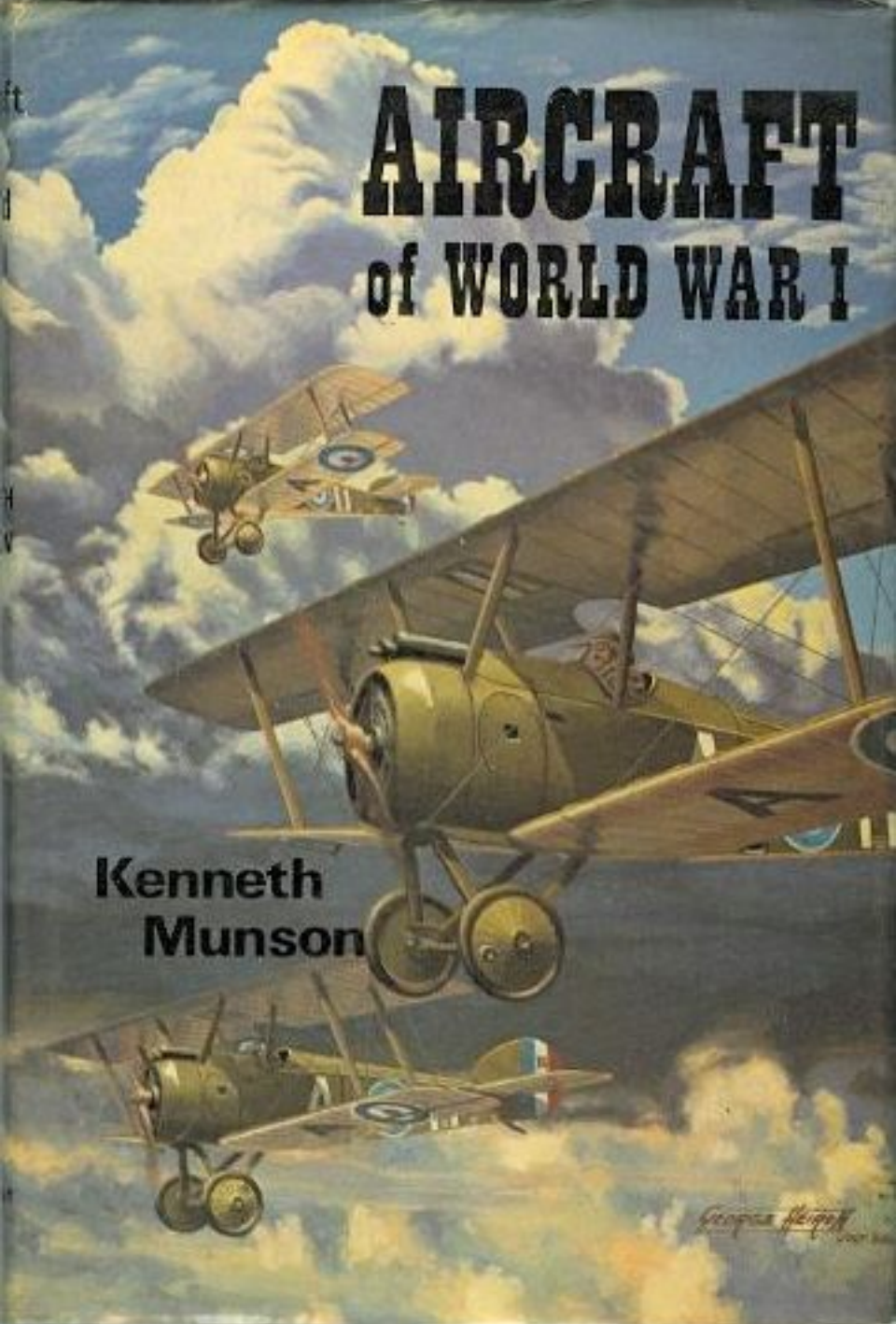
AIRCRAFT of WORLD WAR I



Kenneth Munson

Westland-built D.H.4s at Serny, France, in February 1918. [I.W.M.

AIRCRAFT
of
WORLD WAR I

Kenneth Munson

LONDON

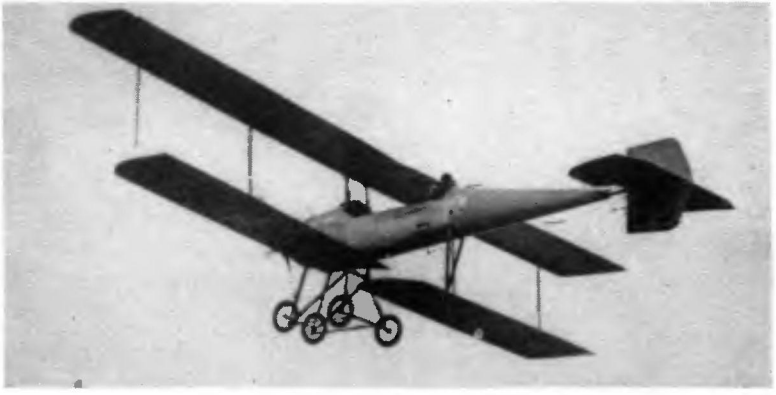
IAN ALLAN

Introduction

THE FIRST WAR IN THE AIR

THE WAR of 1914–18 is usually remembered as a bloody ground battle, fought by thousands of mud-spattered foot soldiers across a landscape littered with trenches and shell holes; and this it certainly was. But it was also the forcing ground for two entirely new weapons of war—the tank and the aeroplane—though the major combatants showed few signs of appreciating this when the conflict began in August 1914. The British War Office still regarded the aeroplane with misgivings, on the ground that it " would frighten the horses "; and even in the mother country of European aviation, France's Director of Aeronautics had stated publicly that the aeroplane was no more than " a substitute for the captive balloon ".

Thus, at first, the aeroplane was regarded officially as being useful only in a limited way for reconnaissance, and scarcely at all for combat purposes. Fortunately, however, a number of far-sighted individuals did not share this view—men whose experiments had endeavoured to prove that the aeroplane could play a positive military role. Among the first of these was Major Brooke-Popham of the Air Battalion of the Royal Engineers, who was swiftly rebuked by his superiors in 1911 for fitting a gun on to his Blériot monoplane. In 1912, the official " interest " when Colonel Isaac Newton Lewis installed his first gun on a Wright biplane of the U.S. Army Signal Corps was so discouraging that Lewis left the United States and set up his own company at Liège in Belgium in January 1913 to manufacture machine guns. In France and Germany respectively, Raymond Saulnier of Morane-Saulnier and Franz Schneider of the Luft-Verkehrs Gesellschaft had by 1914 successfully evolved a way to make a forward-firing machine gun able to fire between the revolving blades of a propeller without damaging them. Saulnier's device was, admittedly, of little



This military version of the Breguet biplane was known familiarly to the Royal Flying Corps as the "Tin Whistle". *[H. J. Nowarra*

This familiar but historic picture shows a Beardmore-built Sopwith Pup undergoing trials of deck arrester gear.

practical combat value, since the gun would only synchronise with one given engine speed, but Schneider, who patented his synchronisation gear in July 1913, later installed it in an improved form in the L.V.G. E.VI monoplane of 1915. The E.VI prototype was unfortunately destroyed on its way to the front for operational trials, but it has the distinction of being the first German aircraft to be fitted with a synchronised forward-firing machine gun.

When war broke out in August 1914, the two largest European air arms were those of France and Germany. France's *Aviation Militaire* had a strength of some 160 aircraft and 15 airships. The Imperial German Military Air Service had 246 aircraft, about half of which were *Tauben*, a type mass-produced by several German manufacturers in the immediate pre-war years, and 7 Zeppelin airships; the Imperial Naval Air Service had 36 seaplanes and 2 Zeppelins. Germany, more than any other country, was a devotee of the airship, through the influence of Count von Zeppelin, who was chiefly responsible for the extensive airship production programme already under way before the war. By contrast, Germany's chief ally, Austro-Hungary, had only 1 airship in addition to its 36 assorted aircraft.

In the early months of the war, much of the burden of Allied aircraft production and deployment fell upon France. Britain, Russia and Belgium had no aircraft industries yet worthy of the name, and their aircraft inventories included a high proportion of French types. There were less than 20 aircraft, all reconnaissance types, in Belgium when that country was invaded on 4th August; to augment these, any suitable civilian machines were impressed for war service, and a few additional Farmans were purchased from France. Many of the Belgian aircraft were lost in the initial German onslaught, but those that survived performed useful reconnaissance work in the Ostend and Dunkirk areas. A motley collection of 244 aircraft, many of them French, made up the front-line strength of the Imperial Russian Air Service, to which the Imperial Russian

Navy could add only a comparatively small quantity of flying boats and float-planes. The Royal Naval Air Service, although it carried out early bombing raids in October and November using such pre-war British types as the Sopwith Tabloid and Avro 504, was still regarded primarily as a home defence force rather than a combat arm. The Royal Flying Corps arrived in France with 73 aircraft, most of which were fit only for observation or artillery co-operation duties.

Thus, many of the first aerial events involving Allied aircraft were performed by French types. Two French aircraft carried out the first bombing attack of the war, when they attacked the Zeppelin hangars at Metz-Frascaty on 14th August, 1914, and a French Voisin bomber scored the first aerial victory when it shot down a German Aviatik two-seater on 5th October. The value of the aeroplane as a reconnaissance medium was also proved quickly when a French machine, by reporting the movement of von Klück's army toward the Marne on 3rd September, 1914, enabled the attack to be anticipated.

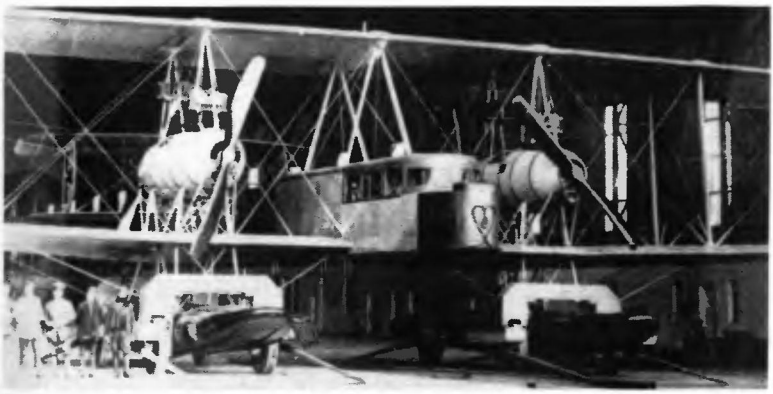
The Fokker Dr.I was produced as an "answer" to the Sopwith triplane, but was a much less successful fighter. *[I.W.M.*

The first concerted move towards using the aeroplane as an offensive weapon came in the autumn of 1914, when the *Aviation Militaire* began to create a French bombing force equipped mostly with Voisins. By the end of the year a similar force was being prepared, from the unexpected direction of Russia. The embryo Russian aircraft industry, although it was slow to expand in size, possessed plenty of design talent. The Ivanov-built Voisins had been a wretched failure, but better Russian designs appeared in the form of the Lebedoff and Anatra types, and Igor Sikorsky designed one or two fighters which were built in small numbers; but a much more important development was Sikorsky's *Ilya Mourometz*, the world's first four-engined bomber. This had flown for the first time in January 1914 and passed its official acceptance trials in the following October. The first squadron of these bombers had formed by the end of the year, and in February 1915 carried out its first bombing attack.

Meanwhile, on 24th May, 1915, Italy had entered the war on the side of the Allies. The *Corpo Aeronautica Militare* then possessed 89 aircraft and 3 airships,

while the Italian Navy had 17 seaplanes and 2 airships. The aircraft, mostly French in origin, were principally reconnaissance types.

The year 1915 was to see the first general acceptance by the warring powers that the aeroplane was a weapon in its own right and not simply a means of observing activities on the ground. By May 1915 the Royal Flying Corps had 2,260 aircraft on order, and France too was building up both her bomber and her fighter strength. A sustained bombing campaign with Voisin bombers was initiated in May, and this force eventually totalled 60 squadrons, each with 10 aircraft. The *Escadrilles de Chasse* were formed initially with Morane-Saulnier Types L and N monoplanes, and it was an aeroplane of the former type which inadvertently brought about the Fokker " scourge " later in the year. Raymond Saulnier, having temporarily abandoned his work on gun synchronisation, had developed instead a propeller fitted with steel deflector plates to divert the passage of any bullets that happened to strike the blades. Unfortunately for the Allies, Roland Garros, the first airman to fly a Morane equipped with this device, had to force-land behind enemy lines in April, only a few weeks after he received his machine. He was unable to destroy the Morane, and soon it was being closely studied by German experts. The outcome of this incident was the appearance over the Western Front in July 1915 of the Fokker E type monoplanes, armed with forward-firing machine guns and the first fully-practical interrupter gear to be used in aerial combat. For most of the remainder of that year, these German fighters wrought havoc among the slow and unmanoeuvrable Allied aircraft which they encountered, and the menace continued virtually unchecked until the first Nieuport 11s began to appear towards the end of the year. The beginning of Zeppelin air attacks on Great Britain at the end of May, which had caused many R.F.C. and R.N.A.S. aircraft to be recalled from the Western Front for Home Defence duties, contributed indirectly to the success



Germany's only successful giant bomber was the Zeppelin (Staaken) R.VI. Above is one of these machines mounted on two enormous floats, in which form it was known as the Type L. *[H. J. Nowarra*

of the Fokker monoplanes during the summer months. Zeppelin production was increased in 1915, when 14 were ordered for the Military Air Service and 12 for the Naval Air Service. Because of the Fokkers' air superiority, fighters and armed two-seaters were obliged to accompany Allied bomber formations as escorts. This method of protecting the bombers was reasonably effective, at any rate until the introduction of the German fighter " circuses " a year or so later.

By the winter of 1915–16 the balance of air power in Europe was beginning to swing back in favour of the Allies. The Nieuport 11 had entered French service late in 1915, and with the Royal Flying Corps in March 1916. In the latter service it was joined by the D.H.2 and F.E.2b, both relatively slow pusher types, though a distinct improvement over the " Fokker fodder " B.E.2c of the year before. However, the situation improved with the arrival of the first Bristol Scouts and Sopwith 1½-Strutters armed with synchronised machine guns. Growing Allied air strength also began to be evident in the marked increase in bombing activities, not only by Britain and France against Germany, but by the Italian air service flying across the Alps to strike at targets in Austro-Hungary.

Russia's *Ilya Mourometz* four-engined bomber was in existence before the outbreak of World War I. Above is the Type E prototype, photographed in 1916.

[H. J. Nowarra

Like Russia, Italy had been quick to see the potentialities of the heavy bomber, and the large Capronis were used in increasing numbers as 1916 went on. Apart from these, the Italian air services relied heavily, as did most of the other Allies, on French equipment, although there was a rapid expansion of Italian domestic output from 1916 onwards, mostly of French types built under licence.

Germany retained its faith in the Zeppelin as the medium for such activities, although the Military Aviation Service cut its order for 1916 to only 9 airships. The Navy, however, ordered 14 Zeppelins in 1916, and continued to be a thorn in the Allies' flesh in the Mediterranean and North Sea. By the end of 1916, Germany began to regain its former air supremacy, partly by the quality of new aircraft such as the Albatros single-seaters and partly by sheer weight of numbers. German aircraft production in 1916 amounted to more than 8,000 machines, almost twice its output in the previous year. Moreover, France was now beginning to feel the strain of supplying her allies, and in November 1916 had only 1,418 front-line operational aircraft. Only 253 of these were bombers; 328 were fighters, and only 28 of the fighters were relatively modern Spad VIIs.

Early in 1917, the German Navy ordered another 22 Zeppelins, and the Military Air Service began daylight air raids on Great Britain with twin-engined A.E.G. and Gotha G type bombers. The peak period of German air activity over the Western Front, however, came in April 1917—"Bloody April"—when, in a month of bitter and intensive air fighting, large numbers of Allied aircraft were shot down. On 6th April, the United States entered the war. Numerically, its total aircraft strength was roughly on a par with that possessed by Russia three years earlier, and the U.S. aircraft industry, although it had contributed a large number of training machines to the Allied war effort in earlier years, had had virtually no experience of designing or building operational aircraft. Wisely, therefore, it concentrated its activities for the remainder of the war on building trainers and flying boats, selecting its combat aircraft from already proven types of French, British or Italian origin.

In the summer of 1917 the German Gotha raids on Britain increased, but the Home Defence force resisted them with reasonable success until they were finally abandoned in May 1918. To a large extent this was due to the high-quality British fighters then coming into service, such as the S.E.5a and the Bristol F.2B which, with the Camel and the new Spad XIII, were also to be chiefly responsible for the recovery of Allied air superiority in Europe. This began in the autumn of 1917 and, except for a brief period following the appearance of the renowned Fokker D.VII in the summer of 1918, was sustained until the end of the war. In the spring of 1918, Germany concluded a peace treaty with Russia (whose air force, disrupted by the Revolution in the previous November, could no longer be regarded as a serious weapon), and an armistice with Rumania. Relieved of military commitments on these fronts, she threw all her remaining strength against France and Britain. However, when the German offensive was turned into retreat after the Battle of the Marne in July, the final outcome was only a matter of time.

On 5th June, 1918, Britain established the Independent Force to mount a strategic offensive against Germany. This force was equipped principally with Handley Page O/100s and O/400s—the latter, towards the end of the war, carrying a 1,650 lb. bomb—the largest developed up to that time. A considerable contribution was also made by the U.S. Navy, which, despite its brief period of operational service, dropped 126,302 lb. of bombs on enemy targets. There had been American volunteers serving in Europe since 1915, but the first operational squadron of the American Expeditionary Force was not formed in France until February 1918, when the celebrated *Escadrille Lafayette* became the 1st Aero Squadron of the A.E.F. From then until the end of the war, the A.E.F. boasted no less than 71 U.S. aces (pilots with 5 or more victories) and claimed a total of 781 enemy aircraft destroyed. It still remained predominantly French-orientated as regards equipment, 4,880 of the aircraft delivered—about three-quarters of the overall total—being of French origin.

Germany and Austro-Hungary made tremendous efforts in the final year of war to overtake the Allies' output of aeroplanes, and by the Armistice Austro-Hungary had built 5,431 aircraft and 4,346 engines; Germany had built 47,931 aircraft, over 19,700 of them in 1917 alone. Of the overall German total, 25,057 were reconnaissance or observation types and 12,207 were fighters. At the Armistice, the German Military Aviation Service had 4,050 aircraft in front-line service, though the total number actually surrendered by it and the Naval Air Service, together with those awaiting delivery, was in the region of 15,000.

On the Allied side, in November 1918 France possessed 1,392 fighters, 479 bombers—nearly half of them Breguet 14s—and 1,566 reconnaissance/observation types on the Western Front alone, and could justly be regarded as the

The Fokker D.VII was the most widely used German fighter during 1918. [I.W.M.

best-equipped air force in Europe at that time. The French aero industry, between August 1914 and the end of December 1918, turned out 24,652 aircraft and 92,594 aero-engines, a very high proportion of these having been built for other Allied air forces. (Less than 10 per cent of the aircraft built in the United States for the A.E.F. actually reached France.) Italy, too, had developed a healthy home industry, with 7 major manufacturers, and a high proportion of its 1,778 aircraft in hand at the end of the war were of home design and manufacture. Great Britain, from a position of having scarcely any aviation industry when the war started, had by 1918 employed no less than 34 manufacturing companies in the building of aircraft for the war effort. Many of these did not remain in the industry after the war, but several now-famous names such as Avro, Armstrong Whitworth, de Havilland and Vickers firmly established their reputations by their efforts during the first war in the air.

[I.W.M.

A.E.G. C.IV

Country of origin: **GERMANY.**
Purpose: **Armed reconnaissance and artillery observation.**
Makers: **Allgemeine Elektrizitäts Gesellschaft.**
In operational use: **1916/18.**

One of the principal types chosen for production under the expansion programme for armed reconnaissance two-seaters early in 1916, the A.E.G. C.IV appeared for the first time in the spring of that year. Its wide-span wings and deep, stubby fuselage gave it a distinctive appearance, and it subsequently became one of the best known German observation types, some remaining in service until the end of the war. An individual production figure for the C.IV does not seem to have survived, but a total of 658 of the various C-type A.E.G. designs was built, among which the C.IV was by far the most important model; an output in the region of 400 would not therefore seem unreasonable. These were built by Fokker's Schwerin factory as well as by the A.E.G. works near Berlin. The A.E.G. C.IV was armed with a forward Spandau machine gun firing through the propeller disc, and a ring-mounted Parabellum gun in the rear cockpit. The latter could also accommodate a light bomb load as occasion required. German reconnaissance units flew the C.IV on the Western Front, in Italy and in Macedonia, and it was also employed by the Bulgarian and Turkish air forces. Some German C.IV's were used as escorts to others of their type on reconnaissance missions. The aircraft's main drawback was the inadequate power of the Mercedes D.III engine for a machine of its size, and this led to the appearance of the C.IVa, powered by a 180 h.p. Argus, and another variant (possibly the C.VI) with a 200 h.p. Benz. Late in 1916 there appeared the C.IV N night bomber, with span increased to 50 ft. 2⅜ in., a 660 lb. bomb load and 150 h.p. Bz.III engine; but this remained a prototype only.

BRIEF TECHNICAL DETAILS (C.IV):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 44 ft. 1⅞ in.
Length: 23 ft. 5½ in.
Height: 10 ft. 11⅞ in.
Weight Empty: 1,760 lb. *Loaded:* 2,469 lb.
Max Speed: 98 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 4 hr.
Armament: One fixed forward-firing Spandau and one free-firing Parabellum machine gun; up to 200 lb. of bombs.

G. III (foreground) [*I.W.M.*

A.E.G. G types

Country of origin: **GERMANY.**
Purpose: **Bomber.**
Makers: **Allgemeine Elektrizitäts Gesellschaft.**
In operational use: **1915/18.**

First of the A.E.G. *Grossflugzeuge* to appear was the G.I (originally designated K.I), which was produced early in 1915. Powered by two 100 h.p. Mercedes D.I engines, this was a three-seat general purpose type and was built in limited numbers only. It was followed in the summer of 1915 by the G.II, a somewhat larger aircraft with 150 h.p. Benz engines and capable of carrying a 440 lb. bomb load. Again production was not extensive. Some G.II's had a single vertical fin and rudder, other aircraft being completed with triple rudders. In December 1915 appeared the G.III, further enlarged and powered by 220 h.p. Mercedes D.IV geared engines and four-blade opposite-rotating propellers. The G.III was armed with two defensive machine guns and could carry up to 660 lb. of bombs, but this, like its predecessors, was built only in small quantities. Major production was reserved for the G.IV, which was first encountered operationally towards the end of 1916. With a Parabellum machine gun in each of the front and rear cockpits, the G.IV was powered by 260 h.p. Mercedes engines, and the useful bomb load was increased to a total of 880 lb. Because of this comparatively modest capacity and a limited range, the G.IV became employed chiefly for short range tactical bombing or photographic reconnaissance rather than long range bombing. The G.IVb was an experimental three-bay version, and the G.IVk (for *kanone* = cannon) was another prototype with a nose-mounted 20 mm. Becker cannon. Final A.E.G. G type was the G.IV, which had just begun to enter service when the war ended. Distinguished by its biplane tail unit, the G.V utilised the same powerplant as the G.IV but could carry up to 1,320 lb. of bombs. Individual production figures are not available, but by far the greater proportion of the 542 G types built were of the G.IV version.

BRIEF TECHNICAL DETAILS (G.IV):
Engines: Two 260 h.p. Mercedes D.IVa inlines.
Span: 60 ft. 2⅝ in.
Length: 32 ft. 3¾ in.
Height: 12 ft. 9½ in.
Weight Empty: 5,280 lb. *Loaded:* 8,003 lb.
Max. Speed: 103 m.p.h. at sea level.
Ceiling: 13,100 ft.
Duration: 4 hr. 30 min. approx.
Armament: Two free-firing Parabellum machine guns.

[*I.W.M.*

Airco D.H.2

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **Aircraft Manufacturing Co.**
In operational use: **1916/17.**

The D.H.2 has the distinction of having formed the equipment of the first-ever single-seat fighter squadron of the R.F.C.—No. 24—and was a progressive development of Geoffrey de Havilland's earlier D.H.1. A strongly-built aeroplane, it was comparatively clean aerodynamically for a "pusher" aeroplane and very responsive on the controls. The latter factor required fairly experienced pilot handling, for in its early days several D.H.2's and their pilots were lost through involuntary spins, a little-understood phenomenon at the time from which the pilot could not recover. The prototype D.H.2 appeared in the summer of 1915, and the type began to enter service early in the following year, a total of 400 being built for the R.F.C. An unorthodox and unsatisfactory gun mounting on the prototype was replaced in production D.H.2's by one in which up-and-down elevation was the only movement possible; but in practice pilots tended to regard the gun (a Lewis) as a fixed weapon, and aimed the complete aircraft at their target. The D.H.2 established a fine reputation on the Western Front, being the fighter mainly responsible for overcoming the so-called "Fokker scourge" and establishing, for a time at least, British air supremacy in this theatre of war. The main shortcomings of the D.H.2 were that the pilot was excessively exposed to the elements (and enemy fire), and that its rotary engine was somewhat unreliable: if a cylinder blew out, as it often did, it was apt to burst through the flimsy "fuselage" and cause the aeroplane to crash. Due to the delay in producing a suitable replacement, the D.H.2 was retained in the front line long after its performance had been surpassed by enemy fighters, and losses were correspondingly heavy. It was not finally withdrawn until mid-1917, after service in Macedonia and Palestine as well as in Europe and at home.

BRIEF TECHNICAL DETAILS:

Engine: One 100 h.p. Gnome Monosoupape rotary.
Span: 28 ft. 3 in.
Length: 25 ft. 2½ in.
Height: 9 ft. 6½ in.
Weight Empty: 943 lb. *Loaded:* 1,441 lb.
Max. Speed: 93 m.p.h. at sea level.
Ceiling: 14,500 ft.
Duration: 2 hr. 45 min.
Armament: One fixed, forward-firing Lewis machine gun.

[I.W.M.

Airco D.H.4

Country of origin: **GREAT BRITAIN.**
Purpose: **Bomber.**
Makers: **Aircraft Manufacturing Co.**
In operational use: **1917/18.**

Generally accepted as being the best single-engined day bomber to serve with any of the combatants in World War I, the de Havilland (Airco) D.H.4 first flew as a prototype at Hendon in August 1916. Its flying qualities, speed and performance generally were excellent, and were the basis of the success achieved by this competent two-seater, 1,449 of which were subsequently built in Britain. The D.H.4 was a well designed and strongly built aeroplane, and was fast enough to outrun all but the speediest German fighters. If it had a serious fault at all, this was probably the unusually great distance between the front and rear cockpits, which made communication between pilot and observer during operations difficult if not actually impossible. This layout had been adopted to give the pilot the best possible view downward past the bottom wing for aiming the 460 lb. of bombs which the D.H.4 could carry. The prototype had been powered by a 230 h.p. B.H.P. engine, but it was decided to instal the 250 h.p. Rolls-Royce Eagle in production aircraft. However, a serious shortage of Rolls-Royce engines led to some production batches being completed with 200 h.p. R.A.F.3a, 230 h.p. Puma or 260 h.p. Fiat A.12 engines. D.H.4's in R.F.C. service were armed normally with a fixed, synchronised forward gun for the pilot and one or two free-firing Lewis guns in the observer's cockpit. Those with R.N.A.S. squadrons had twin Vickers guns for the pilot and could carry depth charges instead of bombs. Some R.N.A.S. D.H.4's were later transferred to the R.F.C. Two D.H.4's were experimentally fitted with 1½-pounder C.O.W. guns, firing upward through the centre-section; these were intended for attacking Zeppelins, but Germany suspended airship raids on Britain and this version was not produced in quantity. The other major wartime user of the D.H.4 was the American Expeditionary Force, for whom nearly 5,000 of these aircraft were built with 400 h.p. Liberty 12 engines; nearly 2,000 of these reached France, and over 600 were in front-line service when the war ended. Apart from its career on the Western Front, the D.H.4 also gave useful service in Italy, Macedonia, Mesopotamia, Palestine and Russia.

BRIEF TECHNICAL DETAILS:

Engine: One 375 h.p. Rolls-Royce Eagle VIII inline.
Span: 42 ft. 4½ in.
Length: 30 ft. 8 in.
Height: 10 ft. 0 in.
Weight Empty: 2,387 lb. *Loaded:* 3,472 lb.
Max. Speed: 143 m.p.h. at sea level.
Ceiling: 22,000 ft.
Range: 435 miles.
Armament: One or two fixed, forward-firing Vickers and one or two free-firing Lewis machine guns; up to 460 lb. of bombs or depth charges.

[I.W.M.

Airco D.H.9

Country of origin: **GREAT BRITAIN.**
Purpose: **Bomber.**
Makers: **Aircraft Manufacturing Co.**
In operational use: **1918.**

The D.H.9 should have been an improvement over the excellent D.H.4, and enough was expected of it that a number of D.H.4 contracts were actually altered to specify D.H.9's. This explains why the numerical output of the later machine was more than double that of its predecessor, despite its obvious inferiority. The D.H.9 was most succinctly described by one cynical observer as " a D.H.4 which has been officially interfered with ". The " interference " chiefly concerned the selection for the D.H.9 of the unproven (and, later, highly troublesome) Siddeley Puma engine, a modified form of the B.H.P. which had powered the prototype D.H.4. This engine was installed rather untidily, with protruding cylinder heads which gave the D.H.9 a somewhat Germanic appearance. The large numbers in which the type was ordered resulted from the decision in mid-1917 to almost double the strength of the R.F.C. bomber force, after the beginning of German bomber raids against London had proved overwhelmingly the value of this form of warfare. But for its engine, the D.H.9 would have been a good aeroplane—the D.H.9A proved this—but it did at least offer one improvement over the D.H.4 in that the two cockpits were placed closer together. This improved pilot/observer communication, although at some expense to the former's view forward and downward. One fixed, synchronised Vickers gun was mounted forward and to the left of the pilot, while the observer was given one or two Lewis guns on a Scarff ring mounting. Bomb load was the same as for the D.H.4. A total of 3,204 British-built D.H.9's were completed, by 16 manufacturers, serving with 12 squadrons on the Western Front and in Macedonia and Palestine. Eighteen were supplied to Belgium, and small quantities also to Russia and to the U.S. Naval Northern Bombing Group in France. America planned to build no less than 14,000 D.H.9's, with 400 h.p. Liberty 12 engines, but only four were completed before the Armistice, when outstanding contracts were cancelled.

