles. See **orbital period**, **orbital velocity**.

moon probe. A lunar probe.

moon rocket. A rocket vehicle designed to launch a lunar probe. See **Pioneer, n.**

moon satellite. A manmade satellite that would orbit about the moon. Cf. **earth-moon satellite**, **lunar satellite**, **Pioneer, n.**

moonscope, n. A telescope for viewing an artificial satellite.

moonship, n. A spacecraft designed for travel to the moon.

moon shot. The launch of a probe vehicle

aimed at placing a lunar probe on course toward the moon.

The first American attempt at a moon shot was at 0818 (EDT) 17 Aug 1958 with a Thor first stage rocket, the second stage being a Vanguard, the third a solid propellant developed by Allegany, and the fourth a Thiokol solid propellant. The rocket exploded at plus count 77 seconds. A launch of 3 Mar 1959, however, was successful. See *Pioneer I*, *Pioneer III*, *Pioneer IV*. See also *Lunik, n.*, *Mechta, n.*

moon suit. A space suit designed esp. for wear in landing on or exploring the moon.

moontracking, n. The process or action of observing and plotting the progress of an earth satellite. See *track, v.*

moon watch. A watch for observing the passing of an earth satellite in orbit. Hence, *moon watcher*.

MOR (abbr.) 'Missile operationally ready.'

motion simulator. A machine or installation that simulates roll, pitch, and heave, used to test and develop missiles that are to be launched from a ship at sea. Cf. *exerciser, n.*, *flat pad*.

mouse, n. A small rodent (*Mus musculus*) used as a test animal in rocket flights. See *Mia, n.*

Mice were first used in V-2 space biology tests conducted at Holloman AFB in 1948, later in Aerobee firings in 1951.

mph (abbr.) 'Mile per hour' or miles per hour.'

MPI (abbr.) 'Mean point of impact.'

MRBM (abbr.) 'Medium-range ballistic missile.'

MRS (abbr.) 'Manned reconnaissance satellite.'

MRS glider. A manned reconnaissance orbital glider.

msn (abbr.) 'Mission.'

MSQ (abbr.) 'Mobile special radar,' a radar guidance system used in conjunction with an airborne radar for interception.

MSTS (abbr.) 'Missile static test site.'

mt (abbr.) Also written MT. 'Megaton.'

multi (combining form). 1. More than one. Used in contexts where a category of two or more is distinguished from a category of one, as in 'a multipropellant fuel system is more complicated than a monopropellant system.' 2. More than two.

multipropellant, n. A propellant that consists of two or more liquid ingredients each separated from the others until introduced into the combustion chamber.

multistage rocket. A rocket having two or more thrust-producing units, each used for a different stage of the rocket's flight.

muon, n. A mu meson. See *meson, n.*

MX-774. An AF sponsored ballistic-missile project begun with Convair in 1946, but cancelled in 1947. Cf. *Atlas, n.*, sense 2.

This project led to an understanding of control techniques employing swiveling engines, of lightweight structures for tanks, and of separation techniques.

N

NAA (abbr.) 'North American Aviation.'

NACA (abbr.) 'National Advisory Committee for Aeronautics.'

NAMTC (abbr.) 'Naval Air Missile Test Center.'

NASA (abbr.) 'National Aeronautics and Space Administration.'

National Advisory Committee for Aeronautics. (NACA) An independent government agency organized in 1915 to direct and supervise study of the problems of flight and to direct and conduct aeronautical research and experiment. Now *hist.*

NACA became the nucleus of the National Aeronautics and Space Administration effective 1 October 1958, under a law of July 1958.

The three principal aeronautical laboratories operated under NACA were the Langley Aeronautical Laboratory at Langley AFB, the Ames Aeronautical Laboratory at Moffett Field, and the Lewis Flight Propulsion Laboratory at Cleveland, Ohio. These laboratories, together with the High Speed Flight Station at Edwards and the rocket research center at Wallops Island, are now a part of the Aeronautical and Space Research Division of NASA.

National Aeronautics and Space Administration. (NASA) An independent government agency authorized by Congress and approved by the President (29 July 1958), and organized to plan, direct, and conduct basic aeronautical and space research, development, and experiment.

NASA, organized as of 1 October 1958 with the National Advisory Committee for Aeronautics (NACA) as its nucleus, is not responsible for projects having direct military value, such projects being retained under the control of the Defense Department under the Advanced Research Projects Agency or the USAF.

Space and meteorological projects having primary scientific interest, however, fall under NASA purview, although initiated and directed by a military department under ARPA. See *Atlas-Able, n.*, *Centaur, n.*, *Juno II, Mercury, n.*, sense 2, *Nova, n.*, *Pioneer, n.*, *Rover, n.*, *Scout, n.*, *Thor-Able, n.*, *Vanguard, n.*, *Vega, n.* See also Advanced Research Projects Agency.

NASA has incorporated the NACA laboratories into its own structure. See *prec. entry*. See also *Goddard Space Flight Center*.

National Aeronautics and Space Council.

(NASC) A council for the National Aeronautics and Space Administration, made up of the President, the Secretary of State, the Secretary of Defense, the Chairman of the Atomic Energy Commission, the Administrator of NASA, and four other members appointed by the President.

NASC is similar in status and operation to the National Security Council.

National Security Council. (NSC) A council serving as an advisory body to the President on the integration of domestic, foreign, and military policies relating to the national security in order that the armed forces and other departments and agencies of the government may cooperate effectively.

The NSC was established by the National Security Act of 1947.

NATO (*abbr.*). 'North Atlantic Treaty Organization.'

Nato, *n.* The noun form of the abbreviation 'NATO.'

nautical mile. (NM) A measure of distance equal to about 6,080 feet. See **knot**, *n.*

To avoid confusion a nautical mile is not called a 'mile' (which see). The nautical mile is one minute of a great circle, but because the earth is not a perfect sphere, its value is not uniform. AF Reg 55-16 (12 Nov 1954) makes it 6,076.10333 feet. For conversion to statute miles, a nautical mile is multiplied by 1.15.

Navaho, *n.* An AF air-breathing guided missile developed by North American originally as an intercontinental missile, but after July 1957 used as a test vehicle in explorations of high altitudes. Also called SM-64.

The Navaho program was cancelled in July 1957, but missiles already in production were converted to test vehicle employment, esp. for obtaining data for development of the B-70, of the rocket motors of Redstone, Jupiter, and Thor, etc. See **Snark**, *n.*

The Navaho is propelled by two ramjet engines, which take over at cruise altitude of 50,000 feet or more after rockets have boosted the vehicle to altitude. On 11 Sep 1958, the missile is reported to have travelled at mach 3 at 72,000 feet.

Naval Air Missile Test Center. A Navy test center for missiles at Point Mugu, California.

Naval Ordnance Test Station. (NOTS) A Navy test installation at China Lake, California.

Naval Research Laboratory. A Navy research installation in Washington, D. C., under the control of the Office of Naval Research.

NBS (*abbr.*). 'National Bureau of Standards.'

NC (*abbr.*). Also written N. C. 1. 'Nuclear capability.' 2. 'Nose cone.'

near space. That part of space that is relatively near the earth.

Near space differs from terrestrial space in that it postulates the observer on the earth, and is a term of distance, not influence.

nebula, *n.* Any celestial structure outside the solar system that occupies a perceptible extent in the sky and is not resolvable into stars by large telescopes.

The contents of nebulae inside the Galaxy are gaseous or finely divided matter. The extragalactic nebulae are considered to be star clusters or other galaxies, too distant to be resolved into stars.

negatron, *n.* A negatively charged electron.

Neptune, *n.* 1. The sun's eighth planet. 2. An early name for the Viking when it was in the development stage.

The mean distance of Neptune from the sun is 30.07 astronomical units (2,793,000,000 miles). Its orbital velocity is about 3.3 mi/sec. Its eccentricity is .009. Its sidereal period is 164.8 years, its synodic period 367.5 days. Its mean diameter is 33,000 miles, its mass 17.2 times that of the earth's. Its rotation period is not known, but is considered to be about 16 hours.

neutral point. A point on a line joining the centers of gravity of two spatial bodies, such as the earth and moon, at which the gravitational field of each cancels the other out.

The neutral point between the earth and moon is at about 23,760 miles distant from the moon.

neutron, *n.* A particle which is one of the constituents of an atomic nucleus in most elements, having no electric charge.

Neutrons are released as radiation in the atomic disintegration of certain elements, and because they are uncharged they serve as particles with which to bombard the atomic nuclei of fissionable matter.

Newton, *n.* Short for 'Sir Isaac Newton' (1642-1727), who formulated the law of gravitation and the laws of motion.

See **gravitation**, *n.*, **laws of motion**.

Nike, *n.* [Pronounced *nigh-kee*.] In Greek mythology, the goddess of victory, attendant to Zeus. Used in the names of missiles. See following entries.

Nike-Ajax, *n.* An Army surface-to-air rocket missile, developed by Western Electric, Douglas, and Aerojet. Designed for use against bomber aircraft. Also called SAM-A-7.

Some 20 feet long without booster (about 31 with it), 1 foot in diameter, and 4 feet in span, this missile is boosted to supersonic speeds by a solid rocket and carried to target by a liquid sustainer, with range of 25 miles. A ground computer through a radar link guides the missile by radio command to intercept point. This missile is launched from a near vertical attitude. It is in service, but is to be, or is being, succeeded by Nike-Hercules. Cf. **Aspan**, *n.*

Ajax was a Greek hero next to Achilles in prowess and beauty.

Nike-Asp, *n.* A rocket research vehicle of the Nike family of rockets that carries cameras designed to photograph the eclipse of the sun.

Nike-Hercules, *n.* An Army surface-to-air, solid-rocket guided missile, developed by Western Electric, Douglas, and others. Also called SAM-A-25.

Some 27 feet in length without booster (41.5 feet with it), 2.5 feet in diameter, and a span of 7.5 feet, Nike-Hercules has a cluster of 4 solid booster rockets by Hercules and a solid sustainer by Thiokol. Its range is reported at 75 miles, and it can carry a nuclear warhead. For use against air-to-surface missiles and bomber aircraft, it is, or is to be, deployed for the defense of SAC bases and metropolitan areas. Its speed exceeds mach 3.

Hercules was a Greek mythological hero celebrated for his strength.

Nike-Zeus, *n.* A surface-to-air solid rocket missile under development as an interceptor of ICBM's.

This missile is reported to be far along in development, with Western Electric, Thiokol, and Douglas the principal contractors. It will be capable of carrying a nuclear warhead, with mach 7 speed, and range of 200 miles. Its powerplant is reported as developing 450,000 pounds of thrust. Test flight of 26 Aug 1959 failed.

Zeus is named after the Greek god, the supreme deity.

nitrogen tetroxide. A toxic liquid oxidizer, N_2O_4 , insensitive to shock and stable at room temperatures. See hydrazine, *n.*, note.

nitromethane, *n.* An oily colorless liquid compound (CH_3NO_2) used as a propellant.

Nitromethane when impure and under certain conditions of temperature and pressure will detonate faster than its flame speed. When used as a propellant it thus requires a special ignition system, being usually fired with a small amount of gaseous oxygen by a spark plug. Under a chamber pressure of 500 psi it will burn without added oxygen.

NM (*abbr.*) 'Nautical mile.'

node, *n.* Either of the two points where the orbit of an orbiting body intersects the plane of the orbit of its primary. Cf. *ecliptic, n.*

NOL (*abbr.*) 'Naval Ordnance Laboratory.'

nonpropulsive power system. A power system used to move or to give power to components within a rocket missile or vehicle.

NorAD (*abbr.*) 'North American Air Defense Command.'

NorADCom (*abbr.*) 'North American Air Defense Command.'

North American. Short for 'North American Aviation,' missile and aircraft contractor, as for Hound Dog, for the powerplants of Atlas, Thor, Jupiter, and Redstone, and for the F-108, and X-15.

North American Air Defense Command. (NorAD) A combined command established

in 1957 between the United States and Canada to coordinate the defenses of the continental United States, Canada, and Alaska against air and ballistic-missile attack.

The Continental Air Defense Command (ConAD) is a part of NorAD. See Air Defense Command, Alaskan Air Command.

North Atlantic Treaty Organization. (NA-TO) An organization of several nations in a treaty alliance for collective defense and the preservation of peace and security against aggression, organized in 1949.

The signatory nations to the North Atlantic Treaty are the US, Great Britain, France, Canada, Italy, Belgium, Luxemburg, the Netherlands, Norway, Denmark, Portugal, and Iceland. Greece, Turkey, and the Federal Republic of Germany were admitted as member nations after the original ratification of the treaty.

Inc., missile contractor, as for Snark.

Northrop, *n.* Short for 'Northrop Aircraft,

Nortronics, *n.* A division of Northrop.

nose cone. (NC) The cone-shaped leading end of a rocket missile or rocket vehicle, consisting (a) of a chamber or chambers in which a warhead, satellite, instruments, animals, plants, or auxiliary equipment may be carried, and (b) of an outer surface built to withstand high temperatures generated by friction with air particles.

In a ballistic missile, the nose cone is separated from the vehicle after thrust cutoff, and itself becomes the effective missile for striking the target. In a satellite vehicle the nose cone may become the satellite itself after separating from the final stage of the rocket, as with Sputnik III, or it may be used to shield the satellite until orbital speed is accomplished, then separating from the satellite by means of an explosive cartridge, as with Vanguard I. See **Jupiter, *n.***, note.

nose-cone building. A building at a launch base at which a missile's nose cone, separately delivered, is received and serviced.

nose-cone reentry. The reentry of a missile's nose cone into the atmosphere. See **Thor-Able, *n.***, note.

NOTS (*abbr.*) 'Naval Ordnance Test Station.'

Nova, *n.* A projected satellite vehicle of NASA, powered by liquid multistage rockets.

Depending upon the mission, Nova may have up to 5 stages, the 3rd and 4th reported as being of liquid hydrogen and oxygen, the 5th of storable liquid fuel. Rated total thrust would be 7,500,000 pounds, capable of placing a 75-ton vehicle in close orbit about the earth.

A 7-stage vehicle is also contemplated; this would include rockets for a moon soft landing, for a takeoff from the moon and reentry into the earth's atmosphere.

The word 'nova' normally applies to a star that suddenly shines more brightly than before, then after a period of months or a few years fades to its former brightness.

nozzle, *n.* A duct through which a fluid may

be directed into a jet stream, the velocity and shape of the stream being subject to control by the design of the nozzle; *specif.*, the exhaust duct of a rocket thrust chamber in which gases are accelerated to high velocities.

NRL (*abbr.*). 'Naval Research Laboratory.'

NSC (*abbr.*). 'National Security Council.'

nuclear airplane. A nuclear-powered airplane.

This airplane, with a capability of indefinite flight, could approach a target from any direction.

nuclear capability. A capability of a missile or aircraft to carry a nuclear warhead if desired.

nuclear energy. Energy held within the nucleus of an atom, released, in part, in certain isotopes by the process of fission, or in certain other elements by the process of nuclear fusion; *restrictive*, that part of this energy that is released by fission or fusion.

In nuclear fission, the energy released comes from the atomic nucleus being split, resulting in the emission of nuclear particles, such as neutrons, the alpha particle, or the beta particle. In nuclear fusion, the combining atomic nuclei fail to utilize their entire atomic mass in forming the new nucleus, the unused mass being converted into energy in accordance with the formula, $E = mc^2$, where E is the energy, m the mass, and c the velocity of light (299,796 kilometers per second). E. g., H^2 (2.014741) + H^2 (2.014741) $\rightarrow$ He^4 (4.003873) + .025609, the latter amount of atomic mass being the measure of released energy, about .7 percent of the original atomic mass.

nuclear fission. The splitting of an atomic nucleus, as by neutron bombardment.

Nuclear fission releases great amounts of energy manifested by thermal radiation, nuclear radiation, and blast.

nuclear fuel. A fuel that consists of a nuclear reactor controlled so as to produce a form of energy that can be used in an engine or motor.

nuclear fusion. The fusing together under intense heat of atomic nuclei, as those of the isotope deuterium, to form other nuclei.

In the fusion of deuterium into helium, a loss of weight occurs that results in the release of energy. See **nuclear energy**, note.

nuclear-heated propulsion. Propulsion by means of nuclear heat acting upon a working fluid.

nuclear missile. A rocket or other missile with a nuclear warhead.

nuclear-powered, a. Powered by an engine that utilizes atomic energy. Said of an aircraft, submarine, spacecraft, or the like. See **nuclear propulsion**.

Nuclear-powered submarines, as in the American Nautilus, Sea Wolf, and Halibut, are proved practical. Nuclear-powered aircraft are in research and development. *Aviation Week* (1 Dec 1958) reported the

probability that Russia had already built a nuclear-powered aircraft. Cf. **CAMAL program**, **Rover, n.**

nuclear propulsion. Propulsion by means of atomic energy.

Nuclear propulsion, for example, may utilize nuclear energy to provide heat, which may in turn be converted, in one way or another, to mechanical energy. Or nuclear propulsion may theoretically use a flow of nuclear particles. See **ion engine**.

The submarines Nautilus and Sea Wolf, for example, use nuclear propulsion.

nuclear reactor. An assembly of radioactive material at critical mass, controlled by the presence of certain other materials, used to produce other elements or isotopes or to generate heat.

nuclear rocket. A rocket in which the energy for the exhaust stream derives from nuclear fission or nuclear fusion.

This rocket may be designed to utilize a nuclear reactor to generate heat acting upon a supply of fluid material and ejecting it as a hot gas; or it may be designed to eject atomic particles directly from the reactor. See **ion engine**.

nuclear warhead. A warhead that consists of a fissionable charge or of a fusionable-fissionable charge.

nutation, n. *Astronomy.* A free but balancing motion of the earth's axis, in which its inclination to the plane of the ecliptic varies by a few seconds of arc, and the celestial poles describe wavy parallels about the poles of the ecliptic; any slight inequality in the motion of precession.

The constant of nutation for the earth is 9.21". *Lunar nutation* is a perturbation due to action of the moon, *solar nutation* due to change in the sun's declination.

O

Oberth, Hermann. A Hungarian-born German pioneer in rocketry theory.

Oberth (1894-) went to Huntsville, Alabama, to work with Wernher von Braun in the early 1950's. He is now in retirement and lives in Germany.

objective force structure. A postulated force structure of the Air Force or other armed service toward which the service works as it programs the development of its major units and equipment. See **force structure**.

OCB (*abbr.*). 'Operations Coordination Board.'

The OCB, organized in 1953 as a working group of the National Security Council, implements NSC policies.

OCR (*abbr.*). 'Office of coordinating responsibility.'

Oerlikon 54. A Swiss surface-to-air liquid rocket missile.

This missile is reported as having a speed of 1,026 mph, a range of 15.5 miles, a length of 19.7 feet, and a span of 4.25 feet. Its guidance is by beam riding. The training version is provided with a parachute to permit recovery.

open-sky inspection. An inspection against secret or sudden preparations for war, esp. atomic war, proposed to be carried out by reconnaissance flights over every nation's territory by duly authorized aircraft, either belonging to the United Nations or belonging to an authorized interested nation.

The proposal for open-sky inspection was made by President Eisenhower at the Geneva Conference on 21 July 1955.

open system. *Aviation medicine.* A system that provides for the body's metabolism in an aircraft or spacecraft cabin by leakage of waste from the cabin and by use of stored food and oxygen. Cf. **closed system**.

operational characteristic. A characteristic of a missile or aircraft significant to its operational capabilities. See **characteristic**, *n.* Cf. **feature**, *n.*

This term is not always skillfully used, being sometimes used where 'feature' would be preferred. The size of a propulsion unit, for example, is a feature, not an operational characteristic. On the other hand, a tendency on the part of a radio receiver to become jammed is a characteristic, not a feature. See **characteristic**, *n.*, **feature**, *n.*

operational launch site. A site for launching operational missiles.

operational missile. 1. A missile designed for use against an enemy target. Distinguished from a research missile or a development missile. 2. A missile that has achieved an operational capability for use against an enemy. See **initial operational capability**.

operational support. The support given a weapon or support system from those pieces of equipment, skills, techniques, and forces that come into play during operations but are not normally identified as components of the system.

opposition, *n.* The situation of a celestial body with respect to another celestial body (esp. the sun) when it lies in a direction 180° from the direction of the reference body (e.g. the sun), as viewed from the earth.

For example, Jupiter is in opposition when the earth is between it and the sun. It is in conjunction when the sun is between it and the earth.

OPR (*abbr.*). 'Office of primary responsibility.'

optical star tracker. A star tracker that locks onto the light of a particular celestial body.

Distinguished from a radiometric star tracker (which see). See **star tracker**.

orb, *n.* A spherical body, esp. a celestial sphere, as the moon, a planet, or a manmade satellite of that shape.

orbit, *n.* 1. The path described by a body in its revolution about another body, as by a planet about the sun or by a manmade satellite about the earth. Sometimes used without an article, as in *to put in orbit*, *to be in orbit* (said of an earth satellite). 2. The path described by a body moving in a parabolic or hyperbolic curve, or in one of its segments, as with a spacecraft traveling from one planet to another. See **parabolic orbit**, **transfer orbit**.

The orbit (sense 1) normally is an ellipse; thus, a line connecting the center of the orbiting body with the center of the primary body sweeps over equal areas in equal times. This means that the orbiting body moves fastest when nearest its primary body.

In sense 2, the orbit of a spacecraft bound from one planet to another would actually describe a resultant path itself made up of segments of other orbits about different spatial bodies.

orbit, *v.* 1. *intr.* Of a celestial body or manmade satellite: To revolve about another body. 2. *tr.* To go around the *earth* or other *body* in an orbit.

orbital bomber. A projected bombing vehicle with the capability of near-orbiting or orbiting speeds to allow the craft to circle the earth one or more times at very high altitudes and then glide back to base. Cf. **Dyna-Soar**, *n.*, **glide rocket**.

Rocket propelled, an unmanned version could do reconnaissance, a manned version bombing.

orbital curve. One of the tracks on a primary body's surface traced by a satellite that orbits about it more than, or less than, once a day in a direction other than due east or west, each successive track being displaced to the west by an amount equal to the degrees of rotation of the primary body between each orbit.

For example, Sputnik I on 11 October 1957 traced a track that ran roughly southeasterly from Newfoundland to the western tip of Africa, crossing the 40th parallel north at 0346 (EST). By the time the satellite had orbited once and had returned to the 40th parallel at 0522 (in a southeasterly direction) the earth had rotated several degrees eastward, so that the satellite's track now ran roughly from Portland, Maine, to the eastern part of Brazil. In 12 hours, when the earth had rotated half its rotational distance, the satellite's orbit passed in a northeasterly direction over the same general points on the 40th parallel that it had passed in a southeasterly direction 12 hours earlier.

orbital direction. The direction that the path of an orbiting body takes.

In the case of an earth satellite, this path may be defined by the angle of inclination to the equator. For a satellite that revolves about the earth several times a day, the compass direction of its passing over a given point will change because of the earth's rotation. See **orbital curve**.

orbital glider. A vehicle that achieves sufficient velocity at a high altitude so as to revolve about the earth a desired number of times before falling (or gliding) back to earth.

Cf. *Dyna-Soar, n., satelloid, n., sustained flight vehicle.*

orbital period. The period of time taken by an orbiting body to make a complete orbit.

The orbital period of *Mercury* is 88.0 days; of *Venus* 224.7 days; of the *earth* 365.3 days; of *Mars* 687.0 days; of *Jupiter* 11.86 years; of *Saturn* 29.46 years; of *Uranus* 84.02 years; of *Neptune* 164.8 years; of *Pluto* 247.7 years; of the *moon* 27 days, 7 hours, 43 minutes; of *Explorer I* about 114.5 minutes. Cf. **sidereal period**.

orbital velocity. 1. The relative average velocity at which an earth satellite or other orbiting body orbits. Cf. **separation velocity**. 2. The velocity of such a body at any given interval in its orbit, as in 'its orbital velocity at the apogee is less than at the perigee.'

When the orbital velocity is given at 17,000 mph, for example, this is considered to be in sense 1. The average orbital velocity of the earth is about 18.5 mi/sec; of the moon 0.649 mi/sec; of *Explorer I* about 5 mi/sec. As orbits get larger, required orbital velocities go down. The velocity required for a satellite near the earth is 4.82 mi/sec.

Orbital velocities are relative to their primary bodies. The moon, for example, has a second orbital velocity, in a sense, equal to that of the earth's, for it likewise orbits about the sun with the earth.

orbiting, a. Of a spacecraft: In orbit about the earth or other spatial body, as in 'an orbiting astronomical laboratory.'

OrDiR (abbr). 'Omnirange digital radar.'

Ordnance Missile Command (OMC) A major command of the Army charged esp. with research and development of missiles, the headquarters located at Redstone Arsenal, Alabama.

This command was established 31 March 1958 to give overall direction to both the Army Ballistic Missile Agency and Army Rocket and Guided Missile Agency, as well as over White Sands and the contracts with JPL.

organizational maintenance. With special reference to missiles: That maintenance on missiles that is performed by, authorized for, or made the responsibility of, a missile squadron.

This maintenance consists of assembly; of prelaunch and periodic inspections of missiles; of daily, minor, and postlaunch inspections of ground support equipment and other materiel; of removal and replacement of com-

ponents; of testing, isolating, and repairing of modules, components, and units.

Orion, n. *Project Orion*, a proposed ARPA project to develop a space platform to weigh several thousand tons.

Studies are reported as under General Atomic Division of General Dynamics. Cf. **Bold Orion**.

Orione Sar. An Italian rocket-propelled winged missile of limited range, surface-to-air.

oscilloscope, n. An electronic or mechanical-electric device for detecting and visually displaying changes occurring in an electric voltage or current. Sometimes called an 'oscillograph.'

One of the chief uses of an oscilloscope is that of an indicator in a radar set. Cf. **recording oscillograph**.

OSD (abbr). 'Office of the Secretary of Defense.'

OSTF (abbr). 'Operational system test facility.'

Otvazhnaya, n. [Russian 'Daring.'] The Russian name of a dog shot by Russian scientists into space on 2 July 1959 and recovered without apparent harm. See **Znezhinka, n.**

outer space. 1. In contexts of currently developing practical aerospace activities, the space above the earth's atmosphere, or above its effective atmosphere. 2. Space beyond the limits of the solar system, as in 'an intruding meteor from outer space.'

