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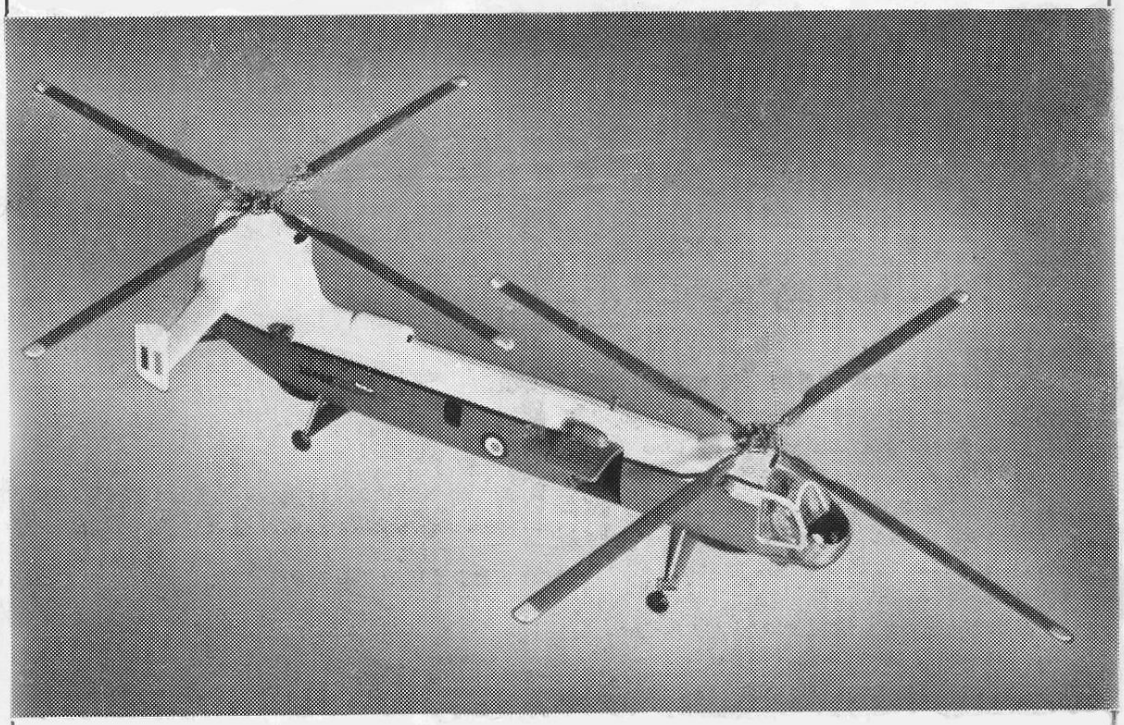

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HELICOPTERS

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Introduction

IT is five years since the last edition of *ABC Helicopters* was published. In that time the helicopter has made tremendous progress, to the extent that it has not only become firmly established as a transport vehicle but has even replaced fixed-wing aircraft for some military duties, such as carrier-based anti-submarine work.

There have been big technical changes, too. As well as the simple helicopters of a few years ago, we now have convertiplanes of a dozen different kinds. The autogyro is making a big come-back, and we have a whole new generation of strange hovercraft, ground-cushion vehicles, flying jeeps and similar machines which never seem quite able to make up their minds whether they are aircraft, motor cars or ships. Even the once-simple helicopter is becoming amphibious, and its piston-engine is giving way to shaft-turbines and a whole variety of tip-drives.

So far as possible, we have included them all in this book, and the result is by far the most comprehensive coverage of helicopters and other VTOL aircraft ever published. We hope you will like it.

June, 1960. J.W.R.T.

DEFINITIONS

The term VTOL (vertical take-off and landing) is used to describe many different types of aircraft, for which a variety of different names are in use, by the makers of the aircraft and others. The Fédération Aéronautique Internationale has adopted six names for different VTOL types, and defines them in these terms:

ROTORCRAFT. An aircraft which derives, for all or part of its flight, the whole or a substantial part of its lift from a rotor system, comprising a set of external wings or blades arranged to rotate about a substantially vertical axis. Rotorcraft are divided into helicopters, convertiplanes, autogiros and vertoplanes.

HELICOPTER. A rotorcraft which derives substantially all its lift, throughout its flight, from a power driven rotor system with a fixed, substantially vertical, shaft.

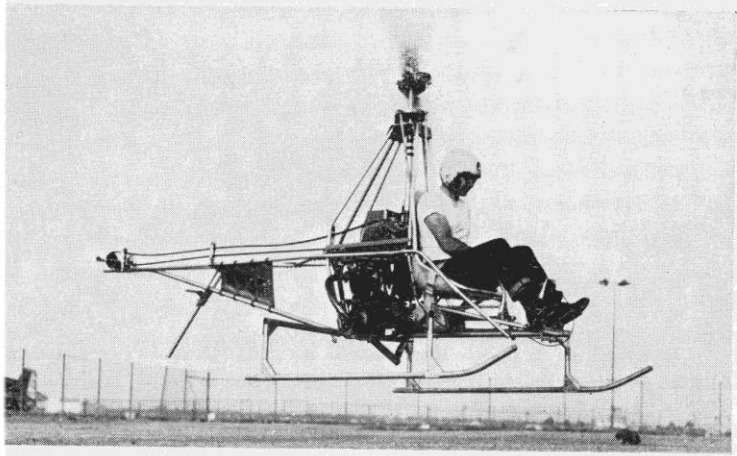
AUTOGIRO. A rotorcraft which derives substantially all its lift, throughout or during part of its flight, from an autorotating rotor system not provided with any form of direct power drive. (NOTE: the name Autogiro was registered by Juan de la Cierva for his series of rotorcraft; the form autogyro or the name gyroplane is sometimes used to distinguish craft of this type other than Cierva's.)

CONVERTIPLANE. A rotorcraft which in vertical or hovering flight derives substantially the whole of its lift from a power-driven rotor system with shaft(s) substantially vertical during such flight; and which, in forward or horizontal flight, derives the whole or a substantial part of its lift from fixed wings.

VERTOPLANE. A rotorcraft capable of taking off and landing vertically by lift from a power-driven rotor system with fixed shaft(s) substantially parallel with the longitudinal axis of the rotorcraft; and capable of flying horizontally by lift from fixed wings when the longitudinal axis of the rotorcraft has been tilted over to a horizontal attitude.

JETLIFT AIRCRAFT. An aircraft (not a rotorcraft) capable of taking off, hovering, flying forward and landing while obtaining substantially the whole of its lift from direct jet thrust, and not requiring lift from external surfaces during take-off and landing.

The term VTOL is applied by the U.S.A.F., U.S.N. and U.S. Army to any aircraft able to reach 50 ft. altitude at 50 ft. distant from the take-off-point—that is to say, able to achieve a 45 degree (or steeper) climb out from a standing start.



ADAMS-WILSON XH-1 HOBBYCOPTER (U.S.A.)

Ultra-light home-built helicopter.

POWERED BY: One 40 h.p. Triumph 650 piston-engine. ACCOMMODATION: One.
ROTOR DIAMETER: 21 ft. 6 in. LENGTH: 14 ft.
GROSS WEIGHT: 555 lb. CRUISING SPEED: 40–45 m.p.h.

Designed, like the Bensen Gyro-Gliders and Gyro-Copters, for home construction by amateurs, the XH-1 is an orthodox helicopter of simple layout. The basic structure is made up of aluminium tubes, bolted together, and the undercarriage comprises tubular skids but no wheels. The motor-cycle engine drives the gearbox by chain, and the gearbox in turn drives the main rotor shaft and a belt to the tail rotor. Main rotor blades are spruce and the tail rotor is aluminium. The prototype Hobbycopter, developed by T. G. Adams and Paul Wilson, first flew in November 1958.

AEROTECNICA AC-12 (Spain)

General-purpose helicopter, in production.

POWERED BY: One 168 h.p. Lycoming O-360-B2A piston-engine. ACCOMMODATION: Two.
ROTOR DIAMETER: 27 ft. 10 in. LENGTH: 27 ft. 3 in.
GROSS WEIGHT: 1,650 lb. CRUISING SPEED: 72 m.p.h.

Like all Aerotecnica designs, the AC-12 has its engine mounted above the cabin, driving the three-blade main rotor through a transmission and reduction gear designed on automobile principles. Two prototypes were built by the AISA company of Madrid, and the first of these flew on July 20, 1956. Twelve more were ordered subsequently by the Spanish Government under the military designation XZ-1.

AERETECNICA AC-14 (Spain)

General-purpose helicopter, in production.

POWERED BY: One 360 s.h.p. Turbomeca Artouste IIB shaft-turbine.
ACCOMMODATION: Pilot and four passengers. GROSS WEIGHT: 2,645 lb.
ROTOR DIAMETER: 31 ft. 6 in. LENGTH: 36 ft. 9 in. MAX. SPEED: 112 m.p.h.

Although larger than the AC-12, the AC-14 has the same general layout, with the power plant above its extensively-soundproofed cabin. Main difference is that in this case the residual thrust from the shaft-turbine is used to provide anti-torque control during vertical and low-speed flight, dispensing with the need for a tail rotor. During cruising flight, this thrust is used to increase forward speed, torque control then being provided by small vertical rudders at the tail. The first of six AC-14s, built by the ENHASA airscrew company, flew on July 16, 1957. The military designation is XZ-4.

AERETECNICA AC-21 (Spain)

Heavy-duty helicopter, under development.

POWERED BY: Two 750–900 s.h.p. Turbomeca Turmo III shaft-turbines.
ACCOMMODATION: Crew of two and up to fourteen passengers. MAX. SPEED: 140 m.p.h.
ROTOR DIAMETER: 59 ft. 1 in. LENGTH: 63 ft. 8 in. GROSS WEIGHT: 11,023 lb.

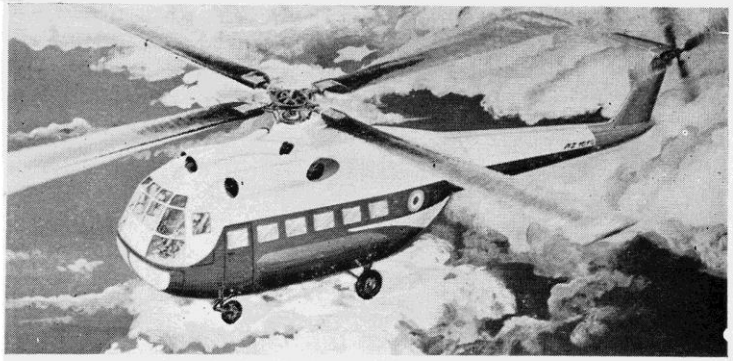
Designed to meet a Spanish Air Force requirement for a general-purpose transport, flying crane and casualty evacuation helicopter, the AC-21 follows the usual Aerotecnica formula, with its engines above the cabin. As in the AC-14, gas-deflection will be used for torque control in low-speed flight. A prototype is under construction.

AGUSTA-BELL 47J (Italy)

Utility helicopter, in production.

POWERED BY: One 220 h.p. Lycoming VO-435 piston-engine.
ACCOMMODATION: Pilot and 3–4 passengers. GROSS WEIGHT: 2,800 lb.
ROTOR DIAMETER: 37 ft. 2 in. LENGTH: 43 ft. 4¾ in. MAX. SPEED: 105 m.p.h.

Costruzioni Aeronautiche Giovanni Agusta acquired a licence for the production of the Bell 47 in Europe in 1952, and the first Italian example, a 47G, flew on May 22, 1954. Since that date, Agusta has built about 450 Bell 47s. These have included the Model 47G with a Franklin 6V4-200-C22 engine and the 47G-2 with a Lycoming VO-435-A1B engine, and the company now has two versions of the 47J in production. Both incorporate modifications by Agusta—one to provide dual controls and the other to seat a fourth passenger.



AGUSTA AZ-101G (Italy)

Military and civil transport helicopter, under development.

POWERED BY: Three 1,000 s.h.p. de Havilland Gnome H1000 shaft-turbines.
ACCOMMODATION: Crew of two and 30 passengers.
ROTOR DIAMETER: 64 ft. LENGTH: 54 ft. 1 in.
GROSS WEIGHT: 25,000 lb. MAX. SPEED: 143 m.p.h.

Expected to fly in the second half of 1960, the AZ-101G is Italy's largest helicopter project, designed for both military and commercial use. Its development has been financed by the Italian Government. Alternative loads will include 16 stretcher patients and attendant, or vehicles loaded via a rear ramp.

AGUSTA-BELL 102 (Italy)

General-purpose and transport helicopter.

POWERED BY: One 600 h.p. Pratt & Whitney R-1340 piston-engine.
ACCOMMODATION: Pilot and 8–9 passengers.
ROTOR DIAMETER: 47 ft. 7 in. LENGTH: 58 ft. 9 in.
GROSS WEIGHT: 6,220 lb. MAX. SPEED: 120 m.p.h.

Developed by Agusta from the original Bell Model 48 design, the 102 prototype flew on February 3, 1959. With accommodation for up to nine passengers, it is being put into production for airline and general duties. Elivie, the helicopter-operating associate of Alitalia, has ordered three for service in the Naples area.

AGUSTA 103 (Italy)

POWERED BY: One 85 h.p. Agusta M.V.G.A. 70 piston-engine.
ACCOMMODATION: One.
ROTOR DIAMETER: 24 ft. 3 in.
LENGTH: 18 ft. 7 in.
GROSS WEIGHT: 1,014 lb.
MAX. SPEED: 93 m.p.h.

Training and observation helicopter, under development.

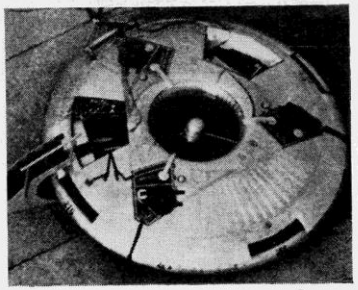
The Agusta 103 is an ultra-light helicopter under development for training, observation, agricultural and other duties. It flew for the first time in October 1959. The Agusta 104 is a larger two-seat development with 140 h.p. M.V.A. 120 engine.

AVIAN 2/180 GYROPLANE(Canada)

Personal gyroplane, under development.

POWERED BY: One 180 h.p. Lycoming piston-engine.
ACCOMMODATION: Two.
ROTOR DIAMETER: 26 ft.
LENGTH: 14 ft. 7 in.
GROSS WEIGHT: 1,600 lb.
CRUISING SPEED: 150 m.p.h.

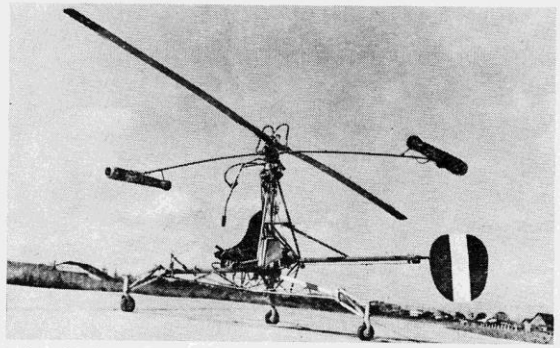
Developed by a group of former employees of Avro Aircraft in Canada, the Avian 2/180 is a jump-start autogyro intended for sporting flying. The Lycoming engine powers a ducted pusher propeller for normal cruising flight, when the all-steel three-blade rotor is unpowered. For jump-starts, tip drive of the rotor is provided from a compressed-air bottle which can be recharged during forward flight. The cabin, which will be enclosed in later models, seats two in tandem. Preliminary tests with the Avian 2/180 began in 1959, but it was damaged subsequently in an accident. A replacement is being built.



AVRO AVROCAR (Canada)

This "flying saucer" VTOL aircraft has been under development by Avro Canada since 1955, under contract from the U.S. Department of Defense, as Weapon System 606A. It uses the ground cushion effect and is designed to be capable of comparatively high speeds for such a type. The prototype flew for the first time on December 5, 1959, but no details have been released officially.

BAUMGARTL PB-64 (Brazil)



Personal helicopter, under development.

POWERED BY: Two 33 lb.s.t. IPD M-60 pulse-jets.
ROTOR DIAMETER: 21 ft.
GROSS WEIGHT: 500 lb. MAX. SPEED: 80 m.p.h

Paul Baumgartl is an Austrian engineer who began his rotary-wing activities in Vienna in 1944 with the construction of strap-on helicopters and gyro-gliders. Since 1948 he has been designing for the Brazilian Air Ministry in Rio de Janeiro and has built the PB-60 gyro-glider, and PB-61 and PB-63 helicopters. His latest project is the PB-64 illustrated.

BEIJA-FLOR I (Brazil)

Light general-purpose helicopter, under development.

POWERED BY: One 225 h.p. Continental E225 piston-engine.
ACCOMMODATION: Two.
ROTOR DIAMETER: 29 ft. 6 in. LENGTH: 28 ft. 10 in.
GROSS WEIGHT: 2,310 lb. MAX. SPEED: 93 m.p.h.

The Beija-Flor prototype was designed by the German engineer Professor Heinrich Focke, who was chief designer at the Brazilian Air Ministry's Centro Tecnico de Aeronautica from 1952 to 1959, returning there in 1960. It is a conventional two-seat helicopter, built at the C.T.A. with as much local material and equipment as possible. The first flight trials were made early in 1959. The Beija-Flor seats two side-by-side in the cabin and has the engine located in the nose (like the Cessna CH-1) for easy access. A three-bladed main rotor is used, and two three-bladed intermeshing tail rotors, at 45 degrees, provide torque compensation and directional control.

BELL HU-1A IROQUOIS (U.S.A.)

Utility helicopter, in production.