BRIEF TECHNICAL DETAILS:
Engine: One 230 h.p. Siddeley Puma inline.
Span: 42 ft. 5 in.
Length: 30 ft. 6 in.
Height: 11 ft. 2 in.
Weight Empty: 2,203 lb. *Loaded:* 3,669 lb.
Max. Speed: 111 m.p.h. at 10,000 ft.
Ceiling: 15,500 ft.
Duration: 4 hr. 30 min.
Armaments: One fixed, forward-firing Vickers and one or two free-firing Lewis machine guns; up to 460 lb. of bombs.

[I.W.M.

Airco D.H.9A

Country of origin: **GREAT BRITAIN.**
Purpose: **Bomber.**
Makers: **Westland Aircraft Ltd.**
In operational use: **1918.**

Thanks to a much more satisfactory powerplant, the D.H.9A vindicated the basic design and unhappy service record of the earlier D.H.9 and was to become a standard R.A.F. day bomber for more than a decade after the end of World War I. From the combat point of view it made only a brief contribution to the war, for although up to the end of the war 885 " Nine-Acks " had been built, the type saw only some two months of active service. The D.H.9A prototype was a converted D.H.9 airframe, adapted to take a 375 h.p. Rolls-Royce Eagle VIII, although the chosen powerplant was the American Liberty 12, of which 3,000 examples had been ordered by Britain. These were somewhat late in arriving, and some early production D.H.9A's also had Eagle engines. Compared with the D.H.9, the D.H.9A was given a frontal radiator, wings of increased span and chord, and a wire-braced fuselage in place of the D.H.9 system of plywood bulkheads. The entire development and production was carried out by Westland Aircraft Ltd., so as to leave Airco free to concentrate on the D.H.10 bomber project. Defensive armament remained the same as for the D.H.9, but the maximum bomb load of the D.H.9A was increased by over 45 per cent and the overall performance was considerably better. First R.A.F. squadron to receive the D.H.9A, in June 1918, was No. 110, which arrived in France on the last day of August. By the Armistice, only four squadrons had received D.H.9A's. The type was also built in Russia with a local equivalent of the Liberty, and in the U.S.A. nine USD-9A's were completed before the Armistice. Contracts for a further 3,991 were then cancelled.

BRIEF TECHNICAL DETAILS:

Engine: One 400 h.p. Liberty 12 inline.
Span: 45 ft. 11 in.
Length: 30 ft. 3 in.
Height: 11 ft. 4 in.
Weight Empty: 2,800 lb. *Loaded:* 4,645 lb.
Max. Speed: 123 m.p.h. at sea level.
Ceiling: 16,750 ft.
Range: 620 miles.
Armament: One fixed, forward-firing Vickers and one or two free-firing Lewis machine guns; up to 660 lb. of bombs.

B.II [I.W.M.

Albatros B.I and B.II

Country of origin: **GERMANY.**
Purpose: **Unarmed reconnaissance and training.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1914/18.**

A mainstay of German air force observation units during the first year or more of the war, the Albatros unarmed two-seater remained in service throughout the conflict, and production of a training variant was ordered as late as 1917. The type which became known as the B.I when it was impressed for war service was actually of pre-war origin, appearing early in 1914 in both single-bay and two-bay forms and powered either by a 100 h.p. Mercedes or a 110 h.p. Benz engine. Albatros B.I's were also built by the Kondor, OAW and Refla companies. The B.II was also of pre-war origin, an aircraft of this type having established an altitude record of 14,764 ft. in the summer of 1914. A strongly-built aircraft, it was smaller than the B.I but, like its predecessor, had the " reversed " (i.e., pilot in the rear cockpit) seating arrangement common during the early days of the war. It was extremely popular with its crews and was used extensively by German reconnaissance units on both the Eastern and Western Fronts. It was principally due to the handling qualities of the B.II that a dual-control training version, the B.IIa, was ordered into widespread production in 1917 by the Bayerische Flugzeugwerke, L.F.G. Roland, Linke-Hofmann, Kondor and Mercur factories. These manufacturers, apart from Kondor, also contributed to B.II production. A few B.II's were delivered to Austro-Hungary, which are thought to have been fitted with machine guns, but normally the Albatros B types were unarmed save for small-arms carried by the observer. The B.I's and B.II's were withdrawn from front-line service towards the end of 1915 following the arrival of C class armed two-seaters. A small batch of B.III's were built in 1915; these had 120 h.p. Mercedes D.II engines and resembled the B.II except for redesigned tail surfaces. About 15 examples were built of a floatplane version of the B.II, which was designated W.1.

BRIEF TECHNICAL DETAILS (B.II):
Engine: One 100 h.p. Mercedes D.I inline.
Span: 42 ft. 0 in.
Length: 25 ft. 0⅜ in.
Height: 10 ft. 4 in.
Weight Empty: 1,591 lb. *Loaded:* 2,361 lb.
Max. Speed: 65 m.p.h. at sea level.
Ceiling: 9,840 ft.
Duration: 4 hr.
Armament: None.

[I.W.M.

Albatros C.I

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and general purpose.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1915/17.**

Appearing in the spring of 1915, the Albatros C.I was basically an adaptation of the unarmed B.II to the newly-conceived C class of armed two-seater. The major differences between it and the B.II lay in the more powerful engine of the C.I and the reversal of the crew positions from those in the unarmed version. A variety of engines were fitted in Albatros C.I's—the 150 h.p. Bz.III, the 160 h.p. Mercedes D.III or the 180 h.p. Argus As.III—and because of their greater power the C.I's airframe was slightly bigger than that of the B.II. The observer, now transferred to the rear cockpit, was furnished with a ring-mounted Parabellum machine gun, and view from this position was improved, compared with the B.II, by an enlarged dual-curve cutout in the upper wing centre-section. Albatros C.I's were built by the parent company and by OAW, and were widely used on both Eastern and Western Fronts during the middle years of the war. Like the B types before them, their robust construction and pleasant handling qualities made them popular with the crews who flew them on reconnaissance, bombing, photographic and artillery observation duties. A cleaned-up version, built also by Bayerische Flugzeugwerke, L.F.G. Roland and Linke-Hofmann, was the C.Ia, in which a leading-edge box radiator was fitted in place of the H. & Z. fuselage radiators of the C.I. The C.Ib was a trainer version, with dual controls, a cleanly-installed Mercedes D.III of 160 h.p. and a horizontal exhaust manifold on the starboard side. This version was built in 1917 by the Mercur Flugzeugbau of Berlin.

BRIEF TECHNICAL DETAILS (C.I):
Engine: See text.
Span: 42 ft. 3⅞ in.
Length: 25 ft. 9 in.
Height: 10 ft. 3⅛ in.
Weight Empty: 1,925 lb. *Loaded:* 2,624 lb.
Max. Speed: 87 m.p.h. at sea level.
Ceiling: 9,840 ft.
Duration: 2 hr. 30 min.
Armament: One free-firing Parabellum machine gun.

[I.W.M.

Albatros C.III

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and artillery co-operation.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1916/17.**

A sturdier and more compact development of the earlier C.I and C.Ia, the Albatros C.III entered service towards the end of 1916 and became the most widely built and used member of the Albatros range of C types. It was employed chiefly for armed reconnaissance or, with up to 200 lb. of small bombs, on artillery co-operation duties. The bombs were carried in a drum-shaped container built vertically into the fuselage between the front and rear cockpits. Early production C.III's were armed only with a single Parabellum machine gun, on a ring mounting in the rear cockpit, but later machines were also given a Spandau front gun for the pilot which, due to imperfect synchronisation, gave a certain amount of trouble when fired. Nevertheless, the C.III gave a good account of itself in combat, and was capable of withstanding fairly heavy punishment. The chief outward difference between the C.III and its predecessors, apart from the more substantial fuselage, lay in the redesigned horizontal tail surfaces. These had the "fishtail" contours later to become a familiar feature of other Albatros designs, and afforded the C.III distinctly better controllability than the C.I. A 150 h.p. Bz.III engine powered the C.III prototype, but most of the production aircraft adopted the Mercedes D.III as standard. The C.III was built by O.A.W., D.F.W., Hansa, Linke-Hofmann, L.V.G. and Siemens-Schuckert, as well as by the parent company. A small quantity was also built of the C.VI, very similar to the C.III except for a 180 h.p. Argus As.III engine; and the W.2 was a twin-float adaptation of the C.III, the only example of which was delivered to the German Navy in June 1916.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Mercedes D.III inline.
Span: 38 ft. 4⅝ in.
Length: 26 ft. 3 in.
Height: 10 ft. 2 in.
Weight Empty: 1,872 lb. *Loaded:* 2,983 lb.
Max. Speed: 87 m.p.h. at sea level.
Ceiling: 11,100 ft.
Duration: 4 hr.
Armament: One Parabellum and (later) one Spandau machine gun; up to 200 lb. of bombs.

[I.W.M.

Albatros C.VII

Country of origin: **GERMANY.**
Purpose: **Reconnaissance, bomber and artillery observation.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1916/17.**

To counteract the lack of success attending the C.V, due to development troubles with the Mercedes D.IV engine, the Albatros Werke decided to produce an interim C type utilising as much as possible of the C.V's airframe in conjunction with a more reliable powerplant. The engine selected was the proven Benz Bz.IV, and the resultant aeroplane was designated C.VII. As things turned out, the different dimensions of the Benz engine necessitated a fair amount of fuselage redesign, and a return was made to the " ear " type of radiator installation employed in the C.V/16. The upper wing of the C.VII was, in effect, that of the C.V/17 minus its radiator, while the lower wing was similar to that of the C.V/16. The C.VII could also be distinguished by the engine cylinder block, which protruded over the cowling much more than that in the C.V. Armament of the C.VII consisted of a Spandau gun fixed on the starboard side of the engine and firing through the propeller arc, and a ring-mounted Parabellum gun for the observer. For tactical missions a light bomb load (probably about 200 lb.) could be carried as well. Flying qualities of the C.VII were good, and it was easier than most two-seaters of its time to land. Hence it became well liked by its crews when it was introduced into service towards the end of 1916. By February 1917, no fewer than 350 C.VII's were recorded in service on all fronts, and the type was built by OAW and Bayerische Flugzeugwerke as well as by the parent company. One example was completed in 1917 of the C.VIII N, a three-bay development of the C.VII with a 54 ft. 11⅛ in. wing span and 160 h.p. D.III engine. Intended for night bombing, it was seriously underpowered and did not go into production.

BRIEF TECHNICAL DETAILS:
Engine: One 200 h.p. Benz Bz.IV inline.
Span: 41 ft. 11¼ in.
Length: 28 ft. 6½ in.
Height: 11 ft. 9⅜ in.
Weight Empty: 2,176 lb. *Loaded:* 3,410 lb.
Max. Speed: 106 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr. 20 min.
Armament: One fixed Spandau and one free-firing Parabellum machine gun.

C. XII [I.W.M.

Albatros C.X and C.XII

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and artillery observation.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1917/18.**

The Albatros C.VII, successful though it was, had been essentially a stop-gap between the unfortunate C.V and a new type to be powered by the much-improved Mercedes D.IVa water-cooled engine. The new design emerged late in 1916 as the C.X, joining the C.VII in service in the early part of 1917. Of generally similar configuration, it was somewhat larger and heavier overall, with a deeper and wider fuselage and increased-span wings with more streamlined tips and double ailerons. A cleaner fuselage resulted from the elimination of the "ear" radiators of the C.VII in favour of a streamlined box radiator in the upper wing centre-section. Armament remained the same as for the C.VII. A handsome machine, the C.X was built in substantial numbers by Albatros, Bayerische Flugzeugwerke, L.F.G. Roland, Linke-Hofmann and OAW, and 300 were in service in October 1917. By this time the C.X was beginning to be joined by its successor, the Albatros C.XII. This introduced various refinements, but the most noticeable were the new elliptical-section fuselage (with an underfin supporting the tailskid) and a tailplane reduced considerably in area. These features clearly owed their inspiration and outline to the D series of Albatros fighters. Apart from L.F.G. Roland, the same group of sub-contractors built the C.XII as had produced the C.X, and the later type served in substantial numbers on the Western Front until the Armistice. A smaller derivative, the C.XIV, was flown in the spring of 1918 with a 220 h.p. Bz.IVa and staggered wings. The prototype was then converted to a C.XV by having a rectangular cutout in the upper wing, overhung ailerons and a slight increase in size. Production of the C.XV began in mid-1918, but only a handful entered service.

BRIEF TECHNICAL DETAILS (C.XII):
Engine: One 260 h.p. Mercedes D.IVa inline.
Span: 47 ft. 1⅛ in.
Length: 29 ft. 0⅛ in.
Height: 10 ft. 8 in.
Weight Empty: 2,246 lb. *Loaded:* 3,616 lb.
Max. Speed: 109 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr. 15 min.
Armament: One fixed Spandau and one free-firing Parabellum machine gun; small bomb load optional.

D.I [I.W.M.

Albatros D.I and D.II

Country of origin: **GERMANY.**
Purpose: **Single-seat fighting scout.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1916/18.**

Operational for the last two years of the war, the Albatros D.I and the essentially similar D.II were first introduced into service in the autumn of 1916 as a gradual replacement for the single-seat Fokker and Halberstadt scouts. Design of the D.I originated with the 1914 Albatros racing biplane, and was to some extent unorthodox for its time in employing a semi-monocoque fuselage of all-wooden construction. The unequal-span wings also had a wood framework, but were fabric-covered. The typical Albatros tail assembly and bulbous spinner combined to give the D.I a characteristically " fishy " appearance. Early production aircraft normally carried a single forward-firing machine gun; later attempts to instal a second gun incurred wing-loading penalties and had a detrimental effect on the fighter's performance. In general, however, the D.I was a good fighter for its time and in particular boasted an excellent climb rate which helped give it ascendancy over the D.H.2's, B.E.2c's and Nieuports which were its principal opponents when it first came into service. Albatros D.I's were built with either the 150 h.p. Bz.III or 160 h.p. D.III engine, but the latter powerplant was standardised for the D.II which followed them into service during the winter of 1916–17. Other improvements in the D.II included a modified cabane which improved the view from the cockpit by reducing the gap between the upper wing and the fuselage. Production of the D.II was also undertaken by L.V.G. at Koeslin, and the Oeffag company at Wiener-Neustadt built twenty with 185 h.p. Austro-Daimler engines for the Austro-Hungarian forces. At the peak of their involvement, about 250 D.I's and D.II's were in service, being flown by several celebrated German pilots including Boelcke and Richthofen.

BRIEF TECHNICAL DETAILS (D.II):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 27 ft. 10⅝ in.
Length: 24 ft. 3½ in.
Height: 8 ft. 8 in.
Weight Empty: 1,401 lb. *Loaded:* 1,958 lb.
Max. Speed: 108·7 m.p.h. at sea level.
Ceiling: 17,060 ft.
Duration: 1 hr. 30 min.
Armament: Two fixed, forward-firing Spandau machine guns.

[I.W.M.

Albatros D.III

Country of origin: **GERMANY.**
Purpose: **Single-seat fighting scout.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1917/18.**

Basically, the Albatros D.III represented a further stage in the development of the earlier D.I and D.II fighters, incorporating many components of the latter in its construction. Chief differences from the earlier Albatroses were a somewhat more powerful engine and various features culled from captured examples of French Nieuport scouts. Revision of the design was carried out under the direction of Dipl. Ing. Robert Thelen, chief engineer of the Albatros Werke, and perhaps the most noticeable modification was to the wings, which were some 2 feet greater in span and, supported by V struts, did not have the inverse stagger of the earlier Albatros machines. The more powerful Mercedes engine offered a better ceiling and endurance to the D.III for virtually the same all-up weight as the D.II, although the former's top speed was marginally lower than that of its predecessor. Albatros D.III's began to serve operationally with front-line units early in 1917, and by the end of the year nearly 450 were known to be in service. One of the first German units to receive the D.III was Richthofen's *Jasta* 11, and the type was encountered in Macedonia and Palestine as well as on the Western Front. The heyday of the D.III came in the spring of 1917, and during " Bloody April " they took especially heavy toll of the Allied B.E.2c's, which were no match for the faster, more heavily gunned German machines. Later in the year, however, with the appearance of the later Sopwith and Spad fighters and the S.E.5a, the Albatros D.III's found the going appreciably harder and were phased out in favour of the D.V from the same stable. Some late-production D.III's were fitted with D.V-type rudders. The OAW and Oeffag companies also built Albatros D.III's, the latter company installing the 185 h.p. Austro-Daimler engine which increased the top speed to about 115 m.p.h.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Mercedes D.IIIa inline.
Span: 29 ft. 8⅓ in.
Length: 24 ft. 0⅝ in.
Height: 9 ft. 9⅛ in.
Weight Empty: 1,454 lb. *Loaded:* 1,953 lb.
Max Speed: 108·7 m.p.h at sea level.
Ceiling: 18,050 ft.
Duration: 2 hr. 0 min.
Armament: Two fixed, forward-firing Spandau machine guns.

D. Va [I.W.M.

Albatros D.V and D.Va

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1917/18.**

Lulled into a false sense of superiority by the success of the D.I, D.II and D.III fighters before the appearance of such Allied fighters as the Sopwith Pup and triplane, S.E.5a and Spad single-seaters, the German air force and the Albatros Werke failed to ensure in the next Albatros fighter, the D.V. a sufficient overall improvement in performance to maintain their erstwhile lead in aerial combat. Moreover, both the D.V and the D.Va exhibited weakness in the wing structure when they were dived. Despite this, large quantities were ordered from Albatros and OAW, and at the peak of their career (May 1918) a total of 1,059 aircraft of both types were in service. By September this figure had dwindled to 327. By comparison with the D.III, the D.V had a smaller gap between the fuselage and top wing, in order to improve the pilot's field of view. For similar reasons the headrest behind the cockpit was often removed in the field. The major differences from the D.III, however, were the new oval-section fuselage, bigger spinner and (on production D.V's) fully-rounded rudder. The engine remained the same type, but with an enhanced compression ratio yielded 20 h.p. more than the version powering the D.III. The D.Va was virtually identical to the D.V: outwardly they could be distinguished only by the location of the aileron control wires, which in the D.V ran via the upper wing and in the D.Va via the lower wing. Both the D.V and D.Va saw widespread service, being used on the Western Front, in Italy and in Palestine. Their manufacture was halted in February 1918, when the Albatros Werke was named as a sub-contractor for the Fokker D.VII. Not surprisingly, in view of the numbers in service, Albatros D.V/Va's were flown by many of Germany's leading fighter pilots, including Goering, Hippel, Richthofen and Schleich.

BRIEF TECHNICAL DETAILS:
Engine: One 160/180 h.p. Mercedes D.IIIa inline.
Span: 29 ft. 8⅛ in.
Length: 24 ft. 0⅝ in.
Height: 9 ft. 4⅛ in.
Weight Empty: 1,511 lb. *Loaded:* 2,066 lb.
Max. Speed: 116 m.p.h. at 3,280 ft.
Ceiling: 20,500 ft.
Duration: 2 hr.
Armament: Two fixed forward-firing Spandau machine guns.

[H. J. Nowarra

Albatros W.4

Country of origin: **GERMANY.**
Purpose: **Station defence fighter.**
Makers: **Albatros Werke G.m.b.H.**
In operational use: **1916/18.**

The W.4 was evolved during the summer of 1916 in response to a German Admiralty requirement for a single-seater fighter to defend its naval air bases along the coast of Flanders. It was based very largely on the design of the Albatros D.I landplane fighter, but was somewhat larger. The wooden-framed semi-monocoque fuselage was very similar to that of the D.I, but instead of the latter's underfin the W.4 had a main fin and tailplane of increased area. The single-bay wing cellule was greater in span than the D.I, and also had a deeper gap. Several float designs were tried out on the W.4, the very early ones being square-sectioned and unstreamlined. Floats of a better hydrodynamic shape appeared on subsequent production aircraft. Three W.4's were delivered during the last three months of 1916, and during the following year a further 114 were supplied to the German Navy. As a further aerodynamic improvement, later production W.4's had wing-mounted radiators in place of the earlier fuselage-mounted " ear " type. Despite its float undercarriage, the W.4 had a good turn of speed, and gave a fairly good account of itself until it encountered the later and better armed British flying boats. It was employed mostly over the North Sea off the north-western coast of Europe, although a few W.4's were encountered in the Aegean. The type was gradually replaced by the two-seat Hansa-Brandenburg W.12 from the early summer of 1917, although the final production batch of W.4's was not delivered until the end of that year.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Mercedes D.III inline.
Span: 31 ft. 2⅛ in.
Length: 27 ft. 10⅜ in.
Height: 11 ft. 11⅜ in.
Weight Empty: 1,738 lb. *Loaded:* 2,359 lb.
Max. Speed: 99 m.p.h. at sea level.
Ceiling: 9,840 ft.
Duration: 3 hr.
Armament: One or two fixed forward-firing Spandau machine guns.

Anatra DS [H. J. Nowarra

Anatra D and DS

Country of origin: **RUSSIA.**
Purpose: **Reconnaissance.**
Makers: **Zavod A. A. Anatra.**
In operational use: **1916/18.**

One of the three largest aircraft manufacturing companies in Russia, the Anatra company had suffered no small loss of reputation following the unhappy career of the VI biplane in the early years of World War I. Nevertheless, during 1916 it received substantial orders from the Central Military Technical Board for the Anatra D, a two-seat biplane based on the German Albatros. Designed by Dekar, the Anatra D (or Anade, as it was more popularly known) first entered service in the summer of 1916, an order for 80 aircraft having been placed in the previous April. Much of the VI's reputation rubbed off on the Anade, though the latter was not without its faults, chief among which was a nose-heavy tendency during a glide. To try and overcome this, later machines (designated Anatra Cler) were fitted with the 130 h.p. Clerget rotary engine in place of the 100 h.p. Gnome Monosoupape of earlier models. A further 400 and 300 Anatra D's were ordered in 1916 and 1917 respectively, although only about 205 aircraft of the type were apparently completed. Many crashed through the break-up of their wings in flight, and in mid-1917 the Anatra D began to be supplanted by a later model, the DS, the "S" signifying a Salmson-built Canton-Unné engine. This, like the earlier Anades, suffered from engine cooling difficulties, and only about 100 were completed when production ended with the 1917 revolution. The DS, popularly known as the Anasal, carried a forward-firing 7·62 mm. Vickers gun in addition to the ring-mounted Lewis in the rear cockpit, which was the sole armament of its predecessor. Although the Anatra machines had their faults—some of them serious—they were probably not as lethal as they were claimed to be by some crews, and if handled correctly were no doubt capable of useful service.

BRIEF TECHNICAL DETAILS (DS):
Engine: One 150 h.p. Salmson (Canton-Unné) radial.
Span: 40 ft. 7 in.
Length: 26 ft. 6⅞in.
Height: 10 ft. 5⅝ in.
Weight Empty: 1,800 lb. *Loaded:* 2,566 lb.
Max. Speed 89 m.p.h. at sea level.
Ceiling: 14,100 ft.
Duration: 3 hr. 30 min.
Armament: One fixed Vickers and one free-firing Lewis machine gun.

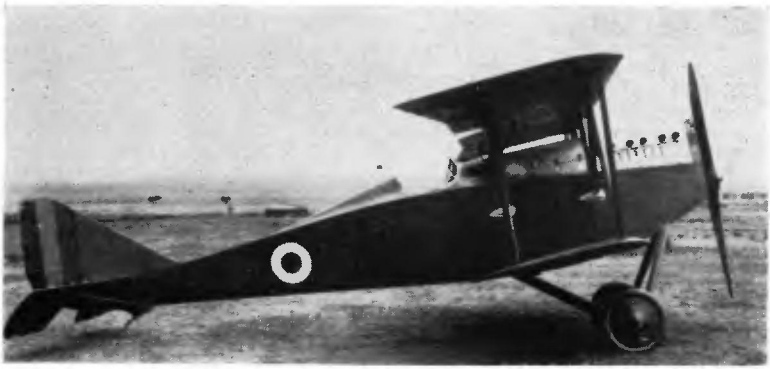
[I.W.M.

Ansaldo A-1 Balilla (Hunter)

Country of origin: **ITALY.**
Purpose: **Fighter.**
Makers: **Società Gio. Ansaldo & Cia.**
In operational use: **1917/18.**

Not until the latter half of 1917 were the fighter squadrons of the Italian air force equipped with a single-seater of Italian design: until that time their equipment had consisted in the main of French-designed Hanriot, Nieuport or Spad types. However, the Ansaldo company began work in the summer of 1917 on the design of a small, single-bay biplane scout powered by a 220 h.p. SPA 6A inline engine, and this aircraft, the A-1, was evaluated by service pilots at Turin during November. The powerful SPA engine gave the A-1 an excellent turn of speed and an excellent rate of climb—it could reach 10,000 ft. in 8 minutes—but, perhaps because of the short-span, broad-chord wings, the fighter's manoeuvrability left much to be desired. Indeed, it was considered inferior in this respect to the foreign fighters already in Italian service. With modifications to try and improve its manoeuvrability, the A-1 was placed in production, and 150 aircraft were built at the Ansaldo works. However, the Balilla remained inferior to the Hanriot HD-1, and never replaced it in front-line fighter units. Most of the A-1's built were employed on home defence or bomber escort duties until the end of the war. The Balilla had a typical armament for the period, in the form of twin Vickers machine guns on the upper engine decking, firing between the propeller blades.

BRIEF TECHNICAL DETAILS:
Engine: One 220 h.p. SPA 6A inline.
Span: 25 ft. 2⅛ in.
Length: 22 ft. 5¼ in.
Height: 8 ft. 3⅝ in.
Weight Empty: 1,823 lb. *Loaded:* 1,951 lb.
Max. Speed: 137 m.p.h. at 6,560 ft.
Ceiling: 16,400 ft.
Duration: 1 hr. 30 min.
Armament: Two fixed forward-firing Vickers machine guns.



S.V.A.5 [I.W.M.

Ansaldo S.V.A.5, 9 and 10

Country of origin: **ITALY.**
Purpose: **Bomber and reconnaissance.**
Makers: **Società Gio. Ansaldo & Cia.**
In operational use: **1918.**

The initials S.V.A. in the designation of this series of multi-purpose biplanes reflect the designership of Savoia and Verduzio and production of the aircraft by the Ansaldo engineering company; another member of the design team was Rosatelli, later to achieve fame with Fiat. The first S.V.A. scout was designed in 1916 and, with extensive governmental backing for its development, made its maiden flight on 3rd March, 1917. Intended originally as a fighter, it possessed excellent speed and range but was rejected for the fighting role, perhaps because it lacked the degree of manoeuvrability of contemporary foreign types. After only a few S.V.A.4's, the first major version, the S.V.A.5 (sometimes called *Primo* = first) entered production in the autumn of 1917. This was a single-seat strategic reconnaissance aircraft, powered by the proven SPA. 6A engine which gave it the excellent top speed of 143 m.p.h. (Alternative powerplants were tested in other S.V.A.'s, some giving an even higher performance than this.) The S.V.A.5 became operational in February 1918, being called upon for light bombing missions and ground strafing in additional to its reconnaissance duties. The S.V.A.10, which appeared in 1918, was a two-seat version, with a 250 h.p. Isotta-Fraschini engine, for similar duties, while the SPA. 6A-powered S.V.A.9 was a two-seat trainer variant. The S.V.A. types were built at several Italian factories, a total of 1,248 of all types being completed by the Armistice, second only to Italian output of the Pomilio scouts. The design of the Ansaldos represented a considerable engineering advance on the part of the Italian aviation industry, and the general excellence of the aircraft is emphasised by the fact that it remained in service for more than a decade after the war had ended. The S.V.A.9 was unarmed, but the S.V.A.5 was fitted with two synchronised forward-firing guns; the S.V.A.10 mounted a single forward gun and a Lewis gun on a flexible mounting in the rear cockpit.

BRIEF TECHNICAL DETAILS (S.V.A.5):
Engine: One 220 h.p. SPA.6A. inline.
Span: 29 ft. 10½ in.
Length: 26 ft. 6⅞ in.
Height: 10 ft. 6 in.
Weight Empty: 1,500 lb. *Loaded:* 2,315 lb.
Max. Speed: 143 m.p.h. at sea level.
Ceiling: 19,685 ft.
Duration: 4 hr.
Armament: Two fixed forward-firing Vickers machine guns.

[I.W.M.

Armstrong Whitworth F.K.8

Country of origin: **GREAT BRITAIN.**
Purpose: **Reconnaissance and light bombing.**
Makers: **Sir W. G. Armstrong Whitworth Aircraft Ltd.**
In operational use: **1917/18.**

Appearing in May 1916 in prototype form, the F.K.8 designed by Frederick Koolhoven was a large, two-seat, two-bay biplane for armed reconnaissance work. The prototype and early production F.K.8's were powered by 120 h.p. Beardmore engines in angular cowlings, with tall radiator blocks on either side meeting in an inverted " V " in front of the forward cabane struts. Later production F.K.8's had a 160 h.p. Beardmore in a much cleaner installation with smaller, " ear " type side radiators. These aircraft also featured a conventional vee-type undercarriage without the primitive and clumsy front skids of earlier machines. A contemporary of the R.E.8, the F.K.8 arrived on the Western Front in January 1917 with No. 35 Squadron, R.F.C., and proved itself to be generally superior to the Royal Aircraft Factory design. In service, it was quickly dubbed " Big Ack " by its crews, to distinguish it from the smaller F.K.3, which inevitably became the " Little Ack ". A valuable, though comparatively unusual, feature of the F.K.8 was the provision of dual controls in the rear cockpit, enabling the observer to control the aircraft if the pilot became incapacitated by enemy action. A Scarff ring mounting was provided in the rear cockpit for a free-firing Lewis gun, while the pilot had a fixed, synchronised Vickers gun. The observer's cockpit could also be used to carry a modest load of small bombs for " nuisance " raids. The F.K.8 served widely on several fronts. It proved an admirable combat type, acquitting itself well against German single-seaters, and two good V.C.s were won on F.K.8's. Of a total of about 1,500 built, there were 694 still on R.A.F. charge at the end of October 1918.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Beardmore inline.
Span: 43 ft. 6 in.
Length: 31 ft. 0 in.
Height: 11 ft. 0 in.
Weight Empty: 1,916 lb. *Loaded:* 2,811 lb.
Max. Speed: 98 m.p.h. at sea level.
Ceiling: 13,000 ft.
Duration: 3 hr.
Armament: One fixed forward-firing Vickers and one free-firing Lewis machine guns; up to 160 lb. of small bombs.