In sense 1, the first sputnik is said to have orbited in 'outer space,' but its orbit at 145 to 560 miles was well within the outer reaches of the earth's atmosphere. It was reported as falling when its perigee declined and reached 120 to 130 miles. See **Pioneer, n.**

overhaul, n. The disassembly, cleaning, inspection, necessary replacement or repair of parts, reassembly, adjustment, and testing of a piece of equipment, component part, or accessory, in accordance with applicable technical orders or other directives.

Overhaul, a function of depot maintenance, is always a large undertaking, but sometimes described by qualifying adjectives, as in 'major overhaul' or 'complete overhaul.'

overpressure, n. Specif. That pressure in excess of atmospheric pressure that results from the explosion of a nuclear bomb.

ox (abbr). 'Oxidizer.' Used only in reference to a rocket fuel oxidizer.

oxidant, n. An oxidizer.

oxidizer, n. (ox) A substance that combines with another to produce heat and, in the case of a rocket, a gas.

The oxidizer normally contains oxygen, or is itself oxygen, but it may be another substance, such as fluorine as used in an exotic fuel. Chemically, an oxi-

dizer increases the proportion of the electronegative part in a substance.

ozonosphere, *n.* A stratum in the upper stratosphere at an altitude of approximately 40 miles having a relatively high concentration of ozone and important for its absorption of ultraviolet radiation from the sun.

P

Pacific Missile Range. (PMR) A missile range on the Pacific coast with Vandenberg Air Force Base as the principal site for launchings, the missile range itself being the responsibility of the Navy to coordinate Air Force, Navy, and Army launchings, to provide instrumentation, and to assure safety factors.

The Pacific Missile Range combines three seaward ranges. Innermost is a range of 250 miles to 500 miles; the outer for ICBM's permits firings westward, south-westward, or southward; the midrange extends 1,500 miles in an arc from northwest to south. See **Atlantic Missile Range**.

Headquarters PMR is located at Point Mugu. See **Air Force Office, PMR**.

pad, *n.* A permanent, semipermanent, or mobile load-bearing surface upon which a missile launcher is placed. See **flat pad, launch pad**.

pad deluge. A deluge of water sprayed upon certain launch pads during the launch of a missile so as to reduce the temperatures of critical parts of the pad or missile engines. See **underdeck spray**.

paddlewheel satellite. A satellite, such as Explorer VI, that has solar vanes or other like-looking objects attached.

PAFB (*abbr.*). 'Patrick Air Force Base.'

Palomar, *n.* *Mount Palomar*, a mountain some 45 miles north-northeast of San Diego, California, 6,126 feet in altitude, and the site of Mount Palomar Observatory.

The observatory, operated jointly by the Carnegie Institution and the California Institute of Technology, has a 200-inch disk in its reflecting telescope. This disk is the largest in the world; it was installed in 1947-1948.

Pan American Airways. (PAA) An airline company under contract with the AF to operate the range facilities of the Atlantic Missile Range.

PAA, directly responsible for pad safety, fire protection, security, meteorology, range clearance, and other support services, subcontracts with the Radio Corporation of America for data-reduction services.

P & W (*abbr.*). 'Pratt & Whitney' Aircraft Division of United Aircraft Corporation, man-

ufacturer of powerplants, as for the Snark and Hound Dog.

parabola, *n.* A conic section made by an intersecting plane parallel to the side of the cone.

The parabola, unlike the circle or ellipse, does not return into itself, but extends to infinity. It has an eccentricity of one, hence representing the minimum value for an escape orbit.

parabolic orbit. An orbit shaped like a parabola, the orbit representing the least eccentricity (that of one) for escape from an attracting body.

parallax, *n.* The apparent displacement of an object, or the apparent difference in its direction of motion, if viewed from two different points.

The parallax of the moon and sun may be observed in the difference between their angular altitudes above the bubble horizon and their angular altitudes above the celestial horizon.

Parca, *n.* A French surface-to-air liquid rocket missile.

Parca has a range of 14 miles, a speed of mach 2. It uses 4 solid boosters.

parsec, *n.* A unit of measure for interstellar space equal to 3.26 light years.

The parsec has a heliocentric parallax of one second of arc.

part, *n.* 1. One of the constituents into which a thing may be divided. Applicable to a major assembly, subassembly, or the smallest individual piece in a given thing. 2. *Restrictive.* The least subdivision of a thing; a piece that functions in interaction with other elements of a thing, but is itself not ordinarily subject to disassembly.

passive satellite. A satellite without instrumentation.

Patrick Air Force Base. An AF base near Cocoa, Florida, once known as the Long Range Proving Ground Air Force Base, renamed for Major General Mason M. Patrick, who died in 1942.

Patrick Air Force Base, located on the Atlantic Ocean across the Banana River from Merritt Island (itself separated from the mainland by the Indian River), is some 18 miles south of Cape Canaveral. From this base, Headquarters Air Force Missile Test Center controls activities at Cape Canaveral. Cf. **Atlantic Missile Range**.

Patrick Henry. USS Patrick Henry, a projected nuclear submarine for carrying the Polaris. See **George Washington**.

pause, *n.* A boundary at the upper limit or limits of one of the atmosphere's strata, where the character of the stratum (as defined by a

given function) disappears. Used as a combining form, as in *aeropause*, *mesopause*, *stratopause*, and *tropopause*.

payload, n. 1. That which is carried in a rocket vehicle, aircraft, or other vehicle so as to obtain the results for which the vehicle is launched or driven. 2. The weight of this load.

In case of a rocket vehicle, the payload, expressed in weight, is over and above the weight of propellants, airframe, tanks, or nose cone. For a guided missile, it consists of the warhead intended to damage or influence the enemy; for a sounding rocket, it comprises the instruments, animals, or mechanisms sent aloft to obtain data (see *sounding rocket*); for a satellite rocket, it is the satellite or the instrumentation within the satellite. In the case of a commercial aircraft, the payload consists of the passengers and air cargo that produce revenue and does not include the crew. In the case of a bomber, the payload consists of the bombs carried or of the guided aircraft missiles carried, or of both, but not of machine gun ammunition or other defensive armament. In the case of a fighter, the payload consists of bullet ammunition, guided aircraft rockets, and other air-to-air weapons. In case of a reconnaissance rocket, the payload consists of the cameras, flares, radar, television, or the like carried in the rocket.

Peacemaker, n. The B-36.

Peenemünde, n. [Pronounced pay-nem-un-de] A small village on an island in North Germany at the mouth of the Peene River on the Baltic, used in WW II as a German missile research and testing station.

The V-2 was developed at Peenemünde.

Pencil, n. A Japanese solid test rocket, 9 inches long, 0.7 inch in diameter, and one-half pound in weight.

penetration missile. A supersonic missile, esp. a strategic missile, used to penetrate enemy defenses or enemy installations.

Pentagonian, n. An official who works in the Pentagon, either for one of the armed services or for the Secretary of Defense.

pentomic division. An Army division equipped with atomic weapons and consisting of five battle groups.

Organized about 5 battle groups instead of the traditional 3 regiments, the pentomic infantry division consists of 13,748 men as compared with 17,425 men in the conventional division. The pentomic airborne division has 11,486 men as compared to 17,097 men in the conventional airborne division.

perigee, n. That point in an earth satellite's orbit at which it approaches nearest the earth. Cf. *apogee, n.*, sense 1.

'Perigee' derives from the Greek *peri* near and *gaia* earth.

perigee speed. The speed of an orbiting body when at perigee. Cf. *apogee speed*.

The perigee speed of Sputnik I was 18,000 mph; of

Sputnik II, 18,000 mph; of Explorer III, 18,860 mph. The perigee speed of Explorer I is 18,400 mph; of Vanguard I, 18,400 mph; of Sputnik III, 18,337 mph; of Vanguard II, 18,379 mph.

perihelion, n. That point on a planet's or comet's orbit nearest the sun. Cf. *aphelion, n.*

The earth's perihelion is about 91,500,000 miles from the sun.

period, n. The interval of time required for a periodic motion to complete a cycle. See *orbital period*, *sidereal period*, *synodic period*.

periscope, n. *Specif.* An optical instrument used in a blockhouse to enable an observer to watch a missile launch as from the top of the blockhouse.

Pershing, n. An Army surface-to-surface solid rocket ballistic missile under development at Redstone Arsenal, with Martin the systems contractor.

Pershing, a two-stage rocket missile, named for General of the Armies John J. Pershing (1860-1948), is 30 feet in length in its first stage, somewhat shorter in its second. It is to be used tactically with selective ranges.

perturbation, n. A disturbance in the regular motion of a celestial body, the result of a force additional to that which causes the regular motion.

For example, the center of mass of the solar system approximates the center of the sun, but the center of mass moves with regard to the center of the sun in response to attractive forces of the planets. This movement introduces perturbations.

Petrel, n. A Navy air-to-underwater turbojet missile developed by Fairchild. Also called 'Mark 3 Model O.'

No longer in production, the Petrel is 24 feet long, 13 feet wide, and homes by radar as an underwater torpedo.

Philco, n. Short for 'Philco Corporation,' missile contractor, as for Diamondback and Sidewinder.

Phobos, n. The inner of the two moons of Mars.

Phobos, named after a Greek word meaning 'fear,' revolves in an orbit 5,800 miles from the center of Mars (some 3,700 miles from the surface), its orbital period being 7 hours, 40 minutes. Its diameter is about 10 miles. See *Martian satellite*.

phosphor, n. A substance, such as zinc sulfide, calcium tungstate, or naphthalene, that emits light when excited by radiation or ionizing particles. See *scintillating counter*.

photon, n. [Greek *photos* light.] *Physics.* A quantum of radiant energy. See *quantum, n.*

photon engine. A projected species of reaction engine in which thrust would be obtained

from a stream of light rays. Cf. *ion engine*.

Although the thrust of this engine would be minute, it may be possible to apply it for extended periods of time. In space, where no resistance is offered by air particles, very high speeds may theoretically be built up.

photon rocket. A photon engine; a rocket vehicle powered by a photon engine.

photosynthesis, *n.* Medicine. A process found in green plants in which carbohydrates are formed under the influence of light with chlorophyll serving as a catalyst.

Cf. *closed ecological system*.

picket ship. *Specif.* One of the ocean-going ships used on a missile range to provide added instrumentation for tracking or recovering the missiles.

The picket ship may be used to extend the length of the range.

Pied Piper. An early name for the Sentry project.

pilot, *n.* (plt) A person who handles the controls of an airplane, space-air vehicle, manned capsule, or spacecraft from within the craft, and in so doing guides or controls it in three dimensional flight.

See USAF Dictionary for other senses.

pilot, *v.* 1. *tr.* To operate, control, or guide an *aircraft, space-air vehicle, or spacecraft* from within the vehicle so as to move in three-dimensional flight through the air or the region above the earth. 2. *intr.* To engage in this activity.

Piloting an aircraft normally includes the action of takeoff and landing; piloting a space-air vehicle or spacecraft may come to be restricted to the control exercised during flight. Cf. *manned, a.*

piloted, *a.* Of a flying vehicle: Under, or subject to, continuous guidance by a person inside the vehicle.

This term is more specific than the term 'manned.'

piloted spacecraft. A spacecraft subject to control by a pilot.

pilotless aircraft. 1. An aircraft, such as a drone, unattended by a human pilot within it, but kept on course by a preset or self-reacting device or radio command. 2. A term formerly applied to a guided missile when being considered as a vehicle. See *guided missile, note, unmanned vehicle*.

pion, *n.* A pi meson. See *meson, n.*

Pioneer, *n.* 1. Any of the space probes launched under the research and development programs of the Air Force, Army, or Navy, under coordination of the National Aeronautics and Space Administration. See following

entries. 2. The project under which these probes are developed and launched.

Cf. *Discoverer, n., Explorer, n., Mechta, n.*

Pioneer I. A space probe launched at 0342 (EST) 11 October 1958 at Cape Canaveral by the AF Thor-Able rocket vehicle, intended as a lunar probe.

Pioneer I was launched at a velocity of 23,450 mph, which was short of the programmed velocity of some 24,000 mph. This resulted in the probe's failure to reach the vicinity of the moon. It attained an altitude of 71,300 miles, then fell back to the earth, plunging into the earth's atmosphere at 1100 (EST) on 12 October 1958. Cf. *escape velocity*.

The probe weighed 85 pounds, with a payload of instruments that reported back data on position and velocity, radiation and micrometeorites encountered, magnetic field measurements, internal temperatures, and Pioneer spin rate.

Pioneer II. An AF space probe that aborted at Cape Canaveral on 8 November 1958.

The Thor-Able II was the booster vehicle for this probe. The Thor and Vanguard stages performed perfectly, but the third stage failed to ignite. The probe achieved 16,000 mph and an altitude of 1,000 miles.

Pioneer III. A space probe launched at 0045 (EST) 6 December 1958 at Cape Canaveral carried by the Army's Juno II rocket vehicle.

Pioneer III, highly instrumented and weighing 13 pounds, was programmed to reach the moon's orbit or itself to go into orbit about the sun. It went, however, to an altitude of only about 65,000 miles, then fell back to the earth, entering the atmosphere over the bulge of Africa. Its signals reported clear in both the upward and downward flights, providing additional data on the space environment, directly useful in programming the flight of Pioneer IV.

Pioneer IV. A space probe, launched at 0010:30 (EST) 3 March 1959 at Cape Canaveral, that achieved a solar orbit.

This probe, a 13-pound gold-plated object, was launched by the four-stage Juno II. At separation the probe achieved a reported velocity of 24,791 mph. Some 41 hours 14 minutes after launch it passed by the moon at a velocity of 4,525 mph and at a distance from the moon's surface of some 37,000 miles. Traveling at about 3,380 mph at a distance of 406,620 miles from the earth it broke radio contact with the earth on 6 March.

Pioneer IV's orbital period about the sun is 392 days, its perihelion of 91,744,000 miles first reached on 17 March 1959, its aphelion of 105,829,000 miles. At perihelion, it is 1,168,000 miles inside the earth's mean orbit; at aphelion, it is 12,917,000 miles outside the earth's mean orbit. The orbital plane is but one-fifth of a degree off the plane of the ecliptic. Cf. *Mechta, n.*

Pioneer IV's instrumentations was designed by Dr. James Van Allen of Iowa.

pitch, *n.* 1. The movement of a missile about an axis that is at once perpendicular to the missile's longitudinal axis and horizontal with respect to the earth. 2. The movement of an aircraft about its lateral axis.

In sense 1, pitch occurs when a missile moves from

vertical flight to a direction other than vertical, or when the missile, in a nonvertical attitude, moves an end closer to or farther from the earth.

pitch, v. intr. Of a rocket missile or vehicle:

1. With *over*: To turn from a vertical direction. 2. With *up*: To turn toward a vertical direction. Said of a missile during ascent that corrects its trajectory from a nonvertical to a vertical.

pitchover, n. 1. The programmed turn from the vertical that a rocket takes as it describes an arc and points in a direction other than upward. 2. The point-in-space of this action.

pitchup, n. A correction movement of a missile in which it assumes a vertical ascent.

pj (abbr). 'Pulsejet.'

planet, n. A spatial body that revolves about the sun or other star; *specif.*, any of the bodies, except the comets and meteoroids, that revolve about the sun.

The *inferior planets* (those nearer the sun than the earth) are Mercury and Venus; the *superior planets* (those more distant from the sun than the earth) are Mars, the asteroids, Jupiter, Saturn, Uranus, Neptune, and Pluto; the *minor planets* are the asteroids, sometimes disregarded as planets because of their small size.

planetocentric, a. 1. Of or pertaining to a planet's center of mass. 2. Of or pertaining to a planet as the center of a system.

planetology, n. The study of planets and satellites, esp. in regard to the interpretation of their surface markings.

plasma, n. An electrically charged gas or body of gas, formed when the gas is subjected to very high temperatures. See *solar plasma*.

Plasma, a mixture of ions, electrons, and neutral particles, may theoretically be held in magnetic bottles for the production of thrust. The plasma of deuterium has already been used experimentally in fusion machines. See also *magnetohydrodynamics, n.*

plasma generator. A machine, such as an electric arc chamber, that will generate very high heat fluxes to convert deuterium or other gas into plasma.

plasma jet. A reaction engine jet stream generated by the discharge of plasma.

Plato, n. An Army surface-to-air transportable antimissile missile once under development, esp. for overseas defense, but announced as cancelled in February 1959.

plotting board. A board on which the movements of an object or objects are shown with reference to given coordinates or to fixed objects.

A plotting board may consist of a chart mounted flat, on which movement is shown by markers, or it may

consist of a screen that displays movement by electronic means.

plus count. In the test launch of a rocket, a count in seconds (*plus 1, plus 2, etc.*) that immediately follows T-time, used to check on the sequence of events after the action of the countdown has ended, and lasting until the rocket reaches target, makes impact with the surface on the missile range, or is destroyed.

Pluto, n. The sun's ninth planet, discovered in 1930.

The mean distance of Pluto from the sun is 39.46 astronomical units (about 3,666,000,000 miles). Its sidereal period is 247.7 years. Its eccentricity of .249 is the greatest of all the planets, and its inclination to the ecliptic is 17.1°, putting it at perihelion more than 800,000 miles from the plane of Neptune's orbit. Its mean diameter is believed to be about 4,000 miles.

PMR (abbr). 'Pacific Missile Range.' Used attrib., as in *PMR facilities*.

Pogo, n. The popular name for the VTOL Convair XFY-1, in allusion to the Pogo stilt.

'Pogo' is a trademark name in its original application.

Pogo booster. A rocket booster that launches a surface-to-air missile vertically.

point defense. The defense of a particular place, as of a city. Cf. *area defense*.

The Army is primarily responsible for the development, procurement, and manning of land-based surface-to-air missile systems for point defense, as with the Nike-Hercules.

Point Mugu. A point on the Pacific coast near Oxnard, California, the site of the US Naval Air Missile Test Center, and of the headquarters of the Pacific Missile Range. See *Air Force Office, PMR*.

POL-1. A Russian research rocket vehicle.

As reported in public sources, this rocket is 13 feet long, 0.9 feet in diameter, with a speed of 3,000 mph, and a ceiling of 10 to 15 miles. Its powerplant consists of 4 solid boosters, and 1 solid sustainer. Its payload is 8 pounds.

POL-2. A Russian research rocket vehicle.

As reported in public sources, this rocket is 22 feet long, 2 feet in diameter, with a speed of 4,000 to 5,000 mph, a thrust of 25,000 pounds, and a ceiling of 100 miles. Its payload is from 50 to 100 pounds.

Polaris, n. A Navy two-stage solid-rocket IRBM designed to be launched from a ship (subsurface or surface), being developed by Lockheed as the prime contractor, with Aerojet, Thiokol, General Electric, Sperry Gyro, and the Massachusetts Institute of Technology the chief associate contractors. Called the FBM.

Some 47 feet in length, 9.3 feet in diameter, with a speed of 6,000 mph, a gross weight of 14 tons, Polaris is to have a range of 1,500 nautical miles. A dummy of

the same size, shape, and weight as the Polaris was successfully ejected from underwater on 23 Mar 1958.

A 3,000-mile range version of the missile is reported as planned.

Five nuclear submarines, capable of launching the Polaris and under construction at the end of 1958 (with 4 additional authorized), can each carry 10 or more Polaris missiles. See George Washington, ship inertial navigation system.

The Polaris is considered to have a high degree of invulnerability. See invulnerability, *n*.

polar orbit. The orbit of an earth satellite that passes over or near the earth's poles. See Discoverer I, Discoverer II.

polyethylene, *n*. A chemically inert synthetic plastic that may be made into a flexible film for covering foods or machinery against moisture, but also for use as the skin of high-altitude research balloons.

Polyethylene is considered a practical material for construction of a sun glass for utilizing solar heat in spacecraft propulsion. Its property of inertness would make it durable in the presence of radiation.

polyurethane, *n*. A polymeric compound of urethane, used as a fuel in a solid propellant.

With its oxidizer, polyurethane has a relatively high specific impulse. It is reported to be a fuel considered for use in the motors of the Minuteman.

Pontus, *n*. A code word for an ARPA project aimed at radical improvement of structural and power conversion materials.

positron, *n*. A positively charged electron.

Positrons, first detected in a cloud chamber in 1934, are formed in beta disintegration and other processes.

postsputnik, *a*. Of or pertaining to time after the launching of the first manmade satellite, Sputnik I, 4 October 1957.

posture, *n*. The military deployment and disposition of a nation or force with respect to its readiness to attack or to react to threat or attack. Often used as the second element in combinations, as in *alert posture*, *defensive posture*, *strategic posture*.

The posture of a nation or force is taken or assumed in terms of its objectives (either offensive or defensive) and of its success in marshalling its resources in support of these objectives. See *space posture*.

powered flight. The flight of a missile vehicle or aircraft during the period or periods in which it is propelled by a self-contained engine.

powered missile. A missile that carries a propulsive unit. Distinguished from a bullet, grenade, or the like.

prelaunch test. A test of a rocket missile or vehicle made any time prior to an actual launch that may include a countdown and a flight readiness firing with the full operation

of the launch complex except for the actual expenditure of the rocket.

preliminary stage. A prestage (both senses). **pre-position, *v. tr*.** To place a *radio trailer*, *tracking station*, or other facility at a particular site in advance, ready for use during the flight of a missile, probe, or the like.

presputnik, *a*. Pertaining to time before the launching of the first manmade satellite, Sputnik I, 4 October 1957.

pressure suit. A garment designed to provide pressure upon the body so that respiratory and circulatory functions may continue normally, or nearly so, under low-pressure conditions, such as occur at high altitudes or in space without benefit of a pressurized cabin.

A pressure suit is distinguished from a pressurized suit, which inflates, although it may be fitted with inflating parts that tighten the garment as ambient pressure decreases.

pressurized cabin. A cabin in an aerospacecraft kept at, or designed to be kept at, an internal air pressure high enough to permit normal respiratory and circulatory functions of persons or other animals within it.

pressurized capsule. A capsule that has within it a gaseous pressure (as that of air) greater than the ambient pressure.

pressurized suit. A suit designed to be inflated so as to provide pressure upon the body. Cf. *pressure suit*.

prestage, *n*. 1. A step in the action of igniting a large liquid rocket taken prior to the ignition of the full flow, and consisting of igniting a partial flow of propellants into the thrust chamber. 2. The partial flow thus ignited.

Also called 'preliminary stage' in both senses.

primary, *n*. Short for 'primary body.'

primary body. The spatial body or central force field about which a satellite or other body orbits, or from which it is escaping, or towards which it is falling.

The primary body of the moon is the earth; the primary body of the earth is the sun. Cf. *central force field*.

primary evidence. In research, evidence that bears directly upon a point of fact, or upon the proof of an hypothesis. See *evidence, n*.

Primary evidence is normally the best evidence that can be related to proof.

primary responsibility. *Office of primary responsibility* (OPR), the office or organization responsible for a mission segment. Cf. *coordinating responsibility*, *mission segment*.

primary system. Any system, as within a mis-

sile, that stands in relationship to an auxiliary system or subsystem as the reason for the latter's function.

prime, *n.* Short for 'prime contractor.'

prime contractor. A contractor whose contract is directly with the government, and who is held responsible for the main development of a rocket or other piece of equipment. Distinguished from a subcontractor, and often called the 'contractor' for short or the 'systems contractor.' See *associate contractor*.

primitive atmosphere. The atmosphere of a spatial body as it existed in the early stages of its formation; *specif.*, the earth's atmosphere of 3 billion or more years ago, consisting of water vapor, carbon dioxide, methane, and ammonia gas (NH_3). Cf. *amino acid*.

Principia, *n.* A code word for an ARPA project to obtain a solid propellant of greater specific impulse than available in any solid propellant now known.

probe, *n.* A thing used to explore, examine, or test something, esp. a test sphere, earth satellite, or other instrumented vehicle used to penetrate outer space and made to report back information on conditions encountered; *specif.*, an instrumented vehicle that moves close to, around, or upon a spatial body, and reports back to the earth, by telemetry or by other means, such information about the body under surveillance, or about the conditions through which the probe is penetrating, as is obtained from the particular instruments used.

This term is often used as the second element in combinations, as in *Jovian probe*, *lunar probe*, *Martian probe*, *moon probe*, *solar probe*, or *space probe*. See separate entries.

probe, *v. tr.* To penetrate *space* or *atmosphere* with a probe; to explore, examine, or test a *spatial body* with a probe.

probe rocket. A rocket vehicle used as a probe; the rocket engine that propels a probe.

program, *v. tr.* 1. To put into an electronic guidance unit or other electronic sequencer a particular *event* or *action*, as in 'to program a roll.' 2. To set a sequence of operations into an electronic *sequencer*. 3. To provide for a series of events during a *flight* or other action, as in 'to program the flight for an early thrust cutoff.' 4. To establish an *undertaking* on such basis as to relate it to expressed objectives, and to provide means by which the undertaking can be carried out in accordance with a schedule.

programmed roll. An automatically controlled roll of a ballistic missile or space vehicle, usually executed during its vertical ascent before pitchover. See *roll, n.*

programmed turn. An automatically controlled turn of a ballistic missile or other rocket vehicle, as from a vertical flight path after liftoff to a curved flight path that leads to a desired trajectory at a desired velocity prior to thrust cutoff. Cf. *free-flight trajectory*, *pitchover, n.*

projectile, *n.* (proj) 1. An object projected by an applied exterior force and continuing in motion by virtue of its own inertia, as a bullet, bomb, shell, or grenade. 2. By extension, a rocket missile.

The extension of meaning to sense 2 has been gradual and unobserved by many writers. In the process, the term has lost sharpness, for the rocket missile is not projected by an exterior force, but carries its own fuel.

propellant, *n.* *Specif.* 1. The mixture of fuel and oxidizer (sometimes of an additive), either in a liquid or solid state, which when ignited in a combustion chamber changes into hot gases with a large increase in pressure, which gases, when released by means of a nozzle into a jet stream, cause a reaction opposite in direction to that of the jet stream, thus propelling the vehicle attached to the nozzle in the direction of the reaction. 2. The stream of hot gases thus released. 3. Any one of the separate ingredients that go into a liquid mixture of fuel and oxidizer, or of fuel, oxidizer, or additive. 4. Also applied to: a. The fissionable or fusionable substance that may be used as a source of energy in a reaction engine. b. The working fluid of a nuclear reactor.