POWERED BY: One 700 s.h.p. Lycoming T53-L-1 shaft-turbine.
ACCOMMODATION: Pilot and five passengers. GROSS WEIGHT: 5,800 lb.
ROTOR DIAMETER: 44 ft. LENGTH: 39 ft. 7½ in. CRUISING SPEED: 115 m.p.h.

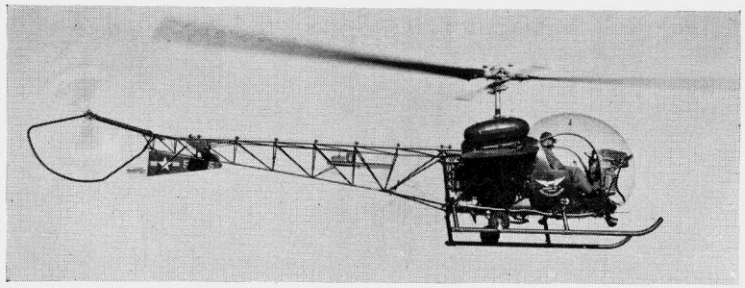
Winner of a U.S. Army design competition for a utility and general-purpose helicopter with turbine power, the Bell Model 204 was at first designated H-40, but has since been redesignated HU-1 as the first of a new series of Army utility helicopters. The first of three prototype XH-40s flew on October 22, 1956, and seven YH-40s followed for service trials. The U.S. Army received the first of a pre-production batch of nine HU-1As on June 30, 1959, and deliveries of a production batch of 100 began in the Spring of 1960. The HU-1A can carry up to 3,000 lb. of freight and one example has flown with an experimental installation of six Nord S.S.11 wire-guided anti-tank missiles. The 960 s.h.p. Lycoming T53-L-5 is being installed experimentally in four HU-1Bs. As the Agusta 204B, the same basic design is to be built in Italy by Agusta, with D. H. Gnome shaft-turbine. The HU-1D has a larger cabin for 12 troops and a 1,100 s.h.p. T53-L-9 shaft-turbine.

BELL XV-3 (U.S.A.)

Research tilting-rotor convertiplane.

POWERED BY: One 450 h.p. Pratt & Whitney R-985 piston-engine.
ROTOR DIAMETER: 25 ft. each. SPAN: 30 ft. LENGTH: 30 ft.
GROSS WEIGHT: 4,700 lb. MAX. SPEED: 175 m.p.h.

One of the three designs in an early U.S. Army research programme into VTOL aircraft, the XV-3 (originally designated XH-33) first flew on August 23, 1955. It is of the tilting rotor type, the large diameter rotor/propellers operating as conventional helicopter-type rotors for take-off and landing but tilting through 90° to become propellers for cruising flight. One of the two XV-3s crashed on October 25, 1956; the second, with two-blade (originally three-blade) rotors and other modifications, is still flying and completed the first 100 per cent. conversion on December 18, 1958, at 4,000 ft. and 132 m.p.h., taking 10–15 seconds.



H-13H

BELL MODEL 47 (U.S.A.)

(Data apply to Model 47G-3)

General-purpose military and commercial helicopter, in production and service.

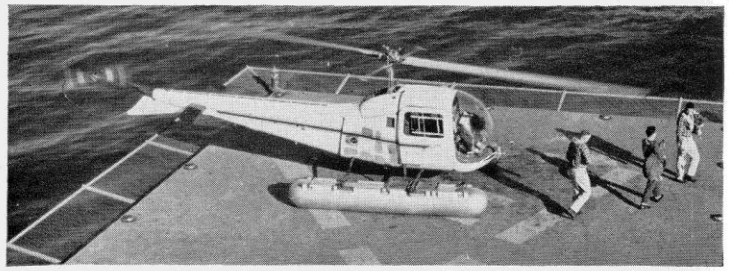
POWERED BY: One 225 h.p. Franklin 6VS-335 piston-engine.
ACCOMMODATION: Three.
ROTOR DIAMETER: 37 ft. 3 in. LENGTH: 28 ft. 6 in.
GROSS WEIGHT: 2,650 lb. CRUISING SPEED: 105 m.p.h.

Ranking second only to the Sikorsky series of single-rotor helicopters among successful post-War rotorcraft, the Bell Model 47 first flew in 1945. Since then it has undergone considerable modification and improvement, and is still in production 15 years later. Bell 47s have flown more than 2½ million hours and serve in over 50 different countries. New models for 1960 are the 47G-3 (data above) and the four-seat 47J-2 Ranger, which has a Lycoming VO-540 engine and a gross weight of 2,850 lb., the heaviest in the series.

The first production version of the Bell helicopter was the Model 47B, which had an enclosed, car-type cabin. This was soon followed by the 47B-3, with an open cockpit, and by the 47D and D-1 with the familiar, all-Plexiglas " goldfish bowl " cabin. All models up to and including the D had a 178 h.p. Franklin engine and were two-seaters. The 47G, with a 200 h.p. Franklin 6V4-200-C32 engine, introduced the elevator control in addition to numerous other refinements. The 47G-2, another major production version, had the 260 h.p. Lycoming VO-435, but, as noted above, the 47G-3 reverts to a Franklin engine. A new, streamlined cabin was a feature on the three-seat 47H (which was not produced in quantity) and the 47J (originally G-1) also is streamlined, as well as being lengthened to increase the seating capacity to four. The 47J went into production with the Lycoming VO-435 engine and utility or de-luxe interiors.

About half of all the Bell 47s built have been for the U.S. Services. The U.S.A.F. designates its Bells as H-13s, and has had the H-13B (47D), H-13D, H-13E (47D-1) and H-13G (47G). A single XH-13F (Bell Model 201) had a Continental XT51-T-3 Artouste shaft-turbine, and the H-13H (47G-2) is the Army's Sioux, of which about 400 have been purchased. Two H-13Js for Presidential use are versions of the 47J. U.S. Navy versions included the HTL-1 (47B), HTL-2 and -3 (47D), HTL-4 and -5 (47D-1) and HTL-6 (47G). Latest Navy versions are the HTL-7

Model 47G-3



Model 47J

(47J) trainer, of which 18 have been ordered; the HUL-1 for utility duties and ice-breaker patrol and two HUL-1Cs for the Coast Guard. Two HUL-2s are being built with 250 s.h.p. Allison YT63-A-3 turbines for evaluation.

European needs are met from the production line of Bell 47s established by Giovanni Agusta in Italy, where both the 47G and 47J are built for military and civil customers. Merckle KG Flugzeugwerke in Germany is assembling 60 Agusta-Bell 47Gs for the German Services.

BELL AIR SCOOTER (U.S.A.)

Single-seat ground-cushion vehicle, under development.

POWERED BY: One 14 h.p. motor scooter piston-engine.
LENGTH: 7 ft. 1 in. WIDTH: 4 ft. 5 in.
GROSS WEIGHT, LESS DRIVER: 160 lb. MAX. SPEED: 25 m.p.h.

Following experimental work on ground cushion vehicles by Bell research engineers Ken and Rod Wernicke, who built small air scooters at home for their children, the company began development of this full-size vehicle in June 1959. The prototype was built by the Wernickes in 33 days. A 30-inch diameter fan gives it a cruising height about 2½ in. above the ground, and it will climb a 1 in 10 slope. Controls comprise bicycle-type handlebars, a throttle grip and accelerator pedal. The body is made of fibreglass and aluminium. It is claimed that anyone could operate it after a few minutes of instruction.

Gyro-Copter

BENSEN B-7 and B-8 (U.S.A.)

(Data apply to B-8M)

Personal gyroplane, in production.

POWERED BY: One 72 h.p. McCulloch 4318E piston-engine.
ROTOR DIAMETER: 20 ft. LENGTH: 11 ft. 4 in.
GROSS WEIGHT: 500 lb. MAX. SPEED: 85 m.p.h.

B-8 Gyro-Glider

Igor Bensen has been developing ultra-light rotorcraft for sporting flying and home construction for a number of years, the B-7 and B-8 being typical examples. The company reported the sale of 100 of these machines and 700 kits of parts in 73 different countries in a single year recently. Both the B-7 and the B-8 are available without motors in Gyro-Glider form, when they can be towed behind a car and obtain lift from the windmilling rotor. The powered B-7M Gyro-Copter has a Nelson or Triumph engine driving a pusher propeller and is a simple autogyro, while the B-8M (data above) has a more powerful engine which can be clutched to the rotor for jump-starts. Other variants of the towed gyroplane are the B-8W Hydro-Glider with floats and the B-8B Gyro-Boat with a dinghy hull, both towed over water by a fast motor-boat.

B-8B Gyro-Boat

BENSEN B-9

LITTLE ZIPSTER (U.S.A.)

Personal helicopter, under development.

POWERED BY: One 60 h.p. piston-engine.
ROTOR DIAMETER: 20 ft.
GROSS WEIGHT: 700 lb.

Although similar in certain details to the B-8 Gyro-Copter, the B-9 is a true helicopter with continuously-powered rotor, and is also unique among the Bensen types in having co-axial rotors. No other details have been released.

BENSEN B-10 PROP-COPTER (U.S.A.)

Research VTOL prototype.

POWERED BY: Two 72 h.p. McCulloch piston-engines.
GROSS WEIGHT: 650 lb. ACCOMMODATION: One.

The Bensen B-10 is a private-venture single-seat VTOL prototype, operating on similar principles to the Piasecki VZ-8P. It comprises a simple frame with a McCulloch engine at each end driving a horizontal propeller. The pilot, sitting astride the frame between the engines, controls the machine by means of air deflector vanes operating in the propeller slipstream. The first flight was made on August 6, 1958. No other details are available.

BERTELSEN AEROMOBILE (U.S.A.) **Single-seat ground effect vehicle.**

POWERED BY: One 72 h.p. McCulloch O-100-1 piston-engine. GROSS WEIGHT: 585 lb.
LENGTH: 8 ft. 5 in. WIDTH: 5 ft. 11 in. MAX. SPEED: 40 m.p.h.

After considerable development work with models and a smaller man-carrying ground effect vehicle, which is claimed to have been the first successful craft of its type in the world, Dr. William Bertelsen built this prototype and flew it for the first time on March 30, 1959. It then had a 35 h.p. engine, which gave a hover height of only 3 in. Substitution of the more powerful engine increased the operating height to a maximum of 6 in. and gave much improved performance, especially in a cross-wind. Control is by means of movable aluminium flaps running longitudinally outside the peripheral jet, which tilt the machine for propulsion. The ducted fan has eight aluminium blades. A larger and much more powerful version is being developed.

BOLKOW

Bo-103

(W. Germany)

Ultra-light personal helicopter, under development.

POWERED BY: One 40 h.p. ILO piston-engine.

ACCOMMODATION: One

ROTOR DIAMETER: 21 ft. 7 in.

GROSS WEIGHT: 882 lb.

CRUISING SPEED: 71 m.p.h.

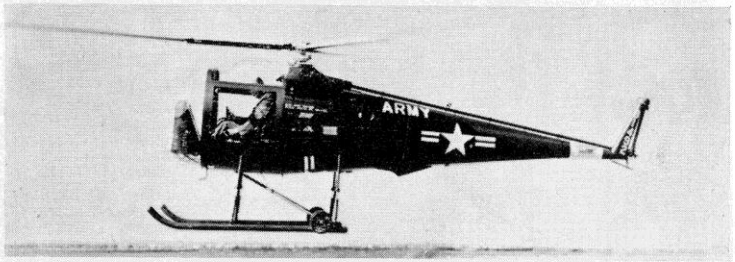
This ultra-light single-seat helicopter started life as the Bo-102 fixed-base Heli-Trainer, five of which have been ordered by the German Defence Ministry. This consists of a small and simple helicopter attached permanently to a steel tube base (or a pontoon for water training), so that it cannot fly. Its control responses are so good, however, that development of a free flight version seemed justified, and the Bo-103 is the result. It differs from the trainer in small details only and is characterized by a counter-balanced, single-blade rotor.

BORGWARD KOLIBRI (W. Germany)

General-purpose helicopter, under development.

POWERED BY: One 260 h.p. Lycoming VO-435-A1B piston-engine.
ACCOMMODATION: Three. GROSS WEIGHT: 2,645 lb.
ROTOR DIAMETER: 30 ft. 10 in. LENGTH: 27 ft. 3 in. CRUISING SPEED: 87 m.p.h.

The Kolibri was the first German post-War helicopter, designed by the doyen of German rotary-wing designers, Professor E. H. Focke. The prototype was first flown on July 8, 1958, the preliminary trials being in the hands of Ewald Rohlfs—who had much to do with Prof. Focke's pre-war Focke-Wulf Fw 61 helicopter. Similarities will be noticed between the Kolibri and the Brazilian C.T.A. Beija-Flor (page 7), which Prof. Focke has designed for the Brazilian Air Ministry. The use of two intermeshing tail rotors, angled in at 45° to the perpendicular is, especially, a feature of both the Koiibri and the Beija-Flor. With accommodation in the cabin for pilot and two passengers or one stretcher, the Kolibri can also carry one stretcher case externally, or 660 lb. of freight on an external sling, or crop dusting or spraying gear.



BRANTLY B-2 (YHO-3BR) (U.S.A.)

Observation and utility helicopter, under development.

POWERED BY: One 162 h.p. Lycoming VO-360-A1A piston-engine.
ACCOMMODATION: Two. GROSS WEIGHT: 1,600 lb.
ROTOR DIAMETER: 23 ft. 8⅝ in. LENGTH: 21 ft. 9 in. CRUISING SPEED: 100 m.p.h.

The B-2 is the second helicopter designed by N. O. Brantly, the first (B-1) having been built and flown in 1946. The B-2, a completely new design, first flew on February 21, 1953; a second, improved, prototype started its trials on August 14, 1956. Production was started in 1958 on five military evaluation models, designated YHO-3BR in the U.S. Army observation helicopter category. Three of these are being evaluated at Fort Rucker and the other two at the U.S. Naval Air Station, Patuxent River, Maryland. Following these military examples, commercial B-2s are now in production; the first two were delivered to Mid-States Helicopter Corp. and Keystone Helicopter Corp. A small tandem-rotor prototype designated the B-3, with two Lycoming engines and a gross weight of 3,400 lb., is under construction.

BRISTOL 171 SYCAMORE (G.B.)

General-purpose helicopter, in service. (*Data apply to H.R. Mk. 14*)

POWERED BY: One 550 h.p. Alvis Leonides 73 piston-engine.
ACCOMMODATION: Pilot and four passengers. GROSS WEIGHT: 5,600 lb.
ROTOR DIAMETER: 48 ft. 7 in. LENGTH: 46 ft. 2 in. CRUISING SPEED: 105 m.p.h.

The Bristol 171 was the company's first rotary-wing aircraft as well as the first helicopter designed and built in Britain after World War II. Two prototype 171 Mk. Is, with R-985 Wasp Junior engines, were built, the first (VL958) flying on July 24, 1947. The single Mk. II (VW905) was a prototype with Alvis Leonides engine, the Mks. III and IV being production versions with this engine and various detail refinements. First military variants were equivalent to the civil Mk. III, and comprised a single H.C. Mk. 10 (WA578) evaluated by the Army; four Army H.C. Mk. 11 used for communications; four H.R. Mk. 12 evaluated by Coastal Command and later used by J.E.H.U., and two H.R. Mk. 13 evaluated by Coastal Command. The major production variants are equivalent to the civil Mk. IV, and are the H.R. Mk. 14 for the R.A.F. and Army and the Mk. 52 for Germany. Other exports have been made to the Royal Belgian Air Force, to the Royal Australian Navy (H.R. Mk. 50 and 51, respectively equivalent to the Mks. 13 and 14) and to Canada. When production of the Sycamore ended, nearly 200 had been built.

BZ-4 ZUK (Poland)

General-purpose helicopter, under development.

POWERED BY: One 320 h.p. Narkiewicz WN-4 piston-engine. ACCOMMODATION: Two.
ROTOR DIAMETER: 39 ft. 4½ in. LENGTH: 41 ft. 10 in.
GROSS WEIGHT: 3,300 lb. MAX. SPEED: 97 m.p.h.

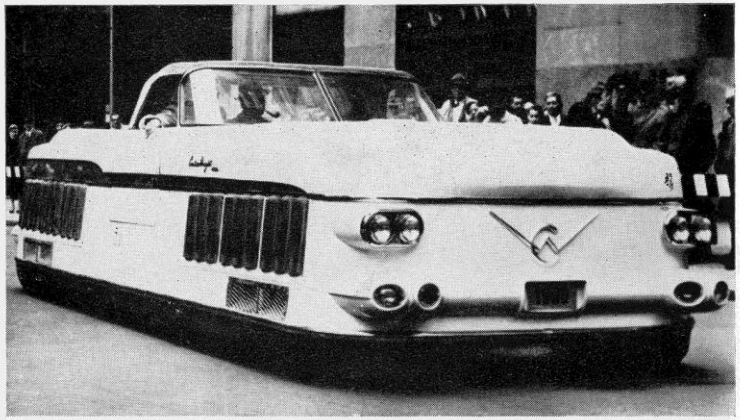
Development of the Zuk was started in 1953 by Dipl. Ing. B. Zurakowski, who had earlier built Poland's first successful helicopter, the GIL. The two-seat prototype Zuk was shown for the first time at the Polish Aviation Day Exhibition in August 1956, when it was stated that production models would have four seats, with provision for carrying a stretcher or agricultural equipment. Since then little has been heard of the Zuk, although it is reported to have begun its ground tests in 1957 and to have been followed by further prototypes.

CESSNA CH-1C and YH-41 SENECA (U.S.A.)

Personal and general-purpose transport helicopter, under development.