B.II [*H. J. Nowarra*

Aviatik B and C types

Country of origin: **GERMANY.**
Purpose: **Reconnaissance.**
Makers: **Automobil und Aviatik A. G.**
In operational use: **1914/17.**

The German-built Aviatik two-seaters, manufactured by the parent company and Hannoversche Waggonfabrik, originated before the war with the P.15A, allocated the military designation B.I. It was built in two- and three-bay versions and powered by a 100 h.p. Mercedes D.I. Late in 1914 it was followed by the B.II (or P.15B), a neater design with a 120 h.p. Mercedes D.II. Both were in widespread use as reconnaissance machines during the early months of the war. The first armed version, the C.I, appeared at the beginning of 1915. This had a 160 h.p. D.III, and was constructed in substantial numbers. The Aviatiks were notable for retaining the outmoded arrangement whereby the observer occupied the front cockpit. In the C.I he was furnished with a single Parabellum machine gun, which could be mounted on a rail on either side of the cockpit. A few C.Ia's were built with the crew positions reversed and a Schneider ring for the observer's gun, but the type was generally inferior to other C types then entering service. A few C.II's were completed, with 200 h.p. Bz.IV engines, no vertical fin and back-to-front seating, but the next (and last major) type was the C.III, which first appeared in 1916. This was basically a refined C.I, with cleaner lines and better performance. The C.III featured a slightly smaller wing span and a cleaned-up engine installation. Even at this late stage, the first C.III's still carried their observers in the front seat, but the more conventional arrangement was adopted later. Subsequent Aviatik C types were unrelated to this series and were mostly prototypes.

BRIEF TECHNICAL DETAILS (C.I.):
Engines: One 160 h.p. Mercedes D.III inline.
Span: 41 ft. 9¼ in.
Length: 26 ft. 0 in.
Height: 9 ft. 8⅛ in.
Weight Empty: 1,650 lb. *Loaded:* 2,732 lb.
Max. Speed: 89 m.p.h. at sea level.
Ceiling: 11,480 ft.
Duration: 3 hr.
Armament: One forward-firing Parabellum machine gun (two on later C.III's).

D.I [H. J. Nowarra

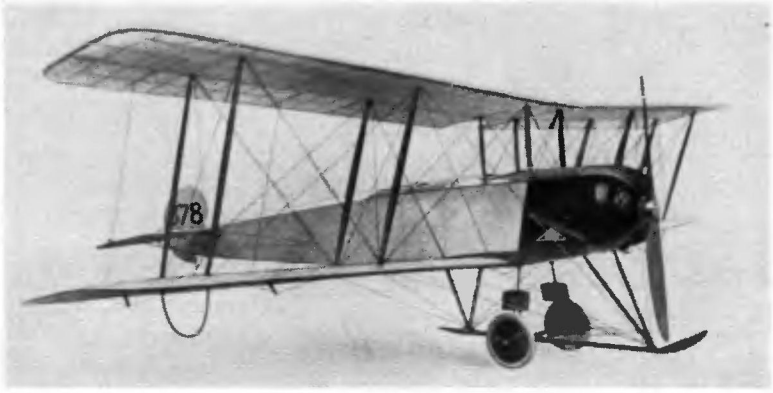
Aviatik C.I and D.I (Austro-Hungary)

Country of origin: **AUSTRO-HUNGARY.**
Purposes: **Reconnaissance (C.I); fighter (D.I).**
Makers: **Oesterreichische-Ungarische Flugzeugfabrik Aviatik.**
In operational use: **1917/18.**

These two generally similar aircraft both appeared in the early part of 1917. Both were the products of Aviatik's chief designer, Julius von Berg, and are sometimes referred to as the Berg C.I and D.I. Both were initially powered by 185 h.p. Austro-Daimler engines, progressing to more powerful versions as these became available. The C.I, being a two-seater (with a communal cockpit), was slightly larger and heavier than the D.I, and on test exhibited a commendable turn of speed for an aeroplane of its class. In addition to the parent company's output (Series 37 and 137), C.I's were built by Lloyd (Series 47). WKF (Series 83 and 183), MAG (Series 91) and Lohner (Series 114 and 214). Series 137, 183 and 214 aircraft had 200 h.p. Austro-Daimler engines. Two Schwarzlose guns were fitted. one on a ring mounting for the observer and the other (at first unsynchronised) firing forward and operated by the pilot. Despite its speed, the C.I was not a strong aeroplane, nor could it be landed very easily in a confined area; consequently most pilots preferred the Brandenburg C.I which, although older, was easier to handle.

The D.I single-seater, Austria's first home-designed fighter, was used widely by the Austro-Hungarian air force from the time of its introduction until the end of the war. Initially it suffered the same structural fragility as the C.I. but after strengthening the later production aircraft gave satisfactory service. Altogether, eleven series of D.I's were built: by Aviatik (Series 38, 138, 238 and 338). WKF (84, 184, 284 and 384), MAG (92), Thone (101) and Lohner (115). They were fitted with Austro-Daimler engines of 185, 200 or 225 h.p., and armed with twin synchronised Schwarzlose machine guns, except for some early machines which had only a single unsynchronised gun. Like the C.I, the D.I fighter was fast and had a good rate of climb, the latter enabling it to reach 13,000 ft. in 11¼ minutes. In 1918, production had begun of the D.II (Series 39), but the war ended before this could become operational.

BRIEF TECHNICAL DETAILS (D.I.):
Engine: One 200 h.p. Austro-Daimler inline.
Span: 26 ft. 3 in.
Length: 22 ft. 9⅝ in.
Height: 8 ft. 1⅝ in.
Weight Empty: 1,475 lb. *Loaded:* 1,878 lb.
Max. Speed: 115 m.p.h. at sea level.
Ceiling: 20,200 ft.
Duration: 2 hr. 30 min.
Armament: Two fixed, forward-firing Schwarzlose machine guns.



Avro 504A

Avro 504 (combat variants)

Country of origin: **GREAT BRITAIN.**
Purpose: **Bomber, anti-airship and night fighter.**
Makers: **A. V. Roe & Co.**
In operational use: **1914/18.**

The Avro 504 is best remembered for its tremendous work as an *ab initio* trainer, but it was conceived for reconnaissance and bombing, and also made its mark as a fighter. The prototype, tested at Brooklands in July 1913, had an 80 h.p. Gnome rotary engine and warp-controlled ailerons. The Gnome was to power most 504 variants built later, but production aircraft were fitted with conventional hinged ailerons. In early summer 1914 the Admiralty ordered one 504 and the War Office 12. During November 1914 an R.F.C. Avro successfully forced down an Albatros two-seater, but the 504's most famous exploit occurred on the 21st when three 504A's of the R.N.A.S. bombed the Zeppelin sheds at Friedrichshafen, destroying one airship and a gas-holder for the loss of one Avro. The next combat variant used by the R.N.A.S. was the 504C, designed for anti-Zeppelin attacks with an upward-elevated Lewis gun, or long range reconnaissance. The 504C was characterised by a fixed fin and plain, rounded rudder in place of the comma-shaped rudder-only configuration of earlier models; the new tail form was a feature of all subsequent Naval models. Eighty 504C's were ordered, in which the pilot sat in the rear, the front cockpit being occupied by an extra fuel tank and faired over. Six Avro 504D's were built to serve on similar duties with the R.F.C., with the typical comma rudder and short ailerons of R.F.C. 504's. A prototype was built of the 504F, actually a 504C adapted to take a 75 h.p. Rolls-Royce Hawk engine. Thirty similar aircraft were ordered, but later this contract was cancelled in favour of the more usual Gnome-powered model. Final combat version was the Avro 504K single-seater, evolved early in 1918 from the two-seat K trainer by fairing over the front cockpit and mounting a 0.303 in. Lewis gun over the top wing. Single seat-504K's were produced for night fighting and served with six home defence units during 1918.

BRIEF TECHNICAL DETAILS (504K):
Engine: One 110 h.p. Le Rhône rotary.
Span: 36 ft. 0 in.
Length: 29 ft. 5 in.
Height: 10 ft. 5 in.
Weight Empty: 1,231 lb. *Loaded:* 1,660 lb.
Max. Speed: 95 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr.
Armament: One fixed, forward-firing Lewis machine gun.

Avro 504K

Avro 504 (trainer variants)

Country of origin: **GREAT BRITAIN.**
Purpose: **Basic trainer.**
Makers: **A. V. Roe & Co.**
In operational use: **1915/18.**

Although it was designed, and first made its mark, as a combat type, it is for its invaluable contribution to the pattern and standard of British service flying training that the Avro 504 will be best remembered; and of the 8,340 Avro 504's built during 1914–18, by far the greater proportion were employed as two-seat *ab initio* trainers. The 504 in its later variants continued in production after the war, and remained in service until 1933. The first trainer variant was the Avro 504B, with the 80 h.p. Gnome engine. About 190 were built for the R.N.A.S., having the long ailerons and fixed fin and rudder which characterised all subsequent 504's of that service. A more powerful model was the 504E, which introduced the 100 h.p. Gnome Monosoupape engine, had a less pronounced wing stagger and the second cockpit further aft. The 504G, thirty of which were built, was a gunnery training version of the B. The 504J, which became the first standard R.F.C. trainer version, had the Monosoupape engine. It was on an Avro 504J that H.R.H. Prince Albert (later H.M. King George VI) learnt to fly. In 1918 the J was superseded by the 504K trainer, owing to shortage of Gnome Mono engines. The 504K's (some of which were actually converted J's) could be fitted with 100 h.p. Gnome Mono, 110 h.p. Le Rhône or 130 h.p. Clerget engines. Some Le Rhône-powered 504K's were converted to single-seaters for home defence night fighting, and after amalgamation of the R.F.C. and R.N.A.S. to form the R.A.F. in April 1918, naval flying training units also re-equipped with the Avro 504K. Of approximately 3,000 Avro 504's on R.A.F. charge in November 1918, 2,267 were serving at flying schools and over 200 with home defence units. Among other useful pioneer work carried out by naval 504's was that concerned with developing deck arrester gear, performed by 504B's; and the Avro 504H (a converted C) was employed for catapult-launching trials in 1917, one of the first aircraft to be so used.

BRIEF TECHNICAL DETAILS (504B):
Engine: One 80 h.p. Gnome rotary.
Span: 36 ft. 0 in.
Length: 29 ft. 5 in.
Height: 10 ft. 5 in.
Weight Empty: 924 lb. *Loaded:* 1,574 lb.
Max. Speed: 82 m.p.h. at sea level.
Ceiling: 12,000 ft.
Duration: 4 hr. 30 min.
Armament: None.

Blériot XI-2 *Artillerie* [*I.W.M.*

Blériot XI

Country of origin: **FRANCE.**
Purpose: **Reconnaissance and training.**
Makers: **S. A. des Avions Blériot.**
In operational use: **1914/15.**

A militarised form of the aeroplane in which Louis Blériot crossed the English Channel in July 1909, the Blériot XI had already seen service in a military capacity before the outbreak of World War I, having been employed for observation duties in French Morocco, the Balkans and the Italo-Turkish confrontation of 1911–12. In 1914 it already formed part of the equipment of several French Army units, and some R.F.C. and R.N.A.S. units also utilised Blériots in small numbers, as did the Belgian and, later, the Italian air forces. The standard configuration of the Blériot XI was that of a shoulder-wing monoplane, of which there were five principal variants. First was the Type XI *Militaire*, a single-seater with a 50 h.p. Gnome rotary engine. Another single-seater was the Type XI *Artillerie*, which was similarly powered but had bigger vertical and horizontal tail surfaces. Two-seat counterparts to these were, respectively, the Type XI-2 *Génie* and the XI-2 *Artillerie*, both with the 70 h.p. Gnome. The fifth version was the Type XI-3, which was a three-seat machine with a 140 h.p. Gnome, twin control pylons and a balanced elevator. Other variants included a parasol-winged version of the XI, and the Blériot 39 which had a fully-covered fuselage. All versions had warp-controlled wings and box-girder fuselages which were usually left uncovered from just aft of the wing trailing edge. Minor variations in the undercarriage can be noted on different models; the elevators, if lowered while the aeroplane was on the ground, almost touched the ground, and to reduce the risk of damage some Blériots had a sprung skid under the centre fuselage to keep the tail up in the air. Some use was made of the Blériot XI as a " nuisance " bomber at the beginning of the war, but by mid-1915 it had been replaced by more up-to-date types, though it continued to be used for the training role. Those used for bombing were the types XI *Militaire* and XI-2 *Génie*, each of which could carry 50 lb. of bombs on the fuselage sides.

BRIEF TECHNICAL DETAILS:
(XI-2 *Artillerie*):
Engine: One 70 h.p. Gnome rotary.
Span: 33 ft. 11 in.
Length: 27 ft. 10 in.
Height: 8 ft. 5 in.
Weight Empty: 770 lb.
Loaded: 1,838 lb.
Max. Speed: 66 m.p.h. at sea level.
Duration: 3 hr. 30 min.
Armament: Small-arms only.

Breguet 14B2 [*I.W.M.*

Breguet 14

Country of origin: **FRANCE.**
Purpose: **Bomber and reconnaissance.**
Makers: **S. A. des Ateliers d'Aviation Louis Breguet.**
In operational use: **1917/18.**

The Breguet 14, by far the best bomber/reconnaissance aeroplane of French origin during World War I, was designed in 1916 to replace the slow and obsolete Farman and Caudron bombers that still equipped many French bomber squadrons. The prototype, with a 220/300 h.p. Renault engine, was designated Breguet AV, signifying *avant*, i.e. that the aeroplane was a tractor biplane. It appeared in November 1916 and after some hesitation on the part of the French authorities, was ordered in substantial numbers in the following March. A strongly-built two-seat, two-bay biplane, the Breguet 14 was produced in two major wartime versions: these were the 14A2 (signifying two-seat *Corps d'Armée* reconnaissance aircraft) and 14B2 (two-seat, *bombardement*). The latter could be distinguished by its wider-span lower wing, with full-span trailing edge flaps and leading-edge extensions for the Michelin-designed automatic bomb racks, and the large rectangular windows in the fuselage sides. The first Breguet 14's began to enter service in September 1917, both the A2 and B2 models being used widely. The A2 was armed with twin Lewis guns on a ring mounting in the observer's cockpit and a forward-firing Vickers for the pilot; initially, this was also the B2's standard armament, though as the intensity of bombing missions increased a downward firing gun was sometimes added, together with some armour protection for the front cockpit. The extensive production of Breguet 14's was widely sub-contracted, the major contribution being made by the Darracq, Farman and Paul Schmitt factories. Production included a few examples of a 14B1 single-seat bomber version, and some aircraft were fitted with 300 h.p, Fiat A.12 *bis* engines to overcome the shortage of Renaults. By the end of 1918. Breguet 14's had been supplied to no less than 55 bomber squadrons of the French air force. Fiat-powered Breguets equipped two Belgian squadrons, and 290 Breguets were bought by the A.E.F. for front-line and training duties. The Breguet 16BN2 was a short-range night bomber with a 1,080 lb. warload. Production had begun in 1918, but this version was too late to see service.

BRIEF TECHNICAL DETAILS (Br. 14B2):
Engine: One 220/300 h.p. Renault inline.
Span: 48 ft. 9 in.
Length: 29 ft. 1½ in.
Height: 10 ft. 9⅞ in.
Weight Empty: 2,290 lb. *Loaded:* 3,891 lb.
Max. Speed: 121 m.p.h. at sea level.
Ceiling: 19,000 ft.
Duration: 2 hr. 45 min.
Armament: One fixed, forward-firing Vickers and two or three free-firing Lewis machine guns; up to 520 lb. of bombs.

Falcon-engined F.2B

Bristol F.2A and F.2B Fighter

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **British & Colonial Aeroplane Co.**
In operational use: **1917/18.**

One of the most famous and successful R.F.C./R.A.F. fighters, the Bristol Fighter entered production and service in 1917. Production continued until 1926, totalling 4,470 aircraft (3,101 of them during the war period), and the type remained in service until 1932. A strong and very manoeuvrable biplane, it was a two-seater and was originally developed for the reconnaissance role to replace the B.E.2 series. The original R.2A design was drawn up around the 120 h.p. Beardmore engine, but when the new 190 h.p. Rolls-Royce Falcon became available it conferred a fighter's performance and the aircraft was re-designated F.2A. A second prototype was fitted with a 150 h.p. Hispano-Suiza engine, but the Falcon was specified for production F.2A's, which first entered service with No. 48 Squadron, R.F.C., early in 1917. The adoption of " two-seat tactics " led to heavy losses at first, but once the Bristol Fighter began to be used as a " single-seater with a sting in the tail " it quickly proved its worth on the Western Front. At dawn on 1st April, 1918, Bristol Fighters of No. 22 Squadron made the first official sorties of the newly-formed Royal Air Force. By this time the 50 production F.2A's had been joined in service by the improved F.2B which, apart from other refinements, was powered by successively lighter variants of the excellent Falcon engine. Unfortunately, the high production rate of F.2B's began to outstrip supplies of these engines, and none of the substitutes (Hispano-Suiza, R.A.F. 4d, Siddeley Puma and Sunbeam Arab) were nearly as satisfactory. The best performance was achieved by those Fighters lucky enough to have the 275 h.p. Falcon III. The Bristol was armed with a fixed, forward-firing Vickers gun, with Constantinesco synchronising gear, and single or twin Lewis guns on a Scarff ring mounting in the rear cockpit. Some aircraft had underwing points for carrying up to twelve 20 lb. bombs. Plans were made late in 1917 for 2,000 Bristol Fighters to be built in the U.S.A. Against British advice these were fitted with 400 h.p. Liberty 12 engines, which made them nose-heavy and awkward to fly, and the U.S. Army cancelled its contract after only 27 had been built by Curtiss as the O-1.

BRIEF TECHNICAL DETAILS (F.2B):
Engine: One 275 h.p. Rolls-Royce Falcon III inline.
Span: 39 ft. 3 in.
Length: 25 ft. 10 in.
Height: 9 ft. 9 in.
Weight Empty: 1,930 lb. *Loaded:* 2,779 lb.
Max. Speed: 125 m.p.h. at sea level.
Ceiling: 20,000 ft.
Duration: 3 hr.
Armament: One fixed, forward-firing Vickers and one or two free-firing Lewis machine guns; up to 240 lb. of bombs (optional).

Bristol M.1C

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **British & Colonial Aeroplane Co.**
In operational use: **1917/18.**

The M.1C is included among the major types in this book on the basis of its potential worth rather than its actual service record, which was severely limited through no fault of the aeroplane itself. Of the modest 125 aircraft built, only about a quarter of these saw actual combat duty, and this was in the comparative obscurity of Macedonia and the Middle Eastern theatres of war. The official reason for thus limiting the Bristol fighter's activity was that its landing speed of 49 m.p.h. was too high; but this alone seems a scarcely adequate explanation, and one is left to suppose that it was a victim of the War Office's known prejudice against monoplanes as a class. The prototype M.1A, completed in the late summer of 1916, proved on test to be a highly manoeuvrable aircraft with a top speed of 132 m.p.h., excellent handling qualities, first class pilot visibility, a 17,000 ft. ceiling and an initial climb rate of more than 1,000 ft./min. Four M.1B's were ordered for service trials, these having a modified cabane, a starboard wing-root cut-out to improve downward view, and the synchronised Vickers gun offset to port. News of the M.1's performance reached pilots on the Western Front, who were impatient to receive the new weapon which would almost certainly have brought them the air supremacy they needed. Yet the War Office, ordering only the 125 M.1C's already mentioned, rejected the type for service in this vital theatre of war on the flimsiest of excuses. The 110 h.p. Clerget of the M.1A and M.1B was replaced in production M.1C's by the Le Rhône rotary of similar power; this was a more thoroughly proven engine, though it somewhat curtailed the M.1C's performance at altitude. As events turned out, this did not matter greatly, since the M.1C was used mainly for low-altitude fighting and ground strafing of Turkish infantry formations; it was never given the chance to prove its undoubted worth against stronger opposition.

BRIEF TECHNICAL DETAILS:
Engine: One 110 h.p. Le Rhône rotary.
Span: 30 ft. 9 in.
Length: 20 ft. 5½ in.
Height: 7 ft 9½ in.
Weight Empty: 900 lb. *Loaded:* 1,348 lb.
Max. Speed: 130 m.p.h. at sea level.
Ceiling: 20,000 ft.
Duration: 1 hr. 45 min.
Armament: One fixed, forward-firing Vickers machine gun.

Scout C [I.W.M.

Bristol Scout

Country of origin: **GREAT BRITAIN.**
Purpose: **Scout.**
Makers: **British & Colonial Aeroplane Co.**
In operational use: **1914/16.**

It is probably fair to say that the Bristol Scout was ahead of its time, for it possessed attributes that would have made it a first-class fighter during the first two years of the war if only a suitable and effective armament had then been available. As it was, Scout pilots were obliged to improvise either with Lewis guns lashed to the fuselage or upper wing or with any kind of small-arms, from carbines to duck rifles and even revolvers. The original Scout, or "Baby Biplane", was designed by Frank Barnwell and flew in February 1914. It was later called Scout A to distinguish it from the next two machines, which became Scout B's. They differed from the prototype only in their engine cowlings and wing bracing, all three machines having 80 h.p. Gnome rotary engines. The two Scout B's were sent to France in September 1914, and the type entered series production as the Scout C with Gnome, Clerget or Le Rhône rotaries of 80 h.p. or the 110 h.p. Clerget engine. Both the R.F.C. and the R.N.A.S. adopted the type late in 1914 for service on the Western Front. The second air V.C. of the war was won by Captain L. G. Hawker, who destroyed three machine gun-armed Albatros two-seaters in a Bristol Scout armed only with a single-shot cavalry carbine. The type was also widely used against the Zeppelin menace, one method of attack being to drop steel-tipped Ranken darts on the airships from above. These attacks were made from both land bases and from seaplane carriers; the Scout C became, on 3rd November, 1915, the first wheel-under-carriage aeroplane ever to take off from the deck of a ship at sea. The improved Scout D appeared in December 1915; this had an 80 h.p. Gnome or Le Rhône, a 100 h.p. Gnome Mono or a 110 h.p. Clerget or Le Rhône engine, shorter-span ailerons and the underwing skids nearer the wingtips. Some late-production D's had a fixed Vickers gun fitted with a Challenger synchronisation gear. Bristol built a total of 161 Scout C's and 210 Scout D's, which served in Macedonia, Mesopotamia, Palestine and the Aegean Sea area as well as on the Western Front. By the autumn of 1916, most had been withdrawn to training units.

BRIEF TECHNICAL DETAILS (Scout D):
Engine: One 110 h.p. Clerget rotary.
Span: 24 ft. 7 in.
Length: 20 ft. 8 in.
Height: 8 ft. 6 in.
Weight Empty: 925 lb. *Loaded:* 1,440 lb.
Max. Speed: 110 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 2 hr.
Armament: One fixed, forward-firing Vickers machine gun.

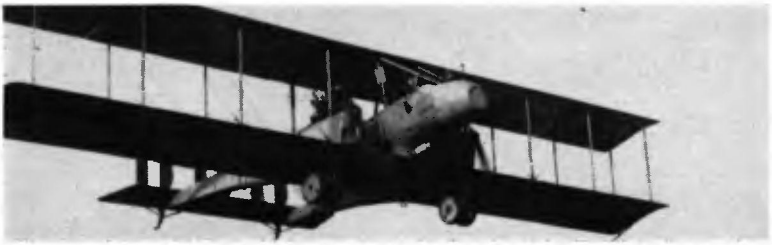
Ca 33 [*I.W.M.*

Caproni Ca 1, Ca 2 and Ca 3

Country of origin: **ITALY.**
Purpose: **Bomber.**
Makers: **Società di Aviazione Ing. Caproni.**
In operational use: **1915/18.**

Unlike the other powers involved in World War I, Italy and Russia had each evolved large, multi-engined aircraft designs before hostilities began. Italy's Caproni Ca 30, which appeared in 1913, was powered by three Gnome rotary engines, one a "pusher" in a central nacelle, the other pair driving tractor propellers in twin fuselage booms through a transmission gear. From this was developed, in 1914, the Ca 31, evaluated at the end of the year by the Italian Army Air Service under the designation Ca 1. This differed from the original design by having the two outer engines at the front of the booms, and trials also included the testing of a 90 h.p. Curtiss engine in place of the central Gnome. However, when ordered into production as the Ca 2 (company designation Ca 32), the powerplant was increased to a trio of 100 h.p. Fiat A.10 engines. Thirty-one Ca 2's were delivered during 1915, and a further 133 in the following year, to form the nucleus of Italy's first strategic bomber force. Later, the Ca 2 was the first Italian type to undertake night bombing. On completion of Ca 2 production late in 1916, it was followed by the Ca 3 (Ca 33), of which 269 were built with Isotta-Fraschini V4B engines of 150 h.p. These were delivered to the Italian and French air forces, and some also served as torpedo-bombers with the Italian Navy, and a further quantity was built in France under licence by Esnault-Pelterie. The Ca 3 carried a four-man crew, with two pilots seated side by side in the centre fuselage and gunners to the front and rear of them. Its multi-wheel landing gear was well suited to operations from rough landing fields, and the aircraft had excellent load-carrying abilities over long ranges. Various projects, which did not reach production status, included the Ca 34, Ca 35 (tandem pilot seating), Ca 36 (detachable outer wings), Ca 37 (single-engined ground attack with a two-man crew) and Ca 39 (floatplane).

BRIEF TECHNICAL DETAILS (Ca 33):
Engines: Three 150 h.p. Isotta-Fraschini V4B.
Span: 72 ft. 10 in.
Length: 35 ft. 9 in.
Height: 12 ft. 2 in.
Weight Empty: 5,080 lb. *Loaded:* 8,400 lb.
Max. Speed: 85 m.p.h. at sea level.
Ceiling: 13,400 ft.
Duration: 3 hr. 30 min.
Armament: Two, three or four Revelli machine guns; up to 1,000 lb. of bombs.



Ca 46 [I.W.M.

Caproni Ca 4 and Ca 5

Country of origin: **ITALY.**
Purpose: **Bomber.**
Makers: **Società di Aviazione Ing. Caproni.**
In operational use: **1917/18.**

The Caproni large bomber line was perpetuated during the latter half of World War I by a further series of designs which entered service under the military designations Ca 4 and Ca 5. While retaining the twin boom and central nacelle layout of their predecessors, however, the Ca 4 was a triplane and was even larger than the earlier multi-engined Capronis. The Ca 4 designation covered four basic types, beginning with the Ca 40, flown for the first time in 1916 and powered by three 200 h.p. Isotta-Fraschini engines. This had the slimmer nacelle first seen on the tandem-seat Ca 35, but in the Ca 40 the two pilots still sat side by side. Front and rear gunners completed the crew of this 98-foot span giant. Only three Ca 40's were delivered (in 1917) before being followed by the more powerful Ca 41 with tandem pilot seats and a simplified landing gear with no nose wheels. The next (and major production) model, the Ca 42, reverted to the original seating arrangement and was powered by Fiat, Isotta-Fraschini or American Liberty engines of 270 h.p. each. Bomb load of the Ca 42 was 3,910 lb., carried in a container below the bottom wing. Four Revelli machine guns were installed, one in each boom behind the wing trailing edge and two in the front cockpit. Forty-one Ca 41/42's were delivered in 1918 to the Italian Army and Navy and the R.N.A.S. Small numbers of the Ca 43, a torpedo-bomber floatplane variant, were also used by the Italian Navy. The Ca 51 and Ca 52 were unsuccessful variants with a biplane tail unit incorporating a mounting for an extra machine gun.

The Ca 5 (embracing types Ca 44 to Ca 47) reverted to biplane configuration and, with 300 h.p. Fiat engines, was an attempt to reduce the type's vulnerability against attacking fighters. The Ca 44 of 1917 was about three-quarters the size of the Ca 4 series, and was quickly developed into the Ca 45 with an improved nacelle shape; this version was built in some numbers by Esnault-Pelterie in France. Main production centred on the Ca 46, 255 of which were built in Italy by a number of manufacturers. Others were built in France and the U.S.A. with a variety of powerplants. Except in range, the Ca 46 had a much better performance than its predecessors and it was widely used both by day and by night. The Ca 47 was a floatplane variant for the Italian Navy, built in limited numbers only; the Ca 50 was an ambulance version of the Ca 46.

BRIEF TECHNICAL DETAILS (Ca 46):
Engines: Three 300 h.p. Fiat A.12 *bis* inlines.
Span: 77 ft. 0 in.
Length: 41 ft. 4 in.
Height: 14 ft. 8 in.
Weight Empty: 6,620 lb. *Loaded:* 11,700 lb.
Max. Speed: 95 m.p.h.
Ceiling: 15,000 ft.
Duration: 4 hr.
Armament: Two Revelli machine guns.

