

A Dictionary of AVIATION

**Compiled by
David W. Wragg**

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A Dictionary of Aviation

Other books by David W. Wragg

World's Air Fleets

World's Air Forces

Flight Before Flying

Speed in the Air

Introduction

The prime purpose of *A Dictionary of Aviation* is to provide a guide to the more important events and personalities in aviation history, as well as to the more commonly used terms and concepts, and to the major airlines, guided weapons, aircraft, and aircraft manufacturers. It is considered that the specialist involved in any particular field of aviation activity does not require such a book to deal with his own interest in depth since he will be either fully conversant with all aspects of his work, or at least know of suitably specialised publications which can assist. The title of the book reflects the non-technical approach, in that the term 'aviation' probably means more to the layman than 'aerospace', the more correct and appropriate word, since the book deals with lighter-than-air flight and spaceflight, albeit sparingly in the latter instance, as well as with aviation proper. Air forces are dealt with briefly and collectively; those requiring more detailed historical and current information on individual air forces and air arms are referred to *World's Air Forces*, published by Osprey in 1971, which deals with this aspect of aviation activity in considerably greater detail than is possible in a work of the extensive coverage of this dictionary.

DAVID W. WRAGG

A

A-: current United States Navy designation for attack aircraft, such as the A-1 Skyraider, A-4 Skyhawk, A-7 Corsair, etc. The designation was used originally by the then United States Army Air Corps and United States Army Air Force for attack aircraft, including light bombers and dive-bombers, and to some extent preceded wide-scale use of the B- bomber designation for such aircraft as the A-20 (q.v.) Havoc and A-30 (q.v.) Baltimore.

A-1 Skyraider, Douglas: probably one of the most long-lasting and versatile warplanes of modern times, the Skyraider originated from a 1944 United States Navy requirement, and more than 3,000 were built before production ended in 1957. The aircraft was used extensively in both the Korean and Vietnam Wars, and users in Vietnam have included the U.S.A.F., U.S.N., and Vietnamese Air Force. A few aircraft also survive in Armée de l'Air service, operating from former French colonial territory in Africa. Originally a carrier-borne attack-bomber, the main use of the A-1 today is on counter-insurgency (COIN) duties. A maximum speed of 300 mph, a range of up to 3,000 miles with wing tanks, and a load of up to 8,000 lb of bombs, rockets, napalm tanks, etc. is provided for, using a single Wright R-3350 piston-engine. Most of the surviving aircraft are single-seat A-1H/J and twin-seat A-1E versions, although production covered several versions from A-1A to A-1J. Amongst other notable users of the aircraft in the past was the Royal Navy, mainly on anti-submarine duties. Airborne-early-warning versions were also produced, the EA-1E and EA-1F.

A-4 Skyhawk, McDonnell Douglas: developed as a simple, light, and cheap jet

replacement for the A-1 (q.v.) Skyraider by Douglas, starting in 1950, the aircraft made its first flight in 1954. The first production version was the A-4A, with basic avionics and a 7,700 lb thrust Wright engine, and deliveries of this version started in 1956, followed by the A-4B, with detail improvements, and the A-4C, with more sophisticated avionics. The A-4E, with an 8,500 lb Pratt and Whitney J52 engine, appeared in 1961, and still more power is available in the A-4F, with its 9,300 lb thrust turbojet. Although normally a single-seat aircraft, tandem twin-seat training versions are the TA-4E, which first flew in 1965, and the TA-4F. It is the only aircraft in the U.S.N.'s inventory which can be parked in the hanger of an aircraft carrier without any need for folding wings, and it was a logical choice for the Royal Australian Navy to order for operations from the small H.M.A.S. *Melbourne* (see aircraft carriers, Australian). The R.A.N. version is designated A-4G, while the Royal New Zealand Air Force uses A-4Ks, the Argentinian Air Force has ex-U.S.N. A-4Bs, and the Israeli Defence Force/Air Force uses A-4Es. A wide variety of weapons can be carried in the tactical strike role, including Bullpup (q.v.) air-to-surface missiles, from a fuselage and four wing strong points, to a total of some 8,000 lb of ordnance. A range of up to 3,000 miles with external tanks is available, with a maximum speed at sea level of 680 mph.

A-5 Vigilante, North American Rockwell: the A-5 Vigilante first flew in 1958, and was designed to meet an all-purpose carrier-borne bomber requirement for the United States Navy, with nuclear strike capability and a Mach 2 speed. The A-5A first became operational in 1962, aboard the U.S.S. *Enterprise* (see aircraft carriers, United States), and was followed by the extended range A-5B, which had extra fuel in a 'saddleback' fuselage fairing. The RA-5C reconnaissance version first flew in 1962, and in addition to new aircraft of this type, the A-5A and A-5B aircraft have now all been converted to RA-5C standard, with a ventral fairing holding cameras,

A-6 Intruder, Grumman

side-looking radar, and other reconnaissance equipment. All RA-5Cs retain their attack capability, and a feature of the aircraft is a bomb bay in the form of a tunnel running the full length of the fuselage, with bombs ejected at the aft end. There are also under-wing strongpoints for bombs or additional fuel tanks. The crew of two have tandem seating. The RA-5C has a range of between 2,000 and 3,000 miles, Mach 2 speed, and uses two re-heated General Electric J79-GE-8 turbojets of 17,000 lb thrust each. In U.S.N. service only.