In sense 3, see *bipropellant, n.*, *liquid propellant*, *monopropellant, n.*, *solid propellant*. In sense 4, see *atomic rocket*.

propellant utilization. (PU) The precise control over the mixture ratio of fuel to oxidizer in the firing of a liquid rocket; the subsystem that automatically provides this control.

propulsion section. 1. That part of a rocket vehicle that houses the propulsion system. 2. A propulsion system. Considered *loose* usage.

propulsion system. A major system of a rocket missile or vehicle that includes the engines, boosters, tanks, and all necessary associated equipment to ensure desired ground and in-flight engine operation, and to provide the thrust necessary to propel the missile through

all phases of powered flight. See *engine, n.*, *thrust, n.*

The propulsion system includes the vernier engines when used on a rocket vehicle.

propulsion system test. A test of a rocket's propulsion system to ascertain the reliability and functioning of the propellant feed system in its relation to the firing chamber.

protoplanet, n. Any of the sun's planets as it emerged or existed in the formative period of the solar system.

protosun, n. The sun as it emerged in the formation of the solar system, orbited by protoplanets.

Proxima Centauri. One of the two nearest known stars to the earth, about 4.3 light years distant.

The other nearest star, *Alpha Centauri*, is in the same constellation.

PRS (abbr). 'Pacific Rocket Society.'

psi or PSI (abbr). 'Pounds per square inch,' used esp. as a measure of overpressure.

pulsejet engine. A kind of jet engine of the athodyd group, having neither compressor nor turbine, but equipped with vanes in the front end which open and shut, taking in air to create power in rapid periodic bursts rather than continuously. Cf. *ramjet engine*.

Air is taken in by the pulsejet engine in two ways: by the forward motion of the engine as it moves through the air, and by suction caused by the creation of low pressure in the engine after each explosion. See V-1.

purge, v. tr. To rid a *line* or *tank* of residual fluid, esp. of fuel or oxygen in the tanks or lines of a missile after a test firing or simulated test firing.

pyrophoric fuel. A fuel that ignites spontaneously in air. Cf. *hypergolic, a.*

'Pyrophoric,' coined from the Greek, meaning 'fire bearing,' was in use as early as 1828.

Q

Q (code). 'Target drone.' Used as a prefix, as in *QB-17*, *QF-80*.

Quail, n. An AF air-to-surface diversionary missile in development by McDonnell and General Electric. Also called the *GAM-72* and 'Green Quail.'

The Quail, 13 feet in length, 5 feet in span, and 1.5 feet in diameter, is powered by a turbojet engine. Its range is reported at 200 miles with a speed just under sonic speed.

quality control. A control exercised over the selection and retention of persons performing

a function, or over the selection of a process or of a material, so as to assure that a service or product measures up to a desired standard.

quantum, n. A unit of radiant energy absorbed or emitted by an unrestricted atom.

An atom may absorb energy if subjected to outside radiation, an increase in temperature, electrical stimulation, or impingement by another particle. In this process, an electron of the atom jumps instantaneously outward from its normal orbit to another orbit, the distance jumped being proportional to the energy received in an integral number of quanta. If the energy received is great, as in a very high temperature, the electron may be lost to the atom, and the atom, with an excess positive charge, becomes ionized. In the case of an atom emitting energy, the electron falls instantaneously from an outer orbit to an inner orbit and loses one quantum of energy, emitting a wave of a length that depends on the distance it falls.

R

R (abbr). 1. 'Reconnaissance.' Used as a prefix letter in missile designations, as in *RM* or *RSM*. 2. 'Rankine scale.'

In *RSM*, the prefix indicates that a strategic missile has been modified to a reconnaissance configuration.

R-051. A French solid-rocket air-to-air missile used on the *Mirage* and *Voutour* fighters.

This missile has a speed of mach 1.5.

rabbit, n. The familiar long-eared mammal used in bioastronautic experiments.

The Russians sent a rabbit into space on 2 Jul 1959. See *Otvazhnaya, n.*

RADAR (abbr). 'Radio detection and ranging.'

radar, n. [See prec.] 1. Any of certain methods or systems of using beamed and reflected radio-frequency energy (radio waves) for detecting and locating objects, for measuring their distance, azimuth, or altitude, or for other purposes, such as navigating, homing, or bombing. See note. 2. The electronic equipment, sets, or devices used in any such system; a radar set.

In its original and principal application, 'radar' has reference to a method or system of detecting and finding the range of objects by means of beamed radio-frequency energy, the objects in the path of the beam reflecting part of the energy back to the source of transmission. The time interval between the transmission of the energy and the reception of the reflected energy establishes the range of any object in the beam's path, the reflected energy being displayed on a cathode-ray screen in such a manner as to indicate this information. In addition, many radar sets also display such information as azimuth, elevation, and direction of movement of the object. Radar functions irrespective of darkness or irrespective of most meteorological conditions.

The principal military use of radar has been in the detection and location of aircraft and missiles, but numerous other uses have arisen, e.g., in air navigation and air traffic control, in altitude measurement, in recon-

naissance and mapping, in bombing and homing, in storm detection, etc. In some applications, as in homing, radar beacons are used, which send out direct transmissions for reception and display on radar sets in the same manner as reflected energy.

In missilery, radar plays an important part as a tracking device.

The basic principle of radar, i.e., the property of radio waves to be reflected like light waves, has been known since the last century, but practical application of this principle was not made until 1924, when radio waves were used to determine the height of the ionosphere. Modern radar was developed by about 1935 in different countries, chiefly in the US and Britain. The first important military use of radar was early in WW II, during the Battle of Britain.

radar probing. The action of obtaining data on distant objects, esp. space bodies, by means of radar signals.

Radar probing of the moon was accomplished in 1946. In February 1958, scientists of the Lincoln Laboratory received echoes of radar signals sent to Venus, some 28,000,000 miles distant.

radar reconnaissance. Reconnaissance by means of radar.

This type of reconnaissance may be obtained by direct use of a radarscope carried by a manned aerospace vehicle, or it may be obtained by photoscope transmittal to readout stations monitoring a reconnaissance satellite.

RADC (abbr). 'Rome Air Development Center.'

radial velocity. The velocity of approach or recession between two bodies, esp. between an observer and a source of radiation, in a line connecting the two.

The magnitude and direction of radial velocity is determined by applying the Doppler-Fizeau principle.

radiant energy. Energy that travels as a wave motion, as with radio waves, infrared rays, visible light, etc.

radiation, *n.* 1. The emission and propagation of energy or matter. 2. That which is radiated: a. Energy traveling as a wave motion; *specif.*, the energy of electromagnetic waves, as of gamma rays, X rays, ultraviolet rays, visible light, infrared rays, and radio waves. b. Radiant particles, such as alpha rays or beta rays.

In sense 2a, see **Lyman-alpha radiation**. In sense 2b, see **corpuscular radiation**.

radiation belt. A layer of trapped charged particles that surrounds a spatial body, esp. such an extent above the ionosphere reaching out into space. See **Van Allen radiation belt**.

The configuration and intensity of the earth's radiation belt or belts are being explored by earth satellites and by space probes such as the Pioneer probes. The charged particles in these belts constitute one of the hazards to man in man-in-space projects.

Two belts are well delineated about the earth. Each belt observed is shaped like a crescent in cross-section, with greatest excitement opposite the equator, and little

excitement at the poles. The inner belt is some 600 miles above the earth and reaches its maximum intensity at 4,000 miles, dropping to a minimum at 6,000 miles. The outer belt gradually rises to its greatest intensity at 11,500 miles, then slowly peters out.

Note. The term **radiation belt** is a misnomer, since the particles are trapped, not radiating. The particles, however, are in motion back and forth, with energies from about 20,000 volts to several million.

radiation medicine. A special branch of aerospace medicine concerned with the protection of health and life against the effects of radiation encountered in the upper atmosphere and outer space.

radiation particle. A particle of matter, as an atomic nucleus, that has been radiated at high velocity from a given source.

radiation pressure. The pressure exerted upon a surface exposed to radiation.

The pressure of the sun's radiation upon the earth is small, about 2 pounds to the square mile.

radiation reflector. Anything that reflects radiation; *specif.*, a projected balloon-shaped satellite that would serve to reflect radio waves back to the earth.

A number of these reflectors placed in orbit at correct positions are considered a more reliable means of radio-wave reflection than that provided by the ionosphere.

radio, *n.* (rad) 1. The use of electromagnetic waves to transmit or receive electric impulses or signals without a connecting wire; the transmission or reception of such impulses or signals: See note. 2. *Specif.* The use of these waves to transmit electric impulses excited by the voice or other sounds or by nonauditory instruments at frequencies below those normally used in radar or television. See note. 3. Any aggregate of electric and electronic equipment used for the wireless transmission or reception of electromagnetic waves, or both, esp. for transmitting and receiving sounds, activating remote-control mechanisms, etc.; a radio set. 4. A manner or technique of doing something by means of, or with the aid of, radio (in sense 2), as communicating, navigating aircraft, controlling, etc., as in the phrases 'the units communicate by radio,' or 'the missile was guided by radio.' 5. A message sent by radio. *Colloq.*

In sense 1, the word 'radio' is broad enough to include wireless television and radar, and is sometimes used in this broad meaning, esp. in combinations. However, 'radio' is more often used, both by itself and in combinations, in sense 2, 'radar' being used in reference to a specific kind of radio operation.

The chief distinctions between radio (in sense 2) and radar lie in the method of transmission and reception of electromagnetic waves, their utilization, the purposes

involved, and the frequencies normally used by each one. Radar frequencies are generally higher than those used for radio communication.

Heinrich Rudolph Hertz (1857-94) first accomplished the transmission and reception of radio waves, with a simple, spark-producing transmitter and a loop antenna, in 1887; radio communication (radiotelegraphy) was achieved by Guglielmo Marconi (1874-1937) in 1896. The earliest instance of the use of radio in aeronautics appears to have been in 1908, when messages were sent from the ground to a radio-receiving set in a US Signal Corps free balloon. Successful one-way and two-way radio-communication experiments in the US between ground and airplane were carried out during the period 1910-11. Aircraft radio direction-finding and air-to-air radio communication were developed during WW I.

radio astronomy. Astronomy that utilizes radio waves, esp. the radio waves emitted by certain celestial bodies as a means of obtaining data. Cf. *radio telescope*.

radiobiology, *n.* A branch of biology concerned with the effects produced on living organisms by radiation.

radio command. A radio signal to which a guided missile, drone, or the like responds.

Radio Corporation of America. (RCA) A subcontractor at the AFMTC responsible for data reduction. See *Pan American Airways*.

radio ear. A radio telescope. *Slang.*

radio-guidance system. A guidance system that uses radio signals to guide a flightborne missile or vehicle, the system including both the flightborne equipment and the guidance station equipment on the ground.

radiometer, *n.* An instrument that detects, and measures the intensity of, thermal radiation, esp. infrared radiation.

radiometric star tracker. A star tracker attuned to the thermal radiation of the celestial body being tracked.

radiometric sun tracker. A sun tracker attuned to lock upon the thermal radiation of the sun. See *track, *v.**, sense 2.

Radioplane, *n.* Short for 'Radioplane Division,' a subsidiary of Northrop, and missile contractor, as for the missile target drone XQ-4.

radio sun. The sun as revealed by a radio telescope, its limiting boundary being indefinite, not sharp, but its diameter about twice that of the visible sun. See *radio wave*, note.

The radio waves emitted from the sun are short waves.

radio telescope. A radio receiving station for detecting radio waves emitted by celestial bodies or by space probes in space.

The largest radio telescope is at Jodrell Bank near Manchester, England. Its receiver, paraboloidal in shape, some 250 feet in diameter, 60 feet deep, participated in tracking Pioneer probes. An even larger radio telescope with 3 times the receiving area is projected by the University of Illinois. Cf. *Goldstone Tracking Facility, Millstone Hill, Smithsonian Astrophysical Observatory*.

radio torpedo. A guided missile controlled by radio command.

This term was sometimes used prior to WW II. See *guided missile*, note.

radio trailer. A trailer vehicle equipped as a radio transmitter, as for giving radio commands to a lunar probe or rocket missile.

radio transmitter. An electromagnetic device that transmits electric impulses at frequencies below those normally used in radar or television.

The impulses may be excited by nonauditory instruments, as in the minitransmitters of an earth satellite, or by the voice or other sounds. In Explorer I, for example, two radio transmitters were installed. One of these operated on a frequency of 108 megacycles, at a power of 10 milliwatts; it went dead on 23 May 1958. The other transmitter, operating on higher power, went dead some time earlier. Both transmitters emitted tracking signals for minitrack stations around the world. Cf. *transistor, *n.**

radio wave. 1. An electromagnetic wave with a length of from 30 kilometers to less than 1 centimeter, or with a frequency from 10 to more than 30,000,000 kilocycles. **2.** One or other such wave used in radio communications, as in standard broadcasting with a frequency from 535 to 1,605 kilocycles.

The radio wave travels with the velocity of light, and differs from a light wave in being of greater length. Since Jansky's discovery in 1931 that radio waves reach the earth from sources both outside the solar system and from the sun, they have become means of discovering and locating celestial bodies or structures. The radio waves that penetrate through the atmosphere range in length between more than 20 meters to less than a centimeter. Were our eyes sensitive to these wave lengths, the sun would appear more than twice as large in diameter. Radio waves may be detected in daylight or under cloud cover.

radio window. The means for viewing the skies through a radio telescope.

radome, *n.* [*Radar plus dome.*] A protective dome or domelike covering for a radar antenna and sometimes for other radar equipment, such covering being pervious to radio-frequency radiation.

RAE (*abbr.*) 'Royal Aircraft Establishment' of the United Kingdom.

ramjet engine. A kind of jet engine consisting essentially of a tube open at both ends in which fuel is burned continuously to create a jet

thrust, and having neither a compressor nor turbine, the air for oxidizing the fuel being rammed into the engine as the engine moves forward.

The terms 'ramjet' and 'ramjet engine,' as applied to the type of athodyd that is open in the front at all times, exclude the pulsejet engine. The pulsejet engine can operate statically after an initial ramming action, and does not burn fuel continuously. See **pulsejet engine**.

Ramo-Wooldridge. Short for 'Ramo-Wooldridge Corporation.'

Ramo-Wooldridge Corporation. (RWC) A formerly organized private corporation, located in Inglewood, California, which carried out the overall systems engineering for the USAF as technical advisor to the Air Force Ballistic Missile Division of Headquarters ARDC. Now *hist*.

Ramo-Wooldridge, through its Space Technology Laboratories, was advisor to the USAF in its technical dealings with associate contractors. It merged with Thompson Products Company, Inc., on 31 Oct 1958 to form Thompson Ramo-Wooldridge, Inc. See **Space Technology Laboratories**.

range, n. (rg) 1. The capability of a rocket missile that indicates how far it can fly or be projected, measured either horizontally from takeoff point to impact point (as with a ballistic missile), or on a straight line between takeoff point and a flightborne target. 2. The capability of a radio transmitter that indicates how far its signals can effectively be sent; the capability of a radio receiver that indicates how far it can effectively detect a radio signal; the capability of a radar set that indicates how far it can effectively detect an object of interest. See note. 3. The capability of a base, launching site, or other place that indicates how far its influence may be felt through the missiles it may launch, through the use of radar, or through other like extensions, as in 'the eastern continent is within the range of the missile base.' 4. A marked off course or area for testing the flight of missiles. See **instrumented range, missile range**. 5. A bombing or gunnery range.

In sense 2, the distance that measures the capability is horizontal, vertical, or on a slant. Context usually indicates which is meant; to distinguish, however, 'horizontal range' and 'slant range' are used. The latter includes the notion of vertical range.

The word 'range' is a term that has many shades of meaning. See the USAF Dictionary (1956) for their analysis.

range safety officer. *Specif.* An officer in Central Control at a missile range responsible

for safeguarding ocean traffic, air traffic, and areas adjacent to the range against the hazards of missile flight.

Besides notifying air traffic control centers long enough in advance before a launch so as to divert air traffic inland, and besides clearing the expected impact area of ocean traffic, the range safety officer watches at a console the course of the missile during the short period of its powered flight, ready to destroy it if its predicted impact point should go beyond the destruct line. See **impact predictor system**.

range surveillance. The surveillance of a missile range by means of electronic and other equipment.

Rankine scale. [After W. J. M. Rankine (1820-1872), Scottish physicist.] ($^{\circ}\text{R}$) A temperature scale that uses Fahrenheit degrees, but makes the zero degree signify absolute zero.

In the scale, water freezes at 491.69 degrees, and boils at 671.69 degrees. Cf. **Kelvin scale**.

Rascal, n. An AF air-to-surface liquid rocket guided aircraft missile, developed by Bell. Also called GAM-63. See **Hound Dog**.

Some 32 feet long, 4 feet in diameter, and fin-span of about 14 feet, Rascal has a 100-mile range, and a speed of mach 1.5. It is carried to launch point by a strategic bomber (see B-47). Its guidance is by radar. Its powerplant is a three-chambered rocket engine. It may carry a nuclear warhead.

RAT (abbr). 'Rocket assisted torpedo.'

Rat, n. A Navy antisubmarine solid-propellant rocket-assisted torpedo, developed by the Naval Ordnance Test Station.

In length 13½ feet and weighing 480 pounds, Rat has a range of about 5 miles. Its guidance is acoustical. It may be air-launched.

Propelled in the air by a rocket, which is dropped upon its being spent, the torpedo continues on trajectory. Carried down to water by a deployed parachute, it releases the parachute, sheds a nose cap, and searches out, by means of an intricate homing device, its submarine target. Rat contracts are cancelled.

rate receiver. A guidance antenna that receives a signal from a launched missile as to its rate of speed.

rate transmitter. A guidance antenna that signals the desired rate of speed for a missile in flight after launch.

rato, n. ['Rocket assisted takeoff.'] 1. A take-off assist by a booster rocket unit normally using dry fuel. 2. The power unit used in such a takeoff.

rato unit. A rocket motor or cluster used esp. to assist an airplane in takeoff; also used as a first step in the takeoff of a rocket vehicle, as in the Aerobee.

Raven, n. A Navy air-to-surface missile under

research and development. Also called the XASM-9.

Raytheon, *n.* Short for 'Raytheon Manufacturing Company,' missile contractor, as for Hawk.

razon, *n.* [Range plus *azon*.] A WW II bomb with control surfaces in the tail providing a means of control by radio signals in range and azimuth. Cf. *azon, n.*

The 6-ton *razon* was called the 'Tarzon' or 'Tarzan.'

RCA (*abbr.*) 'Radio Corporation of America.'

reaction engine. An engine or motor that derives thrust by expelling a stream of moving particles (or quanta, theoretically) to the rear.

This engine works in accordance with the third law of motion, i.e., every action produces an equal and opposite reaction. Jet engines, rocket engines, ion engines, photon engines are species of the reaction engine. Another reaction engine is reported in development—one that will utilize free radicals (which see) as a propellant.

reaction motor. A reaction engine, esp. one that is comparatively uncomplicated in design or operation.

Reaction Motors. Short for 'Reaction Motors, Inc.' or for 'Reaction Motors Division of Thiokol Chemical Corporation.'

reaction time. *Specif.* The elapsed time between a command to launch a missile and the actual launch.

Considered to be an attribute of a weapon or weapon system, as in 'the reaction time of the Thor is such as to make a counterattack effective.' Cf. *firing time*.

read, *v. tr.* To read out, to report data on air pressure, temperature, dew point, radiation, etc. Said of a radio transmitter, as in a radio-sonde or an earth satellite.

readout, *n.* The action of a radio transmitter transmitting data either instantaneously with the computation of the data or by play of a magnetic tape upon which the data has been recorded. See *instantaneous readout*.

readout station. A recording or receiving radio station at which data is received as the transmitter in a missile, probe, satellite, or other spacecraft 'reads the data out.'

The data transmitted may be by instantaneous readout or by play of a magnetic tape on which the data has been stored in the missile, probe, satellite, or other spacecraft.

The same station may serve as both a tracking station and readout station.

ready status. *Specif.* The status of a missile on a launcher, in or out of shelter, readied with propellants for immediate launch. Cf. *alert status*.

real time. Time in which reporting on events

or recording of events is simultaneous with the events.

For example, the real time of a satellite is that time in which it simultaneously reports its environment as it encounters it; the real time of a computer is that time during which it is accepting data.

receptor, *n. Medicine.* A sensory nerve ending that receives physical and chemical stimuli.

reclamation, *n. (reclm) Specif.* The act or process of recovering serviceable equipment or components from damaged, unserviceable, or excess material, depending upon the factors of economy and feasibility.

Reclamation includes inspection, classification, disassembly, cleaning, handling, and shipping, but is ordinarily not construed to include repair.

reconditioning, *n.* The process by which any piece of equipment made unserviceable through fair wear and tear is restored to a condition of complete operational serviceability.

Reconditioning includes compliance with all applicable technical directives, complete disassembly, necessary rework, subassembly, final assembly, adjustment, and testing.

reconnaissance by fire. A method of reconnaissance in which fire is placed upon a suspected enemy position to cause the enemy to reveal his presence by returning the fire.

reconnaissance missile. (RM) A tactical, strategic, or interceptor missile used for reconnaissance.

The technique of use may be by electronics or by fire. Cf. *electronic reconnaissance*.

reconnaissance satellite. An earth satellite designed to obtain strategic and other information on a possible aggressor, as through photography, television, etc.

recording oscillograph. An oscilloscope that leaves a record of its readings.

recover, *v. tr. Specif.* To repossess a *rocket vehicle* or one of its *parts* after flight.

recoverability, *n.* A property built into a test vehicle or one of its components that permits it to be located after flight, repaired if necessary, and used again.

Recoverability is an object of research and development predicated on the necessity of saving materials, time, and effort. Cf. *reliability, n.*

recoverable, *a.* 1. Of a rocket vehicle or one of its parts: So designed or equipped as to be located after flight and recovered with or without essential damage. 2. Of an unserviceable piece of equipment or component: Subject to being returned to serviceable condition through repair or maintenance.

recoverable target. A target drone designed

to survive and be recovered if hit. Cf. **de-structible target**.

recovery, n. Specif. 1. The procedure or action that obtains when the whole of a satellite, or a section, instrumentation package, or other part of a rocket vehicle is recovered after a launch; the resultant of this procedure, as in 'recovery was counted upon to give added data.' 2. The event that marks the repossession of something that for a time has not been possessed or held.

recovery capsule. A capsule designed to be recovered after reentry. See **reentry vehicle**.

recovery gear. The devices and gadgets used to mark and locate a nose cone or other part of a rocket vehicle after impact.

recovery package. A package attached to a reentry or other body designed for recovery that contains devices intended to locate the body after impact.

This package may, for example, release a balloon that will buoy up a reentry body (if it impacts in water) and serve as a radio beacon or light.

recycle, v. 1. *intr.* In a countdown: To stop the count and to return to an earlier point in the countdown, as in 'we have recycled, now at T minus 80 and counting.' Cf. **hold, v.** 2. To give a completely new checkout to a missile or other object.

recycling inspection. A periodic inspection of missiles held in alert status. See **cycle check-out**.

Redeye, n. An Army bazooka-type missile under development by Convair, for defense against low-level flying aircraft with infrared guidance.

red flag system. In programming the development of a ballistic missile, a system whereby a contractor alerts BMD if he anticipates a delay in his schedule.

red shift. A displacement toward the red in the spectra of extragalactic nebulae that indicates a recession of the structures involved.

The greatest observed red shift, if a Doppler phenomenon, indicates a speed of 38,000 miles per second. This is part of the evidence for the theory of an expanding universe. See **Doppler-Fizeau principle**.

Redstone, n. An Army surface-to-surface medium-range, liquid-rocket, supersonic missile developed by the Army Ballistic Missile Agency.

Named for Redstone Arsenal, the Redstone is about 63 feet long, 6 feet in diameter, with a range in excess of 200 miles, and a thrust of 75,000 pounds. Its manufacturer is Chrysler, with Rocketdyne responsible for

propulsion and Ford Instrument for inertial guidance. Used both as a research rocket and an operational missile, it is to be replaced in its latter role by Pershing. See **Jupiter C**.

Redstone Arsenal. The installation and facility at Huntsville, Alabama, headquarters of the Army Ordnance Missile Command.

reentry, n. The event occurring when a ballistic missile or other object comes back into the sensible atmosphere after being rocketed to altitudes above the sensible atmosphere; the action involved in this event. *Attrib.*, as in **reentry problem**.

reentry body. That part of a ballistic missile or other body that reenters the atmosphere after flight above the sensible atmosphere.

reentry nose cone. A nose cone designed esp. for reentry, consisting of one or more chambers protected by an outer shield. See **heat sink, nose cone**.

reentry trajectory. That part of a missile's trajectory that begins at reentry and ends at target or at the surface.

If the missile is unguided at reentry, its reentry trajectory is ballistic in character.

reentry vehicle. That part of an orbiting satellite or other space vehicle that carries something back into the atmosphere.

The reentry vehicle may be the entire space vehicle, or only a part of it. With Discoverer II, for example, the reentry vehicle weighed 195 pounds, the recovery capsule 160 pounds.

Reeves, n. Short for 'Reeves Instrument Corporation,' missile contractor, as for guidance components.

reflector satellite. A satellite so designed that radio or other waves bounce off its surface.

A reflector satellite may be passive or active. See **passive satellite**.

regenerative cooling. The cooling of a rocket engine by circulating the fuel or oxidizer fluid in coils about the engine prior to use in the combustion chamber.

regenerative engine. A liquid rocket engine cooled by regenerative cooling.

Regulus I. A Navy surface-to-surface subsonic turbojet winged missile, developed by Chance Vought and the Bureau of Aeronautics. Also called the SSM-N-8a.

Some 33 feet long, 4.5 feet in diameter, and a wing span of 21 feet, Regulus I has a range of 500 miles and a speed of mach 0.9. Its Allison turbojet engine develops 4,600 pounds of thrust; its two solid boosters have a thrust of 33,000 pounds each. Its Sperry guidance is by command. Its warhead may be nuclear. Regulus I, fired from a ship's deck by means of a rail launcher, is superseded by more advanced systems.

Regulus II. A Navy surface-to-surface supersonic turbojet winged missile, developed by Chance Vought and the Bureau of Aeronautics. Also called the SSM-N-9a.