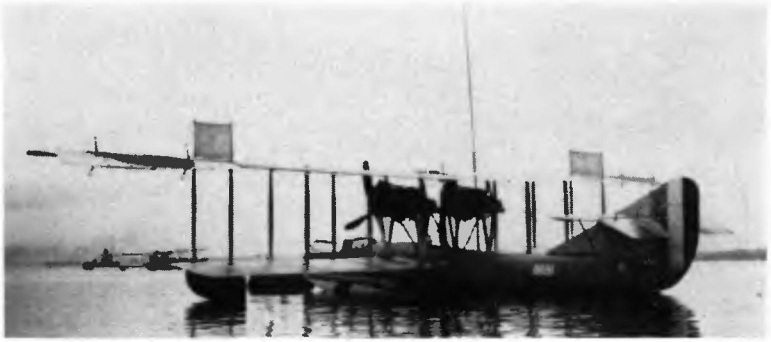
G.III [*I.W.M.*

Caudron G.III and G.IV

Country of origin: **FRANCE.**
Purpose: **Reconnaissance and training.**
Makers: **Caudron Freres.**
In operational use: **1914/17.**

Developed from the pre-war Caudron G.II, the G.III was designed by Gaston Caudron and began to appear in French reconnaissance units late in 1914. A frail-looking two-seat sesquiplane, it was powered by either an 80 h.p. Gnome or Le Rhône rotary engine or a 90 h.p. Anzani, and the wings were warp-controlled. Its career at the front was brief, as its slow speed and lack of a proper defensive armament made it very vulnerable to attack, but after withdrawal from operational duty the type became widely used in the training role, for which it was designated G.IIIE2, indicating two-seat *entrainement*. Some reconnaissance G.IIIA2's continued to be used in less strenuous areas such as the Balkans, Mesopotamia and Russia. Caudron G.III's also served as trainers with the R.N.A.S., which received 124, the R.F.C., and the U.S. Army Air Service, which had 192. Belgium used them in considerable numbers during and after the war, and they were built under licence by A.E.R. in Italy. In the spring of 1915 an enlarged, twin-engined development appeared as the G.IV. With the added power of two engines and bearing one (sometimes two) machine guns to defend it, the G.IV offered some improvement over the virtually defenceless G.III, although the observer's field of vision and fire was limited by the two large engines flanking the tiny central nacelle. Despite this, the G.IV was utilised, between late 1915 and the autumn of 1916, for day bombing duties in addition to reconnaissance; but thereafter their heavy losses led to their withdrawal. Like its predecessor, the G.IV was used by the R.N.A.S. (which also employed it as a bomber) and R.F.C.; by the Italian air force, which had 51 A.E.R.-built G.IV's; and by the U.S.A., which bought 10 as trainers. The G.VIA2 was a developed version of the G.IVA2, in which the latter's frail twin-tailboom fuselage was replaced by a more conventional fuselage with a single fin and rudder; the observer was located more conventionally, in the rear cockpit, with ring-mounted guns. Some 40 French squadrons were at one time or another equipped with Caudron G.III/IV/VI aircraft.

BRIEF TECHNICAL DETAILS (G.IV):
Engines: Two 80 h.p. Le Rhône rotaries.
Span: 55 ft. 5 in.
Length: 23 ft. 6 in.
Height: 8 ft. 5 in.
Weight Empty: 1,870 lb. *Loaded:* 2,970 lb.
Max. Speed: 82 m.p.h. at 6,560 ft.
Ceiling: 14,000 ft.
Duration: 4 hr.
Armament: One fixed and one free-firing Lewis or Vickers machine guns; up to 250 lb. of bombs.



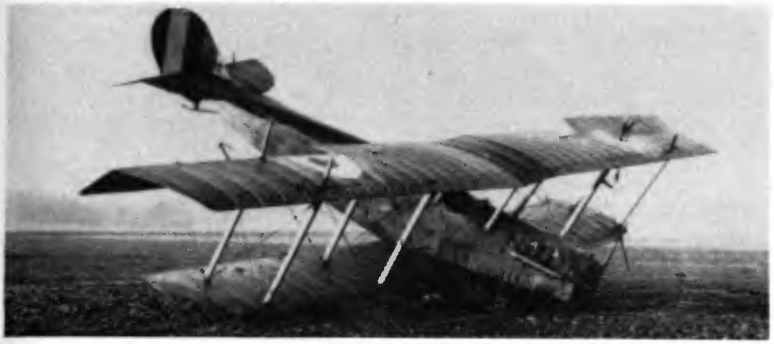
R.N.A.S. H.12 [I.W.M.

Curtiss America Series

Country of origin: **U.S.A.**
Purpose: **Anti-submarine and maritime patrol.**
Makers: **Curtiss Aeroplane and Motor Corporation.**
In operational use: **1915/18.**

At the instigation of J. C. Porte (who did more than anyone to foster British flying boat development during World War I), two Curtiss flying boats were acquired by Britain late in 1914; 12 more were ordered at the same time, and another 50 subsequently. These aircraft, designated H.4 in the U.S.A., were christened " America boats " by the R.N.A.S., with whom they began to enter service in mid-1915. The H.4's chief drawback was a lack of power, and various types of engine from 100 to 150 h.p. were tried in efforts to overcome this. These efforts were, in the main, unsuccessful, and most of the H.4's were relegated to a training role, although some patrol work was carried out and a few were still in service when the type was officially classed as obsolete in August 1918. Far more successful was the bigger Curtiss H.12, which became known as the Large America (the H.4 being dubbed, retrospectively, Small America). Collaboration between Curtiss, Porte and the R.N.A.S. had resulted in a much-refined design, whose only major weakness was in the underside of the front hull, which made take-off rather hazardous on rough water. The R.N.A.S. received 71 Large Americas, which served from early 1917 until the end of the war and were extremely effective in combating both Zeppelins and U-boats in the North Sea area and the English Channel. A larger-still development of the H.12 was the H.16, with a stronger hull of better hydrodynamic shape, and other detail improvements. The R.N.A.S. ordered a total of 125 H.16's; delivery of these began early in 1918, but by the Armistice only about 15 were in operational service, a further 50 being in store. The U.S. Navy also ordered the H.16 in quantity, and about 50 of these were also in operation over British home waters. The U.S. Navy H.16's were powered by 330 h.p. Liberty engines in place of the 320 h.p. Rolls-Royce Eagle VIII's of their British counterparts.

BRIEF TECHNICAL DETAILS (H.12):
Engines: Two 275 h.p. Rolls-Royce Eagle I inlines.
Span: 92 ft. 8½ in.
Length: 46 ft. 6 in.
Height: 16 ft. 6 in.
Weight Empty: 7,293 lb. *Loaded:* 10,650 lb.
Max. Speed: 93 m.p.h. at 2,000 ft.
Ceiling: 10,800 ft.
Duration: 6 hr.
Armament: Three or four free-firing Lewis machine guns; up to 460 lb. of bombs.



[I.W.M.

Curtiss JN-4

Country of origin: **U.S.A.**
Purpose: **Trainer.**
Makers: **Curtiss Aeroplane and Motor Corporation.**
In operational use: **1915/18.**

The popular and ubiquitous Curtiss trainers of World War I were employed in large numbers on both sides of the Atlantic, and became—then and subsequently—one of the best known aeroplanes ever to be built. The nickname of "Jenny", derived from the designation, applies collectively to all variants, although it most often conjures up a picture of the JN-4 models, of which more than 6,440 were built. The "Jenny" actually originated in England, where B. D. Thomas of the Sopwith company drew up a design known as the Type J to a Curtiss specification. This was later blended, in America, with Curtiss's own Type N, the resultant prototype being known as the JN. First production model was the JN-2, the small number produced including 10 for the U.S. Army. Just over 100 examples followed of the improved JN-3; most of these were for the R.N.A.S., which received 97. The JN-4 series appeared in 1916, and its most significant difference from earlier "Jennies" was the replacement of the former "Deperdussin" method (of separate controls for the rudder and elevators) by a single stick control. These changes were made at the request of the British authorities. The tremendous output of JN-4 variants included 701 JN-4's, 781 JN-4A's, 2,664 JN-4D's, 101 JN-4D-2's, 929 JN-4H's and 1,260 Canadian-built JN-4Can's. Large numbers of these were purchased by both the R.F.C. and R.N.A.S.; the latter service finally received 80 of a total of 250 ordered, but 100 more were transferred to the R.F.C. Compared with the original JN-4, the JN-4A had enlarged tail surfaces; the JN-4D had upper wing ailerons only and was the first model to introduce the new stick control; the JN-4H was powered by the 150 h.p. Hispano-Suiza engine. This last named version was further improved as the JN-6H, most of them with JN-4-type tail surfaces, ailerons at all four wingtips and the Hispano engine; 1,035 JN-6H's were built. The original Curtiss Type N design also pursued its own separate line of development, of which the most important development was the N-9.

BRIEF TECHNICAL DETAILS (JN-4D):
Engine: One 90 h.p. Curtiss OX-5 inline.
Span: 43 ft. 7⅞ in.
Length: 27 ft. 4 in.
Height: 9 ft. 10⅛ in.
Weight Empty: 1,580 lb. *Loaded:* 2,130 lb.
Max. Speed: 75 m.p.h. at sea level.
Ceiling: 11,000 ft.
Duration: 2 hr. 15 min.
Armament: None.

C.V

D.F.W. C.IV, C.V and C.VI

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and army co-operation.**
Makers: **Deutsche Flugzeug-Werke G.m.b.H.**
In operational use: **1916/18.**

The C.IV, a neat two-bay biplane powered by a cleanly-cowled 150 h.p. Bz.III inline engine, first appeared in the early part of 1916. It was built in series by both D.F.W. and the German Aviatik works, and was in service with both Army and Navy reconnaissance units until the end of the war. Armed with a fixed, forward-firing Spandau gun and a ring-mounted Parabellum in the rear cockpit, it was both a handsome and efficient machine, but it was overshadowed by the even better C.V which was developed from it. The C.V, while retaining substantially the same airframe as the C.IV, had the much more powerful Bz.IV engine (neatly spinnered on later aircraft), balanced tail control surfaces and " ear " type side radiators in place of the centre-section radiator of the C.IV. The C.V handled well, was liked by its crews, and was probably one of the best C class aircraft to be used by the German Air Force, with whom it remained in service until the end of the war. Aviatik, Halberstadt, L.V.G. and Schütte-Lanz factories joined D.F.W. in manufacturing large quantities of C.V's, probably one of the most widely-produced German types of the entire war. Again, as in the C.IV, the neat cowling-in of the Benz engine was a feature of the C.V, although in the field the engine side covers were often left off to facilitate maintenance and assist engine cooling. The C.V was truly a general-purpose aircraft, being used for reconnaissance and photographic work, artillery co-operation and infantry contact patrols. Overall production records have not survived, but close on 1,000 aircraft of this type were recorded in service in the autumn of 1917, and they appeared on the Eastern and Western Fronts, in Italy, Macedonia and Palestine. In 1918 there appeared the D.F.W. C.VI, a developed version with a 220 h.p. Bz.IVa engine, horn-balanced ailerons and redesigned tail surfaces; but this remained a prototype only.

BRIEF TECHNICAL DETAILS (C.V):
Engine: One 200 h.p. Benz Bz. IV inline.
Span: 43 ft. 6⅜ in.
Length: 25 ft. 10¼ in.
Height: 10 ft. 8 in.
Weight Empty: 2,134 lb. *Loaded:* 3,136 lb.
Max. Speed: 97 m.p.h. at 3,280 ft.
Ceiling: 16,400 ft.
Duration: 3 hr. 30 min.
Armament: One fixed, forward-firing Spandau and one free-firing Parabellum machine gun.

L.F.G. (Roland)-built *Stahltaube* [*I.W.M.*

Etrich Taube (Dove)

Country of origin: **AUSTRO-HUNGARY.**
Purpose: **Reconnaissance and training.**
Makers: **See text.**
In operational use: **1914/16.**

Probably no designer before or since has originated a more bird-like aeroplane than the Austrian pioneer Igo Etrich, who successfully evolved his *Taube* monoplane in 1910 after some six years of research and experimentation. From then until 1913 he produced a number of other designs, but none was so successful as the *Taube*, and the two-seat military version of 1912 was to become the most widely built version of all. This was already in service before the outbreak of war with the Austro-Hungarian air service, and was to be built by at least half a dozen German manufacturers during the early part of the war. The Austrian machines were of two types, designated A.I when fitted with an 85 h.p. Austro-Daimler engine and A.II with the 120 h.p. Austrian engine. The first German company to acquire licence rights in the *Taube* was the Rumpler Flugzeug-Werke, in 1911, and of the 500 or so *Tauben* built for the German air force the greater part were probably built by this manufacturer. However, after a dispute with Rumpler, Etrich decided to forego the German rights in his design, with the result that *Tauben* were built by Albatros, D.F.W., Gotha, Halberstadt, Jeannin. Kondor, Krieger, L.F.G. and others. They varied marginally in dimensions and powerplant, but all were basically to the original *Taube* pattern with wood-and-fabric construction except those built by D.F.W. and Jeannin. These were built with steel-tube frames and were known as *Stahltauben*. Usual powerplants of the German *Tauben* were Mercedes or Argus engines of 100 h.p. The production of military machines and the impressment of large numbers of civil versions gave Germany a large fleet of these useful aeroplanes at the beginning of the war, and they remained in service as observation scouts, " nuisance " raiders, escorts and trainers for about two years after the outbreak of war.

BRIEF TECHNICAL DETAILS
(Rumpler *Taube*):
Engine: One 100 h.p. Mercedes D.I inline.
Span: 47 ft. 1 in.
Length: 32 ft. 3⅜ in.
Height: 10 ft. 4⅛ in.
Weight Empty: 1,323 lb.
Loaded: 1,918 lb.
Max. Speed: 71·5 m.p.h. at sea level.
Ceiling: 9,840 ft.
Duration: 4 hr.
Armament: None.

S.7 "Shorthorn" [I.W.M.

Farman M.F.7 and M.F.11

Country of origin: **FRANCE.**
Purpose: **Reconnaissance, bombing and training.**
Makers: **Société Henri et Maurice Farman.**
In operational use: **1914/18.**

These two related designs by Maurice Farman gave long and widespread service with the air forces of France, Britain, Belgium, Italy and Russia. The M.F.7's supplied to the R.F.C. and R.N.A.S. were soon dubbed " Longhorns ", from the long outriggers which stretched far in front of the crew nacelle to support the forward elevator; inevitably, the M.F.11, with its short landing skids, became the "Shorthorn". Apart from these differences, the M.F.11 nacelle was mounted midway between the wings, whereas that of the M.F.7 rested on the lower wing; and the biplane tail of the M.F.7 was replaced on the M.F.11 by a single horizontal tail surface with twin rudders. The M.F.7 dated from 1913, and several were in service at the outbreak of World War I; they were powered by a mixture of Renault or Lorraine engines, varying in output from 70 h.p. to 130 h.p. After some limited early use for reconnaissance and " nuisance " bombing, they were mostly withdrawn to training duties. The more sophisticated M.F.11, or Type 1914, appeared in that year and began to enter service in 1915. Engines, usually of Renault or De Dion manufacture, ranged from 80 h.p. to to 130 h.p. Although produced primarily for observation duties, the M.F.11 was used with some success as a bomber by all services, and saw action in Italy, Russia, the Dardanelles and Mesopotamia as well as on the Western Front. It was built under licence in Italy by S.I.A. with Renault or Fiat A.10 engines. The M.F.11 *bis*, developed by Henri Farman, seated the observer in the front cockpit, but in other models the more normal pilot-in-front arrangement was standard. A single defensive Lewis or Hotchkiss gun was carried, and a light bomb load could be suspended under the lower wings.

BRIEF TECHNICAL DETAILS (M.F.11):
Engine: One 100 h.p. Renault inline.
Span: 53 ft. 0 in.
Length: 30 ft. 8 in.
Height: 10 ft. 4 in.
Weight Empty: 1,441 lb. *Loaded:* 2,046 lb.
Max. Speed: 66 m.p.h. at sea level.
Ceiling: 12,500 ft.
Duration: 3 hr. 45 min.
Armament: One free-firing Lewis or Hotchkiss machine gun; up to 288 lb. of bombs.

F.B.A. Type B [*I.W.M.*

F.B.A. flying boats

Country of origin: **FRANCE.**
Purpose: **Anti-submarine and coastal patrol; training.**
Makers: **Franco-British Aviation.**
In operational use: **1915/18.**

Despite its title, the Franco-British Aviation company was almost entirely French, and an office in London was virtually its only claim to a dual nationality. Its early products were designed by Lévêque, and in 1913 examples of F.B.A.-built Lévêque flying boats were supplied to the navies of Austria (three) and Denmark (two). Subsequent F.B.A. products were the work of Max Schreck, though developed along the lines of the Lévêque machines. The first noteworthy example was the Type B, production of which with 100 h.p. Gnome rotary engines began in January 1915. In April 1916 it was superseded by the Type C, which had a 130 h.p. Clerget but otherwise resembled the Type B. A total of 124 Types B and C were supplied to the R.N.A.S. in 1915–16, these being employed chiefly for training; three were later transferred to the R.F.C. The major type, however, was the Type H, which ultimately became the most widely built flying boat of the whole war period. The Type H, which carried a three-man crew, was powered at first by a 150 h.p. Hispano-Suiza engine, though later aircraft were fitted with 160 h.p. Lorraines or 170 h.p. Hispano-Suizas. In Italy the Type H was produced in series by several manufacturers. At least 982 were built for the Italian Navy, the usual powerplant for these being the 180 h.p. Isotta-Fraschini. Apart from the change from a rotary engine to a water-cooled Vee type, the F.B.A. Type H incorporated in its design several modifications suggested by the experience of French naval units in operating the earlier B and C types. Four ex-Italian Type H's were used by the R.N.A.S. at Otranto and Malta in 1917, and the type was also in service with the Belgian Navy. Late in 1917 the H was further developed into the Type S, having a 200 h.p. Hispano-Suiza engine, 220 lb. bomb load, a crew of two and (like the H) a single defensive machine gun in the prow. The Type S was in production and widespread use until the end of the war.

BRIEF TECHNICAL DETAILS
(Italian-built Type H):
Engine: One 180 h.p. Isotta-Fraschini inline.
Span: 47 ft. 8⅜ in.
Length: 33 ft. 5½ in.
Height: 11 ft. 1 in.
Weight Empty: 2,039 lb. *Loaded:* 3,086 lb.
Max. Speed: 87 m.p.h. at sea level.
Ceiling: 16,076 ft.
Range: 373 miles.
Armament: One free-firing Revelli machine gun; small bomb load.

F.2C [I.W.M.

Felixstowe F.2A and F.3

Country of origin: **GREAT BRITAIN.**
Purpose: **Anti-submarine patrol bomber.**
Makers: **Various** (see text).
In operational use: **1917/18.**

The contribution made by Sqn. Cdr. John C. Porte of the R.N.A.S. to the course of British flying boat development cannot be overstated, and in the F.2A he produced perhaps the greatest of all testimonials to his own genius. Basically a redesign of the mediocre Curtiss H.12, the F.2A became one of the best combat aircraft of the war. The F.1 was essentially the Curtiss H.4 with a new, Porte-designed hull and 150 h.p. Hispano-Suizas. Only four F.1's were built, but Porte immediately applied the same approach to the H.12, the prototype being known as the F.2. It entered production as the F.2A in 1917. The F.2A's hull was strongly built, and far superior hydrodynamically to the H.12. The F.2A carried four free-firing Lewis guns, one each in the nose and mid-upper positions and the other two as beam guns; points were provided beneath the lower wing for two 230 lb. bombs. Additional guns were sometimes carried in the fore and aft cockpits. F.2A's were built by the Aircraft Manufacturing Co., S. E. Saunders, Ltd. and Norman Thompson Flight Co.; 160 were ordered, though a little less than 100 were completed by the Armistice. Some outstanding contracts were then amended to specify F.5's. The F.2A's served with seven R.N.A.S. squadrons around the British coast. The slightly larger F.3 could carry twice the F.2A's bomb load over a longer range on the same power. It was built in about the same numbers but, unlike the F.2A, served in the Mediterranean as well as at home stations. The F.2A remained the faster and more manoeuvrable model, and was responsible for several U-boat and Zeppelin " kills " in the North Sea area. Perhaps its finest exploit was on 4th June, 1918 when three F.2A's defended a crippled companion, forced down by a fuel stoppage, to such good effect that they shot down 6 out of 14 attacking enemy aircraft without loss to themselves.

BRIEF TECHNICAL DETAILS (F.2A):
Engines: Two 345 h.p. Rolls-Royce Eagle VIII inlines.
Span: 95 ft. 7½ in.
Length: 46 ft. 3 in.
Height: 17 ft. 6 in.
Weight Empty: 7,549 lb. *Loaded:* 10,978 lb.
Max. Speed: 95 m.p.h. at 2,000 ft.
Ceiling: 9,600 ft.
Duration: 6 hr.
Armament: Four to seven free-firing Lewis machine guns; 460 lb. of bombs.

[I.W.M.

Fokker D.VII

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Fokker Flugzeug-Werke G.m.b.H.**
In operational use: **1918.**

One of the great fighter aircraft of all time, and reputedly the best German single-seater of the 1914–18 war, the Fokker D.VII was the work of Fokker's chief designer, Reinhold Platz. Developed from Platz's V.11 prototype of 1917, which won the January 1918 fighter competition at Adlershof by a handsome margin, the D.VII entered large-scale production by Fokker and Albatros factories almost immediately afterwards and began to reach operational units in April. By the autumn of 1918 over forty *Jastas* were equipped with the type, and in the remaining months of the war the D.VII acquired a highly successful operational record. A sensitive but delightful aeroplane to fly, the Fokker D.VII had an excellent all-round performance including first-class manoeuvrability at altitude; its ability to "hang" on its propeller, even while climbing, was to spell the end of many Allied machines with which it joined in combat. The D.VII carried the standard armament of the period, two synchronised Spandau machine guns fixed over the top-decking in front of the cockpit and firing between the propeller blades. At the time of the Armistice, Fokker had delivered 412 D.VII's, and such was the reputation of the fighter that the Armistice Agreement singled it out by name among the list of items to be surrendered to the Allies. Two kinds of powerplant were installed in D.VII's—the 160 h.p. Mercedes D.III or the 185 h.p. B.M.W.III, both six-cylinder water-cooled inline engines. The D.VII's fuselage frame was built of welded steel tubing, and as a precaution against possible shortage of this commodity Albatros completed one experimental D.VII with an all-wood fuselage. The precaution, however, proved unnecessary. A two-seat development, the C.I, was built in small numbers but did not become operational.

BRIEF TECHNICAL DETAILS:
Engine: One 185 h.p. B.M.W. IIIa inline.
Span: 29 ft. 2¼ in.
Length: 22 ft. 9⅜ in.
Height: 9 ft. 0¼ in.
Weight Empty: 1,513 lb. *Loaded:* 1,993 lb.
Max. Speed: 124 m.p.h. at sea level.
Ceiling: 22,900 ft.
Duration: 1 hr. 30 min.
Armament: Two fixed forward-firing Spandau machine guns.

[I.W.M.

Fokker Dr.I

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Fokker Flugzeug-Werke G.m.b.H.**
In operational use: **1917/18.**

Several German and Austro-Hungarian manufacturers hurriedly tried to cash in on the great success that the Sopwith Triplane achieved in the spring of 1917, some by adaptations of existing biplane fighters, others by more original means. Prominent in the latter category was Fokker, whose designer Reinhold Platz first produced a prototype known as the V.3 with light but strong cantilever wings. These, however, tended to vibrate in flight, so the second machine (V.4) was given lightweight "I" struts to brace the outer sections. The first three production machines were designated F.I, after which the new Dr. (*Dreidecker* = triplane) classification was introduced in the summer of 1917. Production Dr.I's (320 were built up to May 1918) were powered by foreign-built versions of the Le Rhône rotary engine—either the Oberursel UR.II or the Swedish-built Thulin version developing 110 h.p. Experimental installations included the 145 h.p. UR.III, the 160 h.p. Goebel Goe.III and the 160 h.p. Sh.III rotaries, but none of these was adopted for service aircraft. Twin synchronised Spandau guns were mounted on the top-decking to fire between the propeller blades. The first Dr.I's began to reach fighter squadrons during August 1917, but during combat a number of aircraft casualties disclosed that the wing structure was still rather suspect and the type was suspended from operations from October to December while attempts were made to rectify this point. The aircraft was then restored to service until the summer of 1918, by which time it had given way to the D.VII. A number of celebrated German pilots flew the Dr.I, among them Werner Voss of *Jasta* 10, who, when he died, had a total of 48 Allied aircraft to his credit, and Manfred von Richthofen, who was killed on 21st April, 1918 while flying an aeroplane of this type. The Fokker triplane's chief attributes were its agility and rate of climb (10 minutes to 13,120 ft.), although its level speed was rather below that of contemporary fighters.

BRIEF TECHNICAL DETAILS:
Engine: One 110 h.p. Oberursel- or Thulin-built Le Rhône rotary.
Span: 23 ft. 7⅜ in.
Length: 18 ft. 11½ in.
Height: 9 ft. 8⅛ in.
Weight Empty: 893 lb. *Loaded:* 1,290 lb.
Max. Speed: 103 m.p.h. at 13,120 ft.
Ceiling: 20,000 ft.
Duration: 1 hr. 30 min.
Armament: Two fixed, forward-firing Spandau machine guns.

E.III. [I.W.M.

Fokker E types

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Fokker Flugzeug-Werke G.m.b.H.**
In operational use: **1915/16.**

The Fokker *Eindecker* (monoplane) series of fighters, which earned themselves the title " Fokker scourge " during the peak of their combat career in the winter of 1915–16, were not produced in great quantity. Their initial successes were aided appreciably by the surprise element, since opposing aircraft did not expect to be fired on by an enemy approaching them from behind; but once the Fokkers' ability to fire forwards through the propeller arc was known, suitable tactics were evolved for dealing with them and their effectiveness lessened considerably. They were later used on escort work. It was the capture of the French ace Roland Garros's Morane scout that enabled Fokker engineers to develop an interrupter gear, for the Frenchman had had his aircraft fitted with propeller deflector plates to enable him to fire his gun forwards from the cockpit without damaging the propeller. Fokker improved on this arrangement and persuaded German authorities to let him try the idea out in a fighter of his own design. He first installed the interrupter gear in an M.5K monoplane to demonstrate its practicability, and the first E-type fighter, the E.I, appeared in the late summer of 1915. Very few E.I's were built, since they were underpowered with only an 80 h.p. Oberursel U.0 rotary engine. The first major type was therefore the E.II, powered by a 100 h.p. U.I, which entered service in September 1915. Twenty-three E.II's were built, and the design was then further modified and improved as the E.III, still with the U.I engine. Between 120 and 150 E.III's were completed, early aircraft having a Parabellum machine gun and later machines being fitted with a single Spandau. In the spring of 1916, when the myth of the Fokker's invincibility had been exploded, an attempt was made to perpetuate its former superiority by producing a fourth type, the E.IV. This was virtually an enlarged E.III, with two Spandau guns and a 160 h.p. U.III engine; but the extra weight and general unreliability of this large two-row rotary made the E.IV less agile than its predecessors and it was not a great success. Production of the E.IV amounted to some 30–40 aircraft. Among famous German fliers of the E types, chiefly the E.III, were Oswald Boelcke and Max Immelmann. It was on a Fokker E.III that the latter evolved the celebrated Immelmann Turn.

BRIEF TECHNICAL DETAILS (E.III):
Engine: One 100 h.p. Oberursel U.I rotary.
Span: 31 ft. 2⅞ in.
Length: 23 ft. 11⅛ in.
Height: 9 ft. 1¾ in.
Weight Empty: 878 lb. *Loaded:* 1,400 lb.
Max. Speed: 87 m.p.h. at sea level.
Ceiling: 11,500 ft.
Duration: 2 hr. 45 min.
Armament: One fixed forward-firing Parabellum or Spandau machine gun.

FF33L. [H. J. Nowarra

Friedrichshafen FF33 and FF49

Country of origin: **GERMANY.**
Purpose: **Reconnaissance patrol and fighter escort.**
Makers: **Flugzeugbau Friedrichshafen G.m.b.H.**
In operational use: **1915/18.**

Among the wide variety of marine aircraft employed by the German Navy during World War I, numerical honours undoubtedly go to the Friedrichshafen FF33. This was produced in a bewildering variety of variants, but all can be classified into one of two categories. The unarmed reconnaissance versions were three-bay biplanes, whereas the smaller, lighter fighter models had only a two-bay wing cellule. All were two-seaters, and all had twin-float landing gear, those of the fighter variants being somewhat deeper in cross-section than the ones fitted to reconnaissance machines. The first of six FF33A's, with Mercedes D.II engines, made its appearance at the end of 1914, and generally resembled the earlier FF29 (34 of which were delivered from November 1914), having a "back-to-front" allocation of the crew positions. The more conventional seating arrangement was one of several improvements introduced with the FF33B, other features including a more powerful engine with radiators side-mounted on the fuselage. Only 11 FF33B's were completed, the next production reconnaissance model being the FF33E. This dispensed with the under-tail float of its predecessors, the main units being appropriately lengthened and a triangular underfin added beneath the rear fuselage. Powerplant was the thoroughly reliable Bz.III six-cylinder water-cooled inline, whose radiator was sited in the upper centre-section leading edge. Production of the FF33E totalled 162 machines, all but 16 of which were fitted with wireless equipment, and these were completed between April 1915 and January 1917. Three of these aircraft were redesignated FF33F when fitted with guns. Orders were placed for two batches of thirty FF33J's, a refinement of the FF33E with a cleaned-up nose entry which included a spinner. The second of these batches was allocated to training duties, though it is possible that neither was completely delivered.

The fighter variants, more manoeuvrable because of their smaller size, began with the FF33F already mentioned. Probably the first German seaplane fighters, these may be considered little more than evaluation machines, although they

were used in operations. They were quickly followed by the FF33H, which entered service in January 1916. It was virtually an armed version of the FF33E although, as mentioned above, the float design was different and the nose entry contours were also improved. The FF33H was produced throughout most of 1916, a total of 45 being completed by the autumn before yielding to the rather smaller FF33L, which introduced aerodynamic refinements corresponding broadly with those on the FF33J. The FF33L was probably the most efficient variant in the entire series, as might be expected from the incorporation of engineering and operational experience gained with the earlier models. The first FF33L was completed in September 1916 and completed its trials at Warnemünde early the next year; when production ended in October 1917, 135 of this model had been built. Armament of the FF33H was a single movable Parabellum gun in the observer's cockpit; to this the FF33L added a forward-firing Spandau.

The Friedrichshafen FF33 floatplanes were a versatile series and were widely used over the North Sea and the Channel approaches. A small batch of 14 generally similar FF39's were built in 1917, after which the FF49 appeared in May as a replacement for the reconnaissance FF33J. It was a somewhat larger aircraft, with a more powerful Benz engine, sturdier construction and better flying qualities. Two hundred and forty FF49's were built, 22 of them as FF49B light bombers with a single defensive gun and the pilot in the rear seat, and the remainder as FF49C reconnaissance patrol aircraft. These were rugged and reliable aircraft, well able to operate in open sea areas in quite bad weather.

BRIEF TECHNICAL DETAILS:

FF33E	**FF33L**	**FF49C**
Engine: One 150 h.p. Benz Bz. III inline.	As FF33E.	One 200 h.p. Benz Bz. IV inline.
Span: 45 ft. 11½ in.	43 ft. 7⅝ in.	56 ft. 3½ in.
Length: 34 ft. 3½ in.	28 ft. 11½ in.	38 ft. 2⅜ in.
Height: 12 ft. 2⅜ in.	12 ft. 10⅝ in.	14 ft. 9½ in.
Weight Empty: 2,218 lb.	2,022 lb.	3,333 lb.
Loaded: 3,637 lb.	3,021 lb.	4,723 lb.
Max. Speed at sea level: 74 m.p.h.	85 m.p.h.	87 m.p.h.
Duration: 5-6 hr.	5-6 hr.	5 hr. 40 min.
Armament: None.	One fixed Spandau and one free-firing Parabellum machine gun.	As FF33L.