POWERED BY: One 270 h.p. Continental FSO-526-A piston-engine.
ACCOMMODATION: Pilot and 2–3 passengers.
ROTOR DIAMETER: 35 ft. LENGTH: 32 ft. 8 in.
GROSS WEIGHT: 3,100 lb. MAX. SPEED: 122 m.p.h.

Cessna's interest in the helicopter field dates from 1952, when the Seibel Helicopter Company was acquired and formed the basis of the Cessna Helicopter Division. A flying test-bed of the first Cessna design was flown in July 1953, followed by a prototype of the CH-1 in July 1954. A feature of the CH-1 design was that its fuselage and cockpit were styled along conventional lightplane lines, with the engine in the nose and a simple transmission system with only three gears in the main transmission and two in the tail rotor assembly. After being developed into the CH-1B, this helicopter was put into small-scale production and a batch of ten was built for U.S. Army evaluation; these are known as the YH-41 Seneca. One YH-41 set three international helicopter flight records in 1957. Latest variant in the series is the CH-1C, which has mechanical and aerodynamic changes to improve static and dynamic stability, and extra fuel capacity.



CURTISS-WRIGHT MODEL 2500 AIR-CAR (U.S.A.)

Four-seat ground effect vehicle, in production.

POWERED BY: One 300 h.p. piston-engine.
ACCOMMODATION: Four.
LENGTH: 21 ft. WIDTH: 8 ft.
GROSS WEIGHT: approx. 2,800 lb. MAX. SPEED: 60 m.p.h.

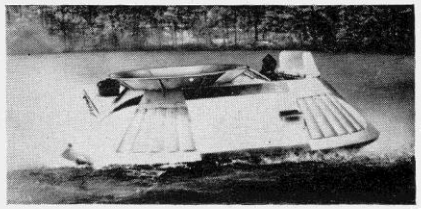
(description opposite)

CURTISS-WRIGHT MODEL 2500 AIR-CAR *(continued)*

First ground effect vehicle to enter production, the Air-Car is offered for off-the-highway use only at this stage. The two ducted fans give a cruising height of 6–12 in. by maintaining an air pressure of approx. 1/10 lb./sq. in. under the vehicle, and are said to make possible negotiation of gradients of up to 6 per cent. Propulsion and steering are by tapping off some of the air and expelling it through louvres disposed around the body.

CURTISS-WRIGHT AIR-CAR (U.S.A.)

This small Curtiss-Wright ground effect vehicle is powered by a 200 h.p. piston-engine, which builds up an air cushion under the body sufficient to give a cruising height of 12 in. above the ground or water. Few details have been released, except that it will carry a 200 lb. load.



CURTISS-WRIGHT VZ-7AP (U.S.A.)

Research VTOL prototype.

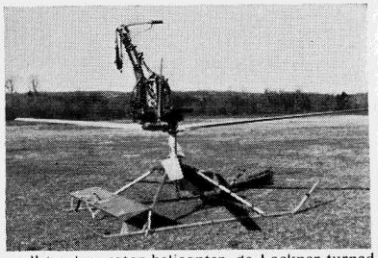
POWERED BY: One 425 h.p. Turbomeca Artouste 11B shaft-turbine.
ACCOMMODATION: Pilot and passengers or freight.
WIDTH: Approx. 16 ft. LENGTH: Approx. 17 ft. GROSS WEIGHT: About 1,700 lb.

One of the series of VTOL research vehicles developed for evaluation by the U.S. Army Transportation Corps in its search for a real "flying jeep," the VZ-7AP was an original design by the Aerophysics Development Corporation, which now constitutes the Santa Barbara Division of Curtiss-Wright. The VZ-7 derives its lift from four small-diameter rotors or horizontal propellers, located one at each corner of the vehicle; a single engine drives all four rotors, although production developments would probably be multi-engined. Pilot's controls of the VZ-7AP, which was first flown in the latter half of 1959, comprise a conventional collective-pitch lever for climb and descent, a control column which changes the rotor pitch differentially for control in pitch and roll, and pedals to operate a rudder in the efflux from the jet engine. Space is provided on a platform behind the pilot for the carriage of personnel, stores or weapons.

CURTISS-WRIGHT X-100 (U.S.A.)

A photograph and brief details of this VTOL research aircraft were released just as this *ABC* closed for press. The X-100 has a shaft-turbine engine, driving tilting "radial lift-force" propellers on wingtip nacelles, and there are pitch-control jet nozzles at the tail. The prototype has completed successful transitions and Curtiss-Wright are developing a six-seat executive aircraft (Model 200) and local-service feeder-liner (Model 300) on the same lines, with four such propellers, two pushers and two tractors, at the tips of the wings.

DE LACKNER AEROCYCLE (U.S.A.)



Ultra-light "stand-on" helicopter, under development.

POWERED BY: One 40 h.p. Mercury 55 piston-engine.
ROTOR DIAMETER: 15 ft.
GROSS WEIGHT: About 500 lb.
CRUISING SPEED: 75 m.p.h.

After some early post-War experiments with a small tandem-rotor helicopter, de Lackner turned his attention to a new form of rotary-winged machine, in which the rotor was *under* the pilot. By thus turning the conventional helicopter upside-down, it was possible to simplify the controls, and in early models of the DH-4 Aerocycle it was possible for the pilot to change course by leaning in the direction in which he wanted to go. Some of the more recent prototypes (DH-5) have small elevators for longitudinal control, and handle-bars for lateral movements. The motorcycle engine is controlled by a twist-grip throttle and drives contra-rotating rotors, above which is the small platform on which the pilot stands.

DOAK VZ-4DA (U.S.A.)

Research tilting-duct VTOL prototype.

POWERED BY: One 850 h.p. Lycoming T53 shaft-turbine.
ACCOMMODATION: Two.
SPAN: 25 ft. 6 in. LENGTH: 32 ft. GROSS WEIGHT: 3,000 lb.

The Doak Model 16 (Army VZ-4DA) is one of several prototypes in the U.S. Army programme of research into VTOL and STOL configurations, and is the only one with ducted-fan propulsion. The single Lycoming T53 turbine engine drives a ducted fan at each wing-tip, and these fans can be tilted through 90° to give vertical thrust for take-off and landing, and horizontal thrust for forward cruising flight. The Doak 16 was first flown on February 25, 1958 and made its first conversion in May 1959.

DOMAN LZ-5 (YH-31) (U.S.A.)

General utility helicopter, in production.

POWERED BY: One 400 h.p. Lycoming SO-580-A1B piston-engine.
ACCOMMODATION: Crew of two and six passengers.
ROTOR DIAMETER: 48 ft. LENGTH: 37 ft. 10 in.
GROSS WEIGHT: 5,200 lb. CRUISING SPEED: 82 m.p.h.

Doman helicopter development was based on the use of a hingeless rotor unit and a hydraulic rotor control system, first flown on a Sikorsky R-5. The LZ-5 was developed from the basically similar civil LZ-4, and first flew on April 27, 1953. It was certificated for commercial use on December 30, 1955, and can carry six passengers or four stretchers or miscellaneous freight. With fuselage covering and other non-structural parts removed, it can operate as a flying crane, or agricultural aircraft with increased disposable load. Arrangements have been made for production of the LZ-5 (which was evaluated by the U.S. Army as the YH-31) by Aerosicula (Aeronautica Sicula, an associate of Ambrosini) in Sicily. The latter company is reported to be building 25 initially, designated D-10, most of them for sale in the American market.

FAIRCHILD-UMBAUGH MODEL 18 (U.S.A.)

Two-seat general-purpose autogyro, in production.

POWERED BY: One 180 h.p. Lycoming piston-engine.

ACCOMMODATION: Two.

ROTOR DIAMETER: 34 ft. 6 in.

LENGTH: 20 ft.

GROSS WEIGHT: 1,600 lb.

CRUISING SPEED: 100 m.p.h.

Designed by the Umbaugh company, this neat tandem two-seat autogyro is being produced by Fairchild. The standard model, as illustrated, is intended as a runabout, but general utility and agricultural versions are planned. Helicopter-type controls are used, the main difference being that the usual collective-pitch lever is replaced by a take-off lever which is used to engage and disengage the drive from the engine to the rotor for jump-starts. An operating cost of only six cents per mile is claimed. The production version has a Vee tail unit.

FIAT MODEL 7002 (Italy)

General-purpose helicopter, under development.

POWERED BY: One 530 e.h.p. Fiat 4700 turbo-generator.
ACCOMMODATION: Crew of two and five passengers.
ROTOR DIAMETER: 39 ft. 4 in. LENGTH: 20 ft. 1 in.
GROSS WEIGHT: 3,087 lb. MAX. SPEED: 106 m.p.h.

The prototype of this interesting helicopter was completed early in 1960 and is now being tested. The two-blade rotor is of the "cold-jet" type, turned by compressed air ejected from nozzles at the blade-tips, without combustion. The small ducted tail-rotor is driven mechanically from the main rotor. Two pilots, or pilot and passenger, occupy the flight deck. A very large door on each side of the cabin provides easy access for five passengers, or for stretcher loading in the ambulance role. The aircraft can carry two stretchers internally and two externally.

Top: MEG-1X; bottom: MEG-3X

GLUHAREFF MEG-3X (U.S.A.)

Personal helicopter, under development.

POWERED BY: Two Gluhareff G8-2 pressure-jets.
ROTOR DIAMETER: 20 ft.
GROSS WEIGHT: 380 lb.

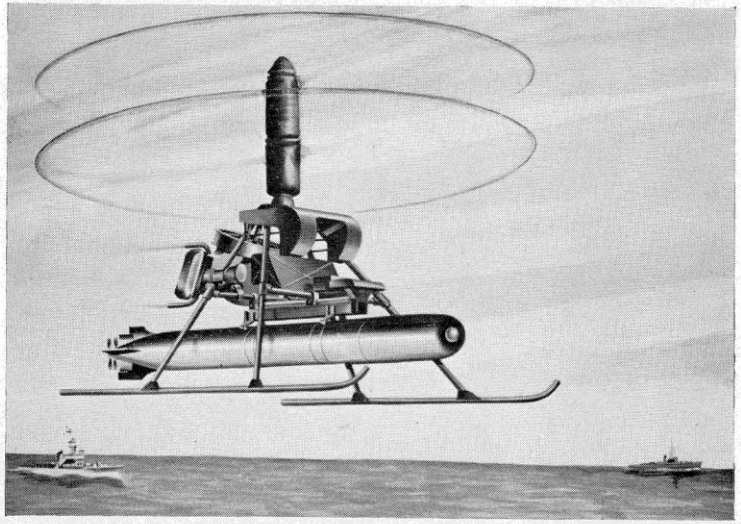
E. Gluhareff Helicopter Corporation was formed in 1956 to undertake development of one-man helicopters designed by Eugene Gluhareff. Two prototypes have been built to date, the MEG-1X and the MEG-3X. The former is a strap-on helicopter which weighs 60 lb. and consists of a counterbalanced single-blade rotor, a 3-gal. propane fuel tank and the necessary controls. The rotor is turned by a Gluhareff 8-8 pressure-jet at the tip, developing about 20 lb. thrust. A prototype of the MEG-3X stand-on helicopter was completed in January 1959 and started tethered tests. The two-blade rotor has an 18 lb. thrust G8-2 pressure-jet at each tip, and the 20-gal. propane tank revolves with the rotor to prevent fuel "sloshing." A two-seat platform is now under construction by Gluhareff.

GOODYEAR GA-400R-3 GIZMO (U.S.A.)

Ultra-light one-man helicopter, under development.

POWERED BY: One 38 h.p. Johnson 35 piston-engine.
ROTOR DIAMETER: 20 ft. LENGTH: 21 ft.
GROSS WEIGHT: 490 lb. MAX. SPEED: 65 m.p.h.

This litt le private-venture helicopter is intended as a military liaison or tactical vehicle for all duties that require the transport of one man at up to 65 m.p.h. It first flew on May 9, 1954, but has since undergone considerable development and is now an extremely simple and efficient light helicopter. The rotors are driven by belt-and-pulley.



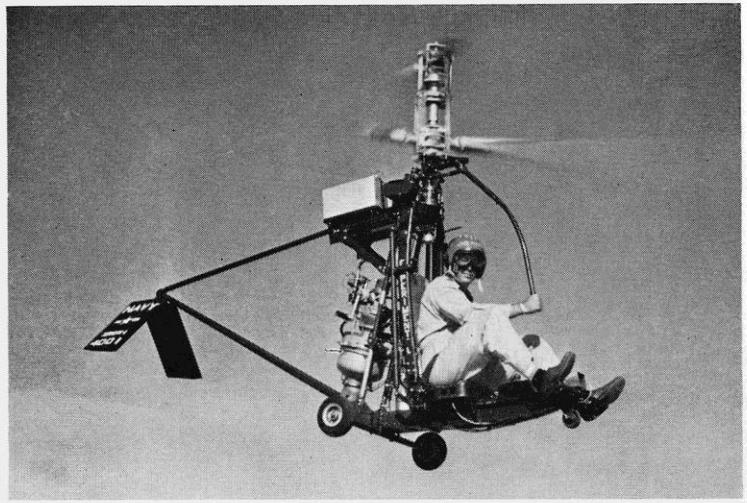
Gyrodyne DSN-1
(description overleaf)

GYRODYNE DSN-1 (U.S.A.)

Remotely-controlled anti-submarine helicopter, under development.

The DSN-1 is a cross between a helicopter and a guided weapon, because it takes off from a destroyer, carrying a homing torpedo, and is then guided by remote-control until it is near the target, when it drops its weapon and is brought back to the parent ship. Developed under a U.S. Bureau of Naval Weapons contract, the DSN-1 is the airborne portion of the DASH (Destroyer Anti-Submarine Helicopter) weapon system, which has been described as being of the utmost importance. No further details are available, except that the production version has a Porsche engine.

GYRODYNE YRON-1 (U.S.A.)



Ultra-light one-man helicopter, under development.

POWERED BY: One 62 h.p. Porsche YO-95-2 piston-engine.
ROTOR DIAMETER: 17ft.
LENGTH: 11 ft. 5 in.
GROSS WEIGHT: 700 lb.
MAX. SPEED: 68 m.p.h.

The YRON-1 was conceived as a light, simple helicopter able to carry one man and a 60 lb. pack a distance of about 12 miles. The two original prototypes had a 40 h.p. Nelson two-stroke engine and a 15 ft. rotor. The data above refer to three Model GCA-41As being tested by the U.S. Marines. Also flying is the Model GCA-41B (above) with a 62 h.p. Solar T62 shaft-turbine. A third version (GCA-59), completed early in 1960, has a 72 h.p. Porsche YO-95-6 engine and 20 ft. rotor and is expected to have a life between overhauls of 1,000 hours. To follow is an ultra-light model, with Solar T62 engine, which will revert to a 15 ft. rotor. Autostabilisation and remote control equipment has been installed on one airframe, which forms the basis for the DSN-1 drone.

GYRODYNE MODEL 55 (U.S.A.)

Single-seat ground-effect vehicle, under development.

POWERED BY: 72 h.p. Porsche piston engine.
DIAMETER: 6 ft.
GROSS WEIGHT: 800 lb.

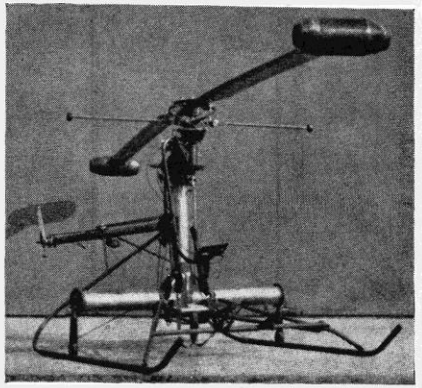
Built around the forward portion of a YRON-1 rotorcycle airframe, this annular-jet ground cushion vehicle was developed under a U.S. Navy Bureau of Aeronautics contract and first flew in October 1959. It is intended mainly as a test-bed to evaluate the feasibility of similar vehicles of up to several hundred feet in diameter, operating at a speed of 100 knots. The body is made of aluminium spinnings, with the engine at the rear. Normal helicopter-type controls are used, with control vanes in the annular jet exit. Operating height is about 6 in. above the ground

HAGIWARA JHX-4 (Japan)

Single-seat ultra-light helicopter, under development.

POWERED BY: Two ramjet engines.
ROTOR DIAMETER: 23 ft. 11 in.
LENGTH: 12 ft. 6 in.
ENDURANCE: 30 minutes.

The JHX-4 is the latest version of an ultra-light single-seat helicopter which has been under development by Hisao Hagiwara since 1952. The original prototype had tip-mounted pulse-jets, but these proved difficult to ignite and excessively noisy, and the switch to ramjet power was made in 1955. At least three prototypes have flown since then, the latest being the JHX-4 in September 1958. Few details are available, except that it has a two-blade main rotor, small tail rotor and conventional controls. The lower illustration shows the machine in its current stripped-down form.



HAIG HK-1 (U.S.A.)

Two-seat light helicopter, under development.

POWERED BY: One 85 h.p. Continental C85 piston-engine.
ROTOR DIAMETER: 26 ft. 4 in. GROSS WEIGHT: 1,020 lb.

This two-seat light helicopter is serving as a flying test-bed for a new type of rotor and control system devised by the Haig-K Aircraft Corporation. No details are available, but the photograph shows that the engine is mounted in front of the pilot and drives a three-blade main rotor and two-blade tail rotor. A production model, designated HK-2, is reported to be under construction.

HC-2 HELI-BABY (Czechoslovakia)

Light general-purpose helicopter, under development.

POWERED BY: One 83 h.p. Praga DH piston-engine.
ACCOMMODATION: Two. GROSS WEIGHT: 1,280 lb.
ROTOR DIAMETER: 28 ft. 10 in. LENGTH: 34 ft. 4 in. CRUISING SPEED: 62 m.p.h.