Some 57 feet long, 6 feet in diameter, and a wing span of 20 feet, Regulus II has a range of 1,000 miles and a speed of mach 2. Its General Electric turbojet engine (J79) develops a thrust of 15,000 pounds; its Aerojet solid booster about 100,000 pounds. Its AC guidance system is by command or inertial. It is launched from submarines, aircraft carriers, cruisers, and shore bases. With a landing gear it is recoverable. Its warhead may be nuclear.

Although a successful test firing was made from a surface ship on 10 Dec 1958 off Point Mugu, the Navy announced a cancellation of the Regulus project on 18 Dec 1958.

relay station satellite. An artificial earth satellite designed and equipped to receive radio signals from the earth, then rebroadcast them on command to other receiving stations.

The Atlas satellite of 18 Dec 1958 demonstrated the practicability of the relay station satellite for communications purposes.

reliability, *n.* A quality or property built into, or inherent in, a thing that indicates that the thing will probably perform its specified function without failure under given conditions for a specified period of time.

Reliability is an attribute or property of a physical object, a process, system, organization, or person. It is measured in terms of its degree of probability, and is an objective sought after preliminary to effective military planning.

reliability research. Theoretical or applied research undertaken to obtain data on the reliability of a piece of equipment.

This research includes the development of test equipment to test test equipment.

reliability testing. Testing aimed at achieving a high degree of reliability in the functioning of the object being tested.

remaining body. That part of a missile or vehicle that remains after the separation of a fallaway section or companion body.

In a multistage rocket, the remaining body diminishes in size successively as each section or part is cast away and successively becomes a different body. With a missile, the ultimate remaining body is that which impacts the target; with a satellite vehicle the ultimate remaining body is the satellite, sometimes separated from the nose cone.

remaining mass. The mass of a rocket missile or vehicle after separation of fallaway sections and afterbodies and after the expenditure of fuel; *specif.*, the payload remaining. Cf. mass ratio.

remote velocity. The velocity of an object taken as a whole relative to the surrounding fluid at a point undisturbed by the moving

object. Distinguished from the local velocity of any of the object's parts.

In transonic flow, the remote velocity of an object may be less than mach 1, whereas the velocity of a local point relative to the fluid flow may be mach 1 or greater.

rendezvous, *n.* (rdvu) 1. The event of two or more objects meeting at a preconceived time and place. 2. The point in space at which such an event takes place, or is to take place.

A rendezvous would be involved, for example, in servicing or resupplying a space station; also in a spacecraft's arrival at a point so as to meet an oncoming spatial body, such as a planet or moon.

See USAF Dictionary for other meanings.

renegotiation, *n.* Specif. An adjustment in the terms of a government contract after the contract has been in effect for a period of time, so as to eliminate excessive profits by the contractor.

Renegotiation is conducted by the Renegotiation Board (established by Act of Congress in 1948) with any individual contractor whose receipts or accruals are in excess of \$1,000,000 for a fiscal year. Adjustments are made by agreement. If agreement cannot be arrived at, the contractor may appeal the Board's decision to the Tax Court of the US. See article in *Armed Forces Management*, May 1959, pp 22-26.

repair, *n.* (rep) 1. The restoring of damaged, worn, or malfunctioning materiel to a previously serviceable, usable, and acceptable condition. 2. The restoring of a plant, building, structure, ground facility, or utility system to a condition substantially equivalent to its original or to its designed condition.

In sense 1, repair normally involves disassembly, necessary rework, assembly, adjustment, and test of the object being restored, together with the test of related support equipment, modules, and auxiliary units.

research, *n.* (rsch) 1. A process by which something is sought out, esp. by systematic effort; a gathering and a close examination of data with a particular object of discovering something, making something, or understanding something; a studious inquiry given direction by a purpose. 2. In the conception, design, growth, and prototype manufacture of a rocket, weapon system, or other complicated object: That phase or aspect of the process that provides the basic design and the basic principles considered to be practicable and applicable to the purpose in mind. See note.

The term 'research' (sense 1) is a broad term. It embraces, in one instance, the activity involved in collecting hitherto unknown or undetected data by any method of investigation, as by running a series of experiments, by uncovering relics or records, or by making observations through reading written records; or it may embrace a second step in this activity, that of classifying collected data, analysing and evaluating it, or developing

principles or hypotheses out of it. This activity is called 'basic research,' because it deals with primary evidence and provides new knowledge and new understandings. See **basic research**.

In another instance, research may apply to the mental and physical activity involved in making something concrete to exemplify some principle or to put knowledge gained in basic research to a practical purpose, as in the research done to build an airplane. This research is called 'applied research.' Often basic research and applied research go hand in hand, applied research being used to test the validity of the basic research and in doing so becoming a part of the basic research process. See **applied research**.

In another instance, research may apply to the activity of a student who searches out from secondary sources those materials that he wishes to use for his own understanding or for a written paper. This research opens up no new facts or principles, but for the student it instructs in methodology and provides for systematic learning. It may be called 'inquisitive research.'

Thus, depending upon the purpose, research may be basic, applied, or inquisitive or self-educative. But this same research, whatever its purpose, may also be characterized by the places where it is performed, as in 'laboratory research,' 'library research,' or 'field research.' Or it may be characterized by reference to the people who do the research, as in 'student research' or 'professional research'; or characterized by the nature of the subject matter in which the research is done, as in 'electronic research,' 'technical research,' 'historical research,' 'literary research,' or 'atomic research.' See **scientific research**.

In sense 2, research is often used in the phrase 'research and development.' In this context it may be basic or applied research, and the point at which it is differentiated from development is often a fine one. In general, however, research provides the basic concept, principles, and design, and establishes their practicability, whereas development carries the concept and design through to a physical product. The two processes may, of course, be more or less simultaneous, or development may be sequential to research. Cf. **state-of-the-art**, *a*, sense 3.

research missile. A missile used as a test vehicle, either to obtain data on its own performance or to obtain data on equipment carried by it. Cf. **operational missile**.

research rocket. A rocket vehicle used to determine the validity or reliability of data and equipment being developed.

research vehicle. A contrivance that carries something used to obtain new data or to confirm old, esp. data about the environment through which the vehicle passes.

The high altitude sounding rockets sent to the upper atmosphere are examples of research vehicles. See **Aerobee**, *n*. The satellites are also, in effect or purpose, research vehicles. Cf. **flight test vehicle**, **test vehicle**, *note*.

restricted propellant. A solid propellant with restricted surfaces exposed for burning, the other surfaces being covered by an inhibitor. See **inhibitor**, *n*.

Other expressions are related to this usage, such as *restricted burning*, *restricted charge*.

RETL (*abbr*). 'Rocket Engine Test Laboratory.'

retrograde motion. Orbital motion opposite in direction to that normal to spatial bodies within a given system.

retrorocket, *n*. [Latin *retro* backward.] A rocket that gives thrust in a direction opposite to the direction of an object's motion, used to slow down the speed of the object or to separate a fallway section or companion body from the remaining body.

The retrorocket may be utilized in overcoming the reentry problem.

Although a propulsion unit, a retrorocket is not considered a part of the propulsion system.

reverse thrust. Thrust applied to a moving object in a direction opposite to the direction of the object's motion.

revetment, *n*. *Specif.* A wall of concrete, earth, sandbags, or the like thrown up for protection, as against the blast of exploding fuel during a missile abort.

revolve, *v. intr.* To move in a path about a focal point, as in 'the planets revolve about the sun.' Hence **revolution**, *n*. See **rotate**, *v*.

right ascension. The arc of the celestial equator, or the angle at the celestial pole, measured eastward from the hour circle of the vernal equinox to the hour circle of a given celestial body, either through 24 hours or 360 degrees.

RIM (*abbr*). 'Receipt, inspection, and maintenance.' Used with regard to missiles received at an operational base.

RIM building. A building at an operational missile base at which a missile is unloaded from a missile transporter and received, then inspected and put in operational order preparatory to emplacement at the launch point.

RISE (*abbr*). 'Research in supersonic environment.' Used in reference to a project exploring high altitudes. See **Navaho**, *n*.

rj (*abbr*). 'Ramjet.'

RJ-1. A liquid fuel somewhat denser than the kerosene-based fuel RP-1, and with greater energy yield.

The RJ-1 powered the Thor first stage of Discoverer V. It was at first developed for use in the Navaho.

rkt (*abbr*). 'Rocket.'

RL (*abbr*). 'Rocket launcher.'

RMD (*abbr*). 'Reaction Motors Division' of Thiokol Chemical Corporation.

RMI (*abbr.*). 'Reaction Motors, Inc.' Merged with Thiokol April 1958.

RMI, founded 16 Dec 1941, was the oldest rocket engine company in the US.

roadable launcher. A launching device, as for the TM-61, that may be moved about by means of roads.

robo, n. A rocket orbital bomber. *Obs.*

robot bomb. An explosive-carrying winged missile or rocket, like the German V-1, normally launched from the surface and directed in powered flight towards its target by an automatic pilot and other automatic devices.

robot plane. An early name applied to a pilotless airplane controlled by radio command.

Robotti, n. A family of battlefield rocket missiles, supersonic and unguided, under development in Italy.

rocket, n. 1. A species of reaction engine in which the stream of particles ejected rearward consists of hot gases obtained by the combustion of fuel oxidized without dependence upon the oxygen in the air. 2. By extension, any other reaction engine not dependent upon the oxygen in the air in generating the exhaust stream, including the nuclear rocket, the ion engine, and the photon engine. 3. A missile propelled by a rocket. 4. A vehicle propelled by a rocket. 5. A propellant used in a rocket, as in the phrase *solid rocket missile*.

The word 'rocket' goes back at least to 1611 in English usage, and was first applied to pyrotechnic or firework devices (skyrockets) projected by reaction to an exhaust stream, and guided by being fastened to a stick. The word, during successive years, has been applied to other devices propelled through the air or through space by use of the same principle of reaction. See *laws of motion*.

In present AF usage, a rocket engine is distinguished from a jet engine, the latter requiring atmospheric oxygen for functional operation. Some users also avoid use of the word 'rocket' in sense 2, preferring the generic term 'reaction engine' for this sense.

Senses 3 and 4 are natural developments, wherein the name of an essential part of the apparatus is given to the whole apparatus. Sense 5 develops from a tendency to telescope or contract a longer phrase, such as *solid propellant rocket*.

See *Congreve rocket, liquid rocket, nuclear rocket, research rocket, solid rocket*.

rocket, v. 1. *tr.* To send an *object*, as an earth satellite or test sphere, into the sky by means of a carrier rocket. 2. *intr.* Of a missile or vehicle: To move upward or forward in reaction to a rocket.

rocket airplane. 1. An airplane using rocket propulsion for its main or only propulsive

power. 2. An airplane fitted out to carry and fire rocket ammunition.

rocket ammunition. Rocket-powered projectiles of relatively small size fired from an aircraft or other platform, mobile or stationary.

rocket artillery. Artillery in which the projectiles are propelled by rocket power, normally given guidance only during launch by the amount of thrust and the direction of take-off, but in some instances guided during flight.

See *artillery guided missile, artillery rocket missile*.

rocket bomb. 1. A self-propelled guided missile or a ballistic missile using rocket propulsion. A term sometimes used in WW II. 2. A vertical bomb given added velocity in its drop by means of a rocket motor.

rocket booster. A booster that consists of a rocket motor, as in a *rato* unit.

Rocketdyne, n. Short for 'Rocketdyne Division' of North American Aviation, Inc., missile contractor, as for the propulsion system of Atlas, Thor, and Jupiter. Cf. *Astrodyne, n.*

rocketeer, n. One whose specialty is rocketry; a person who designs, builds, maintains, handles, and launches rockets.

rocket engine. 1. A powerplant that consists of a rocket, with either liquid or solid propellants, or with some other reaction-type propulsion. 2. *Restrictive.* Such a powerplant that is relatively large and complicated, as is the case with those using liquid propellants, requiring injectors, pumps, and valves together with a combustion chamber and an exhaust nozzle.

When used in sense 1 (as is common) distinction between types is made by means of the phrases 'liquid rocket engine,' 'solid rocket engine,' 'nuclear rocket engine,' etc. See *rocket, n.*

Usage in sense 2 is declining in frequency. It carries over from a distinction sometimes made between an engine and a motor. The engines of Atlas, for example, would in this usage seldom be referred to as 'motors'; on the other hand, a *rato* unit would seldom be called an 'engine.'

Both 'rocket engine' and 'rocket motor' are used as generic terms.

Rocket Engine Test Laboratory. An AF laboratory for static testing of rocket engines, located at Edwards Air Force Base, California. Cf. *Air Force Flight Test Center*.

rocket fuel. A fuel, either liquid or solid, developed for, or used by, a rocket. See *fuel, n.*

rocket head. The leading end of a rocket ve-

hicle once it is set in motion; that part that carries the warhead or other payload.

rocket igniter. A chemical, electrical, or mechanical device used to ignite a rocket.

rocket launcher. A device for launching a rocket. See **launcher, n.**

Rocket launchers are wheel-mounted, motorized, or fixed for use on the ground; or they are mounted on aircraft, as under the wings; or they are installed below or on the decks of ships; or, in the case of the bazooka, they are carried about by persons.

rocket missile. 1. A missile that uses rocket propulsion during flight, such as the Thor, Atlas, Sidewinder, Rat, or Dart. 2. Less exactly, the rocket vehicle of such a missile, even when the vehicle is carrying the rocket head or itself to a destination other than a target, as in the case of the Atlas rocket propelling itself to become an Atlas satellite. 3. Still less exactly, a rocket vehicle never intended nor designed as the carrier of a missile, as in the case of the Vanguard carrier rocket or the Pioneer rocket.

Restriction in the use of this term to sense 1 makes for greater sharpness in communication. When a rocket vehicle is meant, 'rocket vehicle' is a more exact term than 'rocket missile,' since a missile, strictly speaking, is something sent toward a target. The use of these terms is often governed by the particular point of view of the user.

rocket motor. 1. A rocket engine. 2. *Restrictive.* A rocket that is relatively small or uncomplicated, esp. one that burns a solid self-oxidizing fuel, consisting essentially of a combustion chamber that houses the grain, plus a nozzle and igniter. See **rocket engine**, note.

rocket plane. An airplane powered by rocket motors capable of flight both within the sensible atmosphere and within the rarified atmosphere and the space beyond.

In space, the rocket plane would rely upon other devices than airfoil surfaces for guidance and maneuvering.

rocket-powered, a. Powered by one or more rocket engines.

rocket propellant. A propellant used in a rocket.

rocket propulsion. The propulsion of a missile, aircraft, space vehicle, sled, or other device by means of a rocket engine or motor. Often distinguished from 'jet propulsion.'

rocketry, n. The art and science of designing, developing, building, testing, and launching rockets, rocket missiles, or rocket vehicles (including their subsystems), and of guiding

and controlling them during launch, flight, orbit, space travel, reentry, landing, or impact; any segment of this art or science.

rocket ship. An aircraft, space-air vehicle, or spacecraft using rocket propulsion.

rocket sled. A sled that runs on a rail or rails and is accelerated to high velocities by a rocket engine.

This sled is used in determining g-tolerances and for developing crash survival techniques. Rocket sleds are at Edwards Air Force Base, Holloman Air Force Base, and the Naval Ordnance Test Station. Cf. **Snort track.**

rocket society. Any of several private or public societies organized to promote the study and development of rockets and to advance interplanetary travel. See **International Astronautical Congress.**

In the US, the earliest rocket society was the American Interplanetary Society founded in 1930. Various cities, such as Cleveland, Denver, Detroit, Los Angeles, and Washington also have rocket societies.

In Europe, rocket societies were organized as early as 1927, and flourish in Germany, England, Russia, France, Austria, Spain, and the Netherlands.

Canada and Australia also have rocket societies.

rocket thrust. The thrust of a rocket engine or motor, usually expressed in pounds.

On a test stand, rocket thrust may be measured by use of strain gauges, thrust-balancing pistons, dynamometers, or spring scales, each calibrated in pounds to represent the static weight moved by the engine.

rocket turret. A rocket launcher shaped and operated like a gun turret, esp. used on the deck of a ship. Cf. **Weapon Able.**

rocket vehicle. A vehicle propelled by a rocket motor or rocket engine, used to place a satellite in orbit, place a missile upon target, carry a passenger over a rail as on a rocket sled, etc. See **rocket missile.**

rockoon, n. A rocket research vehicle designed to be carried up to very high altitudes by a balloon before being fired. See **Farside rocket.**

roll, n. The movement of a missile body about its longitudinal axis.

roll, v. intr. Of a missile: To move about its longitudinal axis.

roll control. The exercise of control over a missile so as to make it roll to a programmed degree, usually just before pitchover.

Rome Air Development Center. (RADC) An ARDC center at Rome, New York.

RADC is charged with research, development, and testing of ground-based electronic equipment. Testing is done under operational conditions.

rotate, v. intr. To turn about an axis. Said esp. of spatial bodies. Hence **rotation, n.** See **revolve, v.**

ROTI (*abbr.*). 'Recording optical tracking instrument.' See **tracking instrument**.

Rover, *n.* *Project Rover*, a program for the development of a nuclear rocket reactor, initiated by the USAF, but supported by NASA.

RP (*abbr.*). 1. 'Rocket propellant.' Used with a number in designations of different propellants, as in *RP-1*. 2. 'Rocket projectile.' *British.*

RP-1. A rocket propellant consisting essentially of kerosene.

RTV (*abbr.*). 'Reentry test vehicle.'

ruggedize, *v.* To make a *piece* or equipment rugged enough for practical use. *Popular.*

Russian rocketry. Rocketry as engaged in by the Russians.

See *Alpha*, *n.*, *CH-10*, *Comet*, *n.*, *dog*, *n.*, *German Rocket Society*, *J-3*, *Kapustin Yar*, *Laika*, *n.*, *M-2*, *Mechta*, *n.*, *Otvazhnaya*, *n.*, *POL-1*, *POL-2*, *rabbit*, *n.*, *sputnik*, *n.*, *Sputnik I*, *Sputnik II*, *Sputnik III*, *T-1*, *T-2*, *T-3*, *T-3A*, *T-6*, *T-7A*, *Tsiolkovsky*, *n.*, *Znezhinka*, *n.*; also *Lunik*, *n.*

Russian satellite. An artificial earth satellite placed in orbit by Russian scientists. See **sputnik**, *n.*

RWC (*abbr.*). 'Ramo-Wooldridge Corporation.'

Ryan, *n.* Short for 'Ryan Aeronautical Company,' missile contractor, as for the *Firebee*; or aircraft manufacturer, as for the *X-13*.

S

SAC (*abbr.*). 'Strategic Air Command.'

SAC-Mike, *n.* The staff at Headquarters Strategic Air Command that assists the commander in matters pertaining to the employment of missiles.

A part of SAC-Mike is with AFBMD. Cf. **Mike**, *n.*

SAD (*abbr.*). 'Sympathetic aerial detonation.'

safety of flight. 1. That performance during flight of a missile, aircraft, or other piece of flying equipment that assures its own protection during flight or the safety of the crew that handles it, or the safety of others who might be affected by an abortive flight, such safety deriving from a proper functioning of component and accessory parts (or from adequate measures taken to cope with their malfunctioning) and from maintenance and operational procedures calculated to assure proper functioning. 2. The principle of operation that embodies such performance.

A preflight inspection, for example, is dictated by the safety-of-flight principle; likewise a destruct signal

sent to a malfunctioning missile is a safety-of-flight measure.

SAGE (*abbr.*). 'Semiautomatic ground environment,' a name for a defense system that provides instantaneous information needed for waging battles in the environment above the earth's surface, built about a type of electronic digital computer that reports and acts upon a developing situation.

SAGE was developed in the Lincoln Laboratory of the Massachusetts Institute of Technology. See **Bomarc**, *n.*

SAM (*abbr.*). 'Surface-to-air missile.'

This abbreviation is used by the Navy and Army as a designation with suffix endings, as in *SAM-N-6* the *Talos* or *XSAM-A-25* the *Nike-Hercules*.

Samos, *n.* The official designation of **Sentry**.

satellite, *n.* 1. An attendant body that revolves about another body; esp. in the solar system, a secondary body, or moon, that revolves about a planet. 2. A manmade object that revolves about a spatial body, such as *Explorer I* orbiting about the earth. 3. Such a body intended and designed for orbiting, as distinguished from a companion body that may incidentally also orbit, as in 'the observer actually saw the orbiting rocket rather than the satellite when he claimed he saw *Sputnik I*.' 4. An object not yet placed in orbit, but designed or expected to be launched into an orbit.

Cf. **earth-moon satellite**, **earth satellite**, **fixed satellite**, **IGY satellite**, **reconnaissance satellite**.

satellite probe. A probe that orbits the earth or other primary body.

satellite reconnaissance. Strategic reconnaissance conducted by means of data obtained from a telemetering satellite.

satellite vehicle. The rocket vehicle used to place an earth satellite in orbit.

satelloid, *n.* A vehicle that revolves about the earth or other body, but at such altitudes as to require sustaining thrust to balance drag.

This term was suggested in July 1955 by Krafft A. Ehricke, missile engineer with Convair. Ehricke was at Peenemünde during WW II. Cf. **sustained flight vehicle**.

Saturn, *n.* 1. The sun's sixth planet, somewhat smaller than **Jupiter**. 2. An Army rocket test vehicle in research and development, expected to develop some 1,500,000 pounds of thrust.

The mean distance of Saturn (sense 1) from the sun is 9.54 astronomical units (about 886,000,000 miles). Its orbital velocity is about 6 mi/sec. Its eccentricity is .055. Its sidereal period is 29.46 years, its mean synodic period is 378 days. Its mean diameter is 72,000 miles, its mass 95 times that of the earth. Its mean rotation period is about 10 hours 14 minutes.

Like **Jupiter**, Saturn is considered to have an atmosphere of methane and some ammonia. Its surface tem-

perature reaches -150° C. The planet is the least dense of the planets, being less dense than water at .72.

In sense 2, Saturn in its first stage will consist of an 8-engine cluster (kerosene and lox); its second stage engine will be that of an ICBM; its upper stages will be adapted from Centaur. Altogether, the thrust of this vehicle will be capable of placing a 15-ton satellite in orbit. The first stage will be 75 feet long, with a diameter of 22 feet. The 3-stage version is calculated to weigh 580 tons (500 of which would be propellants), and stand 200 feet high. A modified Titan as a second stage would provide 360,000 pounds of thrust. A third stage Centaur (with 2 rockets) would supply 30,000 pounds of thrust.

sbn (*abbr*). 'Spaceborne.'

scientific research. 1. Research in a field of science. 2. Research done by employing methods and techniques considered to reflect a high degree of exactness in the results.

In sense 1, scientific research usually connotes either basic or applied research. In sense 2, scientific research need not be in a field of science.

scientist, n. A person learned in a science or sciences, accustomed and qualified to do theoretical and experimental research as he seeks out new principles or new knowledge. Cf. **engineer, n.**

scintillating counter. An instrument that measures radiation indirectly by counting the light flashes emitted when radiation particles are absorbed into any of several phosphors.

This counter consists of several transparent phosphors that work with a photomultiplier tube. Cf. **Geiger counter.**

Two scintillating counters were reported as a part of Explorer IV's instrumentation to detect and measure radiation encountered. The counter records the radiation on magnetic tape for telemetric transmission to receiving stations on earth.

scintillation counter. A scintillating counter.

scintillator, n. An object or device that emits light flashes when radiation particles are absorbed into it. Cf. **phosphor, n.**

Score, n. *Project Score*, an AF project under the auspices of the Advanced Research Projects Agency (ARPA) to develop a capability for recording of messages by a satellite body and for their subsequent readout.

This term is taken from the first letters of the words 'signal, communications, orbit, relay experiment.'

Under this project the Atlas satellite was launched from Cape Canaveral at 1802 (EST) on 18 Dec 1958. It accepted messages and later relayed them. See **relay station satellite**; cf. **Courier, n.**

Score satellite. The Atlas satellite.

Scout, n. A projected satellite or probe sponsored by NASA to sound space near the earth.

The Scout satellite is programmed to weigh an estimated 150 pounds, launched by clustered solid rockets. It is to orbit at about 300 miles from the earth. Cf. **HETS** (*abbr*).

Scout vehicle. The 4-stage solid booster vehicle for the Scout probe.

The first stage is to be a modified Aerojet Polaris motor; the second stage an improved Thiokol Sergeant; the third stage a scaled-up Vanguard Allegany rocket; the fourth stage a modified Allegany Vanguard engine. Chance Vought is the integrating contractor.

scrub, v. tr. To cancel out a scheduled *test firing*, either before or during countdown.

SD (*abbr*). 'Surveillance drone,' as in 'SD-3 the Army's Snooper.'

SE 4200. A French Army solid rocket missile of about 60 mile range.

SE 4300. A French surface-to-air liquid rocket vehicle, used for training.

This missile is reported in public sources as having a subsonic speed, a range of 12 miles, a weight of 2,200 pounds.

Seacat, n. A British short-range surface-to-air missile under development for the British Navy.

sealed cabin. A cabin, esp. a spacecraft cabin, sealed against exfiltration or infiltration of any gas, liquid, or solid. Cf. **closed system.**

Sea Slug. A British ship-to-air solid rocket subsonic missile.

SEATO (*abbr*). 'Southeast Asia Treaty Organization.'

second of arc. *Astronomy.* A measure of an angle, 1/60th of a minute.

section, n. One of the cross-section parts that a missile or rocket vehicle is divided into, each adjoining another at one or both of its ends. Usually described by a designating word, as in *nose section, aft section, center section, tail section, thrust section, tank section*, etc.

selenocentric, a. Relating to the center of the moon; referring to the moon as a center.

selenoid, n. A lunar satellite.

selenology, n. That branch of astronomy that treats of the moon, its magnitude, motion, constitution, and the like. *Selene* is Greek for the moon.

semiharden, v. tr. To provide an *installation* or *site* with partial reinforcements against blast or heat. See **harden, v.**

semisatellite, n. A missile, orbital glider, or other object that attains such velocity as to become subject to some of the conditions of an orbiting body without, however, achieving an orbit itself.

sensible atmosphere. That part of the atmosphere that may be felt, i.e., that offers resistance. See **effective atmosphere.**

Sentry, n. The popular name for WS-117L,

an AF reconnaissance satellite project under projected development by Advanced Research Projects Agency, with Lockheed the prime contractor. Formerly called 'Pied Piper.'