FF49C. [*H. J. Nowarra*

G.IIIa [I.W.M.

Friedrichshafen G types

Country of origin: **GERMANY.**
Purpose: **Bomber.**
Makers: **Flugzeugbau Friedrichshafen G.m.b.H.**
In operational use: **1916/18.**

Representing one of the few ventures by the Flugzeugbau Friedrichshafen into the realm of landplane design, the G types were the product of the company's chief engineer, Theodor Kober. His first aircraft of this type, later designated G.I, was a three-bay, twin-engined machine powered by 150 h.p. Benz Bz.III "pusher" engines. It remained a prototype only, but a year later, in 1916, there appeared the G.II, a small batch of which were built for operational service, most of them by the Daimler Motoren-Werke. Major differences between the G.I and G.II lay in the latter's two-bay wings, single tail unit and 200 h.p. Bz.IV engines. The G.II, with a gross weight of 6,934 lb., could carry a 1,000 lb. bomb load and was armed with Parabellum machine guns in nose and dorsal positions. A development of the G.II, the G.III reverted to three-bay wings and, with 260 h.p. Mercedes engines, was a much larger machine. It carried a three-man crew consisting of a pilot, gunner and bomb aimer/gunner, and was produced in greater numbers than the two previous versions. The G.IIIa was generally similar except for a biplane tail unit, and in addition to those built by the parent company 245 G.III/IIIa's were completed by Daimler and 93 more by Hansa. In 1918 there followed a small number of G.IV's with a shortened nose minus a front cockpit, tractor engines and reduced wing span. The Friedrichshafen bombers were used exclusively on the Western Front.

BRIEF TECHNICAL DETAILS (G.III):
Engines: Two 260 h.p. Mercedes D.IVa inlines.
Span: 77 ft. 11 in.
Length: 42 ft. 1⅜ in.
Height: 11 ft. 11⅜ in.
Weight Empty: 5,929 lb. *Loaded:* 8,686 lb.
Max. Speed: 87·6 m.p.h. at 3,280 ft.
Ceiling: 14,800 ft.
Duration: 5 hr.
Armament: Two or three free-firing Parabellum machine guns; up to 3,300 lb. of bombs.

G.V. *I.W.M.*

Gotha G.II to G.V

Country of origin: **GERMANY.**
Purpose: **Bomber.**
Makers: **Gothaer Waggonfabrik A.G.**
In operational use: **1916/18.**

The Gotha bombers of World War I, and particularly those of the G.IV and G.V type, were probably among the best known German aircraft of the later war years, and are remembered chiefly for their widespread use on daylight raids over London and southern England. This function they took over from the Zeppelin raiders in June 1917, although they first entered service in the previous autumn. Such was the weight of their attacks—one bomber squadron, BG3, alone dropped more than 186,000 lb. of bombs on British soil in 22 raids over England—that fighters were hastily recalled from France to defend the British capital. Even this did not at first stem the tide of Gotha attacks, and it was not until faster-climbing fighters such as the Camel and S.E.5a came into service that they met with effective opposition. The G.IV's then switched to night attack until the spring of 1918, by which time their attrition rate included more aircraft lost in landing accidents than to Allied fighters. The principal fault was a tendency to nose-over on landing, and the G.Vb which entered limited production and service in 1918 attempted to overcome this by the use of additional landing wheels. Both the G.Va and G.Vb also featured a compound tail assembly. The G.IV's were preceded in service from early 1916 by small numbers of the G.II (220 h.p. Benz) and G.III (260 h.p. Mercedes). The G.III first introduced the rear-fuselage "tunnel" which enabled the rear gunner to fire downwards beneath the tail as well as rearwards and sideways above the level of the fuselage. Production of the G.IV was also undertaken by L.V.G. and Siemens-Schuckert; those built by the former company were mostly supplied to Austro-Hungary, where they were re-engined by Oeffag with 230 h.p. Hiero engines.

BRIEF TECHNICAL DETAILS (G.IV):
Engines: Two 260 h.p. Mercedes D.IVa inlines.
Span: 77 ft. 9½ in.
Length: 38 ft. 11 in.
Height: 14 ft. 1½ in.
Weight Empty: 5,280 lb. *Loaded:* 7,997 lb.
Max. Speed: 87 m.p.h. at 12,000 ft.
Ceiling: 21,320 ft.
Range: 305 miles.
Armament: Two free-firing Parabellum machine guns; up to 1,100 lb. of bombs.

[I.W.M.

Halberstadt C.V

Country of origin: **GERMANY.**
Purpose: **Long range photographic reconnaissance.**
Makers: **Halberstädter Flugzeug-Werke G.m.b.H.**
In operational use: **1918.**

Although it became operational only during the last six months of the war, the Halberstadt C.V performed well under difficult operational conditions, and was built in substantial numbers by the parent company and by the Aviatik, Bayerische Flugzeug-Werke and D.F.W. companies. Stemming from the earlier C.III (200 h.p. Bz.IV engine) which appeared at the end of 1917, the C.V was likewise designed by Karl Theiss and was first tested at the beginning of 1918. Testing was thorough and prolonged, and the type did not enter squadron service until the summer months. In general outline it resembled the smaller CL.IV close-support aircraft from the same stable, but the C.V's function was the rather different one of acquiring photographic intelligence of the advancing Allied forces. In this it often had to run the gauntlet of heavy fighter opposition, frequently at some distance from its own ever-retreating lines, and it says much for the C.V's staying power that it performed this task with no small measure of success. A two-seat, two-bay biplane, the C.V had the typical C-type armament of the period—a free-firing Parabellum machine gun in the rear cockpit and a fixed, forward-firing Spandau for the pilot, mounted on the port side of the upper engine decking. Recognition features included the deep, narrow fuselage, pronounced wing stagger and oval fin and rudder outline.

BRIEF TECHNICAL DETAILS:
Engine: One 220 h.p. Benz Bz. IV inline.
Span: 44 ft. 8½ in.
Length: 22 ft. 8½ in.
Height: 11 ft. 0½ in.
Weight Empty: 2,046 lb. *Loaded:* 3,009 lb.
Max. Speed: 106 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr. 30 min.
Armament: One fixed forward-firing Spandau and one free-firing Parabellum machine gun.

CL.II. [I.W.M.

Halberstadt CL.II and CL.IV

Country of origin: **GERMANY.**
Purpose: **Escort and ground attack.**
Makers: **Halberstadter Flugzeug-Werke G.m.b.H.**
In operational use: **1917/18.**

The CL (light C) category of warplane was introduced by the German High Command in the early part of 1917, and the first aircraft type to be produced to this specification was the Halberstadt CL.II. The principal functions of CL type aircraft were to act as escorts to their heavier C type brethren and to undertake ground attack and close support work. The Halberstadt CL.II was a two-seater, pilot and observer sharing a communal cockpit at the rear of which was an elevated ring mounting for the rearward Parabellum gun; single or twin Spandau guns were mounted in the front fuselage to fire forward through the propeller arc, and grenades or small mortar bombs could be carried on external racks for ground attack missions. Design of the CL.II began early in 1917, and it entered service in the summer; in the attacks on the Somme bridges in September, and in the battle for Cambrai in November, it was conspicuously effective, and thereafter appeared in increasing numbers. Production was undertaken both by Halberstadt and the Bayerische Flugzeug-Werke. A small quantity of CL.IIa's were built, with 185 h.p. B.M.W. engines in a neater installation, but these soon gave way to the CL.IV, which reverted to the Mercedes D.III but was otherwise much redesigned. Changes included re-siting the wing cellule on a rather shorter fuselage, raising and elongating the tailplane, re-shaping the fin and rudder and removing the spinner. The L.F.G. (Roland) works at Berlin-Charlottenburg assisted Halberstadt in production of the CL.IV. which was in service for the German offensive of March 1918. Overall performance of the CL.IV was much the same as that of the CL.II, but the aerodynamic changes conferred a welcome improvement in manoeuvrability. Some CL.II's and CL.IV's were used to intercept Allied night bomber formations.

BRIEF TECHNICAL DETAILS (CL.II):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 35 ft. 4 in.
Length: 23 ft. 11⅜ in.
Height: 9 ft. 0½ in.
Weight Empty: 1,701 lb. *Loaded:* 2,498 lb.
Max. Speed: 103 m.p.h. at 16,400 ft.
Ceiling: 16,700 ft.
Duration: 3 hr.
Armament: One or two fixed forward-firing Spandau and one free-firing Parabellum machine gun.

D.II. [*J.W.M.*

Halberstadt D types

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Halberstädter Flugzeug-Werke G.m.b.H.**
In operational use: **1915/17.**

The operational career of the Halberstadt fighters was comparatively brief, and they were superseded within about a year of entering service, though away from the major fronts they continued to serve for a while in Macedonia and Palestine. Production spanned five generally similar types, of which the total output was probably not much more than about a hundred machines. First to appear, at the end of 1915, was the D.I, which was powered by a 100 h.p. Mercedes D.I engine and entered service in February 1916. Armed with only a single forward-firing machine gun, it was an attractive aeroplane whose deceptively delicate lines belied what was in fact quite a sturdily-built airframe. There was a D.Ia with a 120 h.p. Argus As.II engine, but the next separate model was the D.II with a Mercedes D.II engine of similar power. The D.II and its successor the D.III were the chief production models, the latter returning to an As.II powerplant; apart from this they were generally similar except that the D.III had larger ailerons and other minor improvements to the wing structure. The D.IV, some of which were supplied to Turkey, was virtually identical to the D.III except for its 150 h.p. Bz.III engine; while the D.V of 1917 was basically a cleaned-up D.III with a neater installation for the Argus engine, including a propeller spinner. All of the Halberstadt fighters were armed normally with a single Spandau gun on the port side of the upper front fuselage, although there are reports of some D.IV's fitted with twin guns. The Halberstadt fighters, despite this light armament, acquitted themselves well during their service, but by the beginning of 1917 they had been obsolete and were soon replaced by better-armed and more efficient types.

BRIEF TECHNICAL DETAILS (D.III):
Engine: One 120 h.p. Argus As. II inline.
Span: 28 ft. 10½ in.
Length: 23 ft. 11⅛ in.
Height: 8 ft. 9⅛ in.
Weight Empty: 1,234 lb. *Loaded:* 1,696 lb.
Max. Speed: 90 m.p.h. at sea level.
Ceiling: 19,600 ft.
Duration: 1 hr. 30 min. approx.
Armament: One fixed forward-firing Spandau machine gun.

[I.W.M.

Handley Page O/100

Country of origin: **GREAT BRITAIN.**
Purpose: **Heavy bomber.**
Makers: **Handley Page Ltd.**
In operational use: **1916/18.**

The world's first truly viable heavy night bomber, the O/100 was Handley Page's answer to the call by Cdre. Murray Sueter of the Admiralty's Air Department for a " bloody paralyser " of an aeroplane. It was an enlarged improvement of an earlier Handley Page design drawn up around two 120 h.p. Beardmore engines. The prototype, originally scheduled for 150 h.p. Sunbeams, finally took to the air on 18th December, 1915 powered by two of the new Rolls-Royce engines (later named Eagle) each developing 250 h.p. A rigorous system of testing every major airframe component ensured that the O/100, as it was now called, was an extremely strong and airworthy machine. Originally, the engine nacelles, which incorporated the fuel tanks, were armoured, as was the enclosed cabin for the three-man crew; but on production aircraft the cockpit cover and most of the armour plate was left off. The wings, spanning 100 feet, were made to fold in order that the O/100 could be stored in the standard field hangars of the time. Bomb load ranged in size from sixteen 112 lb. weapons to a single 1,650 lb. bomb, with a maximum load of 2,000 lb.—five times that of the contemporary D.H.4 day bomber. The O/100 was used at first for daylight raids, but owing to losses was soon transferred to night operations. It entered service in September 1916, and the first examples arrived in France two months later; four R.N.A.S. front-line squadrons were equipped with the type. Altogether, Handley Page built 46 O/100's, the last six of which were fitted with 320 h.p. Sunbeam Cossack engines owing to the Eagle being in short supply. One O/100 was based at the Royal Naval Air Station at Mudros in the Aegean Sea, from where, in July 1917, it attacked the German battle cruiser *Goeben* with eight 112 lb. bombs during a raid on Constantinople. The O/100 was armed with single or twin movable Lewis guns in the nose and mid-upper positions, with another gun amidships that could be fired downwards to the rear through an opening in the fuselage floor.

BRIEF TECHNICAL DETAILS:

Engines: Two 250 h.p. Rolls-Royce Eagle II inlines.
Span: 100 ft. 0 in.
Length: 62 ft. 10½ in.
Height: 22 ft. 0 in.

Weight Empty: 8,300 lb. *Loaded:* 14,000 lb.
Max. Speed: 85 m.p.h. at sea level.
Ceiling: 7,000 ft.
Range: 700 miles (approx.).
Armament: Three to five free-firing Lewis machine guns; up to 2,000 lb. of bombs.

[I.W.M.

Handley Page O/400

Country of origin: **GREAT BRITAIN.**
Purpose: **Heavy bomber.**
Makers: **Handley Page Ltd.**
In operational use: **1918.**

The O/400 was a progressive development of the O/100, and incorporated a number of design improvements, some of which were in fact introduced on later production machines of the O/100 type. Apart from an increase in available power, through the use of later variants of the Eagle or Cossack engine (or comparable alternatives), the most important modification concerned the fuel installation. In the O/100, the main fuel tanks had been situated at the rear of each engine, the entire installation being encased by the two nacelles. In the O/400 the fuel tanks were re-located in the fuselage, over the bomb bay, with gravity feed tanks in the upper mainplane. The shorter nacelles, now correspondingly shorter, had an additional wing bracing strut to the rear of them. At one stage, the O/400 was nearly abandoned, due to an official preference for day bombing activities, but this view was ultimately rejected and an initial order for 100 of the new bombers was placed. When the German Gotha bombers began their raids on Britain, O/400 orders rose first to 300 and then to a total of 400 aircraft. The type became the standard equipment of the Independent Force, and in October 1918 was serving with seven bomber squadrons of the R.A.F. In mid-September a 40-strong force of O/400's was sent against targets in the Saar area, the largest bomber force ever deployed up to that time. At about this time the O/400, like the O/100, began to employ the 1,650 lb. "block-buster" bomb. The Standard Aircraft Corporation in the U.S.A. manufactured components for more than 100 further O/400's, the intention being to ship these to England for assembly. A few of these sets were apparently sent to Britain, but they did not become operational before the war ended. One O/400 was assembled in the U.S.A. before the Armistice and another eight afterwards; these were evaluated by the U.S. Army and had 400 h.p. Liberty engines.

BRIEF TECHNICAL DETAILS:

Engines: Two 360 h.p. Rolls-Royce Eagle VIII inlines.
Span: 100 ft. 0 in.
Length: 62 ft. 10½ in.
Height: 22 ft. 0 in.

Weight Empty: 8,502 lb. *Loaded:* 13,360 lb.
Max. Speed: 97·5 m.p.h. at sea level
Ceiling: 8,500 ft.
Duration: 8 hr.
Armament: Three to five free-firing Lewis machine guns; up to 2,000 lb of bombs.

CL.IIIa. [*I.W.M.*

Hannover CL.II and CL.IIIa

Country of origin: **GERMANY.**
Purpose: **Escort fighter and ground attack.**
Makers: **Hannoversche Waggonfabrik A.G.**
In operational use: **1917/18.**

The Hannoversche Waggonfabrik, formerly a manufacturer of railway rolling-stock, entered the field of aeroplane construction in 1915 at the request of the German government. Their first undertaking was the manufacture under contract of the Aviatik C.I, Rumpler C.Ia and Halberstadt D.II, but in 1917 they produced the first design of their own to a CL type specification issued by the High Command. The Hannover CL.II was a neat, stocky single-bay biplane powered by a 180 h.p. Argus As.III inline engine, and first entered service in December 1917. It was small for a two-seater, and many Allied pilots—to their cost—mistook it for a single-seater until they were met with a burst of fire from the observer's Parabellum gun while attacking the CL.II from astern. Well-balanced, generous ailerons gave the CL.II a good degree of lateral control, and it was highly manoeuvrable—an admirable asset in its primary role of ground attack. It was sturdily built and could absorb a considerable amount of punishment. Production totalled 439 aircraft before giving way to the CL.III, a slightly modified version with a 160 h.p. Mercedes D.III engine. However, single-seat fighters had priority for supplies of this engine, and only 80 CL.III's were completed. They were succeeded by the CL.IIIa, which utilised the same powerplant as the CL.II but retained the various structural improvements of the CL.III. The CL.IIIa was built by Hannover and, under contract with the confusing designation of CL.IIa, by L.F.G. (Roland); the two companies between them contributed 537 aircraft of the CL.IIIa type, and the range of Hannover CL types saw widespread service throughout most of 1918. Various experimental developments appeared toward the end of the war, but the only one to have entered production was the CL.V. About 50 of these were completed, with both single and biplane tail assemblies and 185 h.p. B.M.W.IIIa engines, but they did not engage in operational combat before the war ended.

BRIEF TECHNICAL DETAILS (CL.IIIa):
Engine: One 180 h.p. Argus As.III inline.
Span: 38 ft. 4⅝ in.
Length: 24 ft. 10⅜ in.
Height: 9 ft. 2¼ in.
Weight Empty: 1,577 lb. *Loaded:* 2,381 lb.
Max. Speed: 103 m.p.h. at 2,000 ft.
Ceiling: 24,600 ft.
Duration: 3 hr.
Armament: One fixed forward-firing Spandau and one free-firing Parabellum machine gun.

[*I.W.M.*

Hanriot HD-1

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **S. A. des Appareils d'Aviation Hanriot.**
In operational use: **1917/18.**

One of the most rugged, manoeuvrable and pleasant-to-fly fighters produced during World War I, the Hanriot HD-1 was overshadowed in its own country by the Spad VII, and the only operational French machines were a small batch supplied to the French Navy for ship and shore use in 1918. Production of the HD-1 in France was confined mainly to 125 aircraft built for the Belgian air force and a comparatively small number for Italy. Altogether the Italian air force received 831 HD-1's, the majority of them built under licence by Nieuport-Macchi at its Varese factory. The HD-1 entered Italian operational service in August 1917, and pilots soon found it an admirable successor to their much-loved Nieuports. The HD-1's general appearance and flying qualities indicate a strong Sopwith influence (*cf.* especially the Pup, on page 109), and the Hanriot factory did indeed build 1½-Strutters under licence earlier in the war. However, due credit must go to designer Pierre Dupont, who had established a reputation well before the war as a pioneer of fast, elegant aeroplanes. The Belgian HD-1's were the only ones to operate on the Western Front, entering service there at about the same time as their counterparts in Italy. Belgian pilots, too, enthused over its qualities, even preferring it to the Sopwith Camel, which they were offered early in 1918. The HD-1 was rather lightly armed for 1917–18, and various experiments were made with single heavier-calibre guns or twin standard-type guns; but in general their weight caused an unacceptable drop in performance—pilots would rather dispense with additional firepower than with their Hanriots' first-class manoeuvrability. Various higher-powered engines were introduced during the HD-1's career, up to 170 h.p. in some models. The HD-2 was a twin-float version, 10 of which were sold to the U.S. Navy in 1918 for protecting coastal bases in Europe. These were later converted to landplanes.

BRIEF TECHNICAL DETAILS:

Engine: One 120 h.p. Le Rhône 9Jb rotary.
Span: 28 ft. 6½ in.
Length: 19 ft. 2⅞ in.
Height: 8 ft. 4⅜ in.
Weight Empty: 908 lb. *Loaded:* 1,334 lb.
Max. Speed: 114 m.p.h. at sea level.
Ceiling: 20,670 ft.
Duration: 2 hr. 30 min.
Armament: One fixed, forward-firing Vickers machine gun.

[H. J. Nowarra

Hansa-Brandenburg C.I

Country of origin: **GERMANY.**
Purpose: **Reconnaissance, light bombing and artillery observation.**
Makers: **Phönix Flugzeug-Werke A.G. and Ungarische Flugzeugfabrik A.G.**
In operational use: **1916/18.**

Although of German origin, the Hansa-Brandenburg C.I was built entirely in Austro-Hungary and used principally by that country's air service in large numbers for the greater part of World War I. A design of Ernst Heinkel, the C.I was a neat, two-bay biplane of typical appearance for the period except for the inward-sloping interplane struts which were a distinctive recognition feature. In service alongside the smaller B.I trainer from the same stable, the two types were respectively nicknamed " Little Brandenburg " and " Big Brandenburg ". The wings were of uniform chord, with generous ailerons on the upper wing, and a large triangular tailplane was mounted on the upper rear longerons. The two-man crew shared a communal cockpit, the observer having a half-ring mounting at the rear of this carrying a Schwarzlose machine gun. From late 1916 a second gun, for the pilot, was fitted; at first this was mounted above the upper centre-section, but later a synchronised gun was enclosed in the engine cowling on the port side. Brandenburg C.I's were used over a long period on a wide variety of duties including day and night bombing, visual and photographic reconnaissance, and artillery observation. They were well built, handled well and could operate from " difficult " landing grounds: hence they were very popular with their crews. A wide variety of engines, ranging in output from the 160 h.p. Austro-Daimler to the 230 h.p. Hiero, were fitted to production C.I's. The type was built in nearly twenty different series by two of the principal Austro-Hungarian manufacturers. Phönix built the Series 23, 26, 27 and 29 (Austro-Daimlers of varying power) and the Series 29, 129, 229, 329 and 429 (assorted Hiero engines); while Ufag built Series 61, 64, 67, 68 and 269 (various Austro-Daimlers), Series 63 (160 h.p. Mercedes D.III), Series 69 and 369 (200 and 230 h.p. Hiero) and Series 169 (220 h.p. Benz).

BRIEF TECHNICAL DETAILS (Series 26):
Engine: One 160 h.p. Austro-Daimler inline.
Span: 40 ft. 2½ in.
Length: 27 ft. 8⅜ in.
Height: 10 ft. 11⅛ in.
Weight Empty: 1,790 lb.
Loaded: 2,888 lb.
Max. Speed: 87 m.p.h. at sea level.
Ceiling: 19,000 ft.
Armament: One fixed forward-firing and one free-firing Schwarzlose machine gun.

H. J. Nowarra

Hansa-Brandenburg D.I

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Phönix Flugzeug-Werke A.G. and Ungarische Flugzeugfabrik A.G.**
In operational use: **1916/17.**

Like its highly successful contemporary the C.I, the Hansa-Brandenburg D.I single-seat fighter originated at the German headquarters of the Brandenburg company but was built exclusively in and for Austro-Hungary; this is explained by the fact that Brandenburg's owner, Camillo Castiglione, was an Austrian citizen. Designed by Ernst Heinkel, the D.I prototype was known by the manufacturer's designation KD (*Kampf Doppeldecker* = fighter biplane) and made its appearance at the beginning of 1916. A small, stocky biplane, it was immediately distinguished by the novel form of interplane bracing which earned it the nickname " star-strutter " in service. With an improved form of rudder and other detail refinements, the KD entered production at the Phönix and Ufag factories as the D.I, coming into service in the autumn of 1916. The Phönix-built D.I's (Series 28) were fitted with 160 h.p. Austro-Daimler engines, whereas the Ufag-built Series 65 had a more powerful Austro-Daimler developing 185 h.p. Late-production Series 28 aircraft had modified vertical tail surfaces incorporating a fixed fin, in an attempt to overcome lateral stability troubles encountered during operational flying. Some Series 65 D.I's were seen with frontal radiators, possibly indicating that they were built with 200 h.p. Hiero engines. The Brandenburg D.I remained in Austro-Hungarian service as a standard fighter type until the summer of 1917, but could not be rated a great success. Many accidents resulted from the poor controllability of early production aircraft, and the D.I's armament—a single unsynchronised gun mounted above the upper centre-section—was unsatisfactory and inadequate. On the credit side, however, the D.I had a good turn of speed and could climb to 3,280 ft. in three minutes.

BRIEF TECHNICAL DETAILS
(Series 28):
Engine: One 160 h.p. Austro-Daimler inline.
Span: 27 ft. 10⅝ in.
Length: 20 ft. 10 in.
Height: 9 ft. 2½ in.
Weight Empty: 1,478 lb. *Loaded:* 2,024 lb.
Max. Speed: 116 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 2 hr. 30 min. approx.
Armament: One fixed forward-firing Schwarzlose machine gun.

[H. J. Nowarra

Hansa-Brandenburg KDW

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Hansa und Brandenburgische Flugzeug-Werke G.m.b.H.**
In operational use: **1916/18.**

Strictly speaking, the term KDW (*Kampf Doppeldecker, Wasser* = fighter biplane, water) was an operational classification rather than the designation of any single type, but records do not indicate that this floatplane fighter was ever allotted a military designation. In essence, it was an adaptation of the "star-strutter" D.I landplane single-seater, evolved by Ernst Heinkel as a coastal patrol aircraft and local defence fighter for the protection of German seaplane bases along the coastlines of north-west Europe and the Mediterranean. Compared with the D.I, the KDW seaplane had some 2½ feet greater wingspan, but otherwise employed a basically similar airframe. Production was spread over the period July 1916–February 1918, the aircraft being built in five batches to a total of 58 examples. The first three machines had 150 h.p. Bz.III engines, the next ten 160 h.p. Mercedes D.III's, and the remainder 160 h.p. Maybach Mb.III's. The first 38 aircraft were provided with only a single Spandau machine gun, but twin guns were installed on the final 20 aircraft; the 35 aircraft in the two final batches also sported a small fixed fin along the upper rear fuselage. The KDW, like its land-based stablemate, was not an easy aeroplane to fly. It had only been evolved as a stopgap, and long before the final examples were delivered the KDW, already obsolete, had been superseded by the far superior W.12 two-seater.

BRIEF TECHNICAL DETAILS:
Engine: One 150 h.p. Benz Bz.III inline.
Span: 30 ft. 4½ in.
Length: 26 ft. 3 in.
Height: 11 ft. 0 in.

Weight Empty: 2,068 lb. *Loaded:* 2,293 lb.
Max. Speed: 107 m.p.h. at sea level.
Duration: 2 hr. 30 min.
Armament: One or two fixed, forward-firing Spandau machine guns.

W.12. [H. J. Nowarra

Hansa-Brandenburg W.12 and W.19

Country of origin: **GERMANY.**
Purpose: **Fighter (W.12) and maritime patrol (W.19).**
Makers: **Hansa und Brandenburgische Flugzeug-Werke G.m.b.H.**
In operational use: **1917/18.**

Before the entry of the W.12 into service in the summer of 1917, German seaplane bases on the Flanders coast had relied for their air defence chiefly on hasty floatplane adaptations of single-seat land fighters. Hence the arrival of the W.12, which had been designed from the start (by Ernst Heinkel) as a two-seat floatplane fighter, was both timely and welcome. The prototype W.12 was tested at Warnemünde in January 1917 and, with a small modification to the wing area, was placed in production shortly afterwards. One hundred and forty-six W.12's were completed, 80 of which had 150 h.p. Bz.III engines and the remainder having 160 h.p. Mercedes D.III's. Apart from this the basic airframe remained the same, and the upward sweep of the fuselage towards the rear gave the observer a fine view all round and the facility to fire his gun in both fore and aft directions. The pilot was provided with one or two synchronised guns in front of the forward cockpit. Despite its size and weight the W.12 was both fast and manoeuvrable, and achieved no mean success against attacking British flying boats. Another victim of a W.12 was the British airship C.27, shot down in December 1917. The W.12 remained in German Navy service until mid-1918, by which time it had been joined by the W.19, a larger and heavier development of the earlier design. The W.19 was a maritime reconnaissance aeroplane, often acting as " hunter " to the W.12's " killer " in attacks on Allied ships and aircraft in the North Sea and Channel areas. Similarly armed to the W.12, the W.19 was powered by a 260 h.p. Maybach Mb.IV engine. It first appeared in November 1917, entering service two months later and serving up to the end of hostilities; a total of 55 were built, the last being delivered in June 1918. Details of the W.19 include a wing span of 45 ft. 3⅜ in., length 34 ft. 11⅜ in., loaded weight 4,411 lb., max. speed 94 m.p.h. and duration of some 5 hours.

BRIEF TECHNICAL DETAILS (W.12):
Engine: One 150 h.p. Benz Bz.III inline.
Span: 36 ft. 9 in.
Length: 31 ft. 7⅛ in.
Height: 10 ft. 9⅛ in.
Weight Empty: 2,193 lb. *Loaded:* 3,230 lb.
Max. Speed: 100 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr. 30 min.
Armament: One or two fixed, forward firing Spandau and one free-firing Parabellum machine gun.

W.29. [H. J. Nowarra

Hansa-Brandenburg W.29 and W.33

Country of origin: **GERMANY.**
Purpose: **Fighter (W.29) and maritime patrol (W.33).**
Makers: **Hansa und Brandenburgische Flugzeug-Werke G.m.b.H.**
In operational use: **1918.**

The Brandenburg W.29 and W.33 were, respectively, monoplane counterparts and successors to the W.12 and W.19 floatplanes of 1917–18. The monoplane configuration was selected by designer Ernst Heinkel as being the best way to improve the performance of his earlier designs so as to maintain their superiority over the newer and faster Allied types being encountered by the beginning of 1918. The W.29 was, therefore, basically the fuselage and powerplant of the W.12, but with a single mainplane of entirely new design. The armament remained the same as on the W.12, but the observer's field of fire was of course vastly improved due to the absence of an upper wing. The W.29 entered service with German naval air units in April 1918, being well received and successful in action during its necessarily short operational career. By the end of the war, 78 W.29's had been built, the last four of these having the 185 h.p. Bz.IIIa instead of the standard Bz.III. In a similar manner, the W.33 was a monoplane development of the W.19, with a 52 ft. 0 in. wing, 4,510 lb. gross weight and a 245 h.p. Maybach engine giving it a top speed of 108 m.p.h.—some 14 m.p.h. better than the W.19. By the end of the war, 26 W.33's had been delivered, and at least one further batch had been ordered; but comparatively few aircraft of this type were actually engaged in operations before the Armistice.