A-6 Intruder, Grumman: the Intruder was designed to meet a United States Navy and Marine Corps need for a long-range, all-weather, low-level attack aircraft, arising from experience gained during the Korean War. Carrier-borne operation and a heavy warload were also part of the requirement. Grumman won the resulting design competition in 1957 with the Intruder, and the A-6 first flew in 1960. Basically the aircraft is a two-seat machine, using two 8,500 lb thrust Pratt and Whitney J52-P-6 turboprops which give speeds up to Mach 0.95, and carrying up to 18,000 lb of ordnance in a semi-recessed bomb bay and on under-wing strongpoints. The EA-6A, which first flew in 1963, is a U.S.M.C. reconnaissance version, with a four-seat cockpit, and radomes on the fin and on the wing pick-ups, which can operate in the passive reconnaissance or electronics countermeasures role. The A-6 uses a digital integrated attack navigation system (DIANE) which enables the aircraft to fly and deliver its weapons automatically. U.S.N. and U.S.M.C. service only.

A-7 Corsair II, Ling-Temco-Vought: not to be confused with earlier piston-engined aircraft of the same name by Vought, the Corsair II won a 1963 U.S.N. design contest for an A-4 (q.v.) Skyhawk replacement, and was a derivative of the F-8 (q.v.) Crusader fighter, to which it bears more than a superficial resemblance. The first flight of this single-seat, single-engined aircraft took place in 1965. Powerplants are Pratt and Whitney TF30 turboprops of 11,350 lb thrust (A-7A) or

12,200 lb thrust (A-7B), or Allison TF-41 (licence-built Rolls-Royce military Spey) of 14,240 lb thrust (A-7D for U.S.N.) or 15,000 lb thrust (A-7E for U.S.A.F.). Maximum range is 3,600 miles with external tanks for ferrying, and warload is 10,000 lb on two fuselage and six wing strongpoints. The U.S.N.'s versions are carrier-borne, and the aircraft has seen extensive use during the Vietnam War.

A-20 Havoc, Douglas: the Douglas A-20 Havoc twin-engined light bomber served with the then United States Army Air Force, the Royal Air Force, and the Soviet Air Force during World War II. The aircraft was based on the Douglas DB-7, which also served with the U.S.A.A.F. and the R.A.F., which named it the 'Boston'. A-20s were sometimes used as long-range fighters as well as ground-attack aircraft. In appearance, the aircraft was a mid-wing monoplane with tricycle undercarriage and a single-fin tailplane; powerplants were two 2,000 hp Pratt and Whitney radial engines.

A-30 Baltimore, Martin: the Baltimore, also known as the Martin 187, was one of a small series of successful light-medium bombers produced by this American company during World War II, stemming from the Martin XB-10 design of 1932. Two Pratt and Whitney 2,000 hp radials powered this mid-wing monoplane, which was used extensively in North Africa by the Royal Air Force.

A.106, Agusta: a lightweight single-seat anti-submarine warfare helicopter for operation from warships. A single turbomeca-Agusta TAA 230 turbine engine gives a maximum speed of 100 mph. The Italian Navy operates twenty-four of these helicopters, while the Italian Army uses a further twelve on A.O.P. duties.

A.109, Agusta: A twin-turbine helicopter, mainly for the executive market but with military applications if required. The A.109C uses two 400 shp Allison 250-C20 engines, enabling it to carry up to eight persons. First flight was in 1971.

A.300B, Airbus Industrie: the A.300B is the European airbus, denoting that the aircraft is a collaborative venture between

the aircraft industries of France, Germany, the Netherlands, Great Britain, and Spain, although the manufacturer, Airbus Industrie, is French-registered. Consideration of the project started in 1965, as a Hawker Siddeley Trident (q.v.) development, and in 1966 three groups - Hawker Siddeley, Breguet, and Nord; Sud Aviation; and Dornier, Messerschmitt-Bölkow-Blohm, and V.F.W. - were considering three separate airbus designs. The following year the British, West German, and French governments instructed H.S.A., Sud (which later became Aerospatiale on an amalgamation with Nord), and Dornier, V.F.W. and M.B.B., to formulate a common project, for which it was planned to use a new Rolls-Royce engine, the 50,000 lb thrust RB.207. A decision to use a General Electric CF-6 engine was taken in 1969, and early in that year the British Government withdrew official support for the project, leaving H.S.A. in the position officially of a subcontractor with responsibility for design and development of the wing, but unofficially as advisers for the entire project. In 1971 Dornier left the Deutsche Airbus consortium (of which V.F.W. and M.B.B. were the other two partners) rather than contribute substantially to the project's development costs. C.A.S.A. of Spain joined the project in 1971. France and Germany have almost half of the project each, excepting the 8 per cent. share of the Netherlands and the 2 per cent of Spain. Entry into airline service of the 250-300-seat aircraft is scheduled for 1974. First orders include six of the 1,400 mile range A.300B-2 for Air France, with ten options, while Iberia has ordered four of the 2,100 mile range A.300B-4, with eight aircraft on option. Lufthansa has also ordered the aircraft. The B-1 version is the prototype. A special Rolls-Royce RB.211-powered version might be made available for B.E.A. and other interested airlines. Initial development costs were estimated at £260 million in 1972.