Discoverer I was launched on 28 Feb 1959 under the overall Sentry project. See Samos, *n*.

separation, *n*. 1. The action of a fallaway section or companion body as it casts off from the remaining body of a missile or vehicle, or the action of the remaining body as it leaves a fallaway section behind it. 2. The event that marks this action; the moment of this event. Cf. *staging, n*.

separation velocity. The velocity at which a space missile or space vehicle is moving when some part or section is separated from it; *specif.*, the velocity of a space probe at the time of separation from the carrier, or the velocity of a nose cone at the time of separation from the missile carrier.

sequencer, *n*. A mechanical or electronic device that may be set to initiate a series of events and to make the events follow in a given sequence. See *program, v*.

Sergeant, *n*. An Army surface-to-surface solid rocket missile, developed by Jet Propulsion Laboratory and Sperry. Also called FAGMS-S.

Some 34 feet long, 2.6 feet in diameter, and fin-span of about 7 feet, Sergeant has a range of more than 100 miles. Its Thiokol solid rocket motor develops a thrust of 50,000 pounds or more; its Sperry and Minneapolis-Honeywell guidance is inertial. Capable of carrying a nuclear warhead, it is expected to replace Corporal operationally. It is launched by an erector-launcher from a near-vertical position.

serial production. The production of an item of manufacture (as an ICBM, motor car, or the like) one after another by moving its beginning component from station to station, as on an assembly line, at each station an addition being made until it is completed.

Serial or serialized production does not necessarily mean mass production, since the movement from station to station may be slow. Mr. Khrushchev, Russian Premier, asserted in Feb 1959 that ICBM's in Russia were in serial production. See *mass production*.

seven-o-nine computer. Written 709 computer. An IBM computer capable of computing and predicting the orbits of some 10 to 20 earth satellites simultaneously.

This computer, scheduled for installation at the NASA Goddard Space Flight Center, is to supplant the 704 computer in Washington, D. C. Another computer, the 7090 computer, is speedier and can cover more satellites than the 709.

shake-table test. A laboratory test for vibration tolerance, in which an instrument com-

ponent is placed in a vibrator that simulates one of the conditions endured during the launch of a rocket missile or vehicle.

shanicle, *n*. A contraction of 'short range navigation vehicle's system'.

Shanicle, a radio guidance system based on a hyperbolic grid system, is used on the TM-61C Matador.

Shillelagh, *n*. An Army small light-weight solid rocket missile under development by Aeronutronic.

This missile, with a nuclear capability, is expected to be used as a pentomic weapon.

ship-based, *a*. Of a missile: Designed to be launched from a ship, as with Regulus II or Polaris.

ship inertial navigation system. (SINS) A system employed by the Navy to position a ship for firing a ballistic missile, and to supply the data necessary for pinpoint firing.

This system was developed to provide accurate firing of the Polaris and other ballistic missiles from ship-board.

shoot, *v. tr. Specif.* To launch a *missile*. Cf. *launch, v.*, note.

short range. The range of a missile less than about 200 miles in length, suited to weapons used in a battle area. Often used as an attrib., as in *short-range missile*.

The 200-mile limitation of this definition is subject to change as new concepts of weapons employment are entertained.

shot, *n. Specif.* A missile launching, as in 'three previous Atlas shots were highly successful.'

Shrike, *n*. An AF air-to-surface small-scale test vehicle used experimentally between 1948 and 1953 by Bell to develop Rascal.

shutdown, *n*. The process of decreasing engine thrust to zero.

shutoff, *n*. Short for 'fuel shutoff.'

sidereal period. The time taken by a planet or satellite to complete one revolution about its primary as seen from the primary and as referred to a star.

The sidereal period of Mercury, for example, is the time taken for one complete orbital revolution as seen from the sun. Cf. *synodic period*.

This term is seldom used for the orbital period of an artificial earth satellite. 'Orbital period' is used instead.

sidereal time. Time measured by reference to the apparent motion of the first point of Aries.

A sidereal day begins and ends when the first point of Aries is directly over the reference meridian. Due to the motion of the earth around the sun, a sidereal day is almost 4 minutes shorter than the solar day.

Sidewinder, *n*. A Navy and AF air-to-air, solid rocket, antiaircraft missile, developed by

Philco and General Electric for the Navy. Also called the AAM-N-7 and the GAR-8.

Some 9.5 feet long, .42 feet in diameter, and 2 feet in fin-span, Sidewinder has a range of 2 miles at high altitudes, and a speed of mach 2.5. Its solid rocket motor is manufactured by the Naval Powder Factory and by Hercules; its infrared homing guidance by Philco. The missile is considered rugged and relatively inexpensive. It is designed for destroying high-performance enemy fighters and bombers up to 50,000 feet altitude.

The Sidewinder-1C is a second generation weapon expected to develop greater performance, programmed for use on the F-100D and F-100F, F-104A, and F-105.

silicon monoxide. An oxide of silicon, SiO, used as a thin film on the surface of a satellite, as on Vanguard I, to reflect heat and infrared.

silo, n. A missile shelter that consists of a hardened vertical hole in the ground with facilities either for lifting the missile to a launch position, or for direct launch from the shelter. See *inverted silo*.

single-stage rocket. A rocket vehicle or missile provided with a single rocket propulsion system. See *stage, n.*, sense 2.

SINS (abbr). 'Ship inertial navigation system.'

Sirius, n. The brightest star in the heavens, a star of the constellation Canis Major. Cf. *Alpha Centauri*.

skimmer basin. A deluge collection pond.

skin tracking. The tracking of an object by means of radar.

skirt, n. The lower outer part of a rocket vehicle; *specif.*, the half stage of an Atlas.

skirt fog. The cloud of steam and water that surrounds the engines of a missile being launched from a wet emplacement.

Slam, n. A supersonic, nuclear-powered, low-altitude missile in research stage.

slant range. The line-of-sight range of a tracking radar, of a radio transmitter or receiver, or of a missile. See *range, n.*

slenderness ratio. A configuration factor expressing the ratio of a rocket vehicle's length to its diameter.

sloshing, n. The back-and-forth splashing of a liquid fuel in its tank, creating problems of stability and control in the vehicle.

SLV (abbr). 'Satellite launching vehicle.'

SM (abbr). 'Strategic missile.'

This abbreviation is used with a number to designate a particular strategic missile, as in SM-62 the Snark, SM-64 the Navaho, SM-65 the Atlas, SM-68 the Titan, SM-73 the Goose, and SM-75 the Thor.

small war. A term preferred to 'limited war.'

SMEC (abbr). 'Strategic Missile Evaluation Committee.'

Smithsonian Astrophysical Observatory. An observatory of the Smithsonian Institution established in 1890 in Washington, D. C., but with its headquarters moved to Cambridge, Massachusetts, in 1956.

SMSA (abbr). 'Signal Missile Support Agency.'

snakebite, n. An accident. *Slang* at Patrick Air Force Base in allusion to the snakes that live on Cape Canaveral.

Snark, n. An AF surface-to-surface intercontinental air-breathing winged missile, developed by Northrop. Also called the SM-62.

The Snark, about 67 feet long, 4.5 feet in diameter, 42 feet in wing-span, and 30 tons in gross weight, has a speed somewhat less than mach 1 and a range of 5,000 to 6,500 miles. It is powered by an axial-flow turbojet engine (the Pratt & Whitney J57) after attaining altitude, but is boosted to altitude by 2 Aerojet solid rockets with a combined thrust of 66,000 pounds.

Its guidance is stellar inertial.

Snark squadron. A missile squadron that employs the Snark.

A Snark squadron was activated in Dec 1957 at Patrick AFB. Another is scheduled for 1959 at Presque Isle, Maine.

Snooper, n. An Army combat surveillance drone developed by Republic. Also called the SD-3.

The Snooper is conventionally powered but is provided with two solid boosters.

Snort track. A rail track on which a supersonic rocket sled is driven, located at the Naval Ordnance Test Station.

SOFAR (abbr). 'Sound fixing and ranging.' See next.

sofar, n. A method or system used to detect the direction and distance of an object emitting sound waves. Cf. *sonar, n.*

soft, a. Of a ray, such as a gamma ray: Of low penetrating power.

soft base. A launching base that is not hardened for protection against nuclear attack. Cf. *harden, v.*

soft landing. A landing on the moon or other spatial body at such slow speed as to avoid a crash or destruction of the landing vehicle.

Soft landings on the moon are anticipated by use of retrorockets for slowdown of the landing vehicle; soft landing on Mars may be accomplished by partial use of the Martian atmosphere.

solar cell. A cell that converts sunlight into electrical energy. See *Vanguard I*, note.

solar plasma. Plasma formed by the heat of the sun.

solar probe. A probe for obtaining added knowledge of the sun. See *probe, n.*

solar radiation. Radiation emanating from

the sun, including electromagnetic and corpuscular radiation.

solar time. Time measured by reference to the apparent motion of the sun about the earth.

solid propellant. A rocket propellant consisting of a single solid substance, usually a powder made into a grain of a particular size and shape. See *grain, n.* Cf. *specific impulse.*

A solid propellant consists of all the ingredients necessary for sustained chemical combustion. It may be a heterogeneous mixture of an oxidizing agent and a fuel (for example, crystals of perchlorate with asphalt), or it may be a chemical compound that provides its own oxidizer, as with nitrocellulose mixed with other chemicals to control rate and direction of burning.

A solid propellant is also a monopropellant, but the latter term is seldom used to refer to it. See *monopropellant, n., note.*

solid rocket. 1. A rocket that uses a solid propellant. 2. Short for 'solid rocket propellant.'

solid rocket fuel. A solid propellant.

SONAR (*abbr.*). 'Sound, navigation, and ranging.'

sonar, n. A method or system, analogous to radar, in which high-frequency sound waves are emitted so as to be reflected back from objects of interest, and used to detect the objects of interest. Called 'asdic' by the British. Cf. *sofar, n.*

sonar capsule. A capsule that reflects high frequency sound waves.

The sonar capsule, if attached to a reentry body, may be used to locate the reentry body.

sonic boom. 1. The noise heard when a sonic shock wave strikes the ear. 2. The mild pressure disturbance that accompanies a sonic shock wave, registered as noise by the ear, as visible vibrations by light objects, or as glass breakage when internal stresses are already present in the glass. See *sonic shock wave.*

The sonic boom is discussed by Claude Witze in *Air Force*, Jan 1959, pp 35-38.

sonic shock wave. A cone-shaped shock wave generated by an airplane or other object traveling at sonic, supersonic, or hypersonic speeds.

On an aircraft traveling at the speed of sound or greater, a sonic shock wave forms at the nose of the aircraft, another at the tail.

These shock waves cause a rise in atmospheric pressure across the shock wave. As the wave travels away from the moving object, it carries with it this rise in pressure. Striking the ear, the pressure differential is interpreted as noise; striking light bric-a-brac or a window glass, it causes vibrations.

An aircraft flying in level flight at sonic speed or above creates continuous sonic shock waves. The intensity of these waves (proportionate to speed) grad-

ually dissipates with distance, but if the aircraft flies near the earth's surface, a path of sonic booms is formed. An aircraft that develops supersonic speed in a dive generates a sonic shock wave that separates from the aircraft on pullup, and strikes the earth's surface.

See *sonic boom, speed of sound.*

sonic speed. The speed of an object at mach 1 relative to the surrounding fluid.

sophisticated, a. Of a weapon system: Complex and intricate; making use of advanced art; requiring special skills to operate. Accepted *slang.*

sounding rocket. A research rocket used to obtain data on the upper atmosphere.

The Wac Corporal and Aerobee were, or are, sounding rockets. The Aerobee, exemplifying the equipment carried, has a radio antenna, telemetering equipment, telemetering channels, batteries, an animal container, a beacon, and a parachute. This payload weighs 150 pounds. Recovered after flight, the sounding rocket gives up data additional to that obtained during flight.

SP (*abbr.*). 'Solid propellant.'

space, n. 1. That which extends in all directions, and has no outward bounds nor limits of divisibility, as in 'the sun and its planets move in space.' 2. *Restrictive.* A part of this extension marked off or bounded in some way, as by the outer limits of the earth's atmosphere; *specif.*, the extent between the earth's atmosphere, or effective atmosphere, and an outer indefinite boundary, in which extent earth satellites may be put in orbit, ballistic missiles made to follow a plotted trajectory, or vehicles (manned or unmanned) moved about relative to spatial bodies. See *aerospace, n., atmosphere, n., space environment.*

In the specific sense of sense 2, this term is used as an attrib. to designate various actions, things, or concepts associated with space as defined.

Space is often conceived as void, but it is actually diffused with electromagnetic energy and is a receptacle in which radiation particles, meteoric dust, meteoroids, comets, planets, planet satellites, stars, and nebulae are in constant motion.

Different extents of space have been usefully conceived, as in the terms *flight space, terrestrial space, cislunar space, lunar space, interplanetary space, interstellar space, and intergalactic space.* See separate entries.

In sense 1, space, as conceived by non-Euclideans, is boundless but not infinite in extent; its conception is inseparable from the conception of time.

space age. An historical age in which man has achieved power in some degree to project missiles or vehicles into space.

The dawn of this age was gradual, having been foreshadowed in the discovery of the laws of motion by Galileo Galilei (1564-1642) and Sir Isaac Newton (1642-1727), and of the laws of planetary motion by Johannes Kepler (1571-1630). Theoretical and practical experimentation began with such men as Jules Verne (1828-1905), Konstantin Tsiolkovsky (1857-1935),

and Robert Goddard (1882-1945). See **Sputnik I**.
space-air, a. Of or pertaining to both space and the atmosphere. Cf. **air-space, a.**

space-air vehicle. A vehicle that may be operated both within and above the sensible atmosphere.

When regarded as vehicles, missiles with trajectories that enter space above the sensible atmosphere fall in the category of space-air vehicles.

space biology. A branch of biology concerned with life as it may come to exist, or as it exists, in space.

Space biology is a discipline used in the practice of space medicine.

spaceborne, a. (sbn) 1. Of a person or thing: Supported in space by velocity. 2. Of an operation or action: Carried out or conducted with spacecraft or with missiles that travel through space.

space cabin. The cabin in a spacecraft, pressurized and climatized for its occupants.

space capsule. A capsule for carrying out an experiment or operation in space.

Space Council. Short for 'National Aeronautics and Space Council.'

spacecraft, n. A contrivance that goes into, or through, space, esp. such a contrivance that carries something. See **spaceship, n.**

A spacecraft may be a satellite, following a course in space determined by its orbit, or it may be a vehicle that enters space above the sensible atmosphere then glides back through the atmosphere, or it may be a vehicle subject to continuous or intermittent directional control within the limits of the general rotation of the solar system. A spacecraft may be manned or unmanned. It is a species of aerospacecraft and may be a space-air vehicle. Cf. **interplanetary travel**.

space environment. The environment encountered by vehicles, missiles, and living creatures upon entry into space.

This environment may be a satellite, following a course in space determined by its orbit, or it may be a vehicle that enters space above the sensible atmosphere then glides back through the atmosphere, or it may be a vehicle subject to continuous or intermittent directional control within the limits of the general rotation of the solar system. A spacecraft may be manned or unmanned. It is a species of aerospacecraft and may be a space-air vehicle. Cf. **interplanetary travel**.

Man's knowledge of this environment is considered to be meager, compared to what is expected to be learned about it in the next few decades. Yet the knowledge accumulated since ancient times is not inconsiderable, and this provides a scientific basis upon which new knowledge can be obtained. The discoveries of the past—made by men like Aristarchus of Samos (fl. 280-264 B.C.), Hipparchus (fl. 130 B.C.), Ptolemy (2nd century A.D.), Copernicus (1473-1543), Galileo (1564-1642), Kepler (1571-1630), Newton (1642-1727), Kant (1724-1804), Herschel (1792-1871), Laplace (1749-1827), Darwin (1809-1882), Chamberlin (1843-1928), Moulton (1872-1952), Millikan (1868-1953), and Einstein (1879-1953)—were all made by observations from the earth's surface and by processes of deduction from facts obtained through the sciences of astronomy, geology, physics, chemistry, and

biology. Direct exploration of the environment awaited the event of a rocket powerful enough to propel a probe or vehicle beyond the limits of the earth's atmosphere. Unexpected concentrations of radiation particles and small meteoroids are being encountered, and previously unknown magnetic fields near the earth have been discovered. The charting of these discoveries is just begun. See **Van Allen radiation belt**.

space equivalence. A postulation or principle that a condition or conditions within the atmosphere may be virtually identical with a condition or conditions in outer space.

Space equivalence is a postulation; a space equivalent is a particular condition. See next.

space equivalent. A condition within the earth's atmosphere that is virtually identical, in terms of a particular function, with a condition in outer space.

For example, at 50,000 feet the drop in air pressure and the scarcity of oxygen creates a condition, so far as respiration is concerned, that is equivalent to a condition in outer space where no appreciable oxygen is present; thus, a physiological space equivalent is present in the atmosphere. Likewise, for example, a condition of zero gravity can be created for a particular body within the atmosphere by the body being subjected to a given turning velocity.

Space equivalents are discussed by Dr. Hubertus Strughold in *The Air Power Historian*, Jan 1958, pp 31-37.

spaceflight, n. The flight of a man-operated or man-controlled vehicle or other device into or through space.

The vehicle in spaceflight may or may not be manned.

space laboratory. 1. A space vehicle carrying sensing and measuring instruments, recording equipment, radio-transmitting equipment, and other related instruments, used as a means of obtaining scientific data on conditions in the upper regions of the earth's atmosphere or in outer space, or used as a means of measuring the adaptability of terrestrial life forms to such conditions. 2. A laboratory that simulates the conditions of a space vehicle.

The space laboratory (sense 1) may be manned or unmanned.

space law. A projected code of international law that would govern the use or control of space by different nations.

Andrew G. Haley and Theodor von Kármán have suggested that the line between the jurisdiction of air law and space law be drawn at the altitude where continuous flight by aircraft ceases to be possible, about 55 miles above the earth.

space medicine. A branch of aerospace medicine concerned with the health of persons who make, or expect to make, flights into space beyond the sensible atmosphere. See **aerospace medicine**.

Space medicine is in many respects an extension of aeromedicine. Cf. **space equivalent**.

space platform. An orbiting installation (normally geocentric) used as a platform for the launch of other space vehicles or for the conduct of space research.

space posture. The particular posture taken by a nation or military force in respect to its utilization of space, esp. as it bears upon the nation's ability to react immediately if attacked, and to use aerospace power to its own advantage. See **posture**, *n*.

spacepower, *n*. Also written **space power**. 1. A power of man that arises from his ability to penetrate into outer space with probes, missiles, and manned vehicles, and to exploit in lesser or greater degree the complex relationships that derive from this ability in political, military, diplomatic, cultural, and economic affairs. See note. 2. An instance of this power as it exists in a particular country, as determined by the knowledge, inventiveness, financial support, industrial backing, military coordination, and diplomatic skill of the people in that country.

Spacepower is a contingent power that does not exist except as a resultant of other powers of man; and it comes about by adaptation of man to nature's laws, not by man's changing or modifying nature's laws. Thus, as it emerges, it is essentially a phenomenon, like airpower or seapower, with its own special attributes, capabilities, and limitations. It is strong or weak in proportion to man's understanding of its nature multiplied by his ability to adapt himself and his machines to the laws that apply to this power. Cf. **aerospace power**, **airpower**, *n*.

space probe. An instrumented vehicle, as a test sphere or earth satellite, that is rocketed into space (sometimes into proximity with a spatial body) in order to obtain new knowledge on conditions detected by the instruments of the vehicle.

Space Projects Center. (SPC) A NASA center located at Beltsville, Maryland, for administration and control of space projects.

space propulsion. Propulsion of a space vehicle through space.

This term usually implies intermittent or sustained propulsion after the vehicle has actually reached space.

space satellite. A manmade satellite body that orbits the earth, moon, or other spatial body.

spaceship, *n*. A spacecraft.

This term has the connotation of being manned.

space station. An orbiting facility by means of which, or from which, space travel or space exploration may be further effected.

The space station may be manned or unmanned. If

manned, it could serve as a staging position for flight to more distant points.

space suit. A pressure suit designed for wear in space or at very low-pressure altitudes within the atmosphere, designed to permit the wearer to leave the protection of a pressurized cabin.

space system. A total complex consisting of a space vehicle, the industrial base required to produce it, the operational facilities for its operation and maintenance, the command communications system for its operational control, the supply and transportation system for its support, the training facilities and the instructors, and the people organized and trained to operate and maintain the vehicle.

Space Technology Laboratories. (STL) A corporation owned by Thompson Ramo-Woolridge, Inc., located at Inglewood, California, and responsible for the systems engineering of ballistic missiles (the Atlas, Thor, and Titan) being developed by the USAF, as well as of other space vehicles, such as Sentry.

The STL, with its own board of directors, serves the AF in the design, production, and testing of missiles and aerospace vehicles by coordinating the work of associate contractors.

space travel. Travel through space, esp. travel by man in spacecraft. See **interplanetary travel**.

space vehicle. 1. A contrivance that carries something into or through space, either returning to the earth or not. 2. *Restrictive.* A vehicle designed for sustained flight in space. See **spacecraft**, *n*.

A space vehicle may be manned or unmanned, but is considered to be under man's control in at least a part of its flight. The term in its broad sense includes objects otherwise called guided missiles (which see, sense 1) or ballistic missiles if they are being considered as carriers of something through space. These objects, however, may properly be called 'space-air vehicles' or 'space-air carriers.' The true space vehicle would be defined as in sense 2.

space warfare. Warfare conducted by use of weapons brought to bear upon earth targets from outer space, or brought to bear upon targets in outer space.

space weapon. A weapon that travels through space and is directed against an enemy target whether on the ground, in the air, or in space.

Spaerobee, *n*. The Aerobee 300.

Sparrow I. A Navy air-to-air solid rocket missile, developed by Sperry. Also called AAM-N-2.

This missile, phased out in favor of Sparrow III, is

guided to target by a beam transmitted by the launching aircraft's radar.

Sparrow II. A Navy air-to-air solid rocket missile, undergoing development by Douglas. Also called XAAM-N-4.

This missile is an experimental missile intended for use by the Royal Canadian Air Force.

Sparrow III. A Navy air-to-air solid rocket missile in production by Raytheon.

Some 12 feet long, .75 feet in diameter, and about 3.25 feet in span, Sparrow III has a range of 5 to 8 miles and a speed of mach 2.5 to 3. Its Aerojet rocket engine gives it a speed of 1,000 mph immediately after launch. Its Raytheon guidance is by radar homing. It is considered a versatile missile, highly effective in high or low altitude attack. It is to replace the Sparrow I in operations.

spatial body. Any body or aggregate of matter that exists in space and behaves in accordance with astronomic or astrophysical law.

This term includes the earth as well as celestial bodies. Cf. *celestial body*, *celestial structure*.

spatio (suffix). A combining form meaning 'space.' Pronounced 'spashio.'

spatiography, n. The science of space, esp. concerned with the charting of magnetic fields, radiation belts, meteoroid belts, the gravipause of different spatial bodies, etc.

spationautics, n. Astronautics.

SPC (abbr). 'Space Projects Center.'

specific impulse. (I_s) A performance parameter of a rocket propellant, expressed in seconds, and equal to the thrust in pounds divided by the weight flow rate in pounds per second ($I_s = F/\dot{w}$). See *thrust, n.*

Specific impulse is also equivalent to the effective exhaust velocity divided by gravity.

As in the formula for measuring thrust the flow rate in determining specific impulse is really a function of mass, but at sea level, weight is normally used for it.

Some typical sea-level specific impulses for different propellants are listed not for absolute correctness, but as a comparative guide. Liquid oxygen and ammonia, 255-265; liquid oxygen and ethyl alcohol, 243; liquid oxygen and gasoline, 242; liquid oxygen and hydrazine, 259; liquid oxygen and liquid hydrogen, 317-364; hydrogen peroxide and hydrazine, 252; nitromethane, 218; potassium perchlorate ($KClO_4$) and C_2H_4O , 165-210; potassium perchlorate and asphalt, 180-185; nitrocellulose, nitroglycerin, and additives, 205-230. See *Hustler, n., note*, *hydrazine, n., note*.

specific propellant consumption. (W_s) The reciprocal of the specific impulse, i.e., the required propellant flow to produce one pound of thrust in an equivalent rocket.

The weight flow rate is divided by the thrust ($\dot{w}/F$).

specific thrust. The specific impulse of a liquid rocket propellant.

specified air command. An air command specified for establishment by act of Congress,

as by the Organization Act of 1951, or by the Secretary of Defense.

The Air Defense Command, Tactical Air Command, and Strategic Air Command were specified air commands under the act of 1951; they remained so until the Department of Defense Reorganization Act of 1958. Under this act they are subject to reorganization by the Secretary of Defense.

speed of light. The speed at which light travels, approximately 186,000 miles per second.

speed of sound. The speed at which sound waves travel through a medium. See *note* and *mach, n.*

Sound travels at different speeds through different mediums, and at different speeds under different conditions of temperature, pressure, etc. In air under standard sea-level conditions, sound travels at about 1,100 ft/sec or 750 mph. See *'atmosphere, n., note*.

Sperry, n. Short for 'Sperry Gyroscope Co.,' a division of Sperry Rand Corporation, missile contractor, as for Sparrow I and Sergeant.

sphere of gravitational influence. The gravisphere.

spherical balloon reflector. A balloon-shaped radiation reflector for radio waves.

SPIA (abbr). 'Solid Propellant Information Agency.'

spin rocket. A small rocket that imparts spin to a rocket airframe or remaining body.

spr (abbr). 'Solid propellant rocket.'

sputnik, n. [Russian *s* 'with' *put* 'path' and *nik* 'agent,' i.e., 'that on a path with.'] A satellite, esp. a manmade moon launched by the Russians. *Capitalized* in specific names.

Americans generally pronounce the syllable *sput* as a rime of *buff*, but some people pronounce it as a rime of *cute*. The full Russian designation is *Iskustvennyi Sputnik Zemli* 'artificial companion of the earth.'

Sputnik I. The first manmade earth satellite ever to reach and remain in orbit, launched by Russian scientists on 4 October 1957. Also called '1957 Alpha' or '1957 Alpha 2' by IGY scientists.