BRIEF TECHNICAL DETAILS (W.29):
Engine: One 150 h.p. Benz Bz.III inline.
Span: 44 ft. 3½ in.
Length: 30 ft. 8⅛ in.
Height: 9 ft. 10⅛ in.
Weight Empty: 2,200 lb. *Loaded:* 3,243 lb.
Max. Speed: 109 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 4 hr. (approx.).
Armament: One or two fixed, forward-firing Spandau and one free-firing Parabellum machine gun.

[H. J. Nowarra

Junkers J.I

Country of origin: **GERMANY.**
Purpose: **Low-level reconnaissance and close support.**
Makers: **Junkers Flugzeug-Werke A.G.**
In operational use: **1917/18.**

Dr. Hugo Junkers, who did more than anyone of his time to pioneer the field of all-metal aircraft construction, had already spent some two years at this task before the appearance of the J.I in the early months of 1917. Designed with the assistance of Professor Madelung, the J.I (which was actually Junkers' fourth design) was also noteworthy for having thick-section cantilever wings, the lower one being of much shorter span than the upper one. It was evolved to meet a *Flugzeugmeisterei* requirement for a well-armoured two-seat close support biplane, and was large for a single-engined aeroplane. Its size and extremely strong appearance quickly earned it the nickname *Möbelwagen* (furniture van), which was (though it may not have sounded like it) a tribute to the J.I's ruggedness and ability to absorb a considerable amount of combat punishment. On the other hand, for the same reasons the J.I was rather heavy on the controls and needed fairly generous take-off and landing space. Nevertheless, when it first entered service during the late summer of 1917 it quickly found favour with those who flew it because of the high degree of personal protection which the armoured fuselage offered. It also carried a useful armament, comprising a free-firing Parabellum gun in the rear cockpit and twin forward-firing Spandaus on either side of the engine decking, and radio equipment was installed in the observer's cockpit. In all, 227 J.I's were completed by the Junkers factory at Dessau.

BRIEF TECHNICAL DETAILS:
Engine: One 200 h.p. Benz Bz.IV inline.
Span: 52 ft. 5⅞ in.
Length: 29 ft. 10½ in.
Height: 11 ft. 1⅞ in.

Weight Empty: 3,885 lb. *Loaded:* 4,795 lb
Max. Speed: 96 m.p.h. at sea level.
Duration: 2 hr. (approx.).
Armament: Two Spandau fixed machine guns and one free-firing Parabellum gun.

[I.W.M.

L.F.G. (Roland) C.II

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and escort.**
Makers: **Luftfahrzeug Gesellschaft m.b.H.**
In operational use: **1916/17.**

Widely (but unofficially) known by the nickname *Walfisch* (Whale), the Roland C.II was not destined for great achievements during World War I, but it was an extremely advanced design for its time and was to have a marked influence on the approach to later C and CL types built for the German air force. It was of dumpy appearance, due mainly to the capacious and strongly-built fuselage which completely bridged the gap between the wings. The result of this arrangement was to give both pilot and observer a completely unrestricted field of view in the upper hemisphere. Downward view, despite the two large, square windows either side, was less good, especially for the pilot when landing. Unfortunately, the strength of the fuselage was not matched by that of the wings, whose durability in service left something to be desired. Nevertheless, the C.II was considerably cleaner aerodynamically than most of its contemporaries, and several hundred were built both by L.F.G. and Linke-Hofmann. In the reconnaissance role the C.II would normally carry only a single Parabellum gun in the observer's cockpit, but other C.II's were frequently used to escort their patrolling brethren, and these carried a forward-firing Spandau as well, mounted on the top centre-section in front of the pilot. One other novel feature of the C.II was the individualistic style of the single interplane struts, to which the wings were attached by ball-and-cup joints. A Roland C.II was the first officially-confirmed victim of Captain Albert Ball of the R.F.C., who in the latter half of 1916 described the aircraft as "the best German machine now"; but by about a year later the *Walfisch* was no longer in operational service.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Mercedes D.III inline.
Span: 33 ft. 10⅜ in.
Length: 24 ft. 8⅛ in.
Height: 9 ft. 5⅜ in.
Weight Empty: 1,681 lb. *Loaded:* 2,886 lb.
Max. Speed: 103 m.p.h. at sea level.
Ceiling: 13,100 ft.
Duration: 4 hr.
Armament: One Spandau and one Parabellum machine gun.

D.IIa. [*I.W.M.*

L.F.G. (Roland) D.I, D.II and D.III

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Luftfahrzeug Gesellschaft m.b.H.**
In operational use: **1917/18.**

The first Roland fighter, the D.I, represented in essence a translation by Dr. Tantzen of the basic design concept of the C.II two-seater into a similar one for a single-seat fighter. The resulting D.I was somewhat smaller and slimmer than the C.II, a fact reflected by their respective nicknames—the C.II was dubbed *Walfisch* (whale) and the D.I *Haifisch* (shark). The D.I, powered by a 160 h.p. Mercedes D.III engine, entered limited production at the end of 1916, but it was quickly supplanted by what was to become the principal model, the D.II. This had been test-flown in October, and differed mainly in the changes made to improve the pilot's forward and downward view. Whereas the D.I's fuselage had completely filled the wing gap, that of the D.II was fined down so as to leave the upper wing supported by a narrow pylon in front of the cockpit, and the sides of the cockpit were themselves lowered. The " ear " type radiators of the D.I were eliminated in favour of a flush radiator in the top wing, and the twin Spandau guns were mounted inside instead of on top of the front fuselage. The D.II retained the same Mercedes engine as the D.I, but a D.IIa model was also produced, powered by a 180 h.p. Argus As.III. Both versions were built in quantity by L.F.G. and Pfalz. total output of the D.I, D.II and D.IIa being in the region of 300 aircraft. Despite the improvements made on the D.II, neither type was yet entirely satisfactory: no squadron seems to have been exclusively equipped with the Roland fighters, and D.I/D.II wastage was frequently made up with the more successful Albatros designs. A number of D.III's were also produced, these having reduced-chord lower wings, strut-bracing instead of the upper wing pylon, and a larger fin; but most were allocated to non-operational duties and only some two dozen to front-line units.

BRIEF TECHNICAL DETAILS (D.II):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 29 ft. 4 in.
Length: 22 ft. 8⅞ in.
Height: 10 ft. 2⅛ in.
Weight Empty: 1,573 lb. *Loaded:* 1,753 lb.
Max. speed: 105 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 2 hr.
Armament: Two fixed, forward-firing Spandau machine guns.

D.VIb. [*I.W.M.*

L.F.G. (Roland) D.VI

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Luftfahrzeug Gesellschaft m.b.H.**
In operational use: **1918.**

Like almost every other German fighter that appeared in the last year of the war, the career of the Roland D.VI was overshadowed by the all-conquering Fokker D.VII. However, it performed well enough in the January 1918 fighter competition to become one of the few designs ordered into limited production as a safeguard against the possible production failure of the Fokker aeroplane. Although obviously descended from the earlier Roland D types, the D.VI was a much more elegant machine, and its fuselage was built on the new "clinker" system of overlapping longitudinal wooden strips which Roland had first used on the experimental D.IV triplane the year before. This method, though it made for strength and aerodynamic cleanness, may by its very unorthodoxy have prevented the Roland fighter from being ordered in greater numbers, for it was reported as highly manoeuvrable and easy to fly. Moreover, careful redesigning had eliminated the poor cockpit view that was such a drawback in the earlier Roland fighters. Only the prototype was designated D.VI; it was, incidentally, the thousandth aeroplane to be built by the company. Production aircraft were designated D.VIa when fitted with Mercedes engines of 160 or 180 h.p., and D.VIb when the 200 h.p. Benz IIIa was installed. The D.VIa also differed from the prototype in having a smaller gap between upper wing and fuselage, and horn-balanced ailerons. Further minor refinements to both wing and tail control surfaces were made in the D.VIb. Both versions were armed with twin Spandaus mounted on the top-decking in front of the cockpit. Roland D.VIa/D.VIb fighters served both with the German Air Force and with the German Navy, as defensive fighters on a number of seaplane bases.

BRIEF TECHNICAL DETAILS (D.VIb):
Engine: One 150/200 h.p. Benz Bz.IIIa inline.
Span: 30 ft. 10½ in.
Length: 20 ft. 8¾ in.
Height: 9 ft. 2¼ in.
Weight Empty: 1,450 lb. *Loaded:* 1,896 lb.
Max. Speed: 113 m.p.h. at 6,560 ft.
Ceiling: 19,000 ft.
Duration: 2 hr.
Armament: Two fixed, forward-firing Spandau machine guns.

C.II. [*I.W.M.*

Lloyd C types

Country of origin: **AUSTRO-HUNGARY.**
Purpose: **Reconnaissance and training.**
Makers: **Ungarische Lloyd Flugzeug und Motorenfabrik A.G.**
In operational use: **1915/18.**

One of the comparatively unsung stalwarts of the 1914–18 war, the Lloyd series of two-seat biplanes were built in substantial numbers and rendered steady and useful service to the Austro-Hungarian air service for the major part of the war period. Little is known about the C.I, or Series 41, although one example, carrying a full load, flew to an altitude of more than 20,200 ft. during a 1914 air display near Vienna. The C.I was powered by an Austro-Daimler engine, probably of 120 h.p. It is not believed to have been built in great quantity, but during 1915 one hundred examples of the C.II (Series 42) were delivered, half of them built by Lloyd and the other half by W.K.F. Powerplant of the C.II was the 145 h.p. Hiero, and this aircraft also had a greater wing span than the C.I. Like its predecessor, it exhibited an excellent climb and altitude performance and was an ideal reconnaissance type. Its slim lines and gently sweptback wings gave it an attractive appearance. A Schwarzlose machine gun was added to late-production C.II's, on a ring mounting in the rear of the communal cockpit. The principal difference between the C.II and the C.III, which appeared a year later, was the latter's 160 h.p. Austro-Daimler engine. Like its predecessor, the C.III (Series 43) was built by Lloyd and W.K.F., each manufacturer completing 50 aircraft. The C.II and C.III were widely used by the Austro-Hungarian air force, notably in Italy, but also in Rumania. It seems doubtful if the C.IV, or Series 44, was used in the front line, but a number may have been built for the training role. Powerplant remained the same as for the C.III, but a single-bay wing cellule replaced the latter's two-bay configuration and this venture may not have been entirely successful. The final Lloyd C type was the C.V, which was a cleaned-up, short-span derivative of the C.III used primarily for training. The C.V (Series 46) was built entirely by Lloyd, the first 50 having 185 h.p. Austro-Daimlers and the second 50 being powered by Austrian-built Benz engines of 200 h.p.

BRIEF TECHNICAL DETAILS (C.III):
Engine: One 160 h.p. Austro-Daimler inline.
Span: 45 ft. 11 in.
Length: 29 ft. 6 in.
Height: 11 ft. 2 in.
Weight Empty: 2,040 lb. *Loaded:* 3,040 lb.
Max. Speed: 83 *m.p.h.* at sea level.
Ceiling: 19,685 ft.
Duration: 3 hr. 30 min.
Armament: One free-firing Schwarzlose machine gun.

[I.W.M.

Lohner Type L

Country of origin: **AUSTRO-HUNGARY.**
Purpose: **Maritime patrol and reconnaissance.**
Maker: **Jakob Lohner A.G.**
In operational use: **1915/18.**

The Austro-Hungarian Navy, both before and during World War I, placed more faith in the value of the flying boat than did its German ally, and several hundred boats of Lohner design were in service during the war period. Of these, the second major type to be built was the three-seat Type L reconnaissance, patrol and anti-shipping 'boat, which was used extensively in the Adriatic Sea theatre of war. The Type L was preceded by the Lohner E, forty of which were built with 85 h.p. Hiero engines, entering service in 1914. Exact production of the L type is uncertain, but Lohner were allocated a block of 160 serial numbers and a further 10 similar machines were ordered from the Pola naval dockyard as the Type M. One other Type L was built in Germany by Hansa-Brandenburg. Standard powerplant of the Type L was the 140 h.p. Austro-Daimler, though other engines were fitted to some aircraft. Peak activity of the Lohner L's was during 1916, and during their operational career they were flown by most Austrian Navy pilots. A variant of the Type L was the Lohner R, which carried cameras in place of a bomb load and was purely a reconnaissance type. Some 35–40 Type R's were built during 1915–16. An unarmed, dual-control version of the earlier Type E was designated Type S and used as a trainer; some Hansa-Brandenburg K type 'boats were similarly converted and known by the same designation. The Lohner L's were used both by day and by night, and in addition to their maritime missions were often used for bombing raids on land targets along the Western Italian seaboard.

BRIEF TECHNICAL DETAILS:
Engine: One 160 h.p. Austro-Daimler inline.
Span: 53 ft. 1¾ in.
Length: 33 ft. 7⅛ in.
Height: 12 ft. 7⅝ in.
Weight Empty: 2,535 lb. *Loaded:* 3,748 lb.
Max. Speed: 65 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 4 hr. approx.
Armament: One free-firing Schwarzlose machine gun; up to 440 lb. of bombs.

B.I. [I.W.M.

L.V.G. B.I to B.III and C.I to C.IV

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and training.**
Makers: **Luft-Verkehrs Gesellschaft m.b.H.**
In operational use: **1914/17.**

Progeny of Swiss-born Franz Schneider, the L.V.G. B.I was one of the best general purpose types in German service at the outbreak of war. It was used chiefly for unarmed scouting or training duties, and was built both by L.V.G. and the Otto company of Munich with either the 100 h.p. Mercedes D.I or the 110 h.p. Benz engine. A 120 h.p. D.II engine, smaller wingspan and other refinements characterised the B.II, which was the chief production B type and was built by Otto and Schütte-Lanz. The latter company also completed several examples of the B.III (*Schül*) trainer of 1917, which made more extensive use of plywood covering and had redesigned tail surfaces. Meanwhile, the B.I had also formed the basis, in 1915, for the first armed version, the C.I. This was powered by a 150 h.p. Bz.III engine and was placed in immediate but limited production to counter the armed Allied aircraft that were then beginning to appear on the Western Front. It was, in fact, the first operational German two-seater to give the observer a free-firing gun in the rear cockpit. The C.I was, however, only an interim type: the C.II, which appeared towards the end of 1915, closely resembled the unarmed B.II except for its Mercedes D.III engine and Parabellum machine gun. Later production C.II's also carried a forward-firing Spandau gun, and the type was sometimes used as a bomber, with a small load of 22 lb. bombs. It was an L.V.G. C.II that was credited, on 28th November, 1916, with making the first aeroplane raid on London. At the peak of their service some 250 C.I's and C.II's were in use on duties including bombing, reconnaissance and photographic missions. A one-off C.I variant was built and flown in June 1915 as a single-seat torpedo-carrying aircraft, with a 200 h.p. Bz.IV engine and oversize tyres, but no production was undertaken. Two C.II developments were the C.III (with crew positions reversed) and the C.IV, a slightly bigger machine with a 220 h.p. Mercedes D.IV, but neither of these went beyond the experimental stage.

BRIEF TECHNICAL DETAILS (C.III):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 42 ft. 2 in.
Length: 26 ft. 7 in.
Height: 9 ft. 7½ in.
Weight Empty: 1,859 lb. *Loaded:* 3,091 lb.
Max. Speed: 81 m.p.h.
Ceiling: 13,120 ft.
Duration: 4 hr.
Armament: One Spandau and one Parabellum machine gun (see text).

C.V. [I.W.M.

L.V.G. C.V and C.VI

Country of origin: **GERMANY.**
Purpose: **Armed reconnaissance and light bombing.**
Makers: **Luft-Verkehrs Gesellschaft m.b.H.**
In operational use: **1917/18.**

One of the biggest two-seat aircraft built in Germany during World War I, the L.V.G. C.V first appeared on the Western Front in the summer of 1917 and was soon in widespread service both there and in Palestine. Its close resemblance to the D.F.W. C.V is explained by the fact that its designer was Sabersky-Müssigbrod, who had joined L.V.G. from D.F.W. at the beginning of 1917. A sturdily-built aeroplane, the C.V proved to be a steady gun and bomb-aiming platform, and in general it was liked by those who flew it. Its chief drawbacks were the rather restricted view from the cockpits, due to the lack of any sweep or stagger to the wings, but it nevertheless acquitted itself well on a range of duties that included reconnaissance, artillery observation and light bombing. There was a single fixed forward-firing Spandau gun for the pilot, and a ring-mounted Parabellum in the observer's cockpit. Racks beneath the lower wings could accommodate up to 250 lb. of bombs. The C.V was joined in service in 1918 by the C.VI, which had the same powerplant but a number of modifications to improve its flying qualities and general efficiency. A deeper fuselage and smaller wing gap, together with large cut-outs in both wings (which now had a slight stagger), eliminated some of the blind spots and generally improved the view from both cockpits, at the same time increasing the observer's field of fire. Relocated radiator(s) and replacement of the C.V's horn-balanced ailerons by plain ones contributed to a cleaner overall appearance. About 500 C.V's and C.VI's were recorded in service three months before the Armistice. A prototype was completed of the C.VIII, with a 200 h.p. Bz.IVü engine and ailerons on both mainplanes, but no production of this version was undertaken.

BRIEF TECHNICAL DETAILS (C.VI):
Engine: One 200 h.p. Benz Bz.IV inline.
Span: 42 ft. 7¾ in.
Length: 24 ft. 5⅛ in.
Height: 9 ft. 2¼ in.
Weight Empty: 2.090 lb. *Loaded:* 2,888 lb.
Max. Speed: 106 m.p.h. at sea level.
Ceiling: 21,350 ft.
Duration: 3 hr. 30 min.
Armaments: One fixed forward-firing Spandau and one free-firing Parabellum machine gun; up to 250 lb. of bombs.

M.8.

Macchi M.5, M.7 and M.8

Country of origin: **ITALY.**
Purpose: **Fighter (M.5 and M.7); maritime patrol (M.8).**
Makers: **Società Anonima Nieuport-Macchi.**
In operational use: **1917/18.**

The first Macchi flying boat to bear an M number was the M.3, which first appeared in 1913 and subsequently set up a world seaplane altitude record of 17,716·5 ft. over Lake Varese, near the Macchi factory. The M.3 was used in some numbers by Italian naval squadrons during the early part of the war for reconnaissance and general duties. From this, Macchi's designers Calzavara and Buzio developed the M.5 single-seat flying boat fighter, incorporating some of the features of the Austrian Lohner flying boats, a captured example of which was handed over to them by the Italian government. Powered by a 160 h.p. Isotta Fraschini V-4B engine driving a pusher propeller, the M.5 was armed with two Fiat machine guns. It entered production in 1917, a total of 240 subsequently being built. These served with several naval squadrons, mostly in the Adriatic coastal area as defensive fighters, and were still operational at the end of (and after) the war. Some later M.5's had 250 h.p. V-6 engines. The M.6 was not officially adopted, but the M.7 was the subject of modest production contracts. This, too, had the V-6 engine and a much better performance. Only three of the 17 completed before the Armistice had been delivered, but in various versions it continued with Italian naval units until the late 1920s. A much larger development was the M.8, 57 of which had been delivered before the war's end. Despite its greater size and weight, the M.8 had only the V-4B engine and a single defensive machine gun. However, they gave useful service for the last few months of the war as coastal patrol and anti-shipping aircraft; after the war they were used for training. The M.9, of which 30 were built, was a further enlargement with a 300 h.p. Fiat engine. Evolved for duties similar to the M.8, it saw only limited operational service.

BRIEF TECHNICAL DETAILS (M.5):
Engine: One 160 h.p. Isotta-Fraschini V-4B inline.
Span: 39 ft. 0½ in.
Length: 26 ft. 5⅞ in.
Height: 10 ft. 4½ in.
Weight Empty: 1,664 lb. *Loaded:* 2,138 lb.
Max. Speed: 117 m.p.h. at sea level.
Ceiling: 15,100 ft.
Range: 373 miles.
Armament: Two fixed, forward-firing Fiat machine guns.

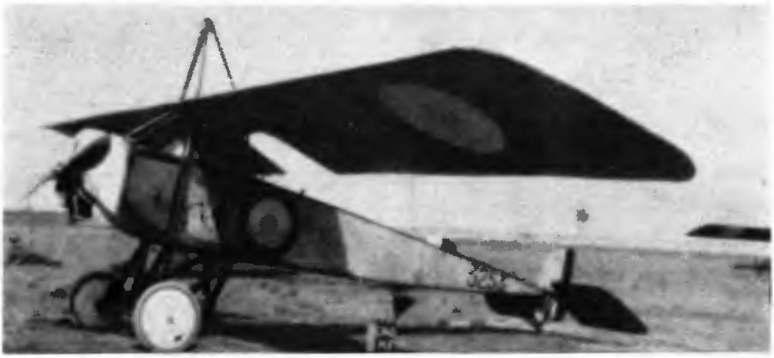
G.102. [*I.W.M.*

Martinsyde "Elephant"

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter, bomber and reconnaissance.**
Makers: **Martin and Handasyde Ltd.**
In operational use: **1916/17.**

Designed in mid-1915, the G.100 was built originally as a long range, single-seat fighter and escort machine, but its size and weight put it in the class of the two-seat D.H.4 day bomber, and it was as a bomber that the Elephant achieved most success. Aerodynamically it was an unusually clean two-bay biplane, with marked forward wing stagger and (in production G.100's) a neatly-installed 120 h.p. Beardmore. Long range it certainly possessed, carrying enough fuel for a 5½-hour flight, but it was too big and heavy to manoeuvre like a fighter. On the other hand, its general handling qualities and obvious lifting power indicated that it would make an efficient bomber, and from the summer of 1916 to the closing weeks of 1917 it was used for this purpose with some success. It was also employed to some extent on long range photographic reconnaissance, another task where its stability and endurance proved of great value. The introduction of the 160 h.p. Beardmore engine, with which the aeroplane was designated G.102, brought an improvement in the Elephant's overall performance, and altogether some 300 of the two variants were completed. These were used in France, Mesopotamia and Palestine, and at least two were used in Russia against the Bolsheviks. Armament, of both versions, consisted of two Lewis guns, one over the top wing centre-section to fire outside the propeller arc and the other inexplicably fixed to the port side of the fuselage to fire rearward. The efficacy of this second gun must have been doubtful, to say the least, and it is unlikely to have been used much in combat, unless in a hopeful attempt to persuade an attacker that he was engaging a two-seater! Up to 260 lb. of bombs could be carried on racks beneath the lower wings.

BRIEF TECHNICAL DETAILS (G.102):
Engine: One 160 h.p. Beardmore inline.
Span: 38 ft. 0 in.
Length: 26 ft. 6 in.
Height: 9 ft. 8 in.
Weight Empty: 1,793 lb. *Loaded:* 2,424 lb
Max. Speed: 104 m.p.h. at 3,000 ft.
Ceiling: 16,400 ft.
Duration: 4 hr. 30 min.
Armament: Two fixed Lewis machine guns; up to 260 lb. of bombs.



[I.W.M.

Morane-Saulnier L

Country of origin: **FRANCE.**
Purpose: **Fighting scout.**
Makers: **Aeroplanes Morane-Saulnier.**
In operational use: **1914/16.**

One of the first aeroplanes ever used for aerial combat, the Morane-Saulnier L was the company's first parasol-winged monoplane and appeared in 1913. It was already serving with French Army units at the outbreak of World War I, after which it was ordered in substantial numbers. Initially the Morane L was unarmed, but crews were encouraged to carry carbines or small arms, and the Morane's superior speed enabled successes to be scored against the slower Albatroses and Aviatiks. At a later stage a machine gun was mounted above the centre-section to fire outside the propeller arc. Raymond Saulnier carried out synchronisation experiments early in 1914 with machine guns installed in the Morane L. Unfortunately, further experiments were abandoned. Instead, Saulnier fitted deflector plates on the propeller blades to prevent them being damaged by bullets from a front-firing gun. The first such machine was handed over to Roland Garros, who achieved a number of successes with it during April 1915; but on 19th April he was forced down behind enemy lines and captured. This enabled the Germans to study the Saulnier system and resulted in the development of a successful interrupter gear for the Fokker E types. A Morane L took part in the destruction of Zeppelin LZ37 on 7th June, 1915. Flight Sub-Lieutenant R. A. J. Warneford, flying R.N.A.S. Morane No. 3253 (*see photo*), had taken of with six 20 lb. bombs to attack the Zeppelin base at Berchem Ste. Agathe, but on the way he met LZ37 bound for a raid on Great Britain. Warneford flew above the 700-foot envelope and released his bombs. With the sixth explosion the Zeppelin blew up, the blast catching Warneford's aircraft and fracturing a fuel pipe. He landed—behind enemy lines—did a quick repair and flew on to Cap Gris Nez before his fuel ran out and forced him down. Warneford was awarded the V.C. for his exploit. The R.N.A.S. received 25 Morane L's, often using them as single-seaters; some were also used by the Imperial Russian Air Service. Total Morane L production was just under 600.

BRIEF TECHNICAL DETAILS:

Engine: One 80 h.p. Gnome or Le Rhône rotary.
Span: 33 ft. 9½ in.
Length: 20 ft. 9 in.
Height: 10 ft. 4 in.

Weight Empty: 869 lb. *Loaded:* 1,499 lb.
Max. Speed: 71 m.p.h. at sea level.
Ceiling: 13,100 ft.
Range: 280 miles.
Armament (later aircraft): One fixed, forward-firing Hotchkiss or Lewis machine gun.

Type LA. [I.W.M.

Morane-Saulnier LA and P

Country of origin: **FRANCE.**
Purpose: **Reconnaissance.**
Makers: **Aéroplanes Morane-Saulnier.**
In operational use: **1915/17.**

The Morane-Saulnier L, although conceived for reconnaissance work, made more impact during the early months of World War I as a combat aeroplane, thanks to its edge of speed over contemporary German two-seaters and the active encouragement given to its crews to carry some kind of hand-held armament on scouting missions. Nevertheless, it also carried out a useful amount of reconnaissance and artillery observation with several French squadrons as well as with the British and Russian air arms. An improved model, the LA (or Type IV), joined it in 1915 and incorporated such design improvements as a conical spinner, a rounded-section fuselage, fixed vertical fins above and below the rear fuselage, and aileron control. Like the Type L before it, the LA was intended originally for reconnaissance but became used for fighting duties until the appearance of the Nieuport 11. Morane LA's were also used by the R.F.C., to whom 24 were supplied. In 1915 the L and LA types were joined by the Morane-Saulnier P, which retained the circular fuselage and general configuration of the LA but was somewhat simpler structurally and slightly larger. French production of the Morane P totalled 595, these being officially designated Type XXI when fitted with 80 h.p. Le Rhône engines and Type XXVI with the 110 h.p. Le Rhône. They were distributed in small numbers to French and R.F.C. squadrons, never completely equipping any one unit, and remained in service until well into 1917. The Type XXVI was the better armed version, having a fixed and synchronised Vickers machine gun for the pilot and a ring mounting for the observer's Lewis. Morane P's performed an especially useful role on photographic reconnaissance duties.

BRIEF TECHNICAL DETAILS
(Type XXVI):
Engine: One 110 h.p. Le Rhône rotary.
Span: 36 ft. 9 in.
Length: 23 ft. 7 in.
Height: 11 ft. 5 in.

Weight Empty: 952 lb. *Loaded:* 1,612 lb
Max. Speed: 97 m.p.h. at 6,560 ft.
Ceiling: 12,000 ft.
Duration: 2 hr. 30 min.
Armament: One fixed, forward-firing Vickers and one free-firing Lewis machine gun.

Morane-Saulnier N

[I.W.M

Country of origin: **FRANCE.**
Purpose: **Fighting scout.**
Makers: **Aéroplanes Morane-Saulnier.**
In operational use: **1914/16.**

Evolved during the latter half of 1913, the Morane-Saulnier N was accepted for service early in 1914. It was an exceptionally clean and well streamlined monoplane, giving an overall appearance ahead of its time and forecasting a formula that was to be carried even further some years later by the Bristol M.1C. The Morane N, or Military Type V as it was subsequently designated, was powered by an 80 h.p. Gnome or Le Rhône rotary engine, had good speed and climbing performance, and was highly manoeuvrable; its main drawback was the rather poor downward view from the cockpit. The Morane N was not built in great numbers: only 49 for French use, a small batch for the R.F.C. (used by four squadrons), and sufficient for one squadron of the Imperial Russian Air Service. The R.F.C. Moranes, fitted with 110 h.p. Le Rhônes, were described by Lord Balfour of Inchrye as " over-engined, inefficient, and never a success ", but this judgment is perhaps a little harsh. The Morane N was not a great aeroplane, and it had its faults—among them over-sensitive controls and a rather high landing speed—but it could be a useful combat type in the hands of a good pilot. In 1916, 31 examples of the improved AC (Type XXIII) were built, having a 120 h.p. Le Rhône and rigid underwing bracing struts. One of these aircraft was fitted experimentally with twin Vickers guns firing through the propeller arc.

BRIEF TECHNICAL DETAILS:

Engine: One 80 h.p. Gnome or Le Rhône rotary.
Span: 27 ft. 2⅜ in.
Length: 21 ft. 11⅜ in.
Height: 8 ft. 2½ in.
Weight Empty: 635 lb. *Loaded:* 981 lb.
Max. Speed: 102 m.p.h. at 6,500 ft.
Ceiling: 13,125 ft.
Duration: 1 hr. 30 min.
Armament: One fixed, forward-firing Hotchkiss or Vickers machine gun.