One of the first helicopters of original Czech design, the HC-2 is a product of the nationalised aircraft industry. Seating two side-by-side, it is reminiscent of the Hiller 360 series of designs and is intended for the full range of light helicopter roles, including agricultural duties. Prototypes have the Praga engine and specification as above; production models will switch to the 105 h.p. M110 engine, under development in Czechoslovakia specially for this helicopter.

HC-3 (Czechoslovakia)

General-purpose helicopter, in production.

POWERED BY: One 240 h.p. M108H piston-engine.
GROSS WEIGHT: 3,086 lb. MAX. SPEED: 100 m.p.h.

Little is known so far about this latest Czech helicopter, which was stated to have entered production early in 1960. The basic version is a five-seater for transport and communications work, but the HC-3 is also to be made available for training, ambulance work, agricultural flying search and rescue, and aerial crane duties.

HELICOP-AIR GIRHEL L50 (France)

Personal gyroplane, under development.

POWERED BY: One 90 h.p. Continental C90 piston-engine.
ACCOMMODATION: Two.
ROTOR DIAMETER: 32 ft. 9½ in. LENGTH: 20 ft.
GROSS WEIGHT: 1,380 lb. CRUISING SPEED: 87 m.p.h.

Another of the growing group of gyroplanes which are being developed for sporting use, the Girhel first flew in 1959. It is similar in layout to a contemporary lightplane, and has a 19 ft. 8 in. span wing to off-load the rotor in cruising flight. For jump-starts, the engine can be clutched to the rotor, which "free-wheels" during cruising flight. Dual controls can be fitted, and a stretcher or crop-spraying gear can be carried. The L51 model has a 150 h.p. Lycoming O-320 piston-engine.

HILLER VZ-1E FLYING PLATFORM (U.S.A.)

Hiller received their original contract to develop a free flight platform late in 1953, from the U.S. Office of Naval Research. The twin-engined prototype made its first free flight on February 4, 1955. It was followed by a slightly larger Platform on the same lines, powered by three Nelson H-56 engines and with a duct diameter of 8 ft. In these early versions the pilot stood above the engines and co-axial contra-rotating fans. His only control was a twist-grip throttle to control climb and descent. For directional control the pilot shifted his weight or leaned in the direction in which he wished to go. No details are available of the latest model (illustrated) except that the pilot now sits and has conventional controls.

H-23

HILLER H-23D RAVEN and UH-12E (U.S.A.)

Three-seat light general-purpose helicopter, in production and service.

POWERED BY: One 250 h.p. Lycoming VO-435-23B piston-engine.
ROTOR DIAMETER: 35 ft. LENGTH: 28 ft.
GROSS WEIGHT: 2,750 lb. MAX. SPEED: 95 m.p.h.

Secret of the success of the little Hiller H-23 and UH-12 is the Rotor-Matic control system in which the pilot " flies " a twin-paddle servo-rotor, which in turn tilts the rotor head to produce the effect of cyclic-pitch changes. The result is unusually good stability and control. A total of around 1,000 helicopters of this basic type have been produced for the U.S. Army (H-23), Navy (HTE trainer) and civilian customers (Model 360 and UH-12). Current military version is the H-23D observation/liaison/casualty evacuation/utility/trainer, as described above. Its commercial counterpart is the UH-12E, with 305 h.p. Lycoming VO-540 engine, and the new UH-12E-4 is similar except that it seats four instead of three. The H-23D is designed for 1,000 hours' flying between overhauls. One has been fitted experimentally with a Boeing T60 shaft-turbine.

UH-12E

HILLER YH-32 and HOE-1 HORNET (U.S.A.)

Two-seat ultra-light helicopter, in service.

POWERED BY: Two 45 e.h.p. Hiller 8RJ2B ramjets.
ROTOR DIAMETER: 23 ft.
GROSS WEIGHT: 1,080 lb. CRUISING SPEED: 69 m.p.h.

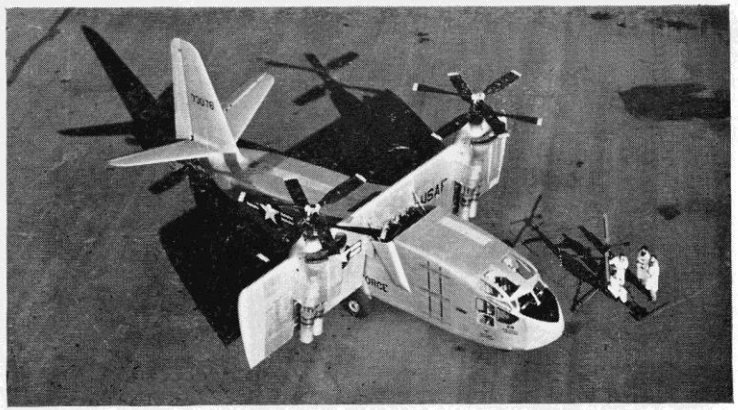
First flown in 1950, the Hornet then had a canted rudder in place of the present tail rotor to counteract torque. It was redesigned extensively to meet military requirements for a light general-purpose liaison/observation helicopter, and eventually 12 were sold to the U.S. Army as the YH-32 and three to the Navy as the HOE-1.

HILLER YROE-1 ROTORCYCLE (U.S.A.)

One-man helicopter, under development.

POWERED BY: One 43 h.p. Nelson H-63B piston-engine.
ROTOR DIAMETER: 18 ft. 6 in. LENGTH: 6 ft. 11 in.
GROSS WEIGHT: 556 lb. CRUISING SPEED: 49 m.p.h.

The Rotorcycle was designed in 1954 to meet an experimental U.S. Navy/Marine requirement for a one-man observation and liaison helicopter. Prototypes were built by Hiller for competitive evaluation with a de Lackner design. Tests are still being conducted in the U.S.A., and a further batch of five YROE-1s was built by Saunders-Roe in Britain and supplied to the U.S. Marine Corps between October 1959 and January 1960. Five more Saro Rotorcycles are to be used for demonstrations in Europe by the Hiller agents, Helicop-Air. Weighing only 300 lb., the Rotorcycle can be easily packed and transported, and can be re-assembled ready for flight in ten minutes.



HILLER X-18 (U.S.A.)

Tilt-wing VTOL research prototype.

POWERED BY: Two 5,850 e.h.p. Allison YT40-A-14 turboprops.
ACCOMMODATION: Crew only.
SPAN: 48 ft. LENGTH: 63 ft.
GROSS WEIGHT: 33,000 lb. MAX. SPEED: 250 m.p.h.

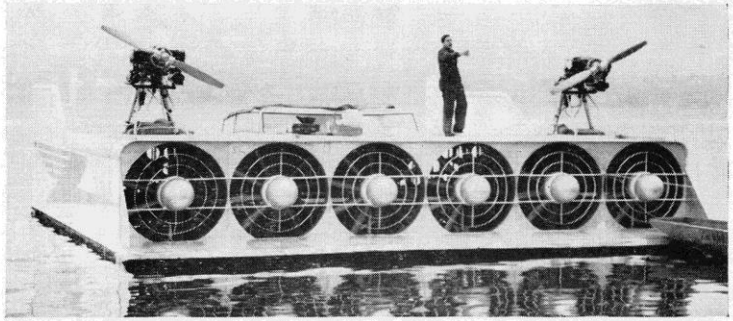
Largest in the present series of American VTOL research aircraft (excluding rotorcraft) the Hiller X-18 is a tilt-wing convertiplane. It takes off with the wing tilted vertically, so that the contraprops function rather as helicopter rotors. During this phase, when forward speed is too low for conventional aerodynamic controls to be effective, pitch control is provided by air ducts at the tail, for which a Westinghouse J34 turbojet in the fuselage provides the power. At a safe height, the wing tilts forward through 90 degrees and the X-18 then flies like a conventional fixed-wing aircraft. To reduce costs and save time, the X-18 uses the basic fuselage structure of a Chase YC-122 transport. Ground tests were completed at Edwards Air Force Base in July 1959 and the first flight—as a conventional aircraft with the wing horizontal—was made on November 24.

HUGHES 269A (YHO-2HU) (U.S.A.)

Ultra-light observation and general-purpose helicopter.

POWERED BY: One 180 h.p. Lycoming O-360-C2B piston-engine.
ACCOMMODATION: Two.
ROTOR DIAMETER: 25 ft. LENGTH: 22 ft. 4 in.
GROSS WEIGHT: 1,550 lb. CRUISING SPEED: 75 m.p.h.

First flown in October 1956, the original Hughes Model 269 was designed as a private-venture two-seat ultra-light helicopter of extremely simple construction. The improved Model 269A has a tubular tail-boom instead of the former girder-type rear fuselage, a wider cabin and lengthened landing skids. Five of this version have been ordered for evaluation by the U.S. Army under the designation YHO-2HU. Powered by a 180 h.p. (derated to 160 h.p.) Lycoming O-360-C2B piston-engine, this little helicopter is claimed to be extremely easy to fly, and Hughes have made provision for fitting small rocket launchers between the skids for close-support duties.



ILEN (Switzerland)

Largest ground effect aircraft yet completed, the Ilen was designed and built in Switzerland by Karl Weiland. The original prototype was destroyed by a storm shortly after it had been launched on Lake Zurich in 1959. The replacement, illustrated, achieved an observed forward speed of 43·5 m.p.h. on February 13, 1960. No details are available.

JK-1 TRZMIEL (Poland)

Light pulsejet-powered helicopter, under development.

POWERED BY: Two 24 lb.s.t. Wojcicki ramjets.
ROTOR DIAMETER: 23 ft. WEIGHT EMPTY: 660 lb.

Designed by J. Kotlinski, the Trzmiel was completed at the Polish Aircraft Institute in the Spring of 1957 and flew a few months later. It has an uncovered steel-tube structure and is fitted with two-blade main and tail rotors. The ramjet engines are mounted on the tips of the main rotor blades.

H-43B

KAMAN H-43B HUSKIE (U.S.A.)

Utility and crash rescue helicopter, in production and service.

POWERED BY: One 720 e.h.p. Lycoming T52-L-1A shaft-turbine.
ACCOMMODATION: Two crew and up to eight passengers.
ROTOR DIAMETER: 47 ft. LENGTH: 25 ft.
GROSS WEIGHT: 6,800 lb. CRUISING SPEED: 75 m.p.h.

This design has its origins in the Kaman HOK-1, an observation helicopter first produced for the U.S. Navy in 1950, with a 600 h.p. Pratt & Whitney R-1340-48 piston-engine. The HOK-1 can carry five passengers, cargo, two stretchers and two sitting wounded, or equipment for specialised duties, and is still in service with the Navy and Marines. The HUK-1 is a utility version, with different equipment and an R-1340-52 engine. The U.S.A.F. ordered a development of the basic design for fire-fighting and crash rescue duties, the first production version being designated H-43A, with R-1340-43 engine. In the H-43B, now in production, a change has been made to the Lycoming shaft-turbine, with improved performance. Orders for the H-43 total 116. On December 9, 1959, a Kaman H-43B flown by two U.S.A.F. pilots, set a new altitude record of 30,100 ft. in the F.A.I. category for helicopters of less than 6,614 lb. weight (the H-43B weighed 5,443 lb. at take-off).

HUK-1

KAMAN HTK-1 (U.S.A.)

Three-seat general-purpose helicopter, in service.

POWERED BY: One 240 h.p. Lycoming O-435 piston-engine.
ROTOR DIAMETER: 41 ft. each. LENGTH: 20 ft. 6½ in.
GROSS WEIGHT: 3,100 lb. MAX. SPEED: 81 m.p.h.

Ordered for the U.S. Navy in 1950, the HTK-1 entered service two years later and has been used mainly as a trainer. It is adaptable for ambulance duties, carrying two stretchers one above the other on the port side of the cabin, and the port half of the transparent nose hinges to the side to facilitate stretcher loading. One HTK-1 was fitted experimentally with two Boeing 502-2 shaft-turbine engines. Others have been used for automatic stabilisation and drone experiments.

KAMAN HU2K-1 SEASPRITE (U.S.A.)

Utility helicopter, in production.

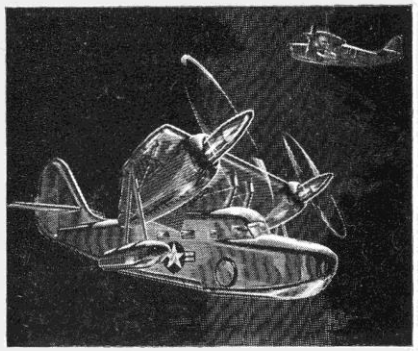
POWERED BY: One 1,050 s.h.p. General Electric T58-GE-6 shaft-turbine.
ACCOMMODATION: Two crew and up to 12 troops.
ROTOR DIAMETER: 44 ft. LENGTH: 52 ft. 2 in.
GROSS WEIGHT: 9,052 lb. MAX. SPEED: Restricted.

The HU2K-1 was the winner of a U.S. Navy design competition in 1956 for a helicopter to perform high-speed, long-range search and rescue duties and utility and liaison flying with the Fleet. Four prototypes were ordered for evaluation and the first of these flew in June 1959; 12 more have been ordered for 1960 delivery and eventual production of large quantities is likely, to replace the U.S. Navy fleet of search and rescue helicopters. The HU2K-1 is Kaman's first production single-rotor helicopter, all the company's other products up to and including the Huskie (see page 30) being of the " synchropter " type with intermeshing rotors. It is operated by a crew of two and has automatic stabilization equipment for " hands-off " flying. In the rescue role, up to four survivors can be accommodated, or two stretchers and four passengers when operating as an ambulance. Twelve troops can be carried, or a variety of freight, including up to 4,000 lb. on an external cargo hook.

KAMAN K-16B (U.S.A.)

SPAN: 38 ft.
LENGTH: 38 ft. 4 in.

The K-16B is a tilt-wing research aircraft which utilises the hull of a Grumman Goose amphibian. Built under a U.S. Navy contract, it is powered by two General Electric T58-GE-2A turboprops, each of which drives a special propeller/rotor fitted with small controllable flaps to give the pilot positive control during vertical flight and hovering, when conventional controls are ineffective. Large Fowler-type wing flaps are fitted. No further details are available, but tethered tests are known to have started early in 1960.



KAMAN K-17 (U.S.A.)

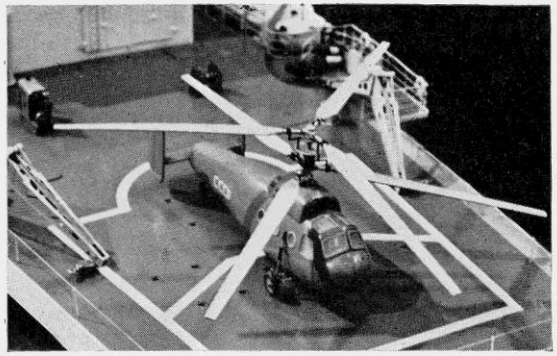
Two-seat research helicopter, under development.

POWERED BY: One 400 s.h.p. Blackburn-Turbomeca Turmo 600 turbine.
ROTOR DIAMETER: 37 ft.
GROSS WEIGHT: 2,000 lb. MAX. SPEED: 80 m.p.h.

Developed as a joint U.S. Army/Kaman project, the K-17 is a two-seat ultra-light helicopter with a " cold-jet " rotor which is turned by ejecting compressed air from nozzles at the tips, without any form of combustion. As in all Kaman designs, each rotor blade is fitted with a small servo-flap instead of the usual pitch-change bearings. The air for the " cold-jet " nozzles is supplied by a Boeing 502 compressor, driven by the Turmo turbine. Little has been heard of this aircraft since it flew for the first time in the Spring of 1958.

KAMOV PROJECT (Russia)

This model of a Kamov helicopter, which would clearly be larger than the Ka-18, has been displayed on the deck of a model of the Soviet atomic ice-breaker *Lenin*. No details are available.



KAMOV Ka-15 (Russia)

General-purpose helicopter, in production and service.

POWERED BY: One 275 h.p. Ivchenko AI-14V piston-engine.
ROTOR DIAMETER: 32 ft. 8½ in.

This was the first production Kamov helicopter, following a series of development models going back to the immediate post-War period. Kamov's first helicopters were designed as strap-on types, and were followed by the Ka-8, a slightly more elaborate machine in which the pilot had a seat beneath the co-axial three-blade rotors.

Development of the Ka-8 was hindered by the absence of a suitable engine, and the 55 h.p. Ivchenko AI-4G was designed specially for the next version, the Ka-10, a small batch of which was built for the Soviet Navy.

The Ka-15 appeared in 1955 and is a two-seat general-purpose helicopter with enclosed cabin and the same co-axial rotor layout as the earlier designs. The rotor blades are wooden, with a foam-plastic core. The Ka-15 is used by the Soviet Forces and by Aeroflot, which also operates the Ka-15M ambulance, carrying two external panniers for stretchers. A Ka-15 in May 1958 set up a 100 km. closed circuit record of 101·19 m.p.h., and in May 1959 a 500 km. record of 105·91 m.p.h. was established.

KAMOV Ka-18 (Russia)

General-purpose helicopter, in production and service.

POWERED BY: One 275 h.p. Ivchenko AI-14V piston-engine.
ROTOR DIAMETER: 32 ft. 8½ in. LENGTH: 23 ft.
GROSS WEIGHT: 2,888 lb. MAX. SPEED: 93 m.p.h.
RANGE: 250 miles at 68–75 m.p.h.

The Ka-18 is similar to the Ka-15, with the same power plant and rotor system, but a larger cabin for three or four occupants including the pilot. An ambulance version carries a stretcher in the cabin, which has a special loading door in the nose. An agricultural version carries two external hoppers and spray-bars or nozzles for liquid or powder insecticide. Other alternative loads include 660 lb. of freight or auxiliary fuel tanks for a maximum range of 465 miles.