A.A.M.: *see* air-to-air missile.

A.B.M.: *see* anti-ballistic missile defences.

A-bombs: *see* Atom-bomb.

AC-: U.S.A.F. designation for gunship

conversions of transport aircraft, often with machine guns firing through window openings in a modern equivalent of a broadside. This form of conversion was introduced during the Vietnam War. AC-47 is a Dakota conversion, AC-119 a Packet, and AC-130 a Hercules.

accident: *see* air safety.

ACE: Allied Command, Europe, a NATO (q.v.) command subordinate to the Supreme Headquarters, Allied Powers in Europe (SHAPE (q.v.)), which in turn is one of the two major NATO commands. ACE has some 3,000 combat aircraft and 150 aircraft put at its disposal by the NATO air forces in Europe.

Achgelis, Focke-Wulf: the Focke-Wulf Achgelis was the first practical helicopter and first flew in 1936, although it was not further developed and did not enter production. The fuselage still owed much to the conventional aircraft, but twin rotors were placed, one on either side, at the end of skeletal wings.

ACLANT: Allied Command Atlantic is one of NATO's (q.v.) two major commands. Headquarters is in the United States at Norfolk, Virginia, and ACLANT is responsible for maritime security from the North Pole to the Tropic of Cancer (the northern tropic). Priority is given to anti-submarine warfare, and in the event of war some 300 land-based aircraft and a part of the United States Navy's carrier-borne aircraft strength could be made available, plus some 300 warships from the British, Canadian, Danish, Dutch, Portuguese, and United States navies. Peacetime strength consists of a handful of frigates.

A.C.V.: *see* Air Cushion Vehicle.

Ader, Clement (1841-1925): a Frenchman, Clement Ader was one of the more important amongst those who hoped to succeed in developing a machine capable of heavier-than-air flight. Ader was certainly one of the more controversial as well. His first 'aircraft' was a steam-powered monoplane called the 'Éole' and this became the first machine in history to leave the ground through its own efforts when Ader attempted to fly it in 1890,

advanced technology engine

although the distance covered only qualified to be counted as a powered leap. In many ways the design of the 'Éole' was already obsolete, since it used the even-then discredited bat-like wing and had only a rudimentary control system.

Undaunted, Ader produced another steam-powered monoplane, also with a bat-wing, in 1897. This was the 'Avion III' (q.v.), which was fitted with two steam engines, each driving a propeller, and still lacking an adequate control system. The 'Avion III' failed to leave the ground, in spite of two attempts by Ader, and a claim made by him in 1906 to have flown 300 metres in the machine – which was completely untrue since his failure had been observed by witnesses of impeccable character.

advanced technology engine: the term given to the modern generation of jet engines, used initially on the airbuses and 'jumbo' jets but also now finding other applications. The principle is that a turbine engine will function more efficiently if the various sets of turbines can revolve at their individual optimum speeds, instead of at the same speed. The true advanced technology engine has a triple spool, meaning that instead of having a single driving shaft, there are three, in order that the three sets of blades may revolve at different speeds. An interim state is the twin-spool engine, allowing only two different speeds for the turbines. Advantages of the advanced technology engines lie mainly in their low noise levels, although the use of new materials, such as carbon fibres, will in due course also lead to lighter and more economical power-plants.

A.E.G.: one of the many German aircraft manufacturers in existence immediately before and during World War I. Apart from the firm's own designs, such as the G.IV bomber biplane, the company was one of those producing the Rumpler Taube for the Military Air Service.

Aerfer-Aermacchi: a joint production arrangement between two Italian firms engaged on production of the AM.3 (q.v.) light liaison and A.O.P. aircraft for the Italian Army.

aerial reconnaissance: aerial reconnaissance was one of the first duties to fall to the military aeroplane. At the outbreak of World War I in 1914, it was envisaged that the main task of the Royal Flying Corps would be aerial reconnaissance duties, and other air arms at this time expected and prepared for the same kind of operation. A number of scout aircraft were developed with this in mind, including the Bristol, Nieuport, and Morane Scouts, and these became some of the first fighter aircraft. Later, Royal Aircraft Factory R.E.8 'Harry Tate' aircraft were used, although usually armed after the evolution of the fighter.

Aerial reconnaissance was not restricted to the land, for during World War I Short seaplanes were carried by seaplane tenders, usually converted cruisers or steam packets, and after the war, many battleships and cruisers were equipped to carry seaplanes. During the 1920s and 1930s, aircraft such as the Fairey IIIF and its successor, the Seal, were used for reconnaissance work at sea.

World War II saw a number of fast reconnaissance aircraft developed, including versions of the Bristol Beaufighter (q.v.) and de Havilland D.H. 98 (q.v.) Mosquito, the North American F-51 (q.v.) Mustang, the Northrop P-61 Black Widow, the Focke-Wulf Fw.189, the Mitsubishi Ki-46, and the Petlyakov Pe-2 (q.v.). Maritime reconnaissance (q.v.) from warships frequently took the form of Supermarine Walrus seaplanes, plus carrier-borne fighter types such as the Grumman (q.v.) series of aircraft, Seafires and Sea Hurricanes. The German submarine menace, and the effects of surface raiders on Allied convoys already being hit hard by the submarines, made long range maritime reconnaissance important, and if anything this importance has increased since. Major maritime-reconnaissance types of World War II included the Short Sunderland (q.v.) and Convair Catalina (q.v.) flying-boats, and the Vickers Wellington (q.v.), Boeing B-17 (q.v.) Flying Fortress, Consolidated B-24 (q.v.) Liberator and Lockheed Ventura and Privateer landplanes. Although convoys were of less importance to the Ger-

mans as a means of supply, their attraction as targets entailed the use of aircraft such as the six-engined Blohm und Voss (q.v.) Bv 222 flying-boat, and the Focke-Wulf Fw.200 (q.v.) Condor, a military version of the four-engined airliner.