A sphere of 22.8 inches in diameter, weighing 184 pounds, Sputnik I was fired to orbital velocity at about 18,000 mph by a three-stage rocket. Its apogee was reported at 560 miles, its perigee at 370 miles (later reported at 145 miles). Orbiting in a plane 64.3° to the plane of the earth's equator, it made some 1,400 revolutions about the earth (some 37 million miles—less than the distance between the earth and Mars) before it disintegrated in the atmosphere on or about 4 Jan 1958, the date reported by the Soviet news agency Tass. Its third-stage rocket, reportedly mistaken for the satellite by some moon watchers, came to an end one month earlier on 3 Dec 1957.

See *earth satellite, note*, for comparative details; see also *sputnik rocket*.

Sputnik II. The second manmade earth satel-

lite to reach and remain in orbit, launched by Russian scientists on 3 November 1957. Also called '1957 Beta' by IGY scientists.

Sputnik II, weighing approximately 3 tons with 1,120 pounds in the instrument section alone, and shaped essentially like a cylinder with a nose cone, 19 feet by 4 feet, included the third stage of the rocket that placed it in orbit (total length 80 ft). Its initial apogee was 1,056 miles, its perigee 140 miles, its orbital velocity 17,897 mph. It orbited until 13 April 1958, when it fell apart, strewing parts along a southeasterly line over the Lesser Antilles, Brazil, and the Atlantic. See *weigh*, *v.*, *note*.

Sputnik II carried the dog Laika (which see).

Sputnik III. The third Russian satellite to reach and remain in orbit, launched on 15 May 1958. Also called '1958 Delta' by IGY scientists.

Sputnik III, reported to weigh 2,920 pounds, carries a payload of instruments and telemetry equipment. It is cylindrically shaped with a blunt nose cone, about 11.5 feet long. The takeoff weight of the rocket that launched it is estimated at requiring 500,000 pounds of thrust for liftoff. Its apogee is 1,168 miles, its perigee 150 miles; its initial orbital period was 106 minutes. Its expected lifetime is 1 to 2 years. Cf. *earth satellite*.

sputnik rocket. A rocket or rocket vehicle used to place a Russian-made satellite into orbit; any stage of such a rocket.

The rocket used to place Sputnik I into orbit was a three-stage rocket, the third stage separating from the satellite after orbital velocity was achieved, but itself orbiting for about two months along with the sputnik (until 3 Dec 1957 according to US and British scientists). At first it trailed the sputnik, but soon appeared ahead of its sputnik. This was brought about by its beginning to fall before its sputnik did, because its larger size brought it into contact with more air particles in the orbit. In its act of falling it picked up additional speed to keep it in orbit, but in doing so orbited inside the orbit of the sputnik. Since its orbit thus became shorter than the orbit of the sputnik it forged ahead. See *Sputnik I*.

The third-stage rocket used to place Sputnik II into orbit became a part of the satellite itself.

squib, *n.* 1. A small explosive charge to separate stages or sections of a rocket during flight. 2. A small igniter used in the ignition of a rocket. Usually called an 'igniter.'

SRBM (*abbr.*) 'Short-range ballistic missile.'

SS-10. A French antitank guided missile, used by American NATO troops.

SS-11. A French antitank guided missile, powered by a solid propellant.

Wire-guided, this missile, as well as the SS-10, is scheduled to replace the Dart in the armament of American troops in Europe. Each may be launched from a ground vehicle, an airplane, or a ground emplacement.

SSM (*abbr.*) 'Surface-to-surface missile.'

This abbreviation is used by the Army and Navy as a designation name with suffix endings, as in the SSM-A-12 Lacrosse and SSM-N-9a Regulus II.

stable, *n.* A term applied to a group of rocket vehicles or missiles considered to be available for different type missions, as in 'a stable of IRBM's' or 'a stable of vehicles for test purposes.'

stage, *n.* 1. One of the successive steps or periods in an action, motion, or process, as in 'the first rocket stage lasted the longest.' 2. A whole action, motion, or process if compared to an action having successive steps, as in 'a single-stage reaction.' 3. In a rocket vehicle powered by successive units, one or other of the separate propulsion units as in 'the first stage developed 200,000 pounds of thrust, the second stage 60,000 pounds.' 4. A section of the rocket vehicle that houses a rocket engine or motor, as in 'the third stage orbited with the satellite.' Cf. *main stage*, sense 2. 5. Used attrib. in sense 3, esp. with a designating number, as in 'a two-stage rocket.'

stage, *v.* 1. *intr.* Of a rocket stage or rocket half-stage: To disengage from the remaining body and become free to follow its own flight path, as in 'the boosters staged before the pitchover.' 2. With the adverb *at*: Of an aircraft or spacecraft: To use a facility that is nearer the ultimate destination than is the point of departure, for purposes of preparing for further flight, as in 'they staged at Patrick before departing for India' or 'they may stage at the space station before going to the moon.' 3. *tr.* To service and equip an *aircraft* or *spacecraft* at an intermediary point on its route to destination; to prepare and equip a *person* at a way station for the next leg or stage of his travel.

stage-and-a-half, *n.* A liquid-rocket propulsion unit only part of which falls away from the rocket vehicle during flight, as in the case of booster rockets falling away to leave the sustainer engine to consume remaining fuel. See *Atlas, n.*

staging, *n.* The process or operation during the flight of a missile or vehicle whereby a full stage or half stage is disengaged from the remaining body and made free to decelerate or be propelled along its own flight path. Cf. *separation, n.*

staging vehicle. A rocket vehicle made up of two or more stages, each separating according to program.

stagnation point. In aerodynamics, a point on a reentry nose cone or other surface at

which relative movement of the airflow about the surface is zero, a condition arising when a streamline boundary intersects another.

stagnation region. *Specif.* The region at the front of a nose cone where the air has negligible relative velocity.

stagnation temperature. The environmental temperature of air about a stagnation point or stagnation region.

This temperature is high with a reentry nose cone, the air in the stagnation region coming to rest from a high relative velocity.

stand, *n.* A fixed facility or station at which some action is carried out, such as the testing of an engine or the launching of a missile. See *launch stand, test stand.*

standoff bomb. A standoff missile. *British.*

standoff missile. An air-to-surface guided missile launched by a bomber at some distance from target.

stand talker. A person on a static test stand responsible for coordinating and timing the preparations for a static test.

star, *n.* 1. *Restrictive.* A self-luminous celestial body exclusive of nebulae, comets, and meteors; any one of the suns seen in the heavens. Distinguished from planets or planet satellites that shine by reflected light. 2. Any luminous body seen in the heavens.

The star (sense 1) of our solar system is the sun. In sense 2, 'star' sometimes excludes the sun, the moon, and manmade satellites from the category.

Starfighter, *n.* The F-104.

star grain propellant. A solid propellant, its cross-section shaped like a star. See *grain, n.*

star tracker. A telescopic instrument on a missile or other flightborne object that locks onto a celestial body and gives guidance to the missile or other object during flight. See *celestial guidance; cf. sun tracker.*

A star tracker may be optical or radiometric. See *radiometric star tracker.*

state of the art. The level to which technology and science have at any designated cutoff time been developed in a given industry or group of industries, as in 'the missile's capabilities were determined by the state of the art at the time it went into production.'

state-of-the-art, *a.* 1. Of a contract: Requiring that the contractor use technology and science already developed. 2. Of a development: Done within the limits of the state of the art. 3. Of applied research: Oriented toward advancing the state of the art.

static firing. The firing of a rocket motor or rocket engine in a hold-down position to measure thrust and accomplish other tests.

static laboratory facility. *Space medicine.* A laboratory for developing data and techniques for use of a closed system in meeting the requirements of a body's metabolism. See *closed system.*

static test. An instance of static testing.

static testing. The testing of a missile or other device in a stationary or hold-down position, either to verify structural design criteria, structural integrity and the effects of limit loads, or to measure the thrust of a rocket engine or motor. Cf. *live testing.*

stationary orbit. A circular orbit in which a satellite moves from west to east at such velocity as to remain fixed above a particular point on the equator. See *fixed satellite.*

At 22,300 miles above the earth's surface, a satellite in a stationary orbit would travel at 1.9 mi/sec as compared to the rotation velocity of the earth at .39 mi/sec.

stellar guidance. Celestial guidance.

stellar-inertial guidance. The guidance of a flightborne vehicle by a combination of celestial and inertial guidance.

stellar map-matching. A process during the flight of a missile or vehicle by which a map of the stars set into the guidance system is matched with the position of the stars observed through telescopes so as to give guidance to the vehicle. See *map-matching guidance.*

step rocket. A rocket with two or more stages; also applied to a two-step rocket (which see).

still, *n.* A heat exchanger. *Slang.*

STL (*abbr.*). 'Space Technology Laboratories.'

STOL (*abbr.*). 1. 'Short takeoff and landing.' *Attrib., as in STOL capability.* 2. Used as a noun. A fixed wing or tiltwing airplane that takes off and lands on a short runway; *specif.,* such an airplane that can clear a 50-foot obstacle 500 feet from the start of takeoff.

'STOL' is usually pronounced letter by letter.

storable, *a.* Of a fuel: Subject to being placed and kept in a fuel tank without benefit of special measures for temperature or pressure control.

stovepipe, *n.* The outside shell of a rocket vehicle or missile. *Slang.*

straddle carrier. A ground vehicle that carries its load suspended between its wheels.

strain gauge. A device for measuring thrust on a test stand. See *rocket thrust, note.*

Strategic Air Command. (SAC) A major air

command of the USAF originally established in the Army Air Forces in March 1946, and responsible for strategic air operations.

SAC equipment includes heavy and medium bombers, long-range reconnaissance planes, and strategic missiles. The command is under the strategic guidance of the Joint Chiefs of Staff. Cf. *specified air command*.

strategic attack. *Specif.* An attack directed at selected vital targets of an enemy nation so as to destroy his war-making capacity or his will to fight.

This attack, if made at a distance, may be made by long-range aerodynamically guided missiles or ballistic missiles, together with long-range bombers for dropping bombs or for serving as launch platforms for air-to-surface missiles.

Strategic Force. *Specif.* A projected military force under a commander directly responsible to the JCS, and equipped with weapon systems operational in aerospace, at sea, or on land.

This force would include SAC and the Polaris-carrying submarines.

strategic missile. (SM) A continuously guided or ballistic missile designed for use in strategic attack.

The Atlas, Goose, Snark, Thor, and Titan are designed for use as strategic missiles. See separate entries. See also *guided missile*.

Strategic Missile Evaluation Committee. A committee of scientists brought together in June 1953 to evaluate the AF strategic missile systems. Sometimes called the 'Von Neumann Committee.'

In its report of 10 February 1954, this committee recommended a vigorous pursuit of ICBM development, and stressed the need of a special management development group able to anticipate technical and scientific developments. The committee's recommendations led to the establishment of the Western Development Division of ARDC. See *concurrency, n.*

strategic missile squadron. An AF squadron organized under the Strategic Air Command and trained to handle, maintain, service, and launch ballistic or guided missiles.

Stratofortress, n. The B-52.

Stratojet, n. The B-47.

stratopause, n. The upper limit or limits of the stratosphere. See *pause, n.*

stratosphere, n. 1. A stratum of the atmosphere lying immediately above the troposphere and, as treated by some meteorologists, immediately below the chemosphere. 2. Also applied to a thicker stratum extending through the chemosphere.

As conceived in sense 1, the stratosphere, extending from above 7 miles to 19 miles, and characterized by horizontal and predominantly westerly air movements with a more or less constant temperature, is also called

the isothermal region. In sense 2, the stratosphere extends to about 50 miles.

stretchout, n. An action whereby the time for completing an action, esp. a contract, is extended beyond the time originally programmed or contracted for.

structural integrity. Structure integrity.

structure integrity. A property inherent in a ballistic or guided missile that keeps it from collapsing or falling apart so that each of its components functions properly. Cf. *balloon-type missile*.

STV (abbr). 'Space test vehicle.'

sub, n. Short for 'subcontractor.'

subassembly, n. An assembly that is a component part of a larger assembly.

subcontract, n. A contract made between a prime contractor, associate contractor, or a subcontractor and a supplier or maker of a part component to the thing being developed by the prime or associate contractor.

subcontractor, n. A contractor who contracts with a prime contractor, an associate contractor, or another subcontractor.

The subcontractor's relationship to the government is indirect. Cf. *associate contractor, prime contractor*.

subcontract structure. A composite listing of critical or major parts or assemblies to be bought by a prime contractor, together with a list of names of proposed subcontractors for the purchase of such parts or assemblies.

The subcontract structure is one part of the make-and-buy structure (which see).

subgravity, n. A gravitational effect that is less than one g, i.e., less than the normal measure of gravity. Cf. *zerogravity, n.*

subminiature, n. A device that is made still smaller than what has already been considered a miniature. Usually attrib., as in *subminiature power package*.

Subroc, n. A Navy underwater-to-air-to-underwater missile under development by the Naval Ordnance Laboratory and Goodyear.

Capable of carrying a nuclear warhead, this missile may be fired above or below the surface from a submarine. Propelled through the air by a rocket motor, it drops its rocket and continues as a warhead to target.

Subroc, equipped to detect submarines at 25 miles, is designed as a defensive weapon for Polaris submarines.

subsattellite, n. An object designed to be carried into orbit inside an artificial earth satellite but later ejected to serve a particular purpose.

For example, an inflatable subsattellite has been designed to measure air density and satellite drag.

subsystem, n. *Specif.* 1. A component system

within a major system of a missile or rocket vehicle. 2. A major system within a weapon system, as in 'a responsibility for a weapon system or subsystem.'

The subsystem is itself a system, but for purposes of orderly breakdown, it is considered subordinate (sense 1) to a major system, and may consist of a single module or a combination of modules, plus other interconnected or interrelated component parts. The words 'system' and 'subsystem' are terms of functional relationship; the words 'assembly,' 'subassembly,' and 'module' are terms of physical relationship.

suitability, *n.* An aspect of a device or system that recommends it as having a capability to achieve desired results, disregarding availability, cost, and feasibility.

Whereas capability, reliability, and availability can usually be measured objectively, suitability is largely a matter of judgment after consideration of desired results and the capabilities of the device or system.

SUM (abbr). 'Surface-to-underwater missile.'

sun, *n.* *Specif.* The earth's sun, the star about which the earth and other planets revolve.

The mean apparent diameter of the sun is 866,000 miles, its volume about 1,300,000 times that of the earth, its mass about 330,000 times that of the earth, its surface gravity about 27.6 times that of the earth, its density about 1.4 times that of water, its visible surface temperature about 6,000° C, its estimated internal temperature up to 40,000,000° C. It rotates in the same direction as the earth upon an axis inclined 83° to the plane of the ecliptic.

The source of the sun's energy is nuclear.

sun glass. A convex lens for converging the sun's rays so as to produce intense heat or to obtain a concentration of radiant energy. Cf. **photon engine, polyethylene, *n.***

sun-powered radio. A radio powered by a solar cell.

sun tracker. A species of star tracker esp. designed to lock onto the sun to afford guidance to a missile or other flightborne object. See **star tracker.**

superior planet. A planet that is farther from the sun than the earth, i.e., Mars, Jupiter, Saturn, Uranus, Neptune, or Pluto.

Super Sabre. The F-100.

supersonic, *a.* Of or pertaining to the speed of an object moving at a speed greater than mach 1, or *specif.*, between mach 1 and mach 5. Cf. **hypersonic, *a.***, speed of sound.

Technically, *supersonic* is generic and includes the concept of *hypersonic*, but some writers use it restrictively for relative speeds between mach 1 and mach 5. Use of *ultrasonic* as a synonym of *supersonic* is discouraged; it is a term of acoustics.

supervisor of range operations. (SRO) At a missile test range, a person in Central Control responsible for overall direction and coordina-

tion of the range during launch and flight proceedings, and for coordination within the operations room of Central Control. Cf. **range safety officer.**

support system. A composite of equipment, skills, and techniques which, though not in itself an instrument of combat, clearly supports a military mission.

A support system may be a part of a weapon system.

surface, *n.* (surf) 1. That which is outermost and without depth in an object; the outside part of a missile or aircraft. 2. The uppermost part of the earth, i.e., of the land and seas, but not of the air. 3. An airfoil that provides an outer contour or plane to perform a function, as in 'lifting surface' or 'control surface.' 4. In sense 2, used in combination to form adjectives, as in *surface-to-air*, *surface-to-surface*, and *air-to-surface*.

surface-to-air missile. (SAM) A missile, esp. a guided missile, launched from the surface to intercept a target in the air. Cf. **interceptor missile.**

surface-to-surface missile. (SSM) A missile launched from the surface (including a silo site), and directed toward a surface target.

The ballistic missiles are usually SSM's, but air-breathing missiles like the Snark may also be SSM's. Cf. **underwater-to-surface missile.**

surveillance, *n.* The close or continued observation, by any means, of an area, place, airspace, lane of approach, or field of activity, in order to be informed of events and actions as they occur in the place under observation. **survivability, *n.*** 1. The ability and power to continue living. Said of a person or other animal, or of a nation. 2. The quality in the makeup of a thing that makes it durable under adverse conditions.

survival, *n.* 1. The primitive act or state of continuing to live, esp. in the presence of immediate peril, such as extreme heat or cold, low atmospheric pressure, radioactivity, dehydration, or starvation. 2. The discipline that enables a person to live in the presence of peril, as in 'man's entry into space will follow his mastery of survival.'

sustained flight vehicle. A powered vehicle capable of flying for an extended period of time; *specif.*, a space-air vehicle that derives most of its lift from aerodynamic forces, but some of it from centrifugal force at altitudes arbitrarily considered to be at 150,000 feet altitude. Cf. **satelloid, *n.***

sustainer, *n.* Anything that acts to sustain an action or movement already begun; *specif.*, a sustainer engine.

sustainer engine. An engine that sustains or increases the velocity of a missile or rocket vehicle once it has achieved its programmed velocity by use of booster or other engine.

This term is applied, for example, to the remaining engine of the Atlas after the two booster engines have been jettisoned. See *Atlas, n.*, note. The term is also applied to a rocket engine used on an orbital glider to provide the small amount of thrust now and then required to compensate for the drag imparted by air particles in the upper atmosphere.

sustainer rocket. A rocket engine used as a sustainer, esp. on an orbital glider or orbiting spacecraft that dips into the atmosphere at its perigee.

Suzano, *n.* A code name for an ARPA study program aimed at construction of a space platform.

SVE (*abbr.*). 'Swept volume efficiency.'

Used in reference to a radar antenna developed by General Bronze Corporation.

SWC (*abbr.*). 'Special Weapons Command.'

Sycamore, *n.* A Convair static firing site near San Diego, California. Also called 'Sycamore Canyon.'

synergic ascent. The ascent of a ballistic missile or space vehicle along a synergic curve.

synergic curve. A curve plotted for the ascent of a ballistic missile, space-air vehicle, or space vehicle calculated to give the missile or vehicle an optimum economy in fuel with an optimum velocity.

This curve, plotted to minimize air resistance, starts off vertically, but bends towards the horizontal between 20 and 60 miles altitude to minimize the thrust required for vertical ascent.

synodic period. The time between two successive inferior conjunctions or between two successive oppositions, as seen from the earth.

The synodic period for some planets is longer, for some shorter, than the sidereal period, because the earth advances during the sidereal periods of the planets. The sidereal period of Mercury, for example, is 88 days, its synodic period is 116 days. On the other hand, the sidereal period of Jupiter is 11.86 years, its synodic period 399 days.

system, *n.* 1. Any organized arrangement in which each component part acts, reacts, or interacts in accordance with an overall design that inheres in the arrangement. 2. *Specif.* A weapon system built about a given missile or airplane. See *weapon system*. 3. Also *specif.* A major component of a given missile, such as a propulsion system or a guidance

system. Usually called a 'major system' to distinguish it from the systems subordinate or auxiliary to it. See *ballistic missile, note*.

The system of sense 1 may become organized by a process of evolution, as in the solar system, or by deliberate action imposed by the designer, as in a missile system or an electrical system.

In sense 3, the system embraces all its own subsystems including checkout equipment, servicing equipment, and associated technicians and attendants. When the term is preceded by such designating nouns as 'propulsion' or 'guidance,' it clearly refers to a major component of the missile. Without the designating noun, the term may become ambiguous. When modified by the word 'major,' however, it loses its ambiguity and refers to a major component of the missile.

See *actuating system, auxiliary system, flight control system, guidance system, major system, primary system, propulsion system, and subsystem, n.*

systems contractor. A contractor who undertakes to do the necessary research and development, reliability research, and production in order to develop a missile or other weapon system.

The systems contractor is normally the prime contractor, working under guidance of the principal. See *ballistic missile, note*; cf. *systems engineering*, and *Space Technology Laboratories*.

systems engineering. *Specif.* The process of applying science and technology to the study and planning of an overall missile system, whereby the relationships of the various parts of the system and the utilization of various subsystems are fully planned and comprehended prior to the time that hardware designs are committed.

Use of the plural 'systems' refers to the many separate systems that must be combined in order to build an overall missile system. See *ballistic missile, note*.

T

T (*abbr.*). Short for 'T-time,' as in 'T minus 150 minutes,' or 'T plus 4 seconds.'

This usage is similar to the use of 'D' and 'H' in 'D-day' and 'H-hour' respectively, terms used in military operations. See entries in *USAF Dictionary* (1956).

T-1. A Soviet single-stage ballistic missile with a reported range of from 400 to 600 miles. Also called the M-101.

The T-1 is reported as an improved V-2, with a speed up to 4,400 mph. It is about 50 feet long, 5.5 feet in diameter, and powered by oxygen-alcohol rocket fuel. It is capable of carrying a nuclear warhead.

The T-1 is considered adaptable for use as a third stage of the T-3.

T-2. A Soviet two-stage liquid rocket IRBM, with a reported thrust of 340,000 pounds. Also called the M-103.

Some 90 feet in length, this missile is reported in

public sources as having a speed up to 5,200 mph, a range of 1,800 miles, a ceiling of 300 miles. It is capable of carrying a nuclear warhead. Its gross weight is 60 tons.

T-3. A Soviet two-stage, liquid rocket ICBM with a reported thrust of 500,000 pounds. Also called the M-104.

This missile is reported in public sources as having a speed of 15,000 mph, a range of 5,000 miles, a ceiling of 600 miles, a length of 110 feet, a diameter of 15 feet, and a guidance that is radio-inertial. It is capable of carrying a nuclear warhead.

T-3A. A Soviet follow-on missile of the T-3, reported as having a range of 6,200 miles and a speed of 16,000 mph.

T-4. A Soviet two-stage IRBM, 50 to 55 feet in length, capable of delivering a one-ton warhead 1,000 miles.

T-4A. A Soviet boost-glide bomber. Cf. *Dyna-Soar, n.*

T-5. A Soviet artillery rocket missile, unguided.

The T-5B and T-5C are advanced versions.

T-6. A Soviet surface-to-air two-stage, radar-guided solid rocket missile.

This missile is reported in public sources as having a speed of 1,650 mph, a range of 25 miles, a ceiling of 60,000 feet, a weight of 80 pounds, a length of 10 feet, and a diameter of 5.2 inches.

T-7A. A Soviet solid or liquid rocket SRBM.

This missile is reported in public sources as having a range up to 100 miles, a ceiling of 45 miles, and a speed of 3,000 mph. Its guidance is radio-inertial.

T-8. A Soviet anti-aircraft missile, counterpart of the Nike-Ajax.

This T-8 has a range of 15 miles, a speed of mach 2 and more. It is boosted by two solid rockets; its second stage is liquid. It is fired from mobile launchers.

tactical air force. An air force with a flexible capability charged with counter-air operations, interdiction operations, support operations to assist surface forces, and reconnaissance.

In the AF, a tactical air force may be a component either of the Tactical Air Command or of an overseas force. See *Composite Air Strike Force*.

tactical missile. (TM) *Specif.* A guided surface-to-surface missile designed esp. for employment in a tactical operation. See *tactical operation*.

The Matador Mace (TM-76A) is an example of a tactical missile.

tactical operation. An operation conducted by either surface or aerospace forces, or by both, against or in the presence of a hostile force so as to achieve an advantage over the hostile force or to ameliorate a disadvantage.

So long as combat between hostile forces was confined to a relatively well defined combat area and the space above, the concept of tactical operations was relatively clear, but with the combat area now extend-

ing to the entire globe and to the space above it, tactical operations may seem to merge and become identical with strategic operations. The essential difference between the two operations remains the same as it has, however, because the two occupy different positions in the scale of objectives. Thus, the tactical operation may be the means of achieving a strategic advantage, but it continues to be tactical in character so long as its immediate objective is to weaken or destroy the hostile military force, or to force him out of position to permit a strategic attack.

For further illustration of the use of this term, see related terms, such as *tactical air operations* and *tactics*, in the USAF Dictionary.

take, v. To take off, to perform the action of a takeoff. Said of a rocket missile, rocket vehicle, or aircraft.

takeoff, n. 1. The action of a rocket vehicle departing from its launch pad. See *liftoff, n.*

2. The action of an aircraft as it becomes airborne.

In sense 2, see entry in USAF Dictionary.

takeoff mass. The mass of a rocket vehicle and its payload at the time of takeoff. Cf. *mass ratio*.

takeoff weight. The weight of a rocket ready for takeoff.

This weight includes the weight of the vehicle, the fuel, and the payload.

Talos, n. A Navy surface-to-air two-stage, supersonic, guided missile, produced by Bendix. Also called SAM-N-6.

Some 20 feet in overall length, 2.5 feet in diameter, and 9.48 feet in span, the Talos has a range of 70 miles, and a speed of more than mach 2. Its Bendix booster first stage is a solid rocket; its McDonnell second stage is a ramjet sustainer. Its guidance is by beam riding or passive homing. It may carry a nuclear warhead.

Talos is operational. It was fired from the USS Galveston 25 Feb 1959.

TAM (abbr). 'Tactical air missile.'

tank, n. 1. A container incorporated into the structure of a liquid rocket from which a liquid propellant or propellants are fed into the firing chamber or chambers. 2. A container for storage of liquid oxygen, liquid fuel, or other liquid propellant until transferred to the rocket's tanks or some other receptacle.

tanker squadron. A squadron composed of tanker aircraft and trained personnel to provide inflight refueling service.

tank trailer. A trailer vehicle for conveyance of liquid propellants.

tape recorder. An instrument that records on magnetic tape variations in electrical quantities, such as current, potential, power, and frequency, the quantities then being subject to a playback with interpretations in sound, graphic display, or the like. Used in the tele-

metering equipment of manmade satellites or missiles, or in the recording of signals from a radio transmitter.

target data. Programmed data on a missile's speed and trajectory fed into an electronic sequencer so as to put the missile on target.

target drone. An unmanned aircraft or a missile used as a target for testing interception equipment and procedures. Cf. **Kingfisher, n.**, **Q (code)**, **target missile**.

target missile. 1. A missile that defense forces are bent upon intercepting and destroying. 2. A missile that serves as a target for testing interception equipment and procedures. See **Kingfisher, n.**

target versatility. An attribute of a missile signifying that it may be used against a variety of targets.