KELLETT KD-1A (U.S.A.)

Two-seat autogyro, in production.

POWERED BY: One 225 h.p. Jacobs R-755-9 piston-engine.
ROTOR DIAMETER: 40 ft. LENGTH: 25 ft. 11 in.
GROSS WEIGHT: 2,200 lb. MAX. SPEED: 125 m.p.h.
RANGE: 190 miles at 110 m.p.h.

This is the pre-war KD-1A autogyro, which has been put back into production for general-utility duties. It is a perfectly conventional jump-start autogyro, with two seats in tandem in open cockpits. When used for agricultural duties, the chemical tank or hopper is installed in the front cockpit. Minimum flying speed under full control, without loss of height, is 22 m.p.h.

KEMMAN-HILL HK-1 (U.S.A.)

Single-seat home-built helicopter.

POWERED BY: One 40 h.p. Mercury outboard piston-engine.

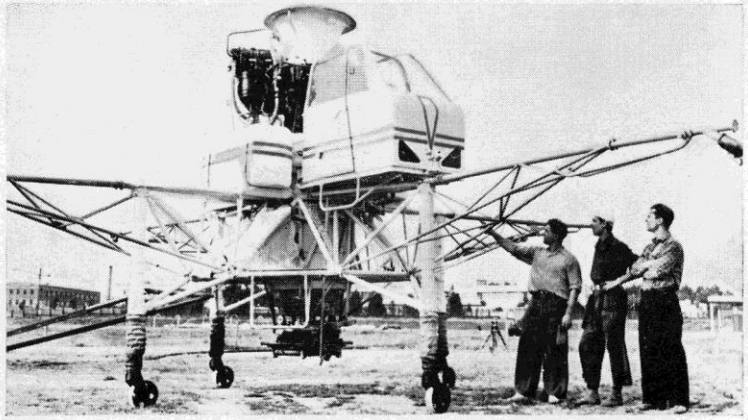
The HK-1 is an outstandingly-simple one-man helicopter designed and built by two members of the Experimental Aircraft Association, Keith Hill and Roger Kemman. In an effort to produce a machine suitable for home construction by amateurs, they have eliminated the usual cyclic pitch control. Instead, the entire transmission shaft of the HK-1 is tilted by movements of the control column. Collective pitch changes are made by fore-and-aft rotation of the handgrips at the top of the control column, one of which incorporates the clutch release switch and the other a twist-grip throttle. No other controls are needed.

LUALDI L.59 (Italy)

Four-seat light helicopter, under development.

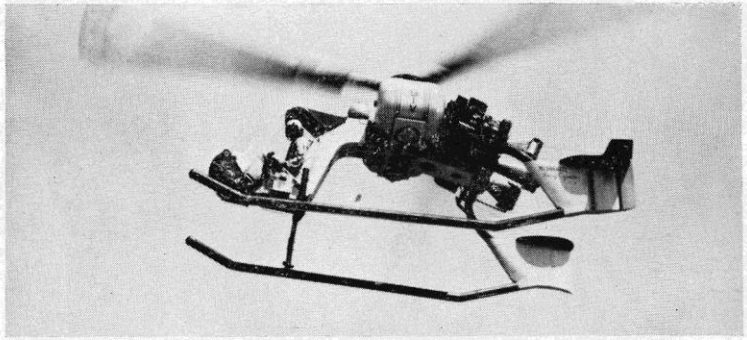
POWERED BY: One 260 h.p. Continental IO-470-D piston-engine.
ROTOR DIAMETER: 34 ft. 9½ in. LENGTH: 29 ft. 9½ in.
GROSS WEIGHT: 2,645 lb. MAX. SPEED: 99 m.p.h. RANGE: 300 miles at 86 m.p.h.

Two prototypes of this neat little helicopter have been built at the Aeronautica Macchi works, and the first has been bought by the Army Department of the Italian Ministry of Defence. Development began with the ES.53 of September 1953, with an 85 h.p. Continental engine, driving a Hiller Rotor-Matic type of rotor system, supplemented by a Lualdi gyroscopic system which has become a feature of all Lualdi designs and is claimed to give smoother flight and easier handling. Next came the L.55 with 180 h.p. Lycoming and fully-streamlined fuselage, and the L.57 with larger rotor and auto-pilot. The L.59 is the production version of the L.57.



MATVIEYEV TURBOLOT (Russia)

Very little has been heard of this Russian counterpart of the Rolls-Royce " Flying Bedstead " since it was first announced in October 1957, but Soviet designers are said to be working on a whole series of aircraft utilising the jet-lift principle. The Turbolot was designed by a team of engineers under the leadership of Prof. Matvieyev and consists of a steel-tube framework surrounding a large vertically-mounted turbojet which could be a Mikulin RD-3 of 14,000–19,000 lb.s.t. Control is by compressed-air nozzles at the ends of the four cruciform arms, which appear to span about 30 ft.



McDONNELL MODEL 120 (U.S.A.)

Single-seat flying-crane helicopter, under development.

POWERED BY: Three 85 h.p. AiResearch GTC-85-35 air-compressors.
GROSS WEIGHT: 6,300 lb. RANGE: 80 miles with full load.

Just about the simplest possible type of flying-crane, the McDonnell Model 120 is able to lift more than 1½ times its own empty weight from a hoist under its c.g. Its three-blade rotor is turned by tip-mounted pressure-jets, supplied with compressed air by the three air-compressors at the rear of the steel-tube frame. Height can be maintained on any two engines, and a complete engine can be replaced in five minutes without tools. Alternative loads include 12 passengers on " toboggan " seats between the undercarriage skids. The prototype flew in 1958.

MERCKLE SM 67 (W. Germany)

General-purpose helicopter, under development.

POWERED BY: One 369 h.p. Turbomeca Artouste IIB. ACCOMMODATION: Five.
ROTOR DIAMETER: 34 ft. 5 in. LENGTH: 33 ft.

The Merckle is a general-purpose helicopter of conventional layout with shaft-driven main rotor and torque-compensating tail rotor. Its development is being undertaken to the order of the German Federal Defence Ministry. Flight trials with the first prototype began in mid-1959, but on August 13 this SM 67 was badly damaged during ground resonance tests. A second prototype is to fly in 1960, and will incorporate various modifications. A 493 h.p. Artouste IIC is to be fitted later.

MONTE-COPTER MODEL 15 TRIPHIBIAN (U.S.A.)

Three-seat amphibious helicopter, under development.

POWERED BY: One 200 h.p. Continental Model 141 air-compressor.
ROTOR DIAMETER: 36 ft. LENGTH: 15 ft. 3 in.
GROSS WEIGHT: 2,000 lb. MAX. SPEED: 95 m.p.h. RANGE: 100 miles at 75 m.p.h.

This extremely neat light helicopter has a "cold-jet" rotor, turned simply by ejecting compressed air from blade-tip nozzles. It can be taxied on land or water by jet thrust from its engine, the wing-tip fuel tanks acting as stabilising floats on water. Development began with the Model 10 of 1955, which had a 135 h.p. Lycoming engine and separate compressor. Installation of two Continental Model 140 (Turbomeca Palouste) air-compressors converted the prototype into the Model 10A which was further modified into the Model 12 of 1958. Work on the fibreglass-skinned Model 15 began in June 1958 and tests of the prototype began in February 1960.

SM-1

MIL Mi-1 and Mi-3 (Russia)

General-utility military and civil helicopter, in service.

POWERED BY: One 575 h.p. Ivchenko AI-26V piston-engine.
ROTOR DIAMETER: 46 ft. 11 in. LENGTH: 39 ft. 9 in.
GROSS WEIGHT: 4,960 lb. CRUISING SPEED: 87 m.p.h.

First Russian helicopter built in quantity, Mikhail Mil's Mi-1 went into production in 1951 for the Soviet Air Force and is now in widespread military and civil service. It is usually powered by the AI-26V seven-cylinder radial engine, horizontally-mounted in the fuselage, but the 540 h.p. M-61 engine has been reported as an alternative installation and mention has been made of a turbine-powered version, saving over 650 lb. on the empty weight. The standard version holds four international records.

Normal accommodation is for a pilot and three passengers in the Mi-1 and pilot and two passengers in the Mi-1T variant. A general-purpose version is designated Mi-1NH and has provision for stretcher panniers, 50-cu. ft. mail containers, 440-lb. insecticide hoppers or 33 Imp. gal. fuel tanks on each side of the fuselage. A training version is designated Mi-1U.

Mi-1s have been supplied to the air forces of several East European countries and some Arab states. In 1956 the type was put into production in Poland, for the Polish Air Force, general civil use and export under the designations SM-1 and SM-1Z.

A further development of the Mi-1, which appeared in 1956, is the Mi-3, with a four-blade rotor and a wider fuselage accommodating three passengers behind the pilot. It can carry similar loads to those of the Mi-1NH.

Mi-1NH

MIL Mi-4 (Russia)

General-purpose helicopter, in production and service.

POWERED BY: One 1,700 h.p. Shvetsov ASh-82V piston-engine.
ROTOR DIAMETER: 68 ft. 11 in. LENGTH: 55 ft. 1 in.
GROSS WEIGHT: 15,500 lb. CRUISING SPEED: 93 m.p.h.

The Mi-4 appeared in 1952 and was in service in quantity one year later. The military version is used as an assault transport, carrying 14 equipped troops or items such as the GAZ-69 command vehicle, a 76 mm. anti-tank gun or two motor-cycle combinations, and has clam-shell rear-loading doors. Its maximum internal freight load is 3,520 lb. A ventral fairing (not always fitted) provides space for a navigator when required, and can be replaced by a long-range fuel tank.

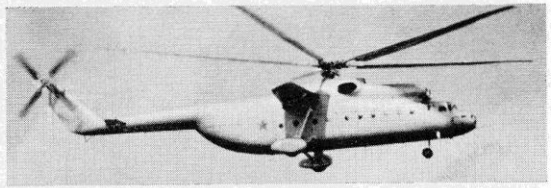
Civil versions of the Mi-4, used by Aeroflot, are the Mi-4S and Mi-4P. The former carries 2,200 lb. of chemical dust or 350 gallons of insecticide, with spray-bars or spreader, for agricultural duties. The Mi-4P carries 11 passengers and 220 lb. of freight over 155-mile stages and is usually fitted with spatted wheels.

Mi-4s have been distributed to many friendly air forces including those of Czechoslovakia, Egypt, Hungary, Poland, Rumania and China. They have made a notable contribution to the success of Soviet expeditions in the Arctic.

In April 1956, an Mi-4 stripped of all unnecessary weight established two helicopter load carrying records, reaching 19,842 ft. with a 1,000 kg. payload and 19,744 ft. with a 2,000 kg. payload. A turbine-engined version, to carry 18 passengers, is said to be under development.

MIL Mi-6 (Russia)

Heavy transport helicopter, in production.



POWERED BY: Two 4,635 h.p. Soloviev TB-2BM shaft-turbine engines.
ROTOR DIAMETER: 114 ft. 10 in. LENGTH: 108 ft.
GROSS WEIGHT: 71,000 lb. CRUISING SPEED: 140 m.p.h.

The Mi-6 was announced towards the end of 1957, and is the World's largest helicopter by a very considerable margin. Its gross weight is, in fact, just about twice that of the heaviest Western helicopter flown to date. Normal accommodation is for 80 passengers, and the Mi-6 has clam-shell rear-loading doors for vehicles.

The Mi-6 is expected to enter service during 1960, and an initial production batch of 30 is reported to be in production. Since the prototype first appeared, it has been modified to have two small wings, which off-load the rotor by providing some 20 per cent. of the lift required in cruising flight. The TB-2BM engines were developed especially for this helicopter and each has two independent turbines, one driving the compressor and the other driving into a common reduction gear-box for the main rotor drive.

In October 1957, when the Mi-6 was still in the early development stages, one of the five prototypes established a record in the category for payload lifted to a height of 2,000 metres (6,560 ft.); the payload carried was 26,464 lb. In April 1959, an Mi-6 carried a 5,000 kg. payload to 18,320 ft. and a 10,000 kg. payload to 16,027 ft., and in November 1959, a speed of 167·206 m.p.h. was recorded over a 100 km. closed circuit. All these stand at the time of going to press.

NATIONAL RESEARCH ASSOCIATES GEM-1 (U.S.A.)

Two-seat ground-effect vehicle, under development.

POWERED BY: Two 40 h.p. piston-engines. WEIGHT: 1,000 lb.

One of many GEMs (Ground-Effect Machines) now under development in America, the GEM-1 was built under contract from the U.S. Army as a potential " flying jeep " or weapon carrier. The two piston-engines drive four ducted rotors, one at each corner of the body. These rotors produce a ground cushion pressure of 10 lb./sq. ft., sufficient to support the GEM-1 at a height of 9–15 in. above the ground. Designed cruising speed is 38–58 m.p.h.

NHI H-3 KOLIBRIE (Netherlands)

Light helicopter, in production and service.

POWERED BY: Two 51 lb.s.t. NHI TJ-5A ramjets.

ROTOR DIAMETER: 32 ft. 8⅛ in.

LENGTH: 14 ft. 2½ in.

GROSS WEIGHT: 1,540 lb.

MAX. SPEED: 72 m.p.h.

RANGE: 46 miles at 56–62 m.p.h.

Following delivery of ten of the original H-3 Kolibries, with 44 lb. s.t. TJ-5 ramjets, Aviolanda are now manufacturing an initial batch of ten improved models with more powerful ramjets. These can be identified by the sweptback stabilising fin mounted on each ramjet, and the earlier machines may be re-engined to the latest standards. They are being used mainly for agricultural duties in Holland, Israel, Germany and the U.K., carrying chemicals in some of the four under-fuselage fuel/payload tanks. Other loads, in addition to the pilot, include one passenger, two stretcher patients, or 825 lb. of freight suspended from an external hook.

N.R.D.C. SR-N1 HOVER-CRAFT (G.B.)

Ground-effect vehicle, under development.

LENGTH: 30 ft.

WIDTH: 24 ft.

GROSS WEIGHT: 8,500 lb.

POWERED BY: One 435 h.p. Alvis Leonides piston-engine and one 880 lb.s.t.Blackburn-Turbomeca Marboré turbojet.

Britain's pioneer Hovercraft, built for the National Research Development Corporation by Saunders-Roe, became jet-propelled in April 1960 when a Marboré turbojet was mounted on its rear deck to provide forward thrust. Previously, the Leonides-driven ducted fan in the centre had had to provide both the peripheral air curtains and thrust and directional control through the side ducts. Carrying a crew of two and 20 fully-equipped troops, the Hovercraft cruised at around 29 m.p.h. at an operating height of 9 in. in its original form. With the Marboré. forward speeds of around 60 m.p.h. are possible.

OMEGA BS-12D (U.S.A.)

General-purpose transport helicopter, in production.

POWERED BY: Two 235 h.p. Lycoming O-540-A1A5 piston-engines.

ACCOMMODATION: Pilot and four passengers or 1,000 lb. freight.

ROTOR DIAMETER: 39 ft.

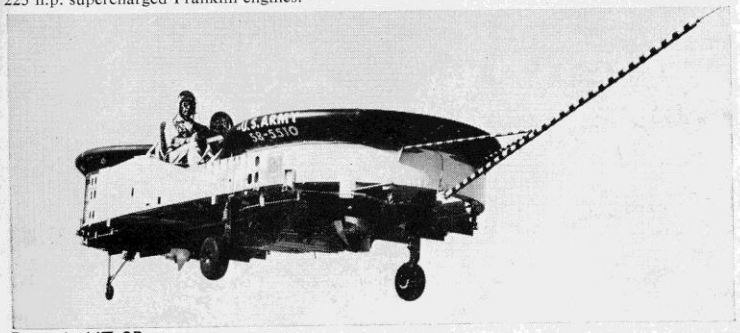
LENGTH: 36 ft.

GROSS WEIGHT: 4,750 lb.

MAX. SPEED: 95 m.p.h.

The " BS " in the designation of this helicopter are the initials of its designer, Mr. B. W. Sznycer, who developed and flew the first Canadian helicopter, the Sznycer-Gottlieb S.G.VI. The BS-12 is produced by Omega Aircraft Corp., which was formed in New Bedford, Mass., in 1953, and the prototype first flew on December 26, 1956. Of conventional single-rotor layout, the BS-12 is unusual in having two engines mounted at right angles to the line of flight under the rotor head. The prototype BS-12 has 225 h.p. Franklin 6VS-335 engines. The first production model of the BS-12D was completed in August 1959 and was one of three ordered by Aero-Copters Aero-Boeing; three others have been ordered by Okanagan Helicopters and by other users.

The company is studying a development of the BS-12 with two (or possibly three) Allison T63-A-3 turbine engines. Available in 1961, this version would have a 1,500 lb. payload on two T63s, or 2,500 lb. with three engines. Also available is the BS-12E, similar to the BS-12D but with 225 h.p. supercharged Franklin engines.



Piasecki VZ-8P *(description overleaf)*

PIASECKI MODEL 59-K SKY CAR (VZ-8P) (U.S.A.)

Research VTOL prototype.

POWERED BY: One 425 h.p. Turbomeca Artouste 11B shaft-turbine.
ACCOMMODATION: Two.