Nieuport 12. [*I.W.M.*

Nieuport 10 and 12

Country of origin: **FRANCE.**
Purpose: **Fighter and reconnaissance.**
Makers: **S.A. des Etablissements Nieuport.**
In operational use: **1915/17.**

First of a famous line of designs evolved by Gustave Delage, who joined Nieuport in January 1914, the Nieuport 10 appeared later that year. Its sesquiplane layout (or " mezzo-monoplane ", as the Italians described it) set a pattern that was soon to become a familiar Nieuport trademark. With an 80 h.p. Le Rhône or Anzani rotary engine, the Nieuport 10 entered service in 1915 as a two-seater, being used chiefly for reconnaissance and only occasionally as a fighter. Nieuport 10's were built in two forms, with alternate crew arrangements, the designation 10AV (= *avant*) or 10AR (= *arrière*) indicating the observer's position. At first the aircraft's armament consisted only of small arms or occasionally, a machine gun firing through a top centre-section cut-out. In the latter form the aircraft was generally flown as a single-seater. The Nieuport 10 was manufactured under licence in Italy by Macchi, and was the first true fighter to go into service with the Italian air service. The R.N.A.S. and R.F.C. also had the type in several squadrons, as did the Belgian *Aviation Militaire*. The Nieuport 12 was a larger and stronger development, the major improvements being designed to improve the crew's field of view and fire as well as the aircraft's general performance and manoeuvrability. Armament of the Nieuport 12 was originally as for its predecessor, but eventually a synchronised forward-firing gun was added for the pilot. Late production Nieuport 12's built in France and Britain had fully circular cowlings instead of the " horse-shoe " type, and some British Nieuports had a small fixed fin in front of the rudder. The R.N.A.S. received a total of 194 Nieuport 10's and 12's, employing them on the Western Front and in the Aegean. The R.F.C. two-seaters remained in service rather longer than most, some still being active in the summer of 1917. The French Nieuport 10/12's were withdrawn in 1916 in favour of the Nieuport 16; they were converted for use as trainers under the new designation Nieuport 83.

BRIEF TECHNICAL DETAILS
(Nieuport 12C.1):
Engine: One 110 or 130 h.p. Clerget rotary.
Span: 29 ft. 7½ in.
Length: 23 ft. 11⅞ in.
Height: 8 ft. 9 in.
Weight Empty: 1,210 lb. *Loaded:* 2,028 lb.
Max. Speed: 96 m.p.h. at sea level.
Ceiling: 15,400 ft.
Duration: 3 hr.
Armament: One fixed, forward-firing Lewis machine gun; one synchronised Vickers gun added in late-production machines.

Nieuport 11. [I.W.M.

Nieuport 11 and 16

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **S.A. des Etablissements Nieuport.**
In operational use: **1915/17.**

The Nieuport 11, also known as the *Bébé* (Baby), was, like the Nieuport 10, evolved from the little racing biplane evolved by Gustave Delage to compete for the 1914 Gordon Bennett Cup. It was an attractive single-seater, powered by an 80 h.p. Gnome or Le Rhône rotary engine, and mounted a Lewis gun above the upper wing to fire outside the propeller arc. First order for the Nieuport 11 came from Britain, but this was quickly followed by others from the French, Belgian, Italian and Russian governments. Pilots were quick to appreciate the aeroplane's excellent manoeuvrability and fast rate of climb, and the Nieuport 11 was the instrument on which several new air fighting tactics were pioneered in 1915–16. Ball, Bishop, de Rose, Navarre and Nungesser were among the many famous fighter pilots who flew the Nieuport 11. In Italy, Macchi built 646 of these aircraft, which remained standard equipment until mid-1917; Holland bought five and built a further 20 under licence. The Nieuport 11's chief contribution to the air war was its part. in company with the British D.H.2, in overcoming the so-called " Fokker scourge ". By the end of 1916, a number of losses had been incurred from the weak lower wing structure, and in any case the Nieuport 11's performance was becoming inadequate by this time. An experimental triplane version appeared in 1917, but this was not followed up. The next derivative was the Nieuport 16, which had a 110 h.p. Le Rhône in an improved cowling and had the top-decking built up to provide a headrest for the pilot. It was used by the R.F.C. and the French in small numbers, and a few were also supplied to Belgium, but it was not a great success. Its principal use seems to have been as an anti-Zeppelin aircraft, for which role the fixed armament would often be omitted, its place being taken by four electrically-fired Le Prieur rockets mounted on each outer bay of interplane struts. Georges Guynemer's famous *Vieux Charles* was a Nieuport 16.

BRIEF TECHNICAL DETAILS (Nieuport 11C.1):
Engine: One 80 h.p. Le Rhône rotary.
Span: 24 ft. 9 in.
Length: 19 ft. 0½ in.
Height: 8 ft. 0½ in.
Weight Empty: 774 lb. *Loaded:* 1,058 lb.
Max. Speed: 97 m.p.h. at sea level.
Ceiling: 15,000 ft.
Duration: 2 hr. 30 min.
Armament: One fixed, forward-firing Lewis machine gun.

Nieuport 17. [I.W.M.

Nieuport 17, 21 and 23

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **S.A. des Etablissements Nieuport.**
In operational use: **1916/18.**

Appearing on the Western Front in March 1916, the Nieuport 17 was a progressive development of the Nieuport 11 and 16 single-seaters, and was to become the most successful and famous of all the Nieuport fighters to serve in the 1914–18 war. It was evolved directly from the Nieuport 16, retaining the same powerplant but introducing enlarged-area wings (15 instead of 13 sq. m.) and various detail improvements. Later production aircraft introduced a fixed synchronised Vickers gun in front of the pilot, in addition to or instead of the Lewis mounted over the centre-section. In general, the weight of the second gun and its ammunition was found to affect the aircraft's ceiling and climbing rate to an unacceptable extent, and it was generally used as a single-gun fighter. Like the Nieuport 16, the 17 was also used for anti-Zeppelin attacks, armed with Le Prieur rockets. French-built Nieuport 17's were supplied to Great Britain (R.F.C. and R.N.A.S.), Belgium and Russia; 75 were delivered to the American Expeditionary Force, and others to non-belligerent Finland (2) and Holland (20). In Italy, 150 were built under licence by Macchi. France, Holland and Rumania also used the 17 *bis*, similar except for a 130 h.p. Clerget in a modified cowling, and examples of this version were also evaluated in Britain and the U.S.A. The Nieuport 21 was an advanced trainer counterpart of the 17; 198 of these, with 110 h.p. Le Rhônes, were bought by the U.S.A.; others, usually with 80 h.p. Le Rhônes, were used by France and Russia. The Nieuport 23 was a variation of the 17, used by Belgium, Britain, France and Italy, which had the machine gun mounted in the side of the cowling; 49 of this type were bought by the U.S.A. in 1918. The Nieuport 17 *bis* flown by Nungesser was later converted to a Nieuport 23. The Nieuport 17 and its derivatives eventually gave way to the Spad VII but in August 1917 there were still over 300 on strength.

BRIEF TECHNICAL DETAILS (Nieuport 17C.1):
Engine: One 110 h.p. Le Rhône rotary.
Span: 26 ft. 11⅝ in.
Length: 18 ft. 10 in.
Height: 7 ft. 7¾ in.
Weight Empty: 825 lb. *Loaded:* 1,246 lb.
Max. Speed: 110 m.p.h. at 6,560 ft.
Ceiling: 17,400 ft.
Duration: 2 hr.
Armament: One fixed, forward-firing Vickers or Lewis machine gun (occasionally both).

Nieuport 27. [I.W.M.

Nieuport 24 and 27

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **S.A. des Etablissements Nieuport.**
In operational use: **1917/18.**

The prototype Nieuport 24, which appeared in 1916, was the aeroplane formerly flown by the French ace Charles Nungesser as a 17 *bis* and later converted to a Nieuport 23. It was further modified, along lines already seen in the experimental Nieuport 18, to have a rounded-section fuselage, a fixed vertical fin, a curved tailplane and a fully-cowled 130 h.p. Le Rhône engine. It thus took on a much more modern appearance and, as the Nieuport 24, served with the A.E.F. (121), France, Belgium and Italy. A version known as the 24 *bis* was also produced, this reverting to a 17-type tail unit and varying somewhat in the shape of the wingtips; Nieuport 24 *bis* aircraft were used by France and Britain and by the A.E.F., which had 140 late in 1917. A fixed, synchronised Vickers gun was usually installed in French service aircraft, but British pilots for some reason seemed to prefer the non-synchronised Lewis firing over the top wing. The American 24/24 *bis* aircraft were used for training. The next production version, and last of the long line of Nieuport " Vee-strutters ", was the Nieuport 27. This broadly resembled the 24, but further aerodynamic refinement was incorporated in the form of more rounded wingtips and an oval-shaped fin and rudder. Powerplant was the 120 h.p. Le Rhône, armament as for the 24 and 24 *bis*. Nieuport 27's were supplied to the British, French and Italian air forces, and 287 were purchased by the A.E.F. in November 1917. The basic Nieuport sesquiplane design reached the limit of its potential in the 27, and the company's subsequent products revealed a much more modern and efficient approach to fighter design.

BRIEF TECHNICAL DETAILS (Nieuport 27C.1):
Engine: One 120 h.p. Le Rhône rotary.
Span: 26 ft. 10⅞ in.
Length: 19 ft. 2⅛ in.
Height: 7 ft. 11½ in.
Weight Empty: 838 lb. *Loaded:* 1,289 lb.
Max. Speed: 116 m.p.h. at sea level.
Ceiling: 18,200 ft.
Range: 155 miles.
Armament: One fixed, forward-firing Vickers and/or one Lewis machine gun.

D.IIIa. [I.W.M.

Pfalz D.III

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Pfalz Flugzeug-Werke G.m.b.H.**
In operational use: **1917/18.**

The D.III was the first single-seat fighter biplane to originate at Pfalz, the D.I and D.II having been licence-built examples of the Roland D.I and D.II. Prior to this, Pfalz had concentrated largely on monoplane construction, and so they drew extensively on the design and constructional features of the Roland fighters in the evolution of their own D.III. The result was an even more shark-like appearance than the Roland "*Haifisch*". Appearing for the first time in the summer of 1917, the Pfalz D.III entered service with German fighter units in September, although it does not appear to have formed the exclusive equipment of any one squadron. Its manoeuvrability and climb were somewhat inferior to contemporary Albatros and Fokker fighters, but it had a useful turn of speed and was responsive on the controls. Moreover, its very sturdy construction stood up well to diving manoeuvres, one good reason why D.III's were often employed, successfully, for attacking balloons and airships. Twin Spandau machine guns were mounted originally inside the engine decking, but to facilitate maintenance in the field they were later removed to the outside of the upper cowling. In 1918 the D.III was joined by the D.IIIa, a refined version with a 180 h.p. Mercedes D.IIIa engine, semi-circular tailplane and more rounded wingtips, giving slightly better performance. By this time, quantity of aircraft was more important to the Germans than quality, and output of Pfalz fighters was increased. Some 600 D.III/IIIa's were built altogether; by the spring of 1918 they were no match for the latest Allied fighters, but more than 300 were still in service when the war ended.

BRIEF TECHNICAL DETAILS (D.III):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 30 ft. 10⅛ in.
Length: 22 ft. 9⅜ in.
Height: 8 ft. 9⅛ in.
Weight Empty: 1,532 lb. *Loaded:* 2,055 lb.
Max. Speed: 102 m.p.h. at 9,840 ft.
Ceiling: 17,000 ft.
Duration: 2 hr. 30 min.
Armament: Two fixed, forward-firing Spandau machine guns.

[I.W.M.

Pfalz D.XII

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Pfalz Flugzeug-Werke G.m.b.H.**
In operational use: **1918.**

The admitted excellence of the Fokker D.VII, boosted still further by intensive German propaganda extolling its many qualities, created a situation whereby any German fighter squadron that did *not* receive Fokkers felt that it was being palmed off with second best; and a number of otherwise excellent designs came to be judged unnecessarily harshly by comparison with the D.VII. Such was the case with the Pfalz D.XII, whose recipients were at first far from enthusiastic about the choice of their new equipment. However, once they had begun to fly the D.XII and became familiar with it, they found that not only was it a first-class machine but it was in fact better than the Fokker in certain respects. Three D.XII's were evaluated in the midsummer fighter competition, having, respectively, Mercedes D.IIIa, B.M.W.IIIa and Bz.IIIb engines. The Mercedes-engined version was selected for production, and began to enter service in the early autumn of 1918. It was a neat, two-bay biplane, not unlike the Fokker D.VII in general configuration, with the Mercedes engine tidily installed in a semi-monocoque wooden fuselage. The shallow rectangular vertical fin of early production D.XII's was replaced later by one of more rounded form, and the twin Spandau guns were mounted on the top-decking immediately in front of the cockpit. Because of the short period it was in production, and its relatively low priority compared with the Fokker D.VII, the Pfalz D.XII was not built in great numbers—perhaps less than 100 all told. It is known to have served with ten front-line *Jastas* and a number of home defence fighter units, and during its short operational life acquitted itself well against the opposing British Camel and S.E.5a. Developed versions included the D.XIV (200 h.p. Benz and enlarged fin) and the D.XV (180 h.p. Mercedes or 185 h.p. B.M.W.IIIa). The latter was tested early in November, and a production order for 180 was placed, but none of these are thought to have been completed.

BRIEF TECHNICAL DETAILS:
Engine: One 180 h.p. Mercedes D.IIIa inline.
Span: 29 ft. 6½ in.
Length: 20 ft. 10 in.
Height: 8 ft. 10½ in.
Weight Empty: 1,571 lb. *Loaded:* 1,978 lb.
Max. speed: 106 m.p.h. at 9,800 ft.
Ceiling: 18,500 ft.
Duration: 2 hr. 30 min.
Armament: Two fixed, forward-firing Spandau machine guns.

D.I of the Austro-Hungarian Navy. [I.W.M.

Phönix D.I, D.II and D.III

Country of origin: **AUSTRO-HUNGARY.**
Purpose: **Fighter.**
Makers: **Phönix Flugzeug-Werke A.G.**
In operational use: **1917/18.**

The need arose for such a fighter as the Phönix D.I early in 1917, when it became apparent that the Brandenburg D.I, which the Phönix Flugzeug-Werke had been building under licence, had reached the limit of its development. Austrian engines of increased power were becoming available, but the airframe of the Brandenburg fighter could not be stretched or strengthened sufficiently to take full advantage of this extra power. Thus Phönix began its own design of a fighter which could take advantage of the new 200 h.p. Austro-Daimler, and the prototype which appeared in mid-1917 was powered by this engine. There is a deal of similarity between the two-seat Phönix C.I and the single-seat D.I, and no doubt both designs owed much to earlier Brandenburg types built by the company. The D.I was a small, stocky single-bay biplane, and production aircraft (Series 128, 228 and 328) were powered by Hiero engines, also of 200 h.p. A synchronised Schwarzlose machine gun was mounted on or in the top-decking on each side of the cylinder block, and fired through the propeller arc. A parallel version with balanced elevators, known as the D.II, was also built in three series—122, 222 and 322. Some D.I/D.II's were allocated to Austrian Navy fighter squadrons, and others were employed on photographic reconnaissance—an unusual task for a single-seater in those days. Like the C.I, the Phönix fighter was a very stable machine, but in a World War I fighter this was an undesirable attribute and did nothing to aid the type's success; and early production aircraft were inclined towards structural weakness. This was rectified on later D.II's and on the D.III which followed it into service in 1918. The latter version differed from the D.II in having ailerons on both the upper and lower wings, and a more powerful (230 h.p.) Hiero engine.

BRIEF TECHNICAL DETAILS (D.I):
Engine: One 200 h.p. Hiero inline.
Span. 32 ft. 5 in.
Length: 21 ft. 9 in.
Height: 9 ft. 2 in.
Weight Empty: 1,441 lb. *Loaded:* 1,771 lb.
Max. Speed: 112 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr.
Armament: Two fixed, forward-firing Schwarzlose machine guns.

Pomilio PE. [I.W.M.

Pomilio PC, PD, PE and PY

Country of origin: **ITALY.**
Purpose: **Armed reconnaissance.**
Makers: **Fabbrica Aeroplani Ing. O. Pomilio.**
In operational use: **1917/18.**

The first of this family of Italian two-seat scouts, the PC, entered service with the Italian Air Force in the spring of 1917. It was a neat, two-bay biplane with a 260 h.p. Fiat A-12 engine, a Revelli machine gun on a ring mounting in the rear cockpit and a similar gun fixed over the top wing centre-section to fire clear of the propeller. When it was introduced into service, the PC's speed was better than that of most contemporary fighters, and its future seemed promising. Unfortunately, it suffered seriously from instability, and was quickly superseded by the PD, in which attempts were made to rectify this fault. The main evidence of this lay in the curved underfin now added to the rear fuselage, other refinements including a cleanly-cowled engine with a relocated radiator. These changes went a long way towards improving the aircraft's flying characteristics, but were evidently only an interim step pending introduction of the PE, which was by far the most widely-built variant. The PE had a slightly smaller underfin, but the upper fin and the tailplane were both increased in area, and in this form was indeed a first-class aeroplane. A further improvement on later production PE's was a synchronised gun for the pilot and a Lewis gun on a Scarff ring for the observer. Output of the Pomilio works comprised 545 PC's and PD's during 1917, and 1,075 PD's and PE's in 1918; the final version was the PY, seven of these being completed during 1918. On completion of these, the Pomilio brothers sold their company to Ansaldo and emigrated to the U.S.A., where their designs included the BVL-12 and FVL-8 for the U.S. government. The Pomilio range of scouts are known to have served with no less than 30 squadrons of the Italian air force.

BRIEF TECHNICAL DETAILS (PD):
Engine: One 260 h.p. Fiat A-12 inline.
Span: 38 ft. 8⅝ in.
Length: 29 ft. 4 in.
Height: 10 ft. 11⅞ in.
Weight Empty: 2,595 lb. *Loaded:* 3,477 lb.
Max. Speed: 114 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr.
Armament: One fixed and one free-firing Revelli machine gun.

B.E.2b. [I.W.M.

Royal Aircraft Factory B.E.2 series

Country of origin: **GREAT BRITAIN.**
Purpose: See text.
Makers: **Various.**
In operational use: **1914/18.**

The outbreak of World War I brought to the Royal Aircraft Factory at Farnborough an enormous increase in the programme of research, inspection and production of aeroplanes that for the first year of the war its staff of 4,000 worked night and day without a break. Their reward for their industry was to be accused of spending too much time on aircraft production and too little on the research and development side which was the Factory's main production. The facts disprove these allegations, and the Factory was completely vindicated by a subsequent enquiry which found that it " has only constructed for use 77 aeroplanes, of which 50 were to assist a private maker in the fulfilment of an order ". In fact, the Factory's contribution to the aerial war effort was considerable—not only in the design and construction of all kinds of aeroplane, but in such subjects as aero-engine technology, bomb-sights, various kinds of armament, variable-pitch propellers, and not least in the field of flight safety. Despite a lack of encouragement from the War Office in the immediate pre-war years, the Factory's administrators had gathered at Farnborough a number of extremely valuable pioneers of aviation—men like Samuel Cody and Geoffrey de Havilland. It is the latter who was primarily responsible for the basic design of the B.E.2 series, one of the Royal Aircraft Factory's best known products. In 1911 a Voisin " boxkite " biplane came to what was then still called the Army Aircraft Factory, and under the guise of " repair and reconstruction "—a ruse to get round the War Office's official ban on aeroplane *building*, as distinct from *repairing*, at the Factory—de Havilland and F. M. Green so transformed the Voisin that it was literally a new aeroplane. They gave it the designation B.E.1. The only link between the B.E.1 and the original Voisin was the 60 h.p. Wolseley engine, and even this was soon replaced by a Renault of the same power. The B.E.1 was a neat but frail-looking two-seat tractor biplane, with equal-span wings. It carried out much useful work for the R.F.C. (serial number 201) until

it was lost in a crash in January 1915. In 1912—in which year the Factory was granted its "Royal" title—de Havilland brought out the B.E.2, which was a development of the B.E.1 with slight dihedral, enlarged horizontal tail surfaces and a 70 h.p. Renault engine. In June it was flown by de Havilland, with a passenger, to a new British altitude record of 10,560 ft. over Lark Hill on Salisbury Plain. Two months later the Military Aeroplane Competition was won officially by Cody's 120 h.p. Austro-Daimler biplane; the B.E.2, as a government design, was ineligible for the competition, but the fact that it outperformed every one of the thirty-odd entrants from Britain and France could not be ignored, and it was later produced in great numbers for the R.F.C. and R.A.F. The first service version was the B.E.2a, in which the interplane bracing struts were reinforced, the fuel system improved and the front (observer's) cockpit given additional protection. The first British aircraft to land in France after the outbreak of war were B.E.2a's of Nos. 2 and 4 Squadron, R.F.C., which were despatched on 13th August, 1914. They were used by these and several other Corps squadrons for reconnaissance and light bombing during the early months of the war. The B.E.2b, which appeared in 1914, had shallower cockpit sides and an improved control system. Later production machines were the first to introduce aileron control surfaces in place of the wing-warping method adopted on previous B.E.'s. By the end of the war's first year all these early, unarmed B.E.2 variants had been recalled from the Western Front, where from April 1915 they had begun to be replaced by the vastly improved B.E.2c, with a 90 h.p. R.A.F.1a engine, staggered wings with top and bottom ailerons, and a defensive machine gun in the front cockpit. Because of its limited field of fire, the gun was not as much use as it might have been in the more conventional (by then) rear position; but the B.E.2c was a much better flying machine. This was largely due to the research and determination of E. T. Busk, who since 1913 had been investigating problems of stability and the then little-understood phenomenon of spinning. Unfortunately, Busk never lived to see the B.E.2c in action: he was killed on 5th November, 1914 when the machine he was flying caught fire and crashed at Farnborough. Ironically, too, the very qualities that made it a better reconnaissance and bombing machine than its predecessors were the cause of its high loss rate when faced by the Fokker monoplane fighters in the second half of 1915: it was too stable to dodge the enemy and too slow to outrun him. Yet in spite of the appalling losses a high production rate was maintained, and the type was still at the Western Front in "Bloody April" 1917. During 1916 the B.E.2c was joined by the B.E.2d. In this version, at last, the

B.E.2c. [I.W.M.

pilot and observer occupied their more logical cockpits, and a forward-firing Vickers gun was added to the armament. The B.E.2c and B.E.2d were also employed in the Aegean area, North Africa, Macedonia and the Middle East; and others were supplied to Belgium and some Commonwealth countries. A more successful career attended those B.E.2c's used by R.F.C. home defence units in Britain, where they were quite effective as night fighters against the raiding German airships. The final and most numerous variant was the B.E.2e, evolved in mid-1916. This retained the powerplant and back-to-front crew arrangement of the B.E.2c, but an entirely new wing design and revised tail surfaces were thought to promise a much better performance. Like its predecessors, however, it had to be pushed into combat in huge numbers before the obvious truth was accepted: that it was just as slow and defenceless as the earlier models, and in home defence squadrons was even inferior to the B.E.2c. The official persistence with B.E.2's in the face of their extremely poor combat record is little short of incredible, and yet the type was mass-produced by more than a score of contractors and kept in active service right up to the time of the Armistice. Deliveries to the R.F.C./R.A.F. included 32 B.E.2's, 15 B.E.2a's, 85 B.E.2b s, 1,308 B.E.2c/2d's and 1,801 B.E.2e's; four of the B.E.2a's and about 95 of the B.E.2e's were transferred to naval units.

BRIEF TECHNICAL DETAILS:

B.E.2b:	**B.E.2c:**	**B.E.2d:**
Engine: One 70 h.p. Renault inline.	One 90 h.p. R.A.F. 1a inline.	As B.E.2c.
Span: 35 ft. 0½ in.	37 ft. 0 in.	As B.E.2c.
Length: 29 ft. 6½ in.	27 ft. 3 in.	As B.E.2c.
Height: 10 ft. 2 in.	11ft. 1½ in.	11 ft. 0 in.
Weight Empty: 1,274 lb.	1,370 lb.	1,375 lb.
Loaded: 1,600 lb.	2,142 lb.	1,912 lb.
Max. Speed:		
at sea level: 70 m.p.h.	72 m.p.h.	As B.E.2c.
Ceiling: 10,000 ft.	As B.E.2b.	7,000 ft.
Duration: 3 hr.	As B.E.2b.	As B.E.2b.
Armament: None.	One fixed Vickers and one free-firing Lewis machine gun.	As B.E.2c.

B.E.2e. [I.W.M.

B.E.12b. [I.W.M.

Royal Aircraft Factory B.E.12

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter and light bomber.**
Makers: **Various.**
In operational use: **1916/18.**

Produced in rather greater numbers than its military worth justified, the B.E.12 was nevertheless in R.F.C./R.A.F. service throughout the second half of World War I. It was evolved, rather hastily, in an effort to combat the threat of the Fokker monoplane in 1916; yet it was little more than a modification of the B.E.2c which the Fokkers were already shooting down in large numbers with comparative ease. It had more power; the front cockpit was eliminated, to make the B.E.12 a single-seater; on production aircraft the fuel and exhaust systems were improved, and the tail surfaces slightly revised. The B.E.12 entered service on the Western Front in August 1916, but it soon became apparent that the shortcomings of the B.E.2c—inadequate speed and manoeuvrability—were still there in the B.E.12, and after a short period of service the type was transferred to bombing. The early armament, of a wing-mounted Lewis firing outside the propeller arc, was later replaced by a fuselage-mounted gun with a primitive interrupter gear, but neither was entirely satisfactory. The B.E.12a was an adaptation of the B.E.2e along similar lines. Production of the B.E. 12/12a reached 468 machines. They were followed by 100–150 B.E.12b, produced for home defence squadrons in 1917 with the 200 h.p. Hispano-Suiza engine and twin Vickers guns firing over the top wing. After German bombing raids on Britain ended in mid-1918 some B.E.12b's were used for anti-submarine duties. The B.E.12b could carry two 112 lb. bombs on underwing points.

BRIEF TECHNICAL DETAILS (B.E.12a):
Engine: One 150 h.p. R.A.F. 4a inline.
Span: 40 ft. 10½ in.
Length: 27 ft. 3 in.
Height: 12 ft. 0 in.
Weight Empty: 1,610 lb. *Loaded:* 2,327 lb.
Max. Speed: 99 m.p.h. at 3,100 ft.
Ceiling: 12,500 ft.
Duration: 2 hr. 30 min. approx.
Armament: One fixed, forward or rearward-firing Vickers machine gun.

F.E.2b. [*I.W.M.*

Royal Aircraft Factory F.E.2a to F.E.2d

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter, reconnaissance and night bomber.**
Makers: **Various.**
In operational use: **1915/18.**

The F.E.2a, which appeared in 1914, was designed from the outset as a combat aeroplane, and was unrelated to the two F.E.2 pusher biplanes produced by the Royal Aircraft Factory in 1911–13. Broadly, it followed the same pusher layout as the contemporary D.H.2, but was a two-seater, having a 100 h.p. Green rotary engine and outer wing panels interchangeable with the B.E.2c. A dozen F.E.2a's were ordered from the Factory at the outbreak of war, but the Green engine proved unsatisfactory and subsequent aircraft, with 120 or 160 h.p. Beardmores, were designated F.E.2b; 1,939 aircraft of this type were built. The first four F.E.2b squadrons arrived in France in the winter of 1915/16, and soon began to show their paces against the Fokker monoplane. Among the early victims were the celebrated Max Immelmann, whose Fokker was shot down by an F.E.2b of No. 25 Squadron, and Karl Schaefer, who then had 30 Allied aircraft to his credit. Armament of the "Fee", as it became known, involved considerable agility and some risk to the observer, who was located in the front cockpit: in addition to the forward-firing Lewis in front of his cockpit, there was a second Lewis mounted to fire rearward over the upper wing, which he could only operate by standing up in his seat. F.E.2b's were also used in some strength as night bombers and ground attack aircraft, some of the latter mounting a one-pounder Vickers pom-pom gun for this purpose. Only two F.E.2c's were built, though both were operationally employed. They were night fighting variants produced experimentally in 1916 with the crew positions reversed. Then, in July 1916, came the F.E.2d, an improved F.E.2b with a 250 h.p. Rolls-Royce Eagle I engine and one or two additional guns operated by the pilot; 251 F.E.2d's were built.

BRIEF TECHNICAL DETAILS (F.E.2b):
Engine: One 160 h.p. Beardmore inline.
Span: 47 ft. 9 in.
Length: 32 ft. 3 in.
Height: 12 ft. 7½ in.
Weight Empty: 2,061 lb. *Loaded:* 3,037 lb.
Max. Speed: 91 m.p.h. at sea level.
Ceiling: 11,000 ft.
Range: 248 miles.
Armament: Two fixed Lewis machine guns, one firing forward and one rearward.

[I.W.M.

Royal Aircraft Factory R.E.8

Country of origin: **GREAT BRITAIN.**
Purpose: **Reconnaissance and light bomber.**
Makers: **Various.**
In operational use: **1916/18.**

Produced in very great numbers, the R.E.8 survived an unfortunate (and not entirely justified) early reputation to become one of the truly standard R.F.C./R.A.F. types of the second half of the war. In all, 4,077 of these aircraft—affectionately known as "Harry Tates"—were produced, and at October 1918 they were in service with no less than 19 Royal Air Force squadrons. The prototype was tested under operational conditions in France in June 1916, and plans were laid for mass production of the type. These were held up somewhat by certain materials being in short supply, and by early teething troubles with the R.A.F. 4a engine; but both these problems were overcome and No. 52 Squadron, the first to receive the type, arrived in France with its R.E.8's in November 1916. A tendency to spin had been noted on the first few aircraft; news of this had preceded the R.E.8 to France, and when a number of accidents befell No. 52 Squadron's machines shortly after their arrival the squadron was temporarily re-equipped with B.E.2e's while the R.E.8's were recalled for modification. However, this squadron's experiences were happily not repeated in other units, and the R.E.8 went into widespread service throughout 1917. Although capable of carrying a 260 lb. bomb load, the R.E.8 was used chiefly as an artillery spotter, infantry contact-patrol and photo-reconnaissance machine, on which duties it rendered yeoman service in the last year and a half of the war. One, later two, Lewis guns were mounted in the rear cockpit, with a forward-firing Vickers gun on the fuselage port side for the pilot. The main weaknesses of the R.E.8 were its lack of agility and its difficult landing characteristics. British R.E.8's served also in Italy and Palestine, and 22 of these aircraft, with 150 h.p. Hispano-Suiza engines, were supplied to the Belgian air force.

BRIEF TECHNICAL DETAILS:
Engine: One 150 h.p. R.A.F. 4a inline.
Span: 42 ft. 7 in.
Length: 27 ft. 10½ in.
Height: 11 ft. 4½ in.
Weight Empty: 1,803 lb. *Loaded:* 2,678 lb.
Max. Speed: 102 m.p.h. at 6,500 ft.
Ceiling: 13,500 ft.
Duration: 4 hr. 15 min.
Armament: One fixed, forward-firing Vickers and one or two free-firing Lewis machine guns; up to 260 lb. of bombs.