By fitting a missile with various warheads, the missile may, for example, be used against tanks, people, factories, etc. By changing the amount of thrust it may be used against targets of different ranges. Such a missile is said to have target versatility.

Tartar, n. A Navy surface-to-air solid rocket guided missile being developed by Convair.

Tartar is reported as similar to Terrier, but is smaller. Its speed exceeds mach 2, and its range is about 10 miles.

TBM (abbr). 'Tactical ballistic missile.'

TC (abbr). 'Thrust chamber.'

TCBM (abbr). 'Transcontinental ballistic missile.'

Teal, n. A Navy air-launched solid-rocket drone, developed by Temco and Phillips. Also called XKDT-1.

Some 11.8 feet long, 4.9 feet in span, and a diameter of .8 foot, the Teal has a speed of mach .95.

Teapot Committee. The Strategic Missile Evaluation Committee.

telefork, n. A missile support vehicle that serves as a tractor, a forklift, and a crane.

telemeter, n. An electronic instrument that senses and measures a quantity, as that of speed, temperature, pressure, or radiation, then transmits radio signals to a distant station, where, indicated or recorded, they are interpreted by code into the quantity provided for. Cf. **tape recorder**.

Telemeters are important instruments in earth satellites or test spheres, also in test ballistic and guided missiles.

telemetry, n. The practical art of using telemeters. Attrib., as in *telemetry device*.

television, n. The transmission and reception of electromagnetic waves transduced from

visible light waves at transmission, and transduced back to visible light rays at reception so as to obtain a picture on a screen of the objects that emitted or reflected the original light waves.

Transmission of the electromagnetic waves may be by wire or by radio.

Temco, n. Short for 'Temco Aircraft Corporation' of Dallas, Texas, missile contractor, as for Corvus.

temperature, n. (temp) The measure of heat intensity on a definite scale.

The theoretical lower limit of temperature is absolute zero (approximately -273.16° C or -459.69° F); no upper limit has been observed. See **Kelvin scale**, **Ran-**
kine scale.

terminal vehicle. That part of a rocket vehicle that is last to separate, but is itself a carrier of something, as in the case of a lunar probe or earth satellite.

terrella, n. A small earth in space, i.e., a space capsule containing an environment equivalent in essential matters to that of the earth.

terrestrial space. Space comparatively near the earth in which the attraction of the earth is predominant. Cf. **near space**.

Terrier, n. Either of two Navy surface-to-air solid rocket guided missiles developed by Convair. Also called SAM-N-7.

Terrier I, 15 feet long (27 feet with a booster), 1 foot in diameter, and 3.5 feet in span, has a range of 10 miles and a speed up to mach 2.5. *Terrier II* is a larger version of Terrier I with modifications chiefly in guidance.

test, n. 1. A procedure or action taken to determine under real or simulated conditions the capabilities, limitations, characteristics, effectiveness, reliability, or suitability of a material, device, system, or method. 2. A similar procedure or action taken to determine the reactions, limitations, abilities, or skills of a person, other animal, or organization.

test equipment. Equipment used in testing the capabilities and characteristics of experimental operational equipment. See **reliability research**.

test failure. A failure to receive instrumentation data or other sought-after results by virtue of an abort, a miscalculation, or a breakdown in test equipment during the research and development phase of a rocket missile or vehicle.

A test failure is relative to purpose. If, for example, a particular substance undergoing test falls short of desired results, the test is not a failure since the data sought after has been obtained. Thus, a rocket that fails

to leave its launching pad may not, in fact, be a test failure if desired data is obtained. Cf. **test objective**.

test firing. The firing of a rocket motor or engine, either live or static, to accomplish some test.

test flight. The flight of a rocket missile or aircraft performed to achieve a specified test objective.

test GSE. The ground support equipment used to maintain operational readiness of an operational weapon system. Cf. **checkout GSE**.

test objective. The particular thing for which a test is made.

The test objective, for example, may be to find out if a particular substance will endure a particular temperature or pressure, or if a given design gives better performance than another. Cf. **test failure**, note.

test sphere. *Specif.* A sphere designed to be rocket-carried to the expected orbital height or to some other environment of a satellite or other space probe, for purposes of testing equipment, such as minitrack transmitters, prior to the launching of the satellite or other space probe.

test stand. A stand at which some mechanism or engine is tested out; *specif.*, a stand at which the static firing of a rocket engine is carried out to test thrust and other reactions. Cf. **rocket thrust**.

test vehicle. (TV) A vehicle, esp. a flight test vehicle, used to test the reliability of experimental equipment being developed for operational use.

The test vehicle may itself be the experimental equipment, or it may be the carrier for testing some other equipment. It differs from a research vehicle in that the latter is used primarily to carry equipment so as to obtain data about the environment through which it passes.

theodolite, n. A sighting and measuring telescopic instrument that gives a reading on horizontal or vertical angles.

thermistor, n. A temperature-sensitive resistor with a negative temperature coefficient of resistance.

thermochemistry, n. A branch of chemistry that treats of the relations of heat and chemical changes.

thermodynamic heating. The heating that results from friction between objects in motion, as in a missile moving through the atmosphere.

thermodynamics, n. A branch of dynamics that treats of the mechanical actions or relations of heat, including the conversion of heat

energy or of mechanical energy one into the other.

thermonuclear, a. Of or pertaining to nuclear fusion and added fission under the intense heat of nuclear fission.

thermosphere, n. The ionosphere considered as a region of temperature variation from minus 28° F to several thousand degrees.

thindown, n. *Specif.* The process by which cosmic rays, atomic particles, meteoroids, or the like lose their identity or their force as they penetrate into the atmosphere. See **bremsstrahlung, n.**

Thiokol, n. Short for 'Thiokol Chemical Corporation,' missile contractor, as for the propulsion systems of Falcon, Lacrosse, and Sergeant.

Thompson Ramo-Wooldridge, Inc. A company organized by the merging of Ramo-Wooldridge Corporation and Thompson Products in October 1958.

This company owns Space Technology Laboratories (which see).

Thor, n. An AF surface-to-surface intermediate range, single-stage, liquid rocket ballistic missile. Also called the SM-75.

The Thor, an IRBM 65 feet long and 8 feet in diameter, with a gross takeoff weight in excess of 55 tons, a range of 1,500 nautical miles (1,726 miles), and a speed of 10,000 mph, has been developed by Douglas (responsible for airframe and assembly), AC Spark Plug (for guidance), Rocketdyne (for propulsion), General Electric (for the nose cone), and Space Technology Laboratories (for systems engineering). First flight-tested in January 1957 (13 months after the initial production order), the Thor was the first IRBM to make a fully guided all-inertial flight. Its propulsion unit develops about 150,000 pounds of thrust. It is capable of carrying a nuclear warhead. As a strategic missile, its employment is coordinated with strategic bombing.

The Thor, which may be air-transported in a C-124, is the first IRBM to be deployed operationally in the US and overseas.

Thor is named after the Norse god of thunder, the god of strength.

Thor-Able, n. A rocket test and research vehicle consisting of Thor as the first stage and of a modified Vanguard second stage as a second stage, with other stages added if required for the purpose involved.

The Thor-Able with two stages was used for test flights on 23 April, 10 July, and 23 July 1958. The latter two flights sent nose cones some 6,000 miles distant, instrumented, in part, for aeromedical and space medicine research. See *Mia, n.*, *Wickie, n.* On 8 April 1959, a two-stage Thor-Able fired an ICBM nose cone to a distance of 5,000 miles on the Atlantic Missile Range, and was so accurate that recovery of the nose cone was effected a few minutes after impact.

The Thor-Able with four stages was used as the

rocket vehicle of Pioneer I on 11 October 1958. The third stage was solid. The fourth stage was a solid retro-rocket originally programmed for use in the near vicinity of the moon, but found to be unignitable when the remaining body was falling back to the earth.

The term 'Thor-Able' is used with suffix roman numerals, each indicating a modification in the second or later stages of the basic vehicle. Thus, **Thor-Able I**, also called 'Able I,' was the carrier for Pioneer I. This vehicle has 4 stages (an Aerojet liquid rocket as the second, an Allegany solid as the third, and a Thiokol solid as the fourth). It is 88.1 feet long. **Thor-Able II**, carrier for Pioneer II, is essentially the same carrier as Thor-Able I.

Guidance in the Thor-Able vehicles is limited to the first stage. Cf. **Thor-Delta, n.**

Thor-Bravo, n. A term used to indicate a second test or research vehicle in a series using the Thor as the first stage.

In the same series is Thor-Able, Thor-Charlie, and Thor-Delta.

Thor-Delta, n. An advanced booster vehicle, essentially the Thor-Able with guidance added in the second stage, designed to carry a lunar impact probe or a lunar satellite to a correct point in space for final launch toward its destination.

The Thor-Delta is calculated to carry a 100-pound payload for lunar impact, a 65-pound payload for lunar orbit. It is also capable of putting a satellite into circular orbit.

Thor-Hustler, n. A rocket research vehicle that incorporates the Thor as the first stage and the Bell Hustler as the second. See **Discoverer I**.

Thor-Vanguard, n. A rocket vehicle made up essentially of the Thor with one or more stages of the Vanguard vehicle.

threat, n. 1. *Specif.* A posture on the part of a nation or force, esp. a military posture, that indicates a readiness, pretense, or preparation to attack or to press for advantage. Often used as the second element in phrases where the first element indicates the nature or source of the threat, as in *economic threat, missile threat, nuclear threat, Soviet threat, verbal threat*. See **posture, n.** 2. More generally, anything that menaces, either by unintended circumstance or by purposeful design, as in 'the threat of disease,' 'threat of radiation,' or 'the threat of attack.'

throatable, a. Of a nozzle: Designed so as to allow a change in the velocity of the exhaust stream through changing the size and shape of the throat of the nozzle.

thrust, n. The force exerted on a rocket or propeller vehicle by its powerplant, normally acting in the direction of the rocket nozzle

axis or propeller shaft, and expressed, in the case of a rocket, as a function of the effective exhaust velocity and the propellant flow rate, i.e., $F = \dot{w}c/g$, wherein F is thrust, $\dot{w}$ is propellant flow weight rate in pounds per second, c is effective exhaust velocity in feet per second, and g is gravitational acceleration of 32.18 feet per second per second.

Although the formula shown considers the propellant flow rate as a function of weight, it is really a function of mass.

The Atlas and Titan develop thrust increments greater than those of most other missiles (the Atlas in excess of 350,000 pounds). It is estimated that Sputnik III required 500,000 pounds of takeoff thrust to be put in orbit; Vanguard required 25,000 pounds.

Thrust, by virtue of its vector component of direction, is subject to use in the flight control system (which see).

thrust buildup. In the launch of a rocket missile or vehicle, esp. of a liquid rocket, the rapid increase in thrust to a point at which liftoff is effective.

thrust chamber. 1. The chamber of a jet or rocket motor in which pressure is enormously increased so as to obtain a high velocity through the nozzle. 2. Sometimes applied to the entire rocket or jet motor, since the motor is essentially a thrust chamber.

The terms 'thrust chamber' and 'firing chamber' refer to the same object, but from two different points of view.

thrust cutoff. The stoppage of thrust in a rocket or jet engine. **Attrib.,** as in **thrust-cutoff point**. See **thrust terminator**.

Thrust cutoff may be accomplished in a liquid engine by stoppage of the reaction process; in a solid motor, by dissipating the exhaust. Thrust cutoff is seldom instantaneous. See **thrust dieaway**.

thrust decay. 1. A sudden and unprogrammed decline in the thrust of a rocket engine. 2. **Thrust dieaway**.

Because of thrust decay, a missile being vertically launched may fall back to the launch pad, sometimes consumed in the flame of its own fuels.

In sense 2, 'thrust dieaway' is the preferred term.

thrust dieaway. The relatively rapid but gradual decrease in the thrust of a rocket engine from normal thrust output to zero—in response to fuel shutoff, fuel expenditure, or failure in the feed system.

This term is considered preferable to 'thrust decay' or 'thrust cutoff' because it better describes the termination of the firing process. During the event, measurable impulse is given the vehicle.

thrust reverser. A device for redirecting a rocket engine's exhaust to an opposite direction.

thrust section. 1. A section in a rocket mis-

sile or vehicle that houses or incorporates the combustion chamber or chambers and nozzles.
2. In loose usage, a propulsion system.

See **propulsion section**.

thrust terminator. A device for ending the thrust in a rocket motor or engine, either through propellant cutoff (in the case of a liquid) or through diverting the flow of gases from the nozzle.

Thunderbird, n. A British surface-to-air solid rocket supersonic missile.

This missile is reported as 22 feet long, with a ceiling of 20 to 30 miles.

Thunderchief, n. The F-105.

tiltwing, n. An airplane wing that may be pivoted 90 degrees about its longitudinal axis, used esp. in convertiplanes. See **X-18**.

Tiros, n. A projected weather satellite using television, under development by NASA.

'Tiros' is an abbreviation of 'Television Infrared Observation Satellite.'

Titan, n. An AF surface-to-surface, long-range, liquid, two-stage rocket missile in research and development under the Ballistic Missile Division (ARDC), with Space Technology Laboratories the systems contractor, and the Ballistic Missiles Center, AMC, and SAC Mike close coordinators. Also called the SM 68 and WS-312.

Some 90 feet in overall length, 8 feet in diameter, and a gross takeoff weight of about 110 tons, Titan has an expected range of approximately 5,500 nautical miles and a maximum speed of 15,000 mph. The first stage is 54 feet long.

The airframe and assembly are the responsibility of Martin; inertial or radio inertial guidance of Arma, Honeywell, Bell Telephone Laboratories, and Remington Rand; the powerplant (2 regenerative liquid boosters and 1 regenerative liquid sustainer) of Aerojet; and the nose cone of Avco. In all, some 9 associate contractors, more than 75 major subcontractors, and thousands of suppliers have contributed to the missile's development.

Although larger than Atlas, the Titan weighs less at takeoff (110 tons vs 130 tons). Its development was accelerated by virtue of lessons learned in developing the Thor and Atlas. Its first successful test flight was made 6 Feb 1959. It will be deployed to Lowry Air Force Base and other launch sites.

Titan is named for one or other of the primeval deities of Greek mythology, noted for their massive force.

tj (abbr). 'Turbojet.'

TM (abbr). 'Tactical missile.'

This abbreviation is used with a number to designate a particular tactical missile, as in *TM-61C* the Matador and *TM-76* the Mace.

TMW (abbr). 'Tactical missile wing (USAF).'

TMG (abbr). 'Tactical missile group (USAF).'

total impulse. (I_t) The integral of a rocket's

thrust in pounds over the operating duration in seconds, expressed in pound-seconds.

This is expressed by the formula

$$I_t = \int_0^t F dt = I_s \dot{w} dt,$$

where F is thrust, t is the duration in seconds, and $\dot{w}$ is the propellant flow weight rate in pounds per second. Total impulse is thus a function of specific impulse.

total war. A war in which the total military, economic, political, and social resources of a contesting nation are utilized, or potentially utilized, affecting directly all its inhabitants.

'Total war' is a point-of-view word. From the standpoint of one nation, the war may be total, but from that of another, it may not be. See **limited war**, note. Total war may, or may not, be waged with nuclear weapons. Cf. **general war**, **small war**.

track, n. 1. A hypothetical trace made by a flying object, as by a missile, aircraft, or spacecraft, the trace being projected either vertically to the earth's surface from the flying object, or to some other set of coordinates. 2. This trace as shown on a radar screen or plotting board.

track, v. tr. 1. To observe and plot the progress of *something* moving, as of a missile or spacecraft, either by sighting and watching it, esp. by means of radar, or by tuning in on a radio transmitter within the object being tracked. 2. Of a flightborne vehicle: To lock onto a *celestial body's radiations* and be guided by them. See **star tracker**.

The action of tracking may be performed by a person or by an instrument.

tracking instrument. An instrument used in tracking.

The tracking instrument is usually photographic (as with ROTI) or electronic (as with radar or radio).

tracking station. A station set up to track an object moving through the atmosphere or space, usually by means of radar or radio. Cf. **minitrack radio**.

A tracking station may also serve as a readout station.

trailerized equipment. Equipment, such as a radio transmitter, tracking instruments, or checkout equipment that is fitted into a trailer so as to be readily moved. Cf. **missile checkout trailer**.

trajectory, n. 1. The curve in the vertical plane traced by a bullet, shell, bomb, or other object thrown, launched, or trajected by an applied exterior force, the projectile continuing in motion after separation from the force. 2. In missilery, the path traced through space in the vertical plane by a guided rocket missile, pilotless decoy vehicle, or ballistic missile,

such missile or vehicle being propelled by fuel either the whole distance or a part of it; a flight profile. 3. A flight path.

The extension of meaning to sense 2 is comparable to that observed in the term 'projectile' (which see). The term thus does not clearly differentiate between a path in the vertical plane traced after cutoff of propulsive force (as in sense 1) and a path traced by a missile that is in part or wholly propelled by fuel. See **ballistic trajectory**.

The term 'flight path' is sometimes used for 'trajectory' in sense 2, but the two terms are usually differentiated. See **coasting flight**, **flight path**, **free-flight trajectory**, **reentry trajectory**.

tranquilized bird. A rocket vehicle that has a stabilized guidance system.

tranquilizer, *n.* An instrument that adds stability to a missile's guidance system. *Slang*.

transcontinental ballistic missile. (TCBM) A ballistic missile with a range capability of 11,000 miles or more.

transfer, *n.* The action of moving from one spatial body to another, or from one orbit to another.

transfer orbit. The flight path of a spacecraft as it moves from the orbit of one spatial body to the orbit of another. See **orbit**, *n.*, sense 2.

transistor, *n.* An electronic device that controls an electron current by the conducting properties of germanium or like material, capable of amplifying signals 100,000 times, but using a small fraction of the power required for an electron tube.

The transistor is similar to the vacuum tube in uses, but is itself a nonvacuum device. Brought out in 1948, it was used, for example, in the radio transmitter of Explorer I.

Transit, *n.* A Navy navigation satellite in development, the booster Thor-Able.

translunar space. That part of space conceived as a belt of space centered on the earth, with its lower limits at the distance of the orbit of the moon, but extending to several hundred thousands of miles beyond. Cf. **lunar space**.

This term is one of distance from the earth but in the direction of the moon's orbit, not one of the moon's influence. Cf. **cislunar space**.

trapping, *n. Specif.* The process by which radiation particles are caught and held in a radiation belt.

Trident, *n.* A rench rocket missile with wings, similar to the Bomarc.

Triton, *n.* A Navy surface-to-surface ramjet missile developed by McDonnell.

Triton develops mach 3 speed and a range of 1,500 miles. Its guidance is inertial.

tropopause, *n.* The upper limit or limits of the troposphere. See **pause**, *n.*

troposphere, *n.* The lower layer of the earth's atmosphere, extending to about 60,000 feet at the equator and 30,000 feet at the poles.

The troposphere is characterized by turbulent air, by a varying moisture content, and by a relatively constant rate of temperature decrease with elevation. The thickness varies with the seasons and with different meteorological conditions.

TRUD (*abbr.*). 'Time remaining until dive.'

trud count. [See preceding.] A count in minutes and seconds after the end of the countdown that measures the time between the launch and the moment the rocket apogees and begins its dive.

Tsiolkovsky, K. E. A Russian engineer and scientist (1857-1935) whose paper "Rockets into Cosmic Space" (1903) was one of the pioneer works in the achievement of rocket flight.

T-time, *n.* The moment at the end of a countdown, when a button is pushed, or some other like action is taken, to begin a chain reaction that results, or is intended to result, in the firing of a rocket propulsion unit that launches a rocket vehicle or missile.

The lag in time between T-time and the actual launch of a rocket varies according to the rocket being launched. With Jupiter, the lag is 16 seconds; with Atlas it is longer because steel clamps, which hold the missile down while the engines build up thrust, have to be withdrawn.

'T-time' is usually shortened to 'T' during countdown or plus count. See separate entries. See also **T** (*abbr.*).

Tu-114. A Russian two-deck passenger airplane powered by four 12,000-horsepower Kuznetsov turboprops, and designed by A. N. Tupolev.

The Tu-114 flew from New York to Moscow on 13 Jul 1959 in 9 hours, 48 minutes. Cf. **Boeing 707**.

tub, *n.* A fanciful name for the bucket-like container of the second, third, and fourth stages of Jupiter C, mounted on the nose section of the Redstone first stage, and above which the fourth stage projects.

The tub is given a spinning motion upon liftoff for stability. Cf. **bucket**, *n.*

tumble, *v. intr.* Of an oblong flying object: To rotate about its horizontal axis, end-over-end. Said of Sputnik II and Sputnik III.

turn, *n.* The motion involved in a moving object when it changes direction, as in 'a turn from vertical flight to horizontal.'

TV (*abbr.*). 1. 'Test vehicle.' 2. 'Television.' 3. 'Terminal velocity.' *Navy*.

TV-4. The test vehicle of the Martin Company that launched Vanguard I.

two-stage rocket. A rocket that has two propulsion systems, each housed in a separate section with its own fuel source, the upper one ignited after separation from the first. See **two-step rocket**.

two-step rocket. 1. A rocket provided with an exterior ratio unit that boosts the vehicle before the main propulsion unit acts, as in the Aerobee. 2. Sometimes applied to a two-stage rocket.

Sense 1 distinguishes a two-step rocket from a two-stage rocket.

type, *n.* Capitalized. A term used with a number that specifies a foreign-made missile or aircraft not otherwise or normally named.

Type 510, Type 511, and Type 5103 are French air-to-air supersonic missiles. *Type 304* is a Swedish air-to-surface attack missile; *Type 315* is a 14-foot Swedish surface-to-surface missile launched from a destroyer. *Type 56* and *Type 57* are advanced versions of the Oerlikon 54.

U

UAM (*abbr.*) 'Underwater-to-air missile.'

UAUM (*abbr.*) 'Underwater-to-air-to underwater missile.'

ultimate range ballistic missile. (URBM) A ballistic missile with a range equal to half, or somewhat more than half, the distance around the earth, capable of striking at a target anywhere upon the globe from any given launch point.

ultrasonic, *a.* Acoustics. Of or pertaining to frequencies above those that affect the human ear, i.e., above 20,000 vibrations per second.

Use of this term in acoustics reserves 'supersonic' for use in aerodynamics.

umbilical, *n.* Short for 'umbilical cord.' Often used in the plural, *umbilicals*.

umbilical cord. Any one of the servicing electrical or fluid lines between the ground and an upright rocket missile or vehicle before the launch.

uncommitted nation. A nation that has not fallen under communist domination or control, but has not committed itself to the support of either the free world or the communist world.

underdeck spray. That part of a pad deluge in which the water is directed upward from under the missile.

underground launching site. A site at which missiles are placed in silos in an alert status.

underwater-to-air-to-underwater missile (UAUM). A rocket missile launched from underwater into the air but projected toward an underwater target. See **Subroc, *n.***

underwater-to-surface missile. (USM) A missile launched from underwater, with a trajectory that goes into, or above, the atmosphere, and turns back to a surface target.

The *Polaris* is either a USM or a SSM.

underwater-to-underwater missile. (UUM) A missile launched from underwater toward an underwater target.

unguided, *a.* Of a missile: Without guidance during flight. See next.

unguided missile. An aimed missile.

The term 'unguided' may be considered a misnomer, since the missile actually receives guidance as it leaves its launcher. The term is used, however, and distinguishes a missile given only initial guidance from the missile guided during flight, either all the way to the target (the guided missile) or over the critical period before thrust shutoff (the ballistic missile). See **guided missile, note.** Cf. *Zuni, n*

unified command. A command made up of elements from two or more services, operating under a single commander.

A unified command may be made up of service forces belonging to one nation, as in the case of the Continental Air Defense Command, or it may be composed of service forces of different nations, as in the case of the North American Air Defense Command.

unit, *n.* Anything considered as complete in itself but functioning as a part of an assembly, subsystem, or system.

universe, *n.* The entire spatial cosmos.

unmanned vehicle. *Specif.* An aerospace vehicle with neither a pilot nor crew within it.

This term, like 'pilotless aircraft' before it, is sometimes applied to a guided missile or ballistic missile. It is a point-of-view term indicating that, for the purpose, the missile object is being considered as the carrier of something, such as payload, a guidance system, or the like. Cf. **maned vehicle, vehicle, *n.***

UOC (*abbr.*) 'Ultimate operational capability.'

upper air. That part of the atmosphere that embraces the ionosphere and the exosphere.

upper stage. A second or later stage in a multi-stage rocket.

Uranus, *n.* The sun's seventh planet.

The mean distance of Uranus from the sun is 19.19 astronomical units (1,783,000,000 miles). Its orbital velocity is about 4 mi/sec. Its eccentricity is .047. Its sidereal period is 84.02 years, its synodic period 369 days. Its mean diameter is 31,000 miles, its mass 14.6 times that of the earth. Its mean rotation period is 10 hours more or less. Its surface temperature is -170° C.

URBM (*abbr.*) 'Ultimate range ballistic missile.'

USAF (*abbr.*) 'United States Air Force.'

USM (*abbr.*) 'Underwater-to-surface missile.'

UUM (*abbr.*) 'Underwater-to-underwater missile.'

V

V-1. [From the German *Vergeltungswaffe Eins* Vengeance Weapon One. See note.] A surface-to-surface German winged robot bomb of WW II, powered by a pulsejet engine mounted on its back, and controlled for altitude and range by an autopilot on a preset course.

The V-1, first launched across the English Channel on 13 June 1944, had a maximum speed of about 400 mph, a range of 150 miles, and a ceiling up to 6,000 feet. Their normal flying altitude was between 2,000 and 3,000 feet. About 2,400 V-1's fell on London and south England, more than 2,000 on Antwerp. Some 20,000 V-1's were launched against target areas.