Another of the U.S. Army's VTOL research prototypes with possible applications as an " aerial jeep," the Piasecki 59 made its first flight on October 12, 1958. It then had two 180 h.p. Lycoming O-360-A2A piston-engines which drove into a common gear-box, from which drives were taken to the two ducted fans, in tandem. Vanes in these ducts, below the propellers, deflect the airflow from the vertical to provide a forward thrust component for cruising flight. A single Artouste engine was later substituted, and the 59 first flew with this engine on June 28, 1959. Piasecki is now building a second prototype, the 59-H, which will be a little larger, with two 425 h.p. Artouste IIC turbines, and will undergo Army evaluation. Civil versions have been proposed, with enclosed cabin for four people, and called the Sky Car. (*Illustration on previous page.*)

ROTOR-CRAFT RH-1 PINWHEEL (U.S.A.)

One-man ultra-light helicopter, under development.

POWERED BY: Two 25 lb.s.t. Rotor-Craft R-1 rocket-motors.
ROTOR DIAMETER: 17 ft.
LENGTH: 7 ft.
GROSS WEIGHT: 500 lb.
MAX. SPEED: 100 m.p.h.

Nearest thing yet to a really practical strap-on helicopter, the RH-1 (first flown in April 1954) lifts more useful load in proportion to its own weight (165 lb.) than any other helicopter ever built. The pilot's legs form the undercarriage, although tripod legs are fitted for parking. The blade-tip rockets burn hydrogen peroxide mono-propellent and weigh only ½ lb. each. Controls consist of an overhead " stick " and conventional cyclic-pitch lever. A military production model known as the Sky Hook, now under development, will be small enough to pack into an oversize suitcase, will weigh less than 75 lb. and have a useful load of over 400 lb.

ROTORWING SPORTSMAN (U.S.A.)

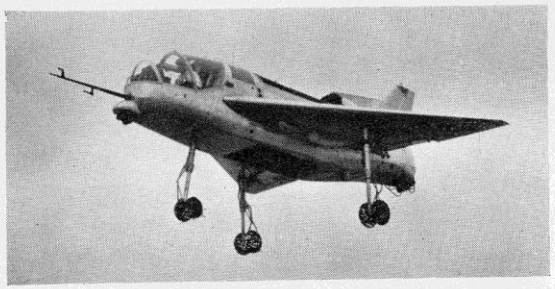
Two-seat light autogyro, under development.

POWERED BY: One 85 h.p. Continental C85 piston-engine.
ROTOR DIAMETER: 27 ft. 6 in. LENGTH: 12 ft.
GROSS WEIGHT: 1,200 lb. MAX. SPEED: 110 m.p.h. RANGE: 350 miles at 87 m.p.h.

Completed in the Spring of 1960, this small jump-start autogyro will be powered by a 115 h.p. engine in its production form, to which the above data apply. The rotor is powered only temporarily for pre-rotation at take-off, the engine being used normally to drive the pusher propeller. Pilot and passenger sit side-by-side in the enclosed cabin. Projected variants are the Pelican over-water model and Grasshopper agricultural model, both with 180 h.p. engine.

SHORT S.C.1 (G.B.)

Fixed-wing jet-lift VTOL prototype.



POWERED BY: Five 2,010 lb.s.t. Rolls-Royce RB108 turbojets.
ACCOMMODATION: One.
SPAN: 23 ft. 6 in. LENGTH: 24 ft. 5 in. GROSS WEIGHT: About 8,000 lb.

Development of the Short S.C.1 to an official M.o.S. specification (ER143) was initiated as a continuation of the early work on jet-lift with the two Rolls-Royce " Flying Bedsteads." The S.C.1 is a small delta-wing aeroplane with four RB108 engines in a vertical cluster in the centre fuselage to provide direct lift, and a fifth engine in the rear fuselage for forward propulsion. The vertical engines can be tilted through about 15 degrees to increase the forward thrust component during the transition from vertical to horizontal flight. During hovering and low-speed flight, control is by means of four " puff-pipes," supplied by engine-bleed air, at the wing tips and at the front and rear of the fuselage.

The first S.C.1 (XG900) made its first flight on April 2, 1957, as a conventional aeroplane, with only the single RB108 installed. Hovering trials on the power of the four RB108s began with the second S.C.1 (XG905) on May 26, 1958, at first with the aircraft tethered in a large gantry. Subsequently, free flights were made with this prototype, from vertical take-offs up to about 35 m.p.h., and from horizontal take-offs down to about 140 m.p.h. The full transition from vertical to horizontal flight, through the remaining " gap " of 105 m.p.h., was first achieved in April 1960 in trials from the R.A.E. at Thurleigh, near Bedford.

SIKORSKY S-51 (U.S.A.)

Four-seat general-purpose helicopter, in service.

POWERED BY: One 450 h.p. Pratt & Whitney R-985 piston-engine.
ROTOR DIAMETER: 49 ft. LENGTH: 41 ft.
GROSS WEIGHT: 5,500 lb. MAX. SPEED: 103 m.p.h.

First Sikorsky helicopter to be licensed for commercial operation, in 1946, the S-51 was in production until 1951, a total of more than 300 being built. Many of these remain in service, together with large numbers of Westland-built Dragonflies. The S-51 was supplied to the U.S.A.F. as the H-5 and U.S. Navy as the HO3S-1. Others went to overseas customers, including the R.C.A.F.

H-19B

SIKORSKY S-55 (U.S.A.)

Twelve-seat general-purpose helicopter, in production and service.

POWERED BY: One 550 h.p. P. & W. R-1340 or 800 h.p. Wright R-1300-3 piston-engine.
ROTOR DIAMETER: 53 ft. LENGTH: 42 ft. 3 in.
GROSS WEIGHT: 7,200–7,900 lb. MAX. SPEED: 101–112 m.p.h.
RANGE: 360 miles at 85/91 m.p.h.

First flown on November 9, 1949, the S-55 is still in production and a total number of 278 had been built by March 1960. Commercial models are the S-55 with R-1340 engine and straight tail-boom, and the S-55C with inclined tail-boom. Other R-1340-powered versions are the H-19A for the U.S.A.F., H-19C for the U.S. Army, HO4S-1 and -2 anti-submarine helicopters for the U.S. Navy, HO4S-2G rescue aircraft for the U.S. Coast Guard, and HRS-1 and -2 assault transports for the U.S. Marine Corps. R-1300-powered versions are the H-19B (U.S.A.F.), H-19D (Army), HO4S-3 (Navy) and HRS-3 (Marines). S-55s have also been built by Westland, as the Whirlwind (see page 62), and Mitsubishi.

HO4S-3

H-37A

SIKORSKY S-56, H-37 MOJAVE and HR2S-1 (U.S.A.)

Twin-engined transport helicopter, in production and service.

POWERED BY: Two 2,100 h.p. Pratt & Whitney R-2800-54 piston-engines.
ACCOMMODATION: Crew of two and 23 troops or 24 stretchers.
ROTOR DIAMETER: 72 ft. LENGTH: 64 ft. 3 in.
GROSS WEIGHT: 31,000 lb. MAX. SPEED: 130 m.p.h.

Designed originally as an assault transport for the U.S. Marine Corps., the prototype Sikorsky S-56 flew on December 18, 1953. More than 100 production machines have since been built, in three versions. The Marine assault transport is the HR2S-1 (first flight October 25, 1955) with accommodation for up to 26 troops, 24 stretchers or freight, loaded through clam-shell nose-doors. A variant for the U.S. Navy is the HR2S-1W with a very large early-warning radar scanner in a plastic fairing under the nose and additional crew members for radar picket duties. The U.S. Army's H-37A Mojave is similar to the HR2S-1, and is used widely for flying crane duties, hauling equipment and missiles such as the Honest John rocket externally under its fuselage. Internal loads can include a 105 mm. howitzer and its crew, or three MM-100 jeep-type vehicles.

In 1956, an HR2S-1 set up an international helicopter speed record (exceeded by the Mil Mi-6 in 1959) of 162·7 m.p.h., and altitude-with-payload records (also beaten by the Mi-6) of 13,350 lb. to 7,000 ft. and 11,050 lb. to more than 12,000 ft.

Although the S-56 was tentatively offered for commercial use, in practice it has proved too expensive for airline operations. It has, however, provided a basis for the development of the S-60 and S-64 (see page 47) and for the Westland Westminster (page 60) all of which use the same rotor and transmission.

HR2S-1W

HUS-1G

SIKORSKY S-58, H-34 CHOCTAW, HSS-1 and HUS-1 (U.S.A.)

Military and civil general-purpose helicopter, in production and service. *Data apply to S-58.*

POWERED BY: One 1,525 h.p. Wright R-1820-84 piston-engine.
ACCOMMODATION: Two crew and 12–18 passengers or 8 stretchers.
ROTOR DIAMETER: 56 ft. LENGTH: 47 ft. 2 in.
GROSS WEIGHT: 13,600 lb. MAX. SPEED: 123 m.p.h.

The prototype S-58 flew for the first time on March 8, 1954. By November 1958, 1,000 helicopters of this type had been built by Sikorsky and the total has now risen to over 1,200, the majority being for military use. As a commercial transport, the S-58 can carry up to 18 passengers, and is used by Sabena, Chicago Helicopter Airways and many other companies for general duties. The U.S. service versions are the H-34A Choctaw, used by the Army; the HSS-1 in service with the Navy and the HUS-1 of the U.S. Marines.

The H-34A is a 16-seat transport which is used also as a flying crane to haul bulky loads externally on a cargo sling or net. Some " plush " examples are provided for Presidential use. The HUS-1 is similar to the Choctaw, and the HSS-1 has specialised anti-submarine search equipment in the cabin. The HSS-1N incorporates many new operational devices including automatic stabilisation equipment, a " hover coupler " which brings the aircraft automatically to a hovering condition 50 ft. above a pre-selected position, and equipment for day and night instrument flying. One HSS-1 has been fitted experimentally with two General Electric T58 shaft-turbines, with which it first flew on January 30, 1957. The S-58 is in production by Sud-Aviation in France, which flew the first of a batch of 150 on July 23, 1959; and, with Napier Gazelle engine, by Westland Aircraft Ltd. as the Wessex (see page 61) in Britain. *S-58*

S-60

SIKORSKY S-60 and S-64 (U.S.A.)

Flying crane helicopters, under development.

POWERED BY: Two 2,100 h.p. Pratt & Whitney R-2800 piston-engines.
ACCOMMODATION: Two crew.
ROTOR DIAMETER: 72 ft.
GROSS WEIGHT: 31,200 lb. CRUISING SPEED: 104 m.p.h.

An outgrowth of the Sikorsky S-56, the S-60 is a flying crane which is in effect the lightest possible airframe built around the S-56 power plant and rotor system. Apart from the main and tail rotors, the engines and a fuselage " backbone," it has a cockpit in which two pilots sit side by side. The co-pilot can pivot his seat to face aft, so that he can control the lifting and setting down of cargo loads of up to 12,000 lb. These loads can be of any shape and size, slung from a winch under the S-60's centre of gravity, and can include faired pods to accommodate troops or passengers, or pre-loaded freight bins.

A prototype S-60 flew in 1959 and has been extensively tested and demonstrated. Sikorsky is now building, for first flight in 1960, a prototype S-64, which will be similar but with two turbine engines side by side in the rotor pylon, in place of the outrigged R-2800 nacelles. The S-64 will have a greatly improved performance, including a 16,000 lb. payload, and is described as the first of a series of Skycranes having payloads of up to 40 tons. Largest project in this series would have four turbines to drive a 12-blade rotor and the gross weight would be 251,000 lb. With a 40 ton payload, this Skycrane could fly for 100 miles at 115 m.p.h.

S-64

HSS-2

SIKORSKY HSS-2 and HR3S (U.S.A.)

Twin-engined amphibious anti-submarine and transport helicopter, in production.

POWERED BY: Two 1,250 h.p. General Electric T58-GE-8 shaft-turbines.
ACCOMMODATION: Two crew and 22–27 passengers (HR3S-1)
ROTOR DIAMETER: 62 ft. LENGTH: 54 ft. 9 in.
GROSS WEIGHT: Approx. 17,500 lb. MAX. SPEED: 117 m.p.h.

Sikorsky first tried out the idea of an amphibious helicopter with a boat-type hull in the S-62, which was developed from the S-55 and first flew during May 1958. In parallel, a similar amphibious development of the larger S-58 was planned, with two turbine engines, and this materialised as the S-61. The HSS-2, which first flew in March 1959, is a version of the S-61 for the U.S. Navy and is of note as the first helicopter produced under the U.S. Navy's weapons system concept, as well as the Navy's first all-weather helicopter and the largest amphibious helicopter yet flown. Unlike earlier types designed to perform as either anti-submarine search or "killer" aircraft, the HSS-2 combines both functions, and on a typical Navy four-hour mission carries dipping sonar detection apparatus and a variety of offensive weapons, including homing torpedoes and rockets. Its flying-boat hull and stablising floats enable it to alight safely on the water in an emergency during long patrols at sea, and it can be operated from relatively calm seas when required. Other features include a 600 lb. capacity rescue hoist, a 6,000 lb. capacity cargo sling for external loads and fully-automatic folding of the five-blade rotor to facilitate shipboard stowage. The U.S. Marines' HR3S-1 is another version of the S-61, with slightly different fuselage-hull design incorporating a tail-loading ramp for heavy equipment and vehicles. The HR3S-1 may be built in Canada by Canadian Pratt & Whitney.

SIKORSKY S-61 (U.S.A.)

Airline helicopter, in production

POWERED BY: Two 1,250 h.p. General Electric CT58-110 shaft-turbines.
ACCOMMODATION: Two crew and 25–28 passengers.
ROTOR DIAMETER: 62 ft. LENGTH: 58 ft. 11 in.
GROSS WEIGHT: 18,700 lb. CRUISING SPEED: 133 m.p.h.

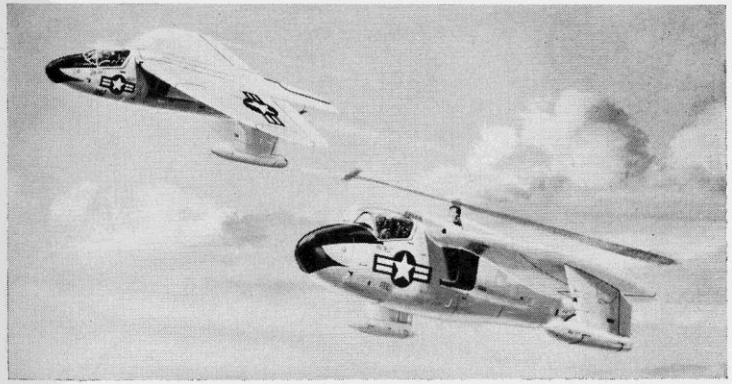
Scheduled to go into service before the end of 1960, the S-61 is a commercial variant of the Navy HSS-2 and Marine HR3S-1, development of which was started by Sikorsky in 1958. Its distinctive features include the boat-type hull and outrigged floats to permit operation onto and off water; the land chassis retracts into the floats, or can be omitted if the helicopter is permanently water-based. A three-engined version of the S-61 is offered for operations at high altitudes or in hot climates. Normal accommodation is for 25 passengers in an airline-type interior; mixed passenger/freight layouts are also available. Los Angeles Airways has ordered five 28-passenger S-61s and Chicago Helicopter Airways has ordered six 25-seaters, both orders being for the twin-engined version.

SIKORSKY S-62 and S-63 (U.S.A.)

General-purpose amphibious helicopter, in production.

POWERED BY: One 1,050 s.h.p. General Electric T58-GE-6 shaft-turbine.
ACCOMMODATION: Two crew and 8–12 passengers or 18 troops.
ROTOR DIAMETER: 53 ft. LENGTH: 44 ft. 7 in.
GROSS WEIGHT: 7,500 lb. CRUISING SPEED: 115 m.p.h.

Sikorsky developed the S-62 during 1957-58 as the first of its new range of turbine-powered helicopters with amphibious capability. Previously, an S-58 had been flown with turbine engines in the front fuselage, but in the S-62 the engine was located more conveniently atop the fuselage and immediately below the rotor. The rotor system, transmission, and parts of the flying control and hydraulic systems of the S-55 were retained, but a new fuselage was built, of about the same size as the S-55 but with many improvements. A basic feature of the design is that the fuselage is a watertight hull to permit water landings and take-offs as a routine operation. The main wheels, for land operations, are semi-retractable in housings which also comprise the stabilising water floats. The first of two prototypes of the S-62, which have been extensively demonstrated throughout the World in 1959, made its first flight in May 1958. Production deliveries are to begin during 1960. The S-63 is a projected variant of the S-62 with the same fuselage but an S-58-type rotor, transmission and controls, and a 1,250 h.p. T58-GE-8 turbine.



SIKORSKY S-57 (U.S.A.)

VTOL convertiplane, under development.

Despite its early designation in the Sikorsky series, this jet-powered convertiplane is one of the latest projects of the company's advanced research group. It utilises a single-blade counter-balanced rotor to take off as a helicopter. When sufficient forward speed has been built up for the fixed wings to take over, the rotor is stopped and retracted into the top of the fuselage. The S-57 has obvious possibilities as a high-performance tactical strike or reconnaissance aircraft. Its power plant is a Pratt & Whitney JT-12 turbojet.

Alouette III

SUD-AVIATION S.E. 3130 and 3160 ALOUETTE (France)

General-purpose helicopter, in production and service.

POWERED BY: One 870 h.p. (de-rated to 450–500 h.p.) Turbomeca Artouste IIIB shaft-turbine.
ACCOMMODATION: Seven.
ROTOR DIAMETER: 36 ft. 1 in. LENGTH: 33 ft. 0½ in.
GROSS WEIGHT: 4,630 lb. MAX. SPEED: 124 m.p.h.