During the post-war period, the Western Allies used a variety of aircraft on reconnaissance duties, including special versions of the English Electric Canberra (q.v.) bomber, the Handley Page Victor (q.v.), the de Havilland Venom (q.v.), the Hawker Hunter (q.v.), the North American F-86 (q.v.) Sabre, and the Republic RF-84F Thunderflash, while maritime-reconnaissance aircraft included the Avro Shackleton (q.v.) and the Lockheed P-2 (q.v.) Neptune. Against this, the Soviet Bloc armed forces also used a variety of conversions of fighter and bomber aircraft, while placing a great deal of the emphasis for maritime-reconnaissance on flying-boats, such as the Beriev Be-6 (q.v.) 'Madge', Be-10 (q.v.) 'Mallow', and Be-12 (q.v.) 'Mail', although recently the trend to landplanes has also been marked in the U.S.S.R. One of the most advanced reconnaissance aircraft ever built, the B.A.C. TSR-2, was cancelled in 1964, well after the first flight and while some thirty machines were actually in course of production.

Aerial reconnaissance today can be divided into three main types, strategic, tactical and maritime, although the latter is dealt with more thoroughly under its appropriate heading.

Strategic air reconnaissance requires the use of such aircraft as the Canberra, the McDonnell Douglas RF-4 Phantom, the Lockheed RF-104 version of the F-104 (q.v.) Starfighter, the Dassault Mirage (q.v.) III-R, the Lockheed U-2 (q.v.) and its successor, the SR-71 (q.v.), and the North American Rockwell RA-5C Vigilante. Such aircraft are always equipped with cameras, and in the most sophisticated versions may have side-looking radar. A new aircraft under development for this task, amongst others, is the Panavia 200 (q.v.) Panther. In the future, there is likely to be an increasing tendency for strategic reconnaissance functions to be taken over by space satellites.

Tactical reconnaissance includes at its

upper level many of the jet fighters already mentioned as undertaking strategic reconnaissance work, plus aircraft such as the Northrop F-5A/B Freedom Fighter, and advanced jet training aircraft in the reconnaissance variant, such as the Aermacchi MB.326. At a lower level, and in support of ground forces within a very confined area, aircraft such as the Cessna 0-1 (q.v.) Bird Dog and 0-2 (q.v.) Super Skymaster were in use in Vietnam. As well as light aircraft and helicopters, reconnaissance 'remotely-piloted' vehicles are nowadays being used for tactical reconnaissance.

The aim of reconnaissance over land targets is primarily to identify suitable targets, such as links in a communications network, strategic industry, airfields, and port areas; to obtain information on air defences for strategic use; or to provide information about the deployment of enemy land forces, and the conditions and terrain prevailing in their area, for tactical use.

Aeritalia: the main Italian airframe manufacturer, Aeritalia was created from the Fiat concern which entered aircraft production in 1918, shortly before the end of World War I, with the R-2 reconnaissance-bomber biplane. The Italian Air Force, the Regia Aeronautica, was maintained at a greater strength during the inter-war period than most European air arms, and Fiat was able to produce a series of fighters designed by Celestino Rosatelli (q.v.), including the C.R.20, C.R.30, and C.R.32 biplanes, in addition to producing some light aircraft designs, such as the A.S.1 biplane of 1929. At the outbreak of World War II, the company was producing the C.R.50 Freccia fighter monoplane, which supplemented C.R.40 and C.R.42 fighters in Regia Aeronautica service, as well as the B.R.20M Cicogna bomber and the G.12 trimotor transport. Other notable wartime Fiats were to include the G.52 and G.55 fighters.

After the war Fiat became principally engaged on licence production of British and American designs, including the de Havilland Vampire (q.v.) fighter and trainer, followed by the North American F-86 (q.v.) Sabre, and then a share in the European Lockheed F-104 (q.v.) Star-

Aer Lingus-Irish International Airlines

fighter production programme. Trainer versions of the wartime fighters were developed and produced in the G.46 and G.59. During the early 1950s, the Fiat G.91 (q.v.) won a NATO design competition for a strike fighter, and this aircraft entered production during the late 1950s, remaining in production throughout much of the 1960s with the twin-engined G.91Y development. Recently the company has been concentrating on development and production of the G.222 (q.v.) light transport, and is the Italian partner in the Panavia 200 (q.v.) Panther multi-role combat aircraft. For most of its existence Fiat has produced aero-engines, sometimes under licence, for many of its products. The present title was taken in 1972.

Aer Lingus-Irish International Airlines: a single integrated structure for what were two separate airlines, Aer Lingus Teoranta, formed in 1936 to operate services to the United Kingdom, and Aerlinite Eireann, formed in 1947 to operate North Atlantic services, Aer Lingus is today the Irish Republic's state-owned airline. Operations began with a de Havilland Dragon Rapide service from Dublin to Bristol, which was later extended to London, and by the outbreak of World War II in 1939 a service to Liverpool was also being operated. Post-war development included Aerlinite Eireann's services to North America with Lockheed Super Constellation; or services which long enjoyed a considerable degree of protection from competition since Aer Lingus could operate from Dublin across the Atlantic, while American airlines were restricted to operations into Shannon.

Currently, Aer Lingus operates a fleet of Boeing 747s, 707s, 720s and 737s, and B.A.C. One-Elevens, on a European and North Atlantic route network.

Aermacchi: an Italian aircraft manufacturer of long standing, Aermacchi's mainstay today is the highly successful MB.326 trainer and tactical strike aircraft, although the company is also working on the Aerfer-Aermacchi AM.3 S.T.O.L. A.O.P. aircraft for the Italian Army.

The company first came into prominence during World War I with the Macchi M.14 fighter and the Nieuport-Macchi M.7 and M.8 fighter-bombers, while the M.8 and an M.9 development were available in civil versions during the post-war period for airline and private use. However, along with the rest of the Italian aircraft industry, the company suffered from the neglect of the armed forces immediately after the end of the war and before Benito Mussolini assumed power in 1923. Aermacchi produced seaplanes for the Schneider Trophy (q.v.) races, notably the Macchi M.33 and the M.39, the latter being a mid-wing monoplane which won the 1926 race. An end product of the Schneider Trophy successes was the Macchi C.200 Saetta of the late 1930s, which was one of the better Italian fighters of World War II, in spite of engine shortcomings, although these were overcome by re-engining with Mercedes Benz engines to produce the C.202 and C.205.

After World War II the company produced de Havilland Vampire jet fighters under licence for the Aeronautica Militaire Italian, before introducing its own design, the MB.326 (q.v.), in 1960. The company also undertakes licence production of the Lockheed Starfighter for the A.M.I., and designed the LASA-60 utility plane for the civil market.

Aero: this Czechoslovak company was responsible for the design of a number of military aircraft after the end of World War I, when Czechoslovakia was established as an independent state. Amongst the first of these were the Aero A-18 fighter, which was followed by the A-24 bomber and A-11 and A-12 A.O.P. aircraft, all of which were operated by the Czech Army Air Force. During the 1930s, the Aero A-30 and A-100 reconnaissance aircraft and Aero A-32 A.O.P. aircraft were put into production. The Aero B-17 was a licence-built Tupolev SB-2 bomber, which entered Czech military service just before World War II started.

Civil work was not neglected during this period. One of the first Czech-produced aircraft was the Aero A-10, which could carry three passengers on the Prague-Kosice route, and this was followed by the

ten-passenger A-22, operated by the manufacturer on a domestic air service. The Aero A-23 entered service in 1928, and in turn was followed by the A-35 and A-38 during the early 1930s.

Post-war products of the company, which is now state-owned since Czechoslovakia is a member of the Soviet Bloc, include the L-60, a high-wing single-engined monoplane used for a variety of duties, of which the most important is aerial crop-spraying, and the L-200, a four-person twin-engined air taxi. A helicopter project is the HC-3, a five-seat executive machine with a single piston engine. The firm is most famous for its L-29 (q.v.) Delfin, a tandem two-seat jet trainer which is used by most East European air forces, and which first flew in 1959. A successor to the Delfin, the L-39, first flew in 1968.

Aero 3: this is one of a small series of wooden Yugoslav light training aircraft, with no connection with the Czechoslovak Aero concern. Basically, the Aero 3 is a development of the Aero 2. A tandem dual-seat low-wing monoplane, with a Lycoming O-435-A piston engine, the Aero 3 has a top speed of about 140 mph. About sixty of these aircraft are in Yugoslav military service.

aerobatics: a contraction of the term 'aerial acrobatics'. Aerobatics are of considerable importance in the evolution of fighter manoeuvres, as well as having an entertainment and a training value.

The first aerobatic manoeuvre was the spin, recovery from which was first performed by an Englishman, Frederick Langham, after stalling in thick fog while flying an Avro biplane in 1911. The first pilot to enter a spin deliberately in order to demonstrate recovery was Lieutenant Wilfred Parke, R.N., in April 1912, while flying an Avro cabin-biplane. The next aerobatic manoeuvre, the loop, was first performed by Lieutenant Nesterov of the Imperial Russian Flying Corps, while flying a Nieuport in August 1913.

Aero Commander: now a division within the North American Rockwell Group,

Aero Commander has been producing light and executive aircraft for a number of years. These have been largely based on the twin-engined, high-wing, Aero Commander 500 (q.v.) series, including the Aero Commander 500 itself, and the 520 and 560 developments, but with the light Aero Commander 100 (q.v.) and Darter Commander single-engined models, which were also high-wing aircraft, to complete the range. The Darter Commander design was 'bought in' by the company, having started life as the *Volaire* 100, but is now out of production. A jet executive aircraft, the twin-engined Aero Commander 1121, or Jet Commander, was in production for some time before the production rights were sold to Israel Aircraft Industries (q.v.), who produce the aircraft as the 1123 Commodore Jet. The reason for Aero Commander leaving the important executive jet market was almost certainly to avoid conflict with the North American T-39 (q.v.) Sabreliner, or Sabre Commander, as it is now known.