Etymological Note

That the 'V' in V-1 and V-2 stands for *Vergeltungswaffe* has been in some dispute, especially since A Report Prepared for the AAF Scientific Advisory Group (Hq AMC, May 1946), Part II, pp 47-48, cited testimony by a consultant to the German Air Ministry that the 'V' stood for *Versuchsmuster* (experimental type). Other testimony seems to indicate, however, that the *Vergeltungswaffe* explanation is the correct one. This is supported by letters of 9 July and 31 October 1958 to the Editor from Robert Lusser, now with the Army Rocket and Guided Missile Agency, Redstone Arsenal, Alabama, but formerly Technical Director of the Fieseler Works at Kassel, Germany, where the V-1 was put into research and development in March and April 1942.

Wrote Lusser, "During the preliminary studies at the Fieseler Aircraft Company, Kassel, the weapon was called 'P 31,' i.e., Fieseler Project No. 31. When the full development contract was awarded on 29 May 1942, the project was called 'Fi 103.' Then for a brief period it was called *Kirschb kern* (Cherrystone) in reference to the pneumatic principle of the catapult by which the missile was launched. But since this was too conspicuous a name, the intentionally cluttered-up designation 'FZG 76,' derived from the word *Fernzielgeraet* (Long Range Weapon), was used in parallel, outside the Fieseler Company.

"It was not until some days after the first launch against England, however, that the designation 'V-1' was used. At that time (16 June 1944), the public press of Germany announced the name 'V-1,' declaring that it meant *Vergeltungswaffe No. Eins*. At the same time, the V-2 was announced as a hint of another weapon to come.

"The V-names were introduced for propaganda purposes. To the Germans they were valuable in two ways: (1) as a counter-measure to the heavy Allied bombardment of German cities, and (2) as a takeoff on the Churchill V-sign for victory."

Between 13 June and the V-name announcement, Britons called the V-1 by a variety of popular names, 'buzz bomb,' 'robot bomb,' 'comet bomb,' and 'Whirley.'

It may be noted that the *Versuchsmuster* explanation would suggest that the V-1 was an earlier experimental type than the V-2. Such was not the case. The V-2,

known until June 1944 as the 'A-4' (which see), was under development during the 30's. Cf. Henschel 293, note.

V-2. [The second *Vergeltungswaffe*: See V-1, note.] A WW II liquid rocket ballistic missile, developed by the Germans. Usually called the 'A-4' by the Germans. Attrib., as in V-2 rocket, V-2 weapon.

The V-2, first launched against England on 8 Sep 1944, developed 60,000 pounds of thrust from its rocket engine. Its fuel was 75% ethyl alcohol and 25% water; its oxidizer was liquid oxygen.

From nose to exhaust tail, it measured 46 feet, and its diameter was about 5 feet. Shaped like an artillery shell it was without wings, but was subject to some guidance through movable panels built into the four tail fins and through graphite vanes extending into the exhaust stream. Launched vertically, it quickly reached a speed of 3,600 mph, then was tilted in the direction of its target. It exhausted its fuel supply of 9 tons in 60 seconds, but reached an altitude of about 60 miles with a range of 200 miles, and plunged earthward at about 1,500 mph. Some 1,115 V-2's were sent across the channel in the last months of WW II. An estimated total of 3,000 were fired at targets on the continent and in England.

Valkyrie, n. The B-70.

Van Allen radiation belt. A name sometimes given the field or fields of trapped particles extending several hundreds of miles beyond the ionosphere, so named for Professor James A. Van Allen (1915-) of the State University of Iowa, physicist and rocketeer.

Van Allen, a pioneer in miniature instrumentation, esp. for the Explorer satellites, has been successful in partly delineating the configuration of the radiation belt or belts, basing his findings upon data obtained from signals emitted by manmade satellites and space probes. Two distinct belts, an inner and an outer, are delineated. See radiation belt.

Vandenberg, n. Short for 'Vandenberg Air Force Base.'

Vandenberg Air Force Base. An AF base twelve miles northwest of Lampoc, California, used as a missile unit training center, a missile test launching site, and an operational ICBM base. Named for General Hoyt S. Vandenberg (1899-1954), former Chief of Staff, USAF (April 1948-June 1953).

Vandenberg AFB utilizes 64,000 acres of the original Camp Cooke reservation of 86,000 acres. See Cooke Air Force Base, Pacific Missile Range.

Vanguard, n. 1. A project of the National Aeronautics and Space Administration (originally of the US Naval Research Laboratory) concerned with developing a carrier rocket and satellites, the latter to be placed in orbit during the International Geophysical Year. Officially called 'Project Vanguard.' 2. Short for

'Vanguard carrier rocket' or 'Vanguard satellite.'

Vanguard I. The first earth satellite launched into orbit by the Vanguard rocket, fired from Canaveral. Also called '1958 Beta.'

This satellite, launched on 17 March 1958, some 19 seconds before 0716 (EST), is a 3.25-pound sphere, 6.4 inches in diameter. Its elliptical orbit is larger than that of previously launched satellites. See data under **earth satellite**.

Made of aluminum, it is coated with a thin film of silicon monoxide that radiates infrared and reflects heat to keep internal temperatures low. Two radio beacon transmitters are inside the sphere, one operated by miniature batteries (which went dead 5 Apr 1958), the other operated by 6 solar cells in the outer surface.

One year after the launch of this satellite, Dr. John P. Hagen (1908-), Director of the Vanguard program, observed that the satellite had travelled 132,000,000 miles in an orbit larger than that of other artificial satellites; that the solar-powered radio transmitter was still working perfectly; that inferences had been made about the earth's shape (pear-shaped with its narrow end toward the North Pole) from putting together precisely known facts on the satellite's orbit with observations on the satellite's perturbations; that distances between points on the earth's surface could be precisely determined by triangulation on the satellite at a given point on its orbit; and that temperature variations on the satellite could be determined during orbit by the fact that the crystal which controls the frequency of the minitrack transmitter has a high coefficient of frequency with temperature (see *The Army-Navy-AF Register*, 28 Mar 1959, p 24). See **earth, n**.

Vanguard II. An earth satellite launched into orbit on 17 February 1959 by the Vanguard carrier rocket. Also called '1959 Alpha.'

This satellite, a 20-inch sphere weighing 21.5 pounds, is a weather satellite with photocells to scan the earth's cloud cover. It apogees at 2,086.5 miles, perigees at 329.4 miles, and has an expected lifetime of more than 100 years. Its perigee speed is 18,379 mph, its apogee speed is 13,041 mph, and its period is 125.9 minutes. Its inclination to the earth's equator is 33.2 degrees.

Vanguard III. A 50-pound satellite attached to the 50-pound third stage of its carrier, launched 18 Sep 1959. Also called '1959 Eta.'

Instrumented to measure magnetic fields, micrometeoroid encounters, solar X rays, and temperatures, Vanguard III lifted from Canaveral at 0020 (EST); Apogee 2,329 miles, perigee 319, perigee speed 18,567 mph, period 130 minutes, inclination 33°. It was the 3rd Vanguard (in 11 attempts in 21 months) to reach orbit.

Vanguard carrier rocket. A three-stage carrier rocket developed by Martin under Project Vanguard for placing a satellite in orbit.

This carrier rocket, 72 feet in length and 22,600 pounds in weight, is a modification of the Viking with a slenderness ratio of about 19 to 1. Its first stage is a General Electric liquid rocket, its second an Aerojet liquid rocket, its third a Grand Central or Allegany solid rocket. Its horizontal velocity increment totals 25,817 ft/sec or 17,603 mph; its thrust is 36,000 pounds.

The first stage develops 27,000 pounds of thrust, the

second 7,500 pounds, the third 1,440 pounds. Cf. **TV-4. vanishing-man concept**. A concept of warfare that visualizes more and more use of robots, machines, and automation with a corresponding use of fewer and fewer men.

This concept is not to be considered necessarily valid.

VC-137. A Boeing-built staff administration version of the four-jet Boeing 707.

The passenger cabin is partitioned into 3 main sections: Communications center with radio teletype forward; an airborne headquarters in midsection; passenger seats aft.

VCO (abbr). 'Vernier engine cutoff.'

Vega, n. A projected test vehicle of the Jet Propulsion Laboratory to consist of Atlas as the first stage, a liquid oxygen and kerosene second stage, and a 6,000-pound thrust liquid third stage. Cf. **Thor-Able, n**.

The Vega vehicle, either 2-stage or 3-stage, is programmed by NASA for such missions as a hard landing on the moon and a 2-man space laboratory in orbit about the earth.

The second stage is the GE Vanguard first stage.

vehicle, n. (veh) 1. In essence, any contrivance or medium used to carry a load from one place to another. 2. In missilery, the airframe that provides a means of carrying those systems required to place the warhead on target. See **vehicle defense**. 3. In rocketry, the entire contrivance (including propulsion and other systems) that carries the payload. See **rocket vehicle**.

When applied to a missile, attention is on the fact that the warhead is dependent upon its carrier to provide it with a propulsion system, guidance system, etc. With a missile guided all the way to target, the vehicle stays with the warhead all the way. With a ballistic missile, the vehicle normally separates at thrust cutoff.

See **unmanned vehicle**.

vehicle defense. The defense of an area or of an entire country by interceptor missiles, each requiring an attached vehicle so as to carry the guidance and propulsion systems necessary to put the missile on target.

velocity, n. 1. A vector quantity that includes both magnitude (speed) and direction relative to a given frame of reference. 2. Rate of motion in a given direction, employed in its higher magnitudes as a means of overcoming the force of gravity. Cf. **orbital velocity**.

Venus, n. The sun's second planet, and the nearest of the sun's other planets to the earth when at inferior conjunction.

The mean distance of Venus from the sun is .72 astronomical units (about 67,000,000 miles). Its closest approach to the earth is at 26 million miles. Its orbital velocity is 22 mi/sec. Its eccentricity is .007 (almost circular). Its sidereal period is 224.7 days, its synodic 584 days. Its greatest elongation is 47°. Its diameter of

7,575 miles is somewhat less than the earth's, and its mass is .82 of the earth's. Its rotation period is not exactly known, considered by some to be 30 days, by others longer.

Venus has a dense atmosphere, with a large amount of carbon dioxide in it. No traces of water or oxygen have been found in it. On its dark side its temperature is about -25°C ; on its bright side the temperature appears to be only a little higher. Both temperatures measure upper atmosphere conditions.

Venus probe. A probe for exploring and reporting on conditions on or about the planet Venus.

Thor-Able IV and Atlas-Able IV were considered at one time for the launching of a Venus probe.

Venutian probe. A space probe designed to be placed in orbit near the planet Venus.

'Venutian' is pronounced 'Venushan.'

vernal equinox. The point where the sun appears to cross the celestial equator from south to north. Also called 'the first point of Aries.'

vernier engine. [Named after Pierre Vernier (1580-1637), French mathematician.] A rocket engine of small thrust used primarily to obtain a fine adjustment in the velocity and trajectory of a ballistic missile or space vehicle just after the thrust cutoff of the last sustainer engine, and used secondarily to add thrust to a booster or sustainer engine.

Pierre Vernier was noted as the inventor of a device for accurate reading of fractional parts of a fixed scale of measurement.

vernier rocket. A vernier engine.

vertical, *n.* (vert) *The vertical*, a reference line or plane that, at any point within, on, or above the earth runs straight to the earth's center of gravity, as in 'one degree off the vertical.'

vertical, *a.* (vert) 1. Of a line or plane: That runs straight to the earth's (or other spatial body's) center of gravity; plumb. 2. Of a motion or direction: a. That follows such a line. b. That lies within the vertical plane, as in 'vertical velocity,' 'vertical component,' 'vertical deflection.'

vertical bomb. The conventional aerial bomb that normally makes a free-fall or drop trajectory, neither gliding nor horizontally self-propelling. Distinguished from a glide bomb or robot bomb.

Vertical bombs include the azon and rason bombs, also a bomb provided with a rocket motor that gives it greater velocity in its drop. See *rocket bomb*, sense 2.

vertical frontier. A border or extent for exploration and control that lies in all directions outward from the earth.

vertical launch. A launch in which the missile or vehicle starts from a vertical position.

vertical plane. 1. Any plane that extends outward from the earth's center of gravity, such as the plane of a vertical circle. 2. *The vertical plane*, a projected plane that represents all the vertical planes (sense 1) in which an object moves, or in which several objects are at rest, as in 'the trajectory of the missile differs from its flight path in that the trajectory lies wholly in the vertical plane.'

Vertijet, *n.* The X-13.

Vigilant, *n.* A British Army antitank solid rocket missile, some 53 inches long.

Viking, *n.* A liquid research and test rocket built by Martin and Reaction Motors for the Navy, first launched 3 May 1949.

The Viking, a single-stage liquid rocket, in length from 42 to 48 feet, in diameter 32 inches, weight between 9,650 and 15,000 pounds, developed a thrust of 20,000 pounds for 75 seconds. Modified, the Viking is the first stage of the Vanguard carrier rocket.

This rocket was called 'Neptune' in its early development. It was also nicknamed 'Marco Polo' by persons who worked on its manufacture.

violet ray. The shortest ray (385 millimicrons) of the visible spectrum, evoking the color violet in the eye.

Von Neumann Committee. The Strategic Missile Evaluation Committee of 1953-54, named for its chairman, Dr. John Von Neumann.

Dr. Von Neumann (1903-1957), was Research Professor of Mathematics at the Institute of Advanced Studies; he later became a member of the Atomic Energy Commission.

Voodoo, *n.* The F-101.

VTO (abbr). 'Vertical takeoff.'

VTOL (abbr). 1. 'Vertical takeoff and landing.' 2. Used as a noun: A nonrotary airplane that takes off and lands vertically; *specif.*, such an airplane that can clear a 50-foot obstacle 50 feet from the start of takeoff. Cf. **STOL (abbr)**, X-13, X-14.

V-weapon, *n.* Either the V-1 or the V-2.

W

WAC (abbr). 'World Aeronautical Chart.'

Wac Corporal. A sounding rocket for very high altitudes, developed by the Jet Propulsion Laboratory during the late 1930's and 1940's.

The Wac Corporal was 16 feet long, 1 foot in diameter, weighed 665 pounds with fuel and payload (280 pounds dry weight), and was propelled by liquid fuel.

Adapted for use as a second stage of the V-2, it reached an altitude of 250 miles on 24 Feb 1949 at White Sands Proving Ground, New Mexico.

Wagtail, *n.* An AF air-to-surface missile under development by Honeywell.

This system is reported as aimed at low-altitude launch and low velocities.

Wallops Island. An Atlantic island near the Virginia-Maryland border, the site of a NASA laboratory facility.

warhead, *n.* That part of a missile that constitutes the explosive, chemical, or other charge intended to damage the enemy; the charge carried by a missile.

WB (*abbr.*). 'Weather bomber,' a bomber adapted to use for weather reconnaissance.

WDD (*abbr.*). 'Western Development Division.' *Hist.*

weapon, *n.* (wpn or W) 1. An instrument of combat, either offensive or defensive, used to destroy, injure, defeat, or threaten an enemy, e.g., a ballistic missile, a fighter aircraft, a gun, or a rock. 2. By extension, any device, method, or circumstance that is used directly or indirectly to destroy, injure, or defeat an enemy, as in 'the weapon of propaganda' or 'the weapon of hunger.'

See USAF Dictionary for further analysis.

Weapon Able. A rocket-propelled, 500-pound, 12.75-inch antisubmarine depth charge developed by the Navy for use by destroyer escorts; the rocket engine that propels this charge.

This weapon, with a conventional explosive charge, is fired from a launcher resembling a gun turret. The rocket turret may be trained in an almost complete circle, permitting instant reaction after submarine detection without the necessity of positioning the destroyer in the immediate area of the submarine. The rocket has variable range.

weapon system. (WS) A total complex of equipment, skills, and techniques which together forms an instrument of combat, usually but not necessarily having an air or space-air vehicle as its major operational element; also the air or space-air vehicle incorporated into the system, as the WS-117.

'The complete weapon system includes all related equipment, materials, services, and personnel required solely for the operation of the . . . vehicle, or other major element of the system, so that the instrument of combat becomes a self-sufficient unit of striking power in its intended operational environment' (AFR 80-28). See support system.

Weary Willie. Any one of certain WW II B-17 or B-24 bombers loaded with TNT and, once airborne, used as guided missiles.

Weary Willies were tried out operationally in WW II, but without notable success. Each was taken aloft by a human pilot, who bailed out to leave the craft guided to target by radio control from a manned mother aircraft.

weigh, *v. tr.* To estimate or calculate the mass of a satellite in orbit.

An orbiting satellite may be weighed on the basis of data obtained on relative brightness, surface area, perigee distance, and lifespan. With Sputnik II, for example, it was 100 times as bright as the two Explorers; from this its surface area was ascertained. With the known factors of its orbit and the known date of its demise, its mass could be calculated. See *Missiles and Rockets* 20 Jul 1959, pp 56-58.

weight, *n.* A measure of a body's attraction to the earth or other spatial body, being equal to the body's mass multiplied by the acceleration of the body due to gravity. See gravity, *n.*, note.

weight flow rate. ($\dot{w}$) The flow rate of a liquid propellant expressed in pounds per second.

weightlessness, *n.* A property or attribute of being without weight.

If a body has overcome the gravitational attraction of the earth (or other spatial body), as by velocity, it is without weight, since weight is defined as the product of the body's mass times the acceleration of the body due to gravity.

Western Development Division. (WDD)

The predecessor organization of the Ballistic Missile Division. Organized in July 1954.

Western Electric. The Western Electric Company, missile contractor, as for the Nike-Zeus.

western world. The free world as led by western powers in their resistance to communist nations; in a more limited sense, the Nato nations.

In its broader sense, the western world includes nations in the East, such as Japan, Nationalist China, and the Philippines. Cf. free world.

wet emplacement. A launch emplacement that provides a deluge of water for cooling the flame bucket, the missile engines, and other equipment during the launch of a missile. See flame deflector, note, dry emplacement.

wet-fuel rocket. A liquid rocket.

WFNA (*abbr.*). 'White fuming nitric acid.'

whip antenna. An antenna shaped and flexible like a whip.

White Lance. An AF air-to-surface missile under development by Martin, designed for use with fighter-bombers.

This missile will be an advanced version of the Navy Bullpup.

White Sands. Short for 'White Sands Missile Range.'

White Sands Missile Range. (WSMR) A proving ground in New Mexico under the control of the Army Ordnance Missile Command as executive agency, used esp. for testing short-range missiles over an instrumented range. Formerly called 'White Sands Proving Ground.'

This installation, in use since Jul 1945, is used for short range testing. See **Atlantic Missile Range**, **Pacific Missile Range**.

White Sands Proving Ground. The former name of the White Sands Missile Range.

Wickie, n. The mouse used in the third flight test of Thor-Able, 23 July 1958.

Willow Run Research Center. (WRRC) A University of Michigan research center at Ypsilanti, Michigan.

Winzen Research. A corporation of Minneapolis, Minnesota, contractor for Project Man High.

wire command. An electric signal transmitted to a missile by wire.

wire-guided, a. Of a missile: Guided by electrical impulses through a wire over a closed circuit between the guidance operator and the missile, as with the Dart.

The guidance operator of a wire-guided missile is in sight of the target.

Wizard, n. An AF surface-to-air missile system undergoing study by Convair and RCA.

Woomera Missile Range. The Woomera Rocket Range.

Woomera Rocket Range. A rocket range located in inland South Australia, at which British missile flight tests are conducted. Cf. **Black Knight**.

working fluid. A fluid (gas or liquid) that converts one form of energy applied to it to another form of energy, or is the medium for the transfer of energy from one part to another.

For example, hydrogen might be the working fluid for nuclear-heated propulsion.

Wright Air Development Center. (WADC) An ARDC center at Wright-Patterson Air Force Base, Dayton, Ohio.

WADC conducts research and development in aircraft, missiles, power plants, propellers, armament, airborne equipment, ground equipment, and other aeronautical and aerospace materials; it also monitors research and development in these same fields as conducted by industry, civilian universities, and civilian research centers.

WRRC (abbr). 'Willow Run Research Center' at Ypsilanti, Michigan.

This is a U. of Michigan research center.

WS (abbr). 'Weapon system.'

This abbreviation is used with a number to designate a particular weapon system, as in WS-107A the Atlas, WS-117L the Sentry, WS-131B the Hound Dog, WS-312 the Titan, and WS-315A the Thor.

WS-110A. The B-70.

WS-132. An AF air-to-ground missile undergoing development by North American for launch from a B-52.

WS-199. The Bold Orion.

WSEG (abbr). 'Weapon Systems Evaluation Group.'

WSMR (abbr). 'White Sands Missile Range.'

WSPG (abbr). 'White Sands Proving Ground.'

X

X (prefix or letter). 1. A prefix to designate a missile or airplane in a developmental or experimental stage as in XASM-N-7 or XH-15.

2. As a letter designation of a special research or test vehicle, as in X-4, X-15, X-17. 3. A letter sometimes used for T-time, as in 'X minus 20.'

X-2. A sweptwing rocket-powered research monoplane developed by Bell, the AF, and NACA.

This airplane has been used in exploring problems of transonic and supersonic flight at extreme altitudes. On a flight of 7 Sep 1956, Capt Iven Kincheloe (1928-1958) took the X-2 to a record altitude of 126,200 feet, with speeds up to 2,000 mph at 70,000 feet. On a flight of 27 Sep 1956, Capt Milburn Apt (1924-1956) achieved a speed of 2,100 mph. Cf. F-104.

X-13. A single-place VTOL experimental aircraft, developed by Ryan, and powered by a single turbojet engine. Also called 'Vertijet.'

The X-13 is designed to take off from a mobile trailer, the aircraft being in a vertical attitude suspended nose up by a hook under its fuselage which engages with the trailer bed. Able to hover, the aircraft lands in the same attitude upon the same apparatus. Airborne, the aircraft may be converted to horizontal flight, or converted from horizontal to nose-up, vertical flight, in each case using the same engine power.

X-14. An experimental VTOL developed by Bell, powered by two Armstrong Siddeley Viper turbojet engines mounted side by side in the nose.

X-15. A rocket research aircraft in research and development, with the National Aeronautics and Space Administration (NASA) the technical director acting for the USAF and the Navy.

Begun in Dec 1954, the X-15 was test-flown without power 8 Jun 1959. North American and Reaction Motors are the contractors. With a length of 50 feet, a

diameter at the tail of 4 feet, short blunt wings of 22 feet span, a gross weight of 16 to 16½ tons, an inertial guidance system, the X-15 is expected to range as high as 300 miles at speeds of mach 5 to mach 7 in terms of lower atmospheric flight. The X-15 in its first test flight was loosed from a B-52 wing at 38,000 feet. The pilot, Scott Crossfield, made the first powered flight 17 Sep 1959, using the RMI XLR-11. The XLR-99, with 50,000-pounds thrust, is programmed for later use.

X-17. A three-stage rocket test vehicle developed by Lockheed and Thiokol.

The X-17, some 40 feet in length, is supersonic, and is used chiefly for reentry research. Its second and third stages are solid rockets.

X-18. A two-engined tiltwing convertiplane under development by Hiller for the USAF.

Designed for transport, the X-18 has a high-set wing that pivots 90 degrees for takeoff, the turboprop engines serving as rotors. During cruising flight, the wing is in conventional position, propelled forward by the engines. Control in yaw and pitch during vertical flight is by small turbojets mounted under the tailplane.

XAAM (abbr). 'Experimental air-to-air missile.'

XASM (abbr). 'Experimental air-to-surface missile.'

XLR (abbr). 'Experimental liquid rocket.'

XM (abbr). 'Experimental missile.'

This abbreviation is used in designating Army missiles until such time as a formal standardization committee places them in the P and P category (production and procurement). Thus a missile in research and development receives an XM designation, for example, the XM-47 (Little John), but this designation stays with the missile even after it is fully developed if the standardization committee does not place it in the P and P category, as with the XM-4E1 (Corporal) before redesignated the M-2, which is operationally used, but is expected to be replaced by the Sergeant.

XQ (abbr). 'Experimental target drone.'

XSAM (abbr). 'Experimental surface-to-air missile.'

XSM (abbr). 'Experimental strategic missile.'

XSSM (abbr). 'Experimental surface-to-surface missile.'

Y

Y (prefix or letter). 1. A prefix to designate a missile or airplane procured in limited numbers for testing and development, as in YC-124B. 2. In designations of Navy aircraft, a symbol for the Convair Division, General Dynamics Corporation, as in F2Y-1.

Z

zero, v. *To zero in.* a. To bring a missile exactly into a position where it can be directed

toward target. b. To adjust any device to an intended purpose so that automatic synchronization results.

zerogravity, n. A condition existent when the centripetal gravitational attraction of the earth or other spatial body is nullified by inertial (centrifugal) forces.

zero launch. The launch of a missile by a zero-length launcher.

zero launcher. A zero-length launcher.

zero-length launcher. A launcher that holds a missile or vehicle in position so that the buildup of thrust, normally rocket thrust, is sufficient to take the missile or vehicle directly into the air without need of a takeoff run.

This term has been applied to a type of rail launcher adapted to launch an airplane (the P-51, for example, in WW II) under rocket power. The Matador TM-61 and the Snark are also launched by zero-length launchers. The term is not normally applied to a pad used for a vertical launch.

zero-length rocket. A rocket with sufficient thrust to launch a missile or vehicle directly into the air. Said esp. of a rocket used to launch an aerodynamic missile or vehicle.

ZETA (abbr). 'Zero energy thermonuclear assembly.'

Ziolkowski, n. Another spelling of 'Tsiolkovsky.'

zip fuel. A boron-based high energy liquid rocket fuel.

Znezhinka, n. [Russian 'Snowflake.'] The Russian name of a dog that accompanied Otavzhnaya without apparent harm on a space flight 2 July 1959. See Otavzhnaya, n.

zodiac, n. A belt on the celestial sphere on which the moon, sun, and planets appear to move about the earth, the middle line of the belt being the ecliptic or the sun's path. Cf. conjunction, n.

Zuni, n. A Navy air-to-surface solid-rocket aimed missile for use against tanks, pillboxes, or other emplacements, developed by the Naval Ordnance Test Station. See aimed missile.

Some 9.17 feet long, 5 inches in diameter, and a gross weight of 107 pounds, Zuni has a range of 5 miles and a speed of mach 3. Its target versatility results from the various types of heads with which it can be armed—flares, fragmentations, armor piercing, etc. See unguided missile.