The Sud-Est factory of the French nationalised industry built its first rotorcraft in 1931 and the first helicopters—the S.E.3000 and S.E.3101—in 1948. The original Alouette was the S.E.3120, with a 200 h.p. Salmson engine. From this was developed the S.E.3130 Alouette II, a five-seater with a 400 h.p. Artouste II engine. This is the principal production version, nearly 500 having been built for service in 22 countries. Licence production has been started by Saab in Sweden, and Republic market the Alouette in the U.S.A.

The Alouette can carry Nord S.S.10 and 11 anti-tank guided missiles, or external stretcher carriers. On July 13, 1958, an Alouette II set the existing helicopter altitude record of 36,089 ft. Variants of the basic design are the prototype S.E.3131 Gouverneur, with an enclosed fuselage; the prototype S.E.3140 with a Turmo II engine; the S.E.3150 Alouette III prototype with an Artouste III engine and the S.E.3160 Alouette III with Artouste IIIB. Two prototypes and two pre-production models of the S.E.3160 have been built and deliveries of an initial production batch of 200 are to start in 1961.

Alouette II

SUD-AVIATION S.A.3210 FRELON (France)

Heavy-duty helicopter, under development.

POWERED BY: Three 1,250 s.h.p. Turbomeca Turmo IIIC shaft-turbines.
ROTOR DIAMETER: 49 ft. 2½ in. LENGTH: 52 ft. 2½ in. GROSS WEIGHT: 22,050 lb.

Two S.E.3200 prototypes of the Frelon have been built, with 750-800 s.h.p. Turmo IIIB engines. The first flew on June 10, 1959. The production model will be designated S.A.3210 and the data above refer to this. It will carry 24-28 passengers for 62 miles, 15 stretcher patients and two medical attendants for 250 miles or two tons of freight internally or externally for 185 miles. Military versions will be able to carry Nord S.S.11 anti-tank missiles, anti-submarine radar and weapons, or a variety of other equipment.

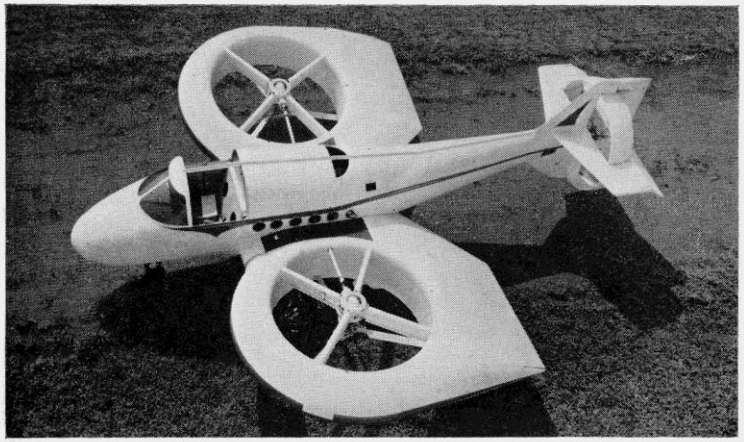
SUD-AVIATION S.O. 1221 DJINN (France)

Utility civil and military helicopter, in production.

POWERED BY: One 240 h.p. Turbomeca Palouste IV air compressor.
ACCOMMODATION: Two.
ROTOR DIAMETER: 36 ft. 1 in.
LENGTH: 17 ft. 4 in.
GROSS WEIGHT: 1,765 lb.
MAX. SPEED: 80 m.p.h.

The prototype Djinn helicopter was produced by the former Sud-Ouest factory of the nationalised French aircraft industry, and made its first flight on January 2, 1951. Five prototypes and a pre-production series of 22 were built by S.N.C.A.S.O., and full-scale production followed. Most of the Djinn production has been handled by the Helicopter Section of Sud-Aviation, formed by an amalgamation of S.N.C.A.S.O. and the Sud-Est group. The Djinn was the first helicopter with a "cold-jet" rotor, turned by compressed air supplied by the Palouste turbine engine; no further combustion occurs at the rotor tips, as is the case in most tip-drive helicopters.

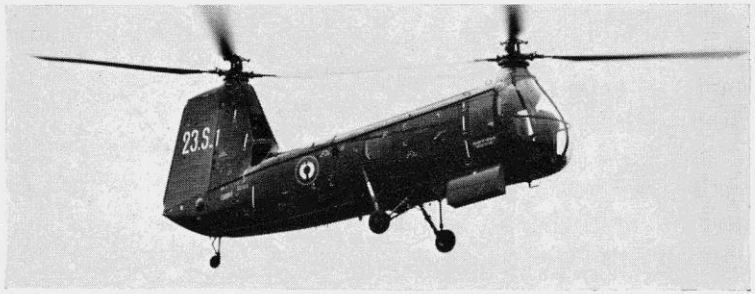
The Djinn can carry external stretchers on each side of the fuselage, anti-tank missiles such as the Nord S.S.10, or crop-spraying gear. In March 1957, a Djinn set an altitude record of 27,860 ft. (since exceeded by an Alouette). The Djinn is in service in at least eleven countries—Argentina (which has five), Australia (1), Austria (1), Cameroons (3), France (over 100), German Federal Republic (8), Italy (1), Mexico (2), Netherlands (1), Switzerland (4) and U.S.A. (3). A two-three seat Djinn III is under development.



VANGUARD 2C OMNIPLANE (U.S.A.)

Experimental convertiplane, under development.
POWERED BY: One 265 h.p. Lycoming O-540 piston-engine.

This interesting convertiplane utilises the rotors, transmission and clutch of the now-defunct Jacobs 104, plus airframe components of an Ercoupe lightplane. It is intended to take off vertically with most of the engine power going into the ducted rotors and with the ducted propeller at the tail in low pitch. At a safe height, the pitch of the propeller is increased to drive the aircraft forward. When the wings develop sufficient lift to maintain flight, the pitch of the rotors is decreased and they are covered by plate-type "lids" which until then have been raised clear of the ducts. The wing undersurfaces are finally sealed by Venetian-blind covers, the rotors are de-clutched and the Omniplane cruises as a conventional fixed-wing aeroplane. Ground tests of the prototype began in August 1959.



VERTOL (BOEING) HUP RETRIEVER and H-25 ARMY MULE (U.S.A.)

Six-seat general-utility helicopter, in service.
POWERED BY: One 525/550 h.p. Continental R-975 piston-engine. GROSS WEIGHT: 5,750 lb.
ROTOR DIAMETER: 35 ft. LENGTH: 32 ft. CRUISING SPEED: 80 m.p.h.

First version of the Retriever was the HUP-1, with 525 h.p. R-975-34 engine, of which 22 were built for the U.S. Navy in 1950–52. The HUP-2 introduced an auto-pilot, permitting deletion of the HUP-1's tail fins, and has a 550 h.p. R-975-46. The HUP-3 is similar to the -2 for medical (three stretchers) or light cargo duties. A total of 243 HUP-2s and -3s was built for the U.S. Navy; others went to the Canadian and French Navies. A variant was the HUP-2S with dipping asdic, the first U.S.N. anti-submarine helicopter. Seventy H-25A Army Mules supplied to the U.S. Army are similar to the HUP-2.

H-21B

VERTOL (BOEING) H-21 WORK HORSE and SHAWNEE (U.S.A.)

Tandem-rotor transport and rescue helicopter, in production and service.

POWERED BY: One 1,425 h.p. Wright R-1820-103 piston-engine.
ACCOMMODATION: Two crew and up to 22 passengers.
ROTOR DIAMETER: 44 ft. LENGTH: 52 ft. 6 in.
GROSS WEIGHT: 15,000 lb. MAX. SPEED: 120 m.p.h.

The pedigree of the Work Horse can be traced all the way back to the Piasecki PV-3, the original tandem-rotor "Flying Banana" which went into production for the U.S. Navy as the HRP-1. From the cleaned up PV-17 HRP-2 was evolved the slightly larger and heavier PD-22, which went into production as the H-21 Work Horse for the U.S.A.F. and, later, as the H-21 Shawnee for the U.S. Army. When Frank Piasecki, originator of these designs, left the company he had founded to start Piasecki Aircraft Corp. (see page 42), the production of the H-21 continued uninterrupted although the name of the company was changed to Vertol (now the Vertol Helicopter Division of Boeing).

The prototype H-21 first flew on April 11, 1952, and 18 YH-21s were built, followed by a first production batch of 32 H-21As, which have been used mainly as Arctic rescue helicopters, with their R-1820-103 engines limited to 1,150 h.p. Next came 153 H-21B personnel/cargo transports for the U.S.A.F., with engines re-rated at 1,425 h.p., and 85 similar aircraft for the U.S. Army under the designation H-21C. The "B" and "C" models have 22 seats, whereas the H-21A seated only 16 and had a gross weight of 11,500 lb. One H-21D was flown, with an experimental installation of two General Electric T58 shaft-turbines. The R.C.A.F. has six each of the H-21A and H-21C version.

A commercial version of the Work Horse was first proposed as the PH-42, this project being superseded by the Model 44. The Vertol 44 is in service with New York Airways for scheduled passenger operations, and others have been supplied for general transport duties; four were purchased by the Swedish Navy.

Vertol 44B

VERTOL (BOEING) 107 and YHC-1 CHINOOK (U.S.A.)

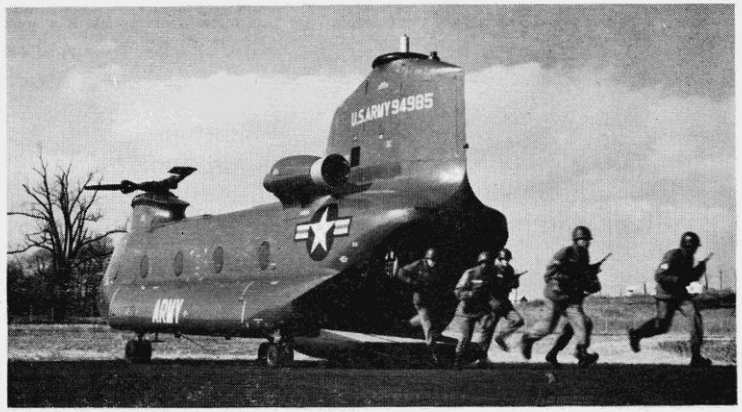
YHC-1A

Commercial and military transport helicopter, in production.

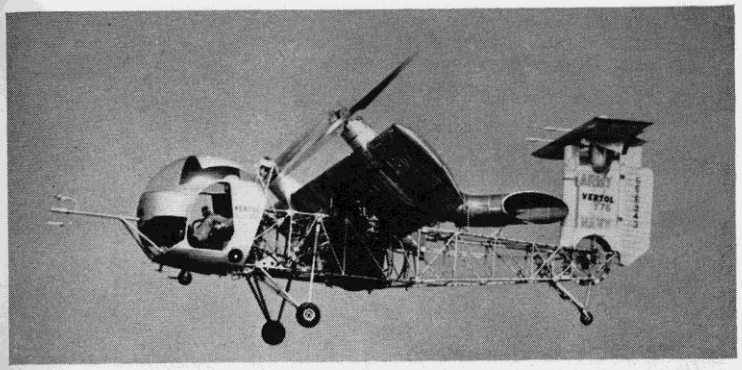
POWERED BY: Two 1,450 s.h.p. General Electric CT58 shaft-turbines.
ACCOMMODATION: Two crew and 25 passengers.
ROTOR DIAMETER: 50 ft. LENGTH: 44 ft. 7 in.
GROSS WEIGHT: 18,400 lb. CRUISING SPEED: 155 m.p.h.

The Vertol 107 is a development of the company's tandem-rotor series of helicopters, designed to take advantage of the new range of turbine engines. A privately-financed prototype of the Vertol 107 was first flown on April 22, 1958 and has been extensively demonstrated in America and Europe. One feature of the design is that the fuselage is sealed as a water-tight hull to permit emergency landings and take-offs from water. New York Airways has ordered five of the production commercial models, known as Vertol 107-IIs, for delivery early in 1961, with an option on five more later. The 107-II has General Electric T58 turbines, whereas the prototype had 850 s.h.p. Lycoming T53s.

For the U.S. Army, the company has built a test quantity of three YHC-1As, similar to the Vertol 107-II and with T58-GE-6 turbines. The first of these flew on August 27, 1959. The design has been further developed into the YHC-1B Chinook, winner of an Army design competition in March 1959 for a helicopter able to carry 6,000 lb. of payload on normal 100-mile missions and up to 15,570 lb. on external slings for 20 miles. Powered by 1,940 h.p. Lycoming YT55-L-5 turbines, the YHC-1B will have 57 ft. diameter rotors and a 50-ft. long fuselage incorporating a rear loading ramp and accommodating 33 troops, 27 paratroops or 24 litters. Gross weight will be 33,000 lb. and mean speed 175 m.p.h. First flight is expected early in 1961; five have been ordered, and five HC-1Bs will be purchased in 1961.



YHC-1B (mock-up)



VERTOL (BOEING) VZ-2 (U.S.A.)

Tilt-wing research convertiplane.

POWERED BY: One 860 h.p. Lycoming T53-L-1 shaft-turbine.
SPAN: 24 ft. 11 in. LENGTH: 26 ft. 5 in.

Development of the VZ-2 under a joint Army/Navy programme began in 1956. As the main object was to prove the practicability of the tilt-wing concept, the airframe was made as simple as possible, using many standard components, and the VZ-2 became the first tilt-wing aircraft to complete successful transitions from vertical to horizontal flight and *vice versa* in July 1958. The single Lycoming turbine in the fuselage drives the two 9 ft. 6 in.-diameter propellers on the leading edge of the tilting wing, and control during the vertical and transitional flight stages is provided by vertical and horizontal ducted fans at the tail.

WESTLAND (BRISTOL) TYPE 192 BELVEDERE (G.B.)

General-purpose tandem-rotor helicopter, in production.

POWERED BY: Two 1,650 e.h.p. Napier Gazelle 100 shaft-turbines.
ROTOR DIAMETER: 48 ft. 8 in. each. LENGTH: 54 ft. 4 in.
GROSS WEIGHT: 18,000 lb. MAX. SPEED: 138 m.p.h.

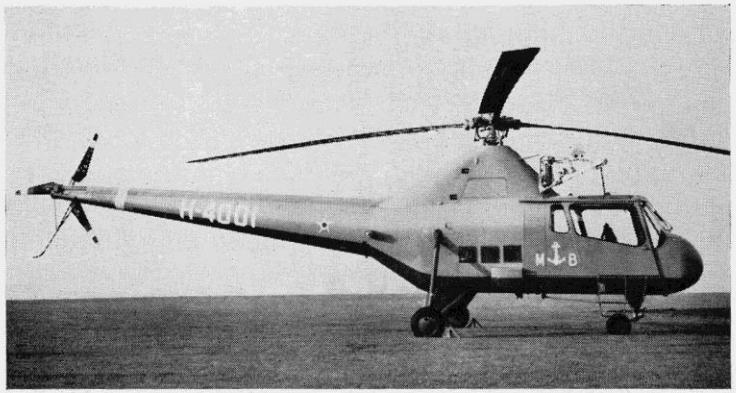
Development of the Belvedere can be traced back at least ten years to the Bristol 173, which was Britain's first tandem-rotor helicopter. The first of two Bristol 173s with Alvis Leonides engines ew for the first time on January 3, 1952. The Bristol 173 Mk. III was similar to these earlier rototypes but had Leonides Major engines. Three examples were ordered but only one was ompleted to the flight testing stage, which began on November 9, 1956. A Naval development of the design for anti-submarine duties, with a shorter fuselage, was ordered as the Type 191, but this was later cancelled, leaving work to continue on the R.A.F's Type 192. The first batch of 192s was planned originally to have Leonides Majors, but in the end Gazelle shaft-turbines were installed from the start. The first of 30 Belvederes (XG447) flew on July 5, 1958. Each can carry up to 25 troops, 6,000 lb. of freight, or stretchers; a winch-carrying door is optional and external fuselage loads can include two A.S.R. packs. Two 274-gallon tanks can be mounted in the fuselage for ferry flights.

WESTLAND WS-51 DRAGONFLY (G.B.)

Single-engined general-purpose helicopter, in service.

POWERED BY: One 520 h.p. Alvis Leonides 50 piston-engine.
ACCOMMODATION: Pilot and three passengers.
ROTOR DIAMETER: 49 ft. LENGTH: 40 ft. 10 in.
GROSS WEIGHT: 5,870 lb. MAX. SPEED: 103 m.p.h

Production rights for the Sikorsky S-51 were acquired by Westland Aircraft Ltd. in 1947, in the first of a series of similar arrangements which placed the company in the forefront of helicopter development in Britain. Several American-built S-51s were imported, as demonstrators and for use by B.E.A. on experimental services, and these sometimes became known—incorrectly—as Westland WS-51s. The first Westland-built helicopter was the WS-51 G-AKTW, flown in 1948, and about a third of the 133 built were for the civil market. The military versions were the H.R. Mk. 1 and 3 for the Royal Navy and the H.C. Mk. 2 and 4 for the R.A.F., the Mks. 3 and 4 having metal rotor blades. Only three Mk. 2 and about a dozen Mk. 4 were built. The Navy had 12 Mk. 1 and about 60 Mk. 3. The Dragonfly H.R.7 was a proposed conversion of the Mk. 3 to Widgeon standard.



Westland Widgeon
(description opposite)

WESTLAND W.B.1 WIDGEON (G.B.)

General-purpose military and civil helicopter, in production and service.

POWERED BY: One 500 h.p. Alvis Leonides 521/2 piston-engine.
ACCOMMODATION: Pilot and four passengers. GROSS WEIGHT: 5,900 lb.
ROTOR DIAMETER: 49 ft. 2 in. LENGTH: 40 ft. 10 in. MAX. SPEED: 104 m.p.h.