Recently, a new range of low-wing, single-engined light aircraft has been introduced, including the Aero Commander 111A 112 (q.v.).

Aero Commander 100: a range of high-wing, single-engined monoplanes using Lycoming piston engines - usually in the O-360 series - of which the most recent versions are the Darter Commander, or basic 100, which started life as the *Volaire* 100, and the higher-performance Lark Commander, which has superior interior finish and equipment in order to appeal to the lower end of the business aircraft market. Maximum cruising speed is in the region of 140 mph, with a range of 500 miles. The aircraft have four seats and non-retractable undercarriages. Now replaced by the Aero Commander 111A/112 (q.v.).

Aero Commander 111A/112: the latest addition to the Aero Commander range is the four-seat, low-wing, 111A/112, with a Lycoming engine. The basic version, the 111A, has a non-retractable undercarriage, but a retractable undercarriage and detail refinements are available on the 112. Maximum speed is in the order

Aero Commander 500

of 160 mph, with a range of around 500 miles.

Aero Commander 500: a successful range of high-wing, twin-engine, executive aircraft has been developed for civil and military use over the post-war period by Aero Commander, using their 500 aircraft as the starting point. Seating varies from five to eight seats in the 500/540/560 range, of which the 500 uses 290 hp Lycoming 10-540-E1A piston engines, and the 540 and 560 up-rated versions of this engine, while a 680F-P has a pressurised cabin, and the Grand Commander has a lengthened fuselage, but otherwise is of 560 standard; the Turbo Commander has the eleven-seat Grand Commander fuselage and 605 shp Air Research TPE-331 turboprop engines. Maximum speed and range vary according to model, but are generally over 250 mph and around 1,200–1,500 miles. Undercarriages are retractable.

aerodrome: *see* airport.

Aerodrome, Langley's: Samuel Langley (q.v.) was awarded a United States Army contract worth \$50,000 in 1898 to build a heavier-than-air flying machine. However, the tandem wing 'Aerodrome', which was catapulted off the roof of a houseboat moored on the Potomac River in 1903, only succeeded in crashing twice into the river after fouling the catapult mechanism. A more successful American aviation pioneer, Glenn Curtiss (q.v.), altered the aircraft extensively, fitting one of his own engines, in 1914, and attempted to fly it, but only succeeded in producing a series of powered leaps.

aerodynamics: the science of flight in heavier-than-air machines can be loosely termed aerodynamics, although a stricter and more accurate description is that it is the science of the motion of air, or other gases, over a body.

The two pioneers who are credited with contributing extensively to the development of the science were the Englishmen Sir George Cayley (q.v.) and Horatio Phillips (q.v.). Cayley's model glider of 1804 was the first real aeroplane with main plane (or wings) and adjustable tail surfaces with a fin, giving both control and

stability. In a paper, 'On Aerial Navigation', published in 1809, Cayley laid the basis for all subsequent studies of aerodynamics, breaking away from the ornithopter concept and pointing towards the idea of a mainplane, tailplane, fuselage and undercarriage.

Phillips's work on high aspect cambered aerofoils (q.v.) was the basis for all subsequent successful wing design, as well as being an extension of Cayley's work. To Phillips must go the credit for discovering that if an aerofoil is made with a deeply-curved upper surface and a shallowly curved lower surface, there will result a high lifting power, the bulk of which is provided by a suction effect on the upper surface rather than by a pressure effect on the lower surface.

Aeroflot: Aeroflot is the world's largest airline, although this is due to its being operated on a semi-military basis and undertaking all manner of aviation activity, air taxi services and crop spraying as well as the more usual air transport. The exact size of the airline can only be guessed at, although it is the only airline in the Soviet Union, and the proportion of its fleet out of service at any one time is likely to be high compared to a western airline, due to the shortcomings of Soviet civil equipment.

The airline's immediate predecessor was Dobroflot, formed in 1923 at the start of the first five-year plan from the amalgamation of several small pioneer airlines. In 1932 Aeroflot was formed, and expanded rapidly until the German invasion of Russia in 1941 halted many of its services. In spite of the fact that Dobroflot started life with the then high route mileage of 6,000 miles, by 1941 Aeroflot was still only carrying 0.16 per cent of all Soviet domestic traffic.

The Douglas DC-3 Dakota was introduced to Soviet service during World War II, along with other Allied designs, and the aircraft was produced under licence in the U.S.S.R. as the Lisunov Li-2, which formed the backbone of the Aeroflot fleet throughout the late 1940s and the 1950s, even after such Russian designs as the Ilyushin Il-12 (q.v.) and Il-14 (q.v.)

entered service. At this time, almost all of Aeroflot's aircraft were single- or twin-engined because air travel was virtually restricted to government officials, and it was not considered worth wasting scant resources on developing aircraft of DC-4 or DC-6 type. After World War II ended, Aeroflot was behind the formation of airlines in Russian-occupied Eastern Europe, using standard packages of Li-2s.

Aeroflot's first jet, the twin-engined Tupolev Tu-104 (q.v.), was introduced in 1956, and soon followed by a shorter range version, the Tu-124, and turboprop airliners, including the Ilyushin Il-18 (q.v.), Antonov An-24 (q.v.), and Tupolev Tu-114 (q.v.). Modern jets include the Tupolev Tu-134 (q.v.), Tu-144 (q.v.), and Tu-154 (q.v.), and the Ilyushin Il-62 (q.v.), approximating to the B.A.C. One-Eleven/ Douglas DC-9, Concorde, Boeing 727, and Vickers VC-10 respectively; and the Yakovlev Yak-40. It is unlikely that Antonov An-22 heavy transports are in Aeroflot service, but many types of light aircraft and a full range of helicopters are likely to be in use by the airline.

aerofoil: a surface designed to obtain a reaction from the air through which it is moved. It is usually an alternative expression for a wing, but it can be a lifting aerofoil fuselage (q.v.), a propeller or rotor, or indeed any control surface of an aircraft.

Aerolineas Argentinas: although Aerolineas Argentinas was formed in 1949 on the nationalisation of all Argentinian airlines, with the exception of the air force-operated L.A.D.E., the airline had its origins in Aeroposta Argentina, which dated from 1927, when it had been formed as a subsidiary of the French airline, Cie Générale Aeropostale. Three other airlines included in the nationalisation were A.L.F.A., or Aviacion del Litoral Fleuva Argentina, Z.O.N.D.A., or Zonas Oeste y Norte de Aerolineas, and F.A.M.A., or Flota Aero Mercante Argentina. All four airlines had a Government minority shareholding at the time of nationalisation.

The new airline had a very mixed fleet, including Douglas DC-3s, DC-4s, and

DC-6s, Avro Yorks, Lancastrians and Ansons, Vickers Vikings, and Junkers Ju.52/3M trimotors, which gave rise to difficulties during the early years. However, by 1959 Argentina was able to become the first South American nation to operate jet airliners, with the delivery of six de Havilland Comet 4 airliners to Aerolineas Argentinas. Further jet equipment, Sud Caravelles, was put into service in 1962, and Boeing 707s followed in 1966.

Currently, Aerolineas Argentinas operates a fleet of Boeing 707s, 737s, Sud Caravelles, and Hawker Siddeley 748s on an extensive domestic network, and on services throughout South America, and to the United States and Europe.

Aeromexico: today a state-owned airline, Aeromexico was formed as a private enterprise company, Aeronaves de Mexico, in 1934, using a small fleet of Beechcraft aeroplanes operating a Mexico City to Acapulco service; at this time the resort of Acapulco was only a small fishing village. Pan American World Airways acquired a 40 per cent interest in Aeronaves in 1940, enabling further expansion of the airline to take place, including the acquisition of Transportes Aereas de Pacifico in 1941. A number of other small airlines have been acquired during the history of Aeromexico.

After the war the Aeronaves fleet consisted of Douglas DC-3 and DC-4 aircraft, and rapid expansion of the internal air service network operated by the airline took place, largely through the acquisition of the existing operators. The Pan American shareholding was sold in 1957 to Mexican interests, and later that year the first international service, to New York, was introduced. The airline was acquired by the Mexican Government in 1959, after a pilots' strike severely damaged the finances of Aeronaves. Further airline acquisitions followed the nationalisation of Aeronaves, including Aerovias Guest, with services to Miami and to South America.

A Government-sponsored reorganisation of Mexican air transport in 1970 has resulted in Aeronaves de Mexico controlling an air transport system which

aeronaut

includes the airline's own network and that of eight smaller carriers - although the smaller airlines have not actually been acquired. The present title was adopted in 1972. Currently, Acromexico operates an extensive domestic network, with international services to the United States, Montreal, Paris, Madrid, and Caracas, using a fleet of McDonnell Douglas DC-8s, including the 'Super Sixty' series, and DC-9s.

aeronaut: traveller by air, usually in a balloon or airship, either as crew or passenger.

aeronautics: the all-embracing term for field of balloons, airships, and heavier-than-air flight.

Aeronca: an American light aircraft manufacturer now no longer trading, but prominent during the pre-World War II period with a number of single- and dual-seat high-wing monoplanes, including the C-2. Wartime and early post-war production included aircraft for both civil and military use, amongst which were the four-seat 'Secan', and the twin-seat 'Champion' and its military counterpart, the L-16A. The manufacturing rights for the 'Champion' were later sold to a manufacturer of that name.

aeroplane: see aircraft.

aerospace: the modern term which groups aviation and space activities together, e.g. 'Society of British Aerospace Companies' has taken over from 'Society of British Aircraft Constructors'.

Aerospatiale: this is the nationalised part of the French aircraft industry, originating from the amalgamation of Nord and Sud Aviation during the late 1960s.

Nord was already noted as the manufacturer of the Noratlas transport aircraft of the early post-war period, although during the war the company had produced the Messerschmitt Bf. 108 trainer, and continued this after the war as the Nord 1100 and 1101 Noralpha. The company also produced the Nord 262 (q.v.) turboprop feeder-liner and the Nord 300 experimental tilt-wing V.I.O.L. air-

craft, while acting as the French partner in the Franco-German C-160 (q.v.) Transall military transport project and producing a range of tactical guided missiles, including the SS.11 (q.v.). The guided missile work fitted in well with Sud's practice and sounding rocket work on the formation of Aerospatiale.

Sud Aviation dated only from 1957, on the amalgamation of Ouest-Aviation and Sud-Est Aviation, which both dated from 1936 and the pre-World War II nationalisation of many small French aircraft manufacturers, which proved tragic for French military aircraft production at the outset of the war. Apart from the successful Caravelle (q.v.) jet airliner, which was one of the first jet aircraft to cater for short distance operations, and the Ouragan light jet bomber, Sud had considerable experience of helicopter and light aircraft manufacture. Sud helicopters have included the Djinn, a light helicopter for aerial crop-dusting, the famous SE. 3130 Alouette (q.v.) II, and SE. 3160 Alouette (q.v.) III and more recently the SA. 330 (q.v.) Puma and SA. 341 (q.v.) Gazelle, which are now part of a package collaborative deal with Westland (q.v.). The largest Sud helicopter is the SA. 321 (q.v.) Super Frelon, while the latest is the W.G.13 (q.v.) Lynx, on which Aerospatiale is Westland's junior partner. Light aircraft, including the M.S. Rallye and Gardan GY-80 Horizon, were originally produced by the Centre Est subsidiary, but these are now produced, with their successors, by the light aircraft division.

Apart from the several helicopter projects, Aerospatiale is the French partner and design leader on two European projects of considerable importance, the Anglo-French Concorde (q.v.) supersonic airliner and the Franco-German-Dutch-Spanish A.300B (q.v.) airbus, for which Sud formed Airbus Industrie (q.v.).

Aerostar: see Mooney Aircraft.

aerostat: see aerostation.

aerostation: the art of flying balloons (q.v.) and airships (q.v.), for which the technical name is aerostat.

Aerovan, Miles: one of the many, post-

AH-1G Huey Cobra, Bell

World War II attempts to produce a light aircraft with potential for exploiting freight traffic as well as carrying passengers, the Miles Aerovan could be considered in many ways to be the precursor of today's ~~Shom~~ Skyvan (q.v.). Aptly nicknamed 'The Flying Tadpole', the Aerovan was a high-wing monoplane, with a twin-fin tailplane, a non-retractable undercarriage, two piston engines, and accommodation for freight, or twelve passengers. The aircraft saw service with a number of small airlines in Britain and Europe, including East Anglian Flying Services, the predecessor of the ill-fated Channel Airways. A four-engined development, the Miles M. 68, was never able to realise its potential, but the Aerovan itself was in small-scale production throughout the late 1940s.

A.E.W.: see airborne-early-warning.

AFCENT: Allied Forces Central Europe, a subordinate command within SHAPE (q.v.), which is one of the two major NATO commands. AFCENT has its headquarters at Brussels in the Netherlands, and is divided into two sub-commands, NORTHAG (Northern Army Group) with its own air support from the Second Allied Tactical Air Force, and CENTAG (Central Army Group), with air support from the Fourth Allied Tactical Air Force.

AFNORTH: Allied Forces Northern Europe, a subordinate command within SHAPE (q.v.), with its headquarters at Kolsaas in Norway. The area covered by AFNORTH includes Norway, Denmark, the Baltic, and Northern Germany. The Royal Norwegian Air Force, the Royal Danish Air Force, and two Luftwaffe wings are available for air support.

AFSOUTH: Allied Forces Southern Europe, another of SHAPE's (q.v.) subordinate commands, and based on Naples. Its area of responsibility includes Italy, Greece, and Turkey, the Mediterranean and Black Sea, and air support is provided by the Italian Air Force, the Royal Hellenic Air Force, and the Turkish Air Force, with United States Navy aircraft from Sicily and the Sixth Fleet, and Royal

Air Force aircraft from Malta and Cyprus. A surveillance force, MARAIRMED, Maritime Air Forces, Mediterranean, has been formed to counter Soviet Naval expansion in the area, and this uses Italian, United States, and British maritime-reconnaissance aircraft.

A.G.M.: air-to-ground, or more accurately air-to-surface (q.v.), missile or stand-off bomb.

Agusta/Agusta-Bell: an Italian helicopter manufacturer most renowned for its licence-production of Bell designs, but also including production of Sikorsky and Boeing helicopters, as well as development and production of its own projects.

Agusta was established in 1907 by Giovanni Agusta to manufacture biplanes. Although the founder died between the wars, the company survived and expanded, even though at one time diversification into motor-cycle production was necessary. A basic training aircraft, the AP-111, was produced after World War II ended, and in 1954 licence-production of the Bell 47 (q.v.) helicopter started. This has been followed by the Bell 204 and 205 (q.v.) Iroquois, the Bell 206 (q.v.) JetRanger, and the civil Bell 212 (q.v.) and it is from these aircraft, and from the development of the Bell 47 with cabin accommodation, that the Agusta-Bell name has become famous.

Other Agusta helicopter work has entailed licence-production of the Sikorsky SH-3D and the Boeing-Vertol Bv. 114 (q.v.) Chinook for the Italian and Iranian armed forces. Agusta's own helicopter designs now include the A.106 (q.v.) for the Italian Navy and Army, and the A.109 (q.v.) executive helicopter. Work on V.T.O.L. includes research on the design for the A.120B Helibus and the A.123 compound helicopter. The Agusta-designed EMA-124 is under production at the Meridionali factory. The company holds a 30 per cent interest in Savoia-Marchetti (q.v.), the Italian light aircraft manufacturer.

AH-1G Huey Cobra, Bell: the Huey Cobra is a combat helicopter development of the successful Bell 204 UH-1 Iroquois. A