S.E.5a. [*I.W.M.*

Royal Aircraft Factory S.E.5 and S.E.5a

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **Various.**
In operational use: **1917/18.**

The S.E.5a was easily the most successful of the Royal Aircraft Factory's products between 1912 and 1918, and is rated second only to the Sopwith Camel as the finest British fighter of World War I. Underlying the design of the original S.E.5 was the necessity to avoid the cardinal fault of the B.E.2c, which was too stable in the air to manoeuvre like a true fighter. At the same time the S.E.5 had to be comparatively easy to fly, since pilots were perforce being turned out with only a minimum of flying training. These requirements were met admirably while still retaining enough stability to make the S.E.5 a first-class firing platform, and it had excellent structural strength that enabled it to absorb heavy punishment. The first production S.E.5's, with 150 h.p. Hispano-Suiza engines, became available in the spring of 1917, followed in June by the first S.E.5a's, which had the 200 h.p. Hispano-Suiza. Later S.E.5a's had 220 or 240 h.p. Hispanos and, finally, 200 h.p. Wolseley Vipers. First S.E.5's at the Western Front were those of No. 56 Squadron, which arrived early in April 1917, and the type quickly won the respect of its adversaries. It more than held its own against the later German fighters, including the redoubtable Fokker D.VII, and was flown by many of the leading British fighter pilots: " Mick " Mannock scored 50 of his 70 victories while flying an S.E.5. Total S.E.5/5a production reached 5,205 machines, and plans were made for a further 1,000 to be built in the U.S.A. by Curtiss. This contract was cancelled after the Armistice, but British-built S.E.5's were flown by some units of the American Expeditionary Force in Europe. Some technical troubles were encountered, both with the 200 h.p. Hispano engines and with the Constantinesco synchronising gear for the Vickers machine gun, but apart from this the S.E.5a proved a first rate fighter, with an especially fine rate of climb.

BRIEF TECHNICAL DETAILS (S.E.5a):
Engine: One 200 h.p. Wolseley Viper inline.
Span: 26 ft. 7⅜ in
Length: 20 ft. 11 in.
Height: 9 ft. 6 in.
Weight Empty: 1,387 lb. *Loaded:* 1,988 lb.
Max. Speed: 138 m.p.h. at sea level.
Ceiling: 19,500 ft.
Range: 340 miles.
Armament: One fixed Vickers and one fixed Lewis machine guns, both firing forward.

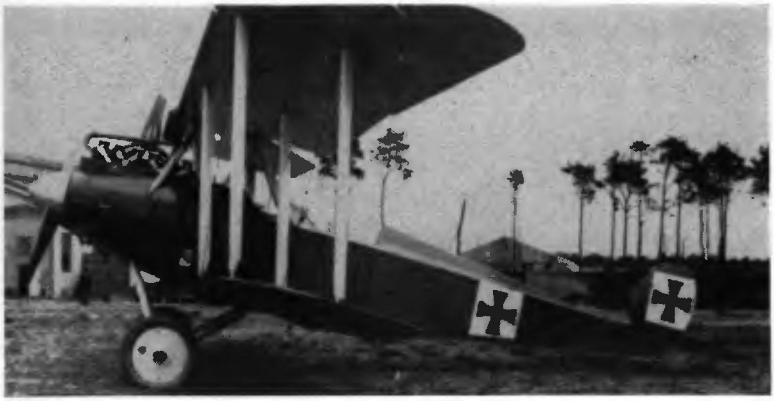
C.I. [I.W.M.

Rumpler B.I and C.I

Country of origin: **GERMANY.**
Purpose: **Reconnaissance and light bomber.**
Makers: **Edmund Rumpler Flugzeug-Werke G.m.b.H.**
In operational use: **1914/18.**

The Rumpler B.I, designed before the outbreak of war as the Rumpler 4A, was one of the most widely used scouting biplanes in use during the early part of World War I, 198 being built by Rumpler at Johannisthal and Pfalz at Speyer-am-Rhein. The B.I was a two-seat, two-bay aircraft, powered by a 100 h.p. Mercedes D.I engine; the aeroplane was unarmed, although several B.I crews often carried small-arms in the cockpit. During 1914–15 it saw an appreciable amount of service on both Eastern and Western Fronts, and in later years gave useful service as a training aircraft. Its armed counterpart, the C.I or Rumpler 5A 2, made its appearance at the beginning of 1915, and was a neat design with appreciably more engine power than the B.I. On early production C.I's, a single Parabellum gun, on a Schneider ring mounting in the rear cockpit, provided the aircraft's only defence, but later aircraft also carried a synchronised Spandau gun installed on the port side of the engine. Up to 220 lb. in small bombs could be carried for light bombing attacks. The C.I appeared first over the Western Front, later being employed in Macedonia and Palestine, as was the C.Ia which joined it shortly afterwards. The C.Ia was virtually the same aeroplane except for a 180 h.p. Argus As.III engine, and both types were produced in quantity by the Germania, Hannover, Märkische and Rinne factories as well as by the parent company. The Bayerische Rumpler-Werke built a version with the 150 h.p. Bz.III engine, this being used in 1918 as a dual-control trainer. Total production figures are unavailable, but at the peak of their service in October 1916 there were about 250 C.I/Ia's with the squadrons. A few were still on front-line duty as late as February 1918, although by then most of these aircraft had been relegated to the training role.

BRIEF TECHNICAL DETAILS (C.I):
Engine: One 160 h.p. Mercedes D.III inline.
Span: 39 ft. 10⅛ in.
Length: 25 ft 9 in.
Height: 10 ft. 0⅞ in.
Weight Empty: 1,745 lb. *Loaded:* 2,932 lb.
Max. Speed: 94 m.p.h. at sea level.
Ceiling: 16,600 ft.
Duration: 4 hr. approx.
Armament: One fixed Spandau and one free-firing Parabellum machine gun.



C.III. [*I.W.M.*

Rumpler C.III, C.IV, C.V and C.VII

Country of origin: **GERMANY.**
Purpose: **Reconnaissance, including photographic reconnaissance.**
Makers: **Rumpler Flugzeug-Werke G.m.b.H.**
In operational use: **1917/18.**

The Rumpler C.III (a C.II was projected but not built) was developed from the C.I with a 220 h.p. Bz.IV and other design changes which included a "comma" rudder (with no fixed fin), propeller spinner, shorter undercarriage legs, pronounced forward wing stagger and balanced ailerons and elevators. One authority quotes 75 C.III's in service by early 1917, but since they were all withdrawn by April they were evidently not a great success. In any case they had already begun to be replaced with the far superior C.IV. Apart from a 260 h.p. Mercedes engine the most noticeable change was the *Libelle* (dragonfly) wing shape with forward-curving tips to the lower mainplane. The C.IV also reverted to the form of fixed fin and rudder of the C.I. It performed yeoman service on long range reconnaissance flights on the Western Front and in Italy and Palestine, and had a first-class performance. The C.V. retained the power-plant and wing form of the C.IV, but reverted to the rudder-only C.III formula; it was not built in quantity. The C.IV's altitude performance was good, but was improved still more in the C.VII, which first appeared at the end of 1917. In appearance the C.VII was almost indistinguishable from the C.IV, except that it had a horizontal exhaust manifold instead of the upward-exhausting one of the C.IV. A specialised photographic/reconnaissance variant was the C.VII *Rubild*. This aircraft, with a high-compression 240 h.p. Maybach engine, had a ceiling of 23,944 ft. At this height it was virtually immune from Allied fighters, and so dispensed with the forward-firing Spandau gun for the pilot.

BRIEF TECHNICAL DETAILS (C.IV):
Engine: One 260 h.p. Mercedes D.IVa inline.
Span: 41 ft. 6⅜ in.
Length: 27 ft. 7⅛ in.
Height: 10 ft. 8 in.
Weight Empty: 2,376 lb. *Loaded:* 3,373 lb.
Max. Speed: 106 m.p.h. at 1,640 ft.
Ceiling: 21,000 ft.
Duration: 3 hr. 30 min.
Armament: One fixed, forward-firing Spandau and one free-firing Parabellum machine gun; up to 220 lb. of bombs (optional).

SF5. [I.W.M.

Sablatnig Floatplanes

Country of origin: **GERMANY.**
Purpose: See text.
Makers: **Sablatnig Flugzeugbau G.m.b.H.**
In operational use: **1916/18.**

Dr. Josef Sablatnig was an Austrian who took German citizenship in 1915. His first design for his new country was the one-off SF1, an elegant two-seat, twin-float biplane with a 160 h.p. Mercedes D.III engine. With slightly revised tail surfaces and a radio transmitter installed, this was ordered into production as the SF2; 26 were delivered to the German Navy between June 1916 and May 1917, ten being built by L.F.G. and ten by L.V.G. They were distributed in ones and twos to seaplane bases as trainers. The one-off SF3 was a larger, heavier, three-bay biplane with a 220 h.p. Bz.IV engine and a single defensive gun completed in 1917. Two SF4 single-seat seaplane fighters were built in 1917, each having a 150 h.p. Bz.III engine. The first of these, when tested, exhibited poor climb rate and manoeuvrability, and the second machine was built as a triplane to overcome the latter failing, but the type was not ordered into production. The SF5 was a higher performance reconnaissance development of the SF2 with a 150 h.p. Bz.III. Ninety-one were built by Sablatnig (51), L.F.G. (10) and L.V.G. (30), but since they were unarmed and were only delivered throughout 1917 and early 1918 it seems more likely that, like the SF2, they were utilised mainly in a training capacity. One SF5 was refitted with a wheeled landing gear as the sole SF6, and only one SF7 is thought to have been completed, although three were ordered. The SF7 had a two-gun defensive armament and 240 h.p. Maybach Mb.IV, but even with this engine the SF7's speed ceiling and climb rate were well below expectations. The final production design, another trainer, was the SF8, 33 of which were ordered. Deliveries began in spring 1918, but there seems some doubt whether the order was completely fulfilled. The SF8 had a 150 h.p. Bz.III engine and was fitted with dual controls.

BRIEF TECHNICAL DETAILS (SF5):
Engine: One 150 h.p. Benz Bz.III inline.
Span: 56 ft. 9½ in.
Length: 31 ft. 6 in.
Height: 11 ft. 7⅞ in.
Weight Empty: 2,314 lb. *Loaded:* 3,531 lb.
Max. Speed: 85 m.p.h. at sea level.
Ceiling: 11,000 ft.
Duration: 4 hr. 30 min. approx.
Armament: None.

[I.W.M.

Salmson 2

Country of origin: **FRANCE.**
Purpose: **Reconnaissance.**
Makers: **Société des Moteurs Salmson.**
In operational use: **1918.**

The company formed in 1912 by Emile Salmson was notable in the early part of World War I chiefly for the licence production of Canton-Unné radial engines. Its first attempt at aeroplane design and construction, the Salmson-Moineau SM-1 of 1916, was too unorthodox to be a success, but in the Salmson 2 which appeared in prototype form in April 1917 it produced one of the best French aircraft of the war. It was a "heavy" two-seat reconnaissance biplane of entirely conventional lines, the only unusual features being the use of a water-cooled radial engine and the absence of a fixed fin or tailplane. In appearance it was not unlike the contemporary Breguet 14 bomber, an impression strengthened by the profusion of louvres in the engine cowling. For an aeroplane of its class and date, the Salmson 2 was rather on the slow side, but this was more than offset by its excellent defensive armament. This consisted of twin Lewis machine guns on a ring mounting in the rear cockpit, and a synchronised Vickers gun manned by the pilot and firing between the propeller blades. As the Salmson 2A.2 (signifying *Corps d'Armée*, 2-seat), it entered immediate production, and ultimately 3,200 machines of this type were built. Starting in April 1918, 705 of these were delivered to the American Expeditionary Force, with whom the Salmson also became a standard observation type. Proof of the Salmson's combat effectiveness is instanced by the exploit of Lieutenant W. P. Erwin of the A.E.F., who from the front seat of his aircraft shot down eight enemy aircraft. Because of its sturdy construction, the 2A.2 was also capable of absorbing considerable punishment itself. Most Salmsons saw out the war on the Western Front, but two French squadrons serving in Italy were also equipped with the type. The American machines were sometimes fitted with a Marlin machine gun in place of the Vickers.

BRIEF TECHNICAL DETAILS:
Engine: One 260 h.p. Salmson-Canton-Unné radial.
Span: 38 ft. 8½ in.
Length: 27 ft. 10⅜ in.
Height: 9 ft. 6⅓ in.
Weight Empty: 1,676 lb. *Loaded:* 2,954 lb.
Max. Speed: 115 m.p.h. at 6,560 ft.
Ceiling: 20,500 ft.
Duration: 3 hr.
Armament: One fixed Vickers and two free-firing Lewis machine guns.

S.A.M.L.2. [I.W.M.

S.A.M.L. 1 and 2

Country of origin: **ITALY.**
Purpose: **Reconnaissance, light bombing and artillery observation.**
Makers: **Società Aeronautica Meccanica Lombarda.**
In operational use: **1917/18.**

The German Aviatik B.I two-seater was built under licence in Italy by S.A.M.L., who in 1915–16 built 63 of these aircraft for reconnaissance and artillery observation duties with the Italian Army. So impressed were the Italians with the Aviatik's general flying qualities that in the final two years of the war they built a further 505 B.I's for the training role. To replace the Aviatik in its original roles, S.A.M.L. developed the design to take a 260 h.p. Fiat A.12 engine, and enlarged the wing cellule to a three-bay configuration with slight sweepback. The new aircraft, known as the S.A.M.L.1, still retained several Aviatik features in its design, though the square-topped rudder gave the vertical tail a curiously "cut-off" look. Armament consisted of a single Revelli machine gun in the rear cockpit. The S.A.M.L.1 inherited the Aviatik's pleasant handling qualities, and was sturdily built. In addition to its normal duties it was often used as a light bomber. It was joined later in 1917 by the S.A.M.L.2, which had reduced-span, two-bay wings, a fully-rounded rudder and a second Revelli mounted over the top wing centre-section to fire outside the propeller arc. Initially, the S.A.M.L.2 retained the same powerplant as its predecessor, but later aircraft were fitted with the 300 h.p. Fiat A.12 *bis*. Altogether, total production of the S.A.M.L.1 and 2 amounted to 660 machines, including prototypes. These aircraft were used in Albania and Macedonia as well as in Italy, equipping a total of 16 *Squadriglie da Ricognizione*.

BRIEF TECHNICAL DETAILS (S.A.M.L.2):
Engine: One 260 h.p. Fiat A.12 inline.
Span: 39 ft. 8⅜ in.
Length: 27 ft. 10⅝ in.
Height: 9 ft. 9⅜ in.
Weight Empty: 2,112 lb. *Loaded:* 3,075 lb.
Max. Speed: 101 m.p.h. at sea level.
Ceiling: 16,400 ft.
Duration: 3 hr. 30 min.
Armament: Two free-firing Revelli machine guns; up to 88 lb. of bombs.

[I.W.M.

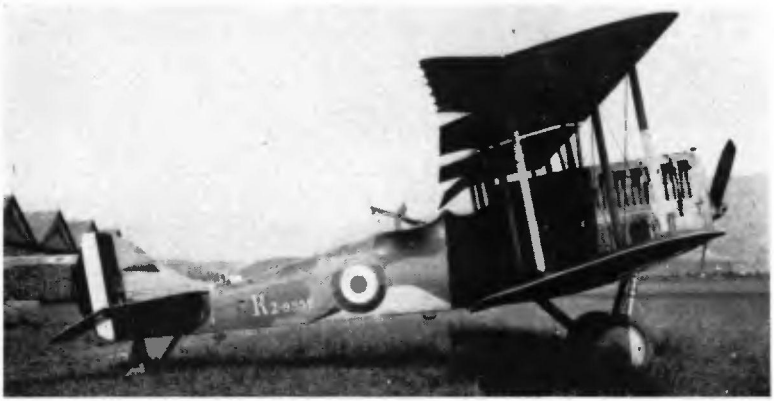
Short 184

Country of origin: **GREAT BRITAIN.**
Purpose: **Torpedo-bombing and reconnaissance.**
Makers: **Short Brothers Ltd.**
In operational use: **1915/18.**

The Short 184 was one of the major seaplane types in service with any of the combatants during World War I, and its record has, justifiably, been compared to that achieved by the Fairey Swordfish a quarter of a century later. Over 900 Short 184's were built, and more than 300 of these were still in service when the war ended. The official designation stems from the then current Admiralty practice of taking, as a Type number, the serial of the first machine received into service; the 184 is sometimes referred to as the Short 225, a reference to the horsepower of its Sunbeam engine, but this is rather misleading since other engines of greater power (and not all of them Sunbeams) were installed on later production batches. On 12th August, 1915, a Short 184 from H.M.S. *Ben-my-Chree* became the first aircraft ever to sink a ship at sea with a torpedo; and on 31st May, 1916 another of these aircraft, from H.M.S. *Engadine*, carried out a valuable reconnaissance of the enemy ships gathering for the Battle of Jutland. It was the only seaplane to play a part in this historic naval engagement. The Short 184 owed its instigation to Commodore Murray Sueter of the Admiralty's Air Department. It entered service early in 1915, and a major part of its subsequent work in practically every sea-girt theatre of the war consisted of oversea reconnaissance and patrol, and the bombing of enemy harbours and shore installations. Normally operated as a two-seater, the Short 184 could carry a 14 in. torpedo between the floats, a single bomb of up to 520 lb. size, or an equivalent load of smaller bombs. When flown as a single-seater, as sometimes happened, up to nine 65 lb. bombs could be stowed vertically in the space normally occupied by the observer's position. When the war ended, replacement of the 184 by Fairey IIIB's and Campanias had begun, but the Short seaplane was still in production. Nine sub-contractors handled production of the Short 184, in addition to the parent company. After the war, small numbers of 184's were supplied to Estonia, Greece and Japan.

BRIEF TECHNICAL DETAILS:

Engine: One 260 h.p. Sunbeam inline.
Span: 63 ft. 6½ in.
Length: 40 ft. 7½ in.
Height: 13 ft. 6 in.
Weight Empty: 3,703 lb. *Loaded:* 5,363 lb.
Max. Speed: 88 m.p.h. at 2,000 ft.
Ceiling: 9,000 ft.
Duration: 2 hr. 45 min.
Armament: One free-firing Lewis machine gun; one 14-in. torpedo or up to 520 lb. of bombs (585 lb. in single-seat version).



Fiat R-2. [*J.W.M.*

S.I.A. 7B and 9B and Fiat R-2

Country of origin: **ITALY.**
Purpose: **Reconnaissance and bombing.**
Makers: **Società Italiana Aviazione.**
In operational use: **1917/18.**

The superficial resemblance between the S.I.A. two-seaters and the S.V.A. Ansaldo scouts is no coincidence, since all were the products of designers Savoia and Verduzio. The S.I.A. 7B1, which first appeared in 1917, was an armed two-seater with two Revelli machine guns, one on a movable mounting in the observer's cockpit and the other above the centre-section. The 7B1 was fast and nimble, and served with 13 squadrons of the Italian Army air service, a total of 501 being built. Soon after its first appearance, the 7B1 set up a new world climb-to-altitude record and a number of impressive non-stop distance flights. It became operational in November 1917, but its speed and agility were somewhat offset by a weakness in the wing structure, and several aircraft broke up in flight. Early in 1918 the U.S. government purchased 18 7B1's for use on training duties. The S.I.A. 7B2, with a 300 h.p. Fiat A.12 *bis* engine and sturdier construction, appeared in May 1918, but this aircraft too suffered from structural failure and the 72 aircraft completed (plus the remaining 7B1's) were withdrawn from service by the middle of the year. A much bigger and heavier development, the S.I.A. 9B, had meanwhile appeared in service in February 1918. This had a 700 h.p. Fiat A.14 engine. However, the Italian Army had had enough of the S.I.A.'s structural troubles—which were still present in the 9B—and the 62 aircraft of the latter type were delivered instead to the Italian Navy, where they equipped three squadrons. The S.I.A. 9B had a wing span of 50 ft. 10¼ in., gross weight of 4,189 lb. (including a 770 lb. bomb load) and a range of over 370 miles. When the S.I.A. concern became Fiat Aviazione later in 1918, Ing. Celestino Rosatelli re-designed the aircraft, which re-emerged as the R-2. The structural faults were eliminated at a slight cost in performance compared with the 7B2. The Fiat R-2 entered production in the autumn of 1918; 129 were completed before the Armistice, but saw comparatively little war service.

BRIEF TECHNICAL DETAILS (7B2):
Engine: One 300 h.p. Fiat A.12 *bis* inline.
Span: 43 ft. 8½ in.
Length: 29 ft. 8⅜ in.
Height: 9 ft. 10½ in.
Weight Empty: 2,650 lb. *Loaded:* 3,760 lb.
Max. Speed: 124 m.p.h. at sea level.
Ceiling: 22,965 ft.
Range: 315 miles.
Armament: One fixed and one free-firing Revelli machine gun; up to 550 lb. of bombs.

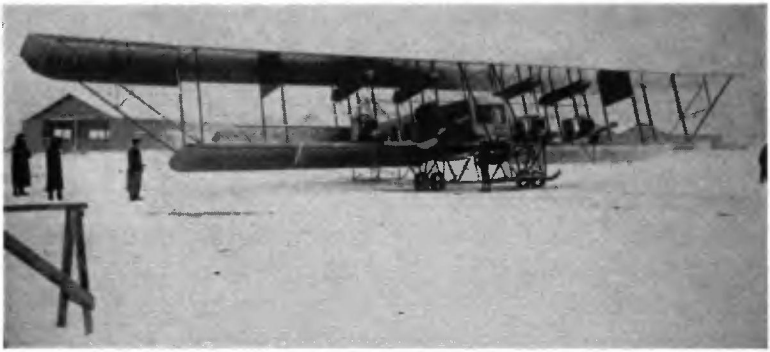
D.IV. [*I.W.M.*

Siemens-Schuckert D.III and D.IV

Country of origin: **GERMANY.**
Purpose: **Fighter.**
Makers: **Siemens-Schuckert Werke G.m.b.H.**
In operational use: **1918.**

While still engaged in production of the D.I (a copy of the French Nieuport), the S.S.W. began to design a fighter of its own. Three prototypes, designated D.II, D.IIa and D.IIb, were completed by early 1917, and performed the additional function of flight-testing the new 160 h.p. Sh.III geared rotary engine. Trials were on the whole satisfactory, and three further machines were ordered subject to the achievement of a higher all-round performance. These three aircraft were subsequently designated D.III, and 20 pre-production examples were ordered at the end of 1917. The first deliveries of these to squadrons were made in January 1918, differing from the prototypes in having four-blade propellers and a correspondingly shorter undercarriage. Thirty more D.III's were ordered in February, most of which were allocated in April to *Jasta* 2. The D.III was a nimble fighter, with an excellent rate of climb and armed with twin Spandau machine guns. Unfortunately, the geared rotary engine gave some trouble after only a few hours flying, and the D.III's had to be temporarily withdrawn from service. After re-engining with the improved Sh.IIIa, in July they were returned to duty, which now consisted chiefly of home defence. A further 30 had been ordered by this time. At an early stage of D.III development, three examples each of D.IV and D.V developments had been ordered, but the former was promising enough for the D.V project to be discarded. The D.IV had a smaller-area top wing than the D.III, but both port wings were some 4 in. longer than the starboard ones to counteract the engine torque. Production started in March 1918, and 119 (of a total 280 ordered) had been completed by the Armistice, though rather less than half this number had actually become operational by that time. Had the war continued, more would undoubtedly have been heard of the D.IV, which was an excellent aeroplane and was enthusiastically acclaimed by those *Jastas* fortunate enough to receive it. When the war ended, three prototypes of a parasol monoplane development, the D.VI, were under construction, and two of these were tested after the Armistice.

BRIEF TECHNICAL DETAILS (D.IV):
Engine: One 160 h.p. Siemens-Halske Sh. IIIa rotary.
Span: 27 ft. 4¾ in.
Length: 18 ft. 8½ in.
Height: 8 ft. 11 in.
Weight Empty: 1,190 lb. *Loaded:* 1,620 lb.
Max. Speed: 119 m.p.h. at 6,560 ft.
Ceiling: 26,240 ft.
Duration: 2 hr.
Armament: Two fixed, forward-firing Spandau machine guns.



[H. J. Nowarra

Sikorsky Ilya Mourometz

Country of origin: **RUSSIA.**
Purpose: **Heavy bomber.**
Makers: **R.B.V.Z. (Russo-Baltic Waggon Factory).**
In operational use: **1915/17.**

Russia was the first country in the world to produce four-engined aeroplanes, with the Sikorsky-designed *Russkü Vitiaz* and *Bolsche* biplanes of 1913, which were powered by 100 h.p. Argus inline engines. Before the outbreak of World War I, Sikorsky had evolved an even larger machine, based on the *Bolsche*, which he named *Ilya Mourometz No.* 1. This giant aeroplane was no freak—it had an endurance of more than 5 hours, and on 12th February, 1914 set up a world load-to-altitude record by carrying 16 passengers (and a dog!) to a height of 2,000 metres. Such an aeroplane had obvious potential as a long-range heavy bomber, and shortly after this record attempt the Russian Central Military Technical Board ordered from the R.B.V.Z. ten aircraft of the *Ilya Mourometz* type for this role. When war broke out in Europe this order was increased to 42, and the ultimate total built was 80 of these giant aircraft. Failure of the first two bombers at the front almost killed the aeroplane's career before it had begun, but a reprieve was obtained and the *Ilya Mourometz* went on to become one of the most, if not *the* most, famous and successful types used by the Imperial Russian Air Service during the entire war period. It was employed on every front where Russian forces were engaged, and up to the time of the Revolution only three were lost; one of these was through sabotage, and another in a crash-landing. Only one was l st to enemy fighter attack, and this managed to destroy or cripple four of its a tackers before being shot down itself. The *Ilya Mourometz* suffered somewhat from powerplant supply difficulties: standard installation on the Type B was two 200 h.p. (inboard) and two 135 h.p. (outboard) Salmson-built Canton-Unné engines, but in the event several aircraft had to be fitted with a wide assortment of engines, not all of which proved satisfactory. A crew of seven on the later Types G-2 and G-3 included two pilots and three gunners.

BRIEF TECHNICAL DETAILS (Type B):
Engine: Two 200 h.p. and two 135 h.p. Salmson-Canton-Unné radials.
Span: 101 ft. 6 in.
Length: 62 ft. 3 in.
Height: 15 ft. 6 in.
Weight Empty: 7,950 lb. *Loaded:* 10,600 lb.
Max. Speed: 60 m.p.h. at 6,560 ft.
Ceiling: 6,560 ft.
Duration: 4-5 hr.
Armament: Two free-firing machine guns; up to 1,120 lb. of bombs.

[I.W.M.

Sopwith 1½-Strutter

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter, bomber and reconnaissance.**
Makers: **Sopwith Aviation Co.**
In operational use: **1916/18.**

Officially titled Type 9700 by the Admiralty, and Sopwith Two-Seater by the R.F.C., it is nevertheless as the 1½-Strutter that this celebrated aeroplane is universally known. The prototype appeared at the end of 1916, and was a two-seat tractor biplane powered by a 110 h.p. Clerget rotary engine. Most of the 5,720 1½-Strutters subsequently built were similarly powered, although some batches were fitted with the 130 h.p. Clerget or the 110 h.p. Le Rhône. Initially produced as a fighter/reconnaissance aircraft, the 1½-Strutter was armed with a free-firing Lewis in the rear cockpit and a fixed, forward-firing Vickers gun mounted centrally in front of the pilot to fire between the propeller blades. It was the first British aircraft already fitted with a synchronised front gun before it entered service. Its combat career with both British air arms began at the Western Front early in 1916, and before long the 1½-Strutter had added the role of light bomber to its repertoire. In this capacity it could be flown as a regulation two-seater, with up to 130 lb. of bombs, or as a single-seater with the maximum load increased to 224 lb. As 1916 advanced, and saw the new Albatros and Halberstadt fighters enter German service, the 1½-Strutter began to be outclassed as a fighter, but in the bombing role its career continued somewhat longer, especially with the R.N.A.S., which pioneered the single-seat version. Of the overall total, only 1,520 were British-built; the remaining 4,200 were built in France for the French air forces. Unfortunately, the French production was so slow that the first examples were not introduced into service until April 1917, by which time they were outclassed and obsolescent. Nevertheless, they were widely used as reconnaissance or bomber two-seaters, or bomber single-seaters, with a variety of Clerget or Le Rhône rotary engines. The American Expeditionary Force purchased 514 of the French-built 1½-Strutters. Early in 1918 the type was withdrawn from front-line operation, but continued to give useful service for the remainder of the war in the training role. The type also served in small numbers with the air forces of Belgium, Latvia, Rumania and Russia.

BRIEF TECHNICAL DETAILS:
(two-seater):
Engine: One 110 h.p. Clerget rotary.
Span: 33 ft. 6 in.
Length: 25 ft. 3 in.
Height: 10 ft. 3 in.
Weight Empty: 1,259 lb. *Loaded:* 2,149 lb.
Max. Speed: 106 m.p.h. at sea level.
Ceiling: 15,000 ft.
Duration: 4 hr. 30 min.
Armament: One fixed, forward-firing Vickers and one free-firing Lewis machine guns; up to 130 lb. of bombs.

[I.W.M.

Sopwith Camel

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **Sopwith Aviation Co.**
In operational use: **1917/18.**

Controversy over whether the Sopwith Camel or the Fokker D.VII was the finest fighter aircraft of World War I will probably always persist; but the Camel is undisputed champion in terms of enemy aircraft destroyed, its tally—during only sixteen months of operations—being 1,294 victories. Developed from the Pup, the Camel was of conventional appearance and was originally designated Sopwith Biplane F.1. The prototype and some production batches were powered by the 110 h.p. Le Rhône rotary engine; others had 100 h.p. Gnome Monosoupapes, 130 h.p. Clergets or 150 h.p. B.R.1's. The short nose and stocky fuselage, combined with the " hump " cover enclosing the breeches of the twin Vickers machine guns, led to the nickname of Camel, later adopted officially. Due partly to the concentration of all heavy items of equipment within a small, compact space, and aided by the pronounced torque of its big rotary engine, the Camel proved to be one of the most manoeuvrable aircraft ever built, a factor that contributed immensely to its combat successes. Both the R.F.C. and the R.N.A.S. began to receive Camels in mid-1917, and in addition to air fighting on the Western Front the type was also used widely on ground-strafing duties with guns or four 25 lb. underwing bombs. On 21st April, 1918 the great Baron Manfred von Richthofen was killed when his