The Widgeon is a British development from the original Sikorsky S-51, built by Westland Aircraft Ltd. as the Dragonfly. Whilst retaining many features of the Dragonfly, the Widgeon has a completely new front fuselage, designed to seat five. It also has a rotor head similar to that used on the larger S-55 Whirlwind, which with offset flapping hinges improves the handling characteristics.

Apart from the passenger version, the Widgeon is offered as an ambulance, carrying two stretchers which can be loaded through a special door in the nose; for air/sea rescue duties or in the anti-submarine role. Crop-spraying gear can be fitted, and low-pressure pontoons are available in place of the wheels. A four-blade main rotor is fitted.

The Widgeon prototype, first flown on August 23, 1955, was a converted Dragonfly, G-AKTW, as was the second example also, G-ALIK. Other Dragonflies have since been converted to Widgeon standard, in addition to production examples supplied to the Brazilian Navy (illustrated), Royal Jordanian Air Force, Hong Kong Government and civil users at home and abroad.

WESTLAND (FAIREY) ROTODYNE (G.B.) *(Data apply to production version)*

Military and civil passenger transport convertiplane, under development.

POWERED BY: Two 5,250 e.h.p. Rolls-Royce Tyne turboprops with auxiliary compressors.
ACCOMMODATION: Two crew and 57–75 passengers.
SPAN: 56 ft. 6 in. ROTOR DIAMETER: 104 ft. LENGTH: 66 ft. 1 in.
GROSS WEIGHT: 53,500 lb. CRUISING SPEED: 200 m.p.h.

The Rotodyne is the latest example of the gyrodyne type of convertiplane which Dr. J. A. J. Bennett first suggested in 1938 and which was first tested in the form of the Fairey Gyrodyne prototypes. The principle is that of providing a powered rotor, for VTOL capability, in combination with conventional forward propulsion and a fixed wing to off-load the rotor and make possible higher cruising speeds. Government interest in the idea permitted the Fairey company to design and build a prototype Rotodyne powered by two 2,800 h.p. Napier Eland engines and having a gross weight of 38,000 lb. This prototype (XE521) made its first flight on November 6, 1957. For the initial phase of the trials it flew as a helicopter, the rotor being turned by the Fairey-developed pressure jets at the blade tips, supplied with compressed air from secondary compressors driven by the engines. In normal forward flight, these compressors are " de-clutched " and all the engine power goes into the propellers, while the rotor " free-wheels." The first complete transition from a vertical take-off to the cruising flight configuration was made in April 1958.

During 1959, some modifications were made, including a re-rigging of the wing to introduce 3° more incidence, the introduction of ailerons and some changes to the tail unit. Further changes were made later in the trials and on February 7, 1960, flight testing started again with a central fin added, a faired rotor head and shorter jet pipes. The production model of the Rotodyne, which is now being developed by Westland with the backing of a £4 million Government development contract, is larger than the prototype, with Tyne engines, and a military version, with rear loading doors and a 60,000 lb. gross weight, is planned. British European Airways and New York Airways have indicated their intention of purchasing six and five production Rotodynes respectively. Deliveries are expected to begin in 1964–65.

Turmo-powered Skeeter

WESTLAND (SARO) P.501 SKEETER (G.B.)

Training and air observation post helicopter, in production and service.

POWERED BY: One 215 h.p. de Havilland Gipsy Major 215 piston-engine.
ACCOMMODATION: Two. GROSS WEIGHT: 2,300 lb.
ROTOR DIAMETER: 32 ft. LENGTH: 28 ft. 5 in. MAX. SPEED: 101 m.p.h.

Now produced by Westland through its wholly-owned subsidiary Saunders-Roe, the Skeeter originated as the W.14 designed and built by the former Cierva Helicopter Co. The prototype W.14 Skeeter 1 (G-AJCJ) had a 106 h.p. Jameson engine and flew on October 10, 1948. A much-modified second prototype, the Skeeter 2 (G-ALUF) had a Gipsy Major 10 engine and flew on October 20, 1949. The first Saro-developed prototypes were two Mk. 3 (WF112 and WF113) with Gipsy Major 10 and a Mk. 4 (WF114) with a Bombardier 702, for military and naval evaluation. The two Mk. 3s were later fitted with Bombardiers and re-designated Mk. 3B, and the Mk. 5 was a Bombardier-engined civil version. In the Mk. 6, a return was made to the 186 h.p. Gipsy Major 30 engine, and examples of this version were evaluated at Boscombe Down and other Ministry establishments, leading to production orders. The first military versions were the A.O.P. Mk. 10 air observation post and T.Mk.11 trainer with a 200 h.p. Gipsy Major 200 engine; these have been followed by the A.O.P. Mk. 12, with 215 h.p. Gipsy Major 215. Civil versions with these engines are the Skeeter 7 and 8, and export versions for the German Air Force and German Navy are, respectively, the Mk. 50 and Mk. 51. Experimental Skeeters include those with metal rotor blades and with Napier rocket boosters at the rotor tips and others with a supercharged Gipsy Major engine and Turmo shaft-turbine. External stretcher carriers can be fitted on the fuselage sides.

Skeeter Mk. 50

P.531-0/N

WESTLAND (SARO) P.531 WASP (G.B.)

Anti-submarine, training, and general-purpose helicopter, in production.

POWERED BY: One 968 s.h.p. Blackburn Nimbus (A129 Mk. 3).
ACCOMMODATION: Pilot and four passengers.
ROTOR DIAMETER: 32 ft. 3 in. LENGTH: 30 ft. 4 in.
GROSS WEIGHT: 5,000 lb. MAX. SPEED: 132 m.p.h.

Development of the P.531 was started as a private venture by Saunders-Roe at the beginning of 1958, and the first of two prototypes (G-APNU) flew on July 20, 1958. These two P.531-0 aircraft had 300 s.h.p. Turbomeca Turmo 600 engines and a gross weight of 4,000 lb. Two much-modified prototypes appeared in 1959: G-APVL with a Blackburn A129 (first flight on August 9, 1959) and G-APVM with a de Havilland Gnome H.1000 turbine engine (first flight May 3, 1960).

In 1959, the Royal Navy ordered three Wasps for evaluation, and to obtain rapid delivery specified the original Turmo engines. These three aircraft (XN332, 333 and 334) are known as P.531-0/N and include the original G-APNU re-numbered. The prototype G-APVL is known as P.531-1 and future production models with the Nimbus engine derated to give 650 s.h.p. at any altitude will be P.531-2s. In December 1959, one of the Naval Wasps completed a series of 31 night landings on the frigate H.M.S. " Undaunted " as part of the evaluation.

The Wasp can carry a variety of offensive stores, including homing torpedoes and wire-guided missiles, on external racks, and can be adapted for a wide range of military and civil duties. It is to be produced for Naval anti-submarine duties from frigates and for the Army as a Skeeter replacement.

P.531-1

WESTLAND WESTMINSTER (G.B.)

Twin-engined commercial transport and aerial crane helicopter, under development.

(Data apply to prototypes)

POWERED BY: Two 3,150 s.h.p. Napier Eland shaft-turbines.
ACCOMMODATION: Crew only. GROSS WEIGHT: 36,000 lb.
ROTOR DIAMETER: 72 ft. LENGTH: 69 ft. CRUISING SPEED: 115 m.p.h.

Development of the Westminster was started in 1957 by Westland on the basis of a licence for the Sikorsky S-56. Whilst using the latter's rotor system and transmission, the Westminster is an almost wholly new design, and is now being offered in two principal forms—the Westminster 1 transport for up to 45 passengers, and the Westminster Crane-Transporter, which can carry a wide variety of military loads, or troop, casualty or passenger pods, in place of a conventional fuselage. To provide experience with the Eland power plant and the general Westminster configuration, Westland built two flying test beds with uncovered framework fuselages. The first of these (G-APLE) flew on June 15, 1958 and the second (G-APTX), with detail refinements, on September 4, 1959. Both have 3,150 s.h.p. Eland E.229A engines, whereas the developed versions will have 3,500 s.h.p. Eland E.211 or specially-developed versions of the Rolls-Royce Tyne.

Westland have now converted G-APLE into an aerodynamic prototype of the Westminster 1 civil transport by completely covering the fuselage. A full-size mock-up is also being built of the military crane-transporter which, with a gross weight of 36,000 lb., would have a disposable load for fuel and payload of 14,000 lb. The detachable pod, weighing 1,000 lb., could carry 50 assault troops, 40 stretchers or other loads. Cruising speed of this version (illustrated below) would be over 115 m.p.h. and the range 205 miles.

WESTLAND W.B.5 WESSEX (G.B.)

Anti-submarine, general-purpose and civil transport helicopter, in production and service.

POWERED BY: One 1,450 s.h.p. Napier Gazelle 160 shaft-turbine.
ROTOR DIAMETER: 56 ft. LENGTH: 56 ft. 7½ in.
GROSS WEIGHT: 12,600 lb. MAX. SPEED: 144 m.p.h. RANGE: 340 miles.

The Wessex is the Westland-developed version of the Sikorsky S-58, from which it differs primarily in having a gas-turbine in place of a piston-engine. Westland obtained a licence for the S-58 in 1955, and imported a production airframe in U.S. Navy HSS-1 configuration (XL722). This airframe was modified to have a Gazelle engine and flew in this form on May 17, 1957. The first of a pre-production batch of anti-submarine Wessex H.A.S.1s for the Royal Navy (XL727) flew on June 20, 1958.

The Wessex 2 is a civil version to seat 14 passengers, with two de Havilland Gnome H.1000 turbines, which is to fly before the end of 1960.

WESTLAND WS-61 WILTSHIRE (G.B.)

Multi-engined civil transport helicopter, under development.

POWERED BY: Two 1,650 h.p. Napier Gazelle shaft-turbines. ROTOR DIAMETER: 62 ft.
ACCOMMODATION: Two crew and 25 passengers. LENGTH: 72 ft. 9 in.

Early in 1960, Westland Aircraft announced plans to build in Britain a version of the Sikorsky S-61 helicopter (see page 48), to be known as the WS-61 Wiltshire. This will be similar to the American model with the exception of the power plant, which will comprise two of the more powerful Gazelle turbines. A later version of the Wiltshire may be offered with Gnome engines. Using imported S-61 components, Westland expect to fly the first Wiltshire before the end of 1960.

WESTLAND W.A.5 WHIRLWIND 5 (G.B.)

Gnome-powered Whirlwind

General-purpose military and civil helicopter, in production and service.

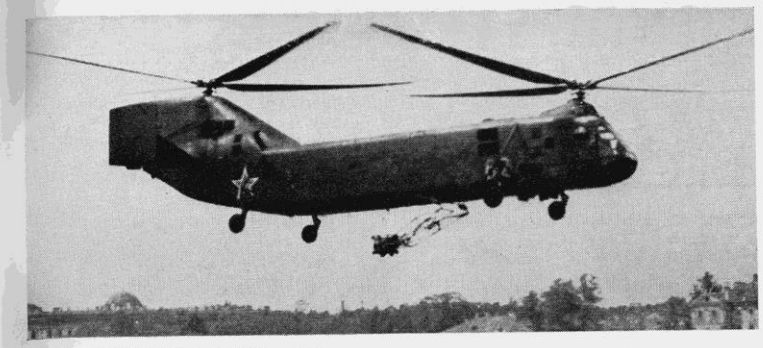
POWERED BY: One 715 h.p. Alvis Leonides Major 155 piston-engine.
ACCOMMODATION: Two crew and 10–12 passengers.
ROTOR DIAMETER: 53 ft. LENGTH: 44 ft. 2 in.
GROSS WEIGHT: 8,000 lb. CRUISING SPEED: 104 m.p.h.

Westland acquired a licence for production of the Sikorsky S-55 in 1952, and imported one American-built example (G-AMHK) for demonstration and development flying. As the Whirlwind, the S-55 was put into production for the Royal Navy and the R.A.F./Army, the first four versions having American engines. These were the Naval H.A.R.1 and Army H.A.R.2 with R-1340-40 engines (10 of each built, the first Mk. 1 flying on August 15, 1953) the Naval H.A.R.3 with R-1300-3 engine and the Air Force H.A.R.4 with R-1340-57 engine. With the Whirlwind H.A.R.5 for the Navy, a change was made to the British Alvis Leonides Major 155 engine, and the first flight with this engine was made on August 28, 1955. All these versions were for general communications and search and rescue duties, and civil versions were also produced, as the WS-55 Series 1 and Series 2 with R-1340 and Leonides Major engines, respectively.

The Whirlwind H.A.S.7, first flown on October 17, 1956, is a combat version for the Royal Navy, equipped to carry radar and dipping asdic for submarine detection, and homing weapons for the attack. This version has been operational since January 1958. Other Whirlwind variants are the Mk. 6, which was to have been a prototype with Twin Turmo engines but now applies to Mk. 2s converted to have Leonides Major, and the H.C.C.8, applied to two Whirlwinds supplied to the Royal Flight in 1959. One Whirlwind was fitted experimentally with a de Havilland Gnome turbine, with which it first flew on February 28, 1959, and in April 1960 a "substantial" order was placed for this version for the R.A.F. with the designation Whirlwind Mk. 10.

Some American-built Sikorsky S-55s supplied to the Royal Navy in 1952 were also known as Whirlwinds. They comprised 10 HRS-2s, called Whirlwind H.A.R.21s, and 15 HO4S-3s known as Whirlwind H.A.R.22s.

Whirlwind Mk. 5



YAKOVLEV Yak-24 (Russia)

Heavy transport helicopter, in production and service.

POWERED BY: Two 1,700 s.h.p. Shvetsov ASh-82V piston-engines.
ROTOR DIAMETER: (each) 68 ft. 11 in. LENGTH: 80 ft.
GROSS WEIGHT: 32,275 lb. MAX. PAYLOAD: 8,000 lb. MAX. SPEED: 158 m.p.h.

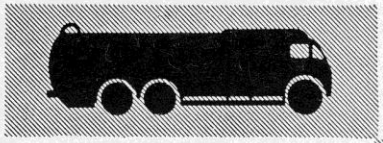
Work on Yakovlev's second helicopter (after the single-engine Yak-100 in 1950) began in mid-1952 to meet an official requirement for a heavy transport helicopter and the first Yak-24 flew in 1953. The original models made use of the proven engine/rotor system of the Mil Mi-4 but development proved slow and production did not begin until 1954, in a factory in Leningrad. Production has subsequently been moved to a new factory in the Ural mountains.

Since 1956, deliveries have been continuing steadily to units of the Soviet Army and, more recently, to Aeroflot, which began to use the Yak-24 for scheduled services in 1959. The Yak-24K has also appeared in Aeroflot markings, and is distinguished by a modified fuselage with large, panoramic windows, and a "luxury" interior with only eight passenger seats.

Between the two engine bays, the Yak-24 provides a 33 ft.-long uninterrupted cabin space and there is a rear-loading door for direct vehicle loading. Loads carried by the Yak-24 include two GAZ-69 command vehicles, three M-20 Pobyeda staff cars, 40 troops or two field or anti-tank guns complete with crews. Loads of over 11,000 lb. can be lifted on the single-point suspension cargo hook beneath the centre of the fuselage.

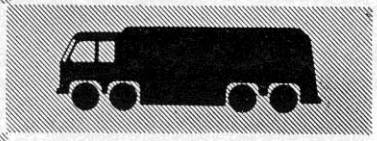
Yak-24K

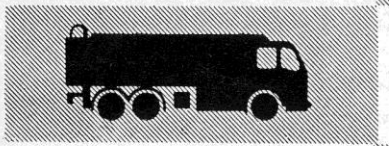
AIRCRAFT FUELLERS



CORNWALL Capacity 3,500 Imperial gallons; max. delivery rate per hose 250 g.p.m. Foden or Leyland chassis. Designed for over and underwing fuelling of large airliners.

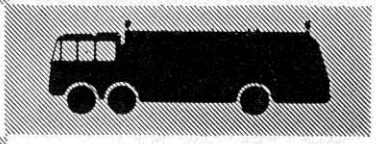
TYNE Capacity 4,000 Imperial gallons; max. delivery rate per hose, 180 g.p.m. Leyland chassis. Among the largest fuellers in the world; used for servicing trans-Atlantic airliners.

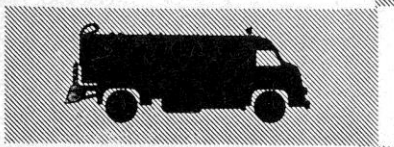




DORSET Capacity 3,000 Imperial gallons; max. delivery rate per hose, 200 g.p.m. Leyland chassis. Designed for underwing fuelling of the D.H. Comets with aviation turbine fuel.

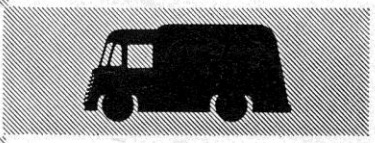
STEER Capacity 2,200 Imperial gallons; max. delivery rate per hose, 150 g.p.m.; Leyland chassis. Used at London Airport only for servicing medium-sized aircraft.

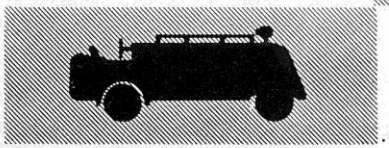




LINCOLN Capacity 1,500 Imperial gallons; max. delivery rate per hose 100 g.p.m. Bedford chassis. Designed for over and underwing fuelling of medium sized airliners.

TWEED Capacity 1,200 Imperial gallons; max. delivery rate per hose, 60/70 g.p.m. Ford chassis. Used for servicing aircraft covering moderate distances on European routes.





T. B. MOBILE Capacity 500 Imperial gallons; max. delivery rate per hose, 30/40 g.p.m. Special 3-wheel chassis. Stationed on the smaller airfields for servicing private and club aircraft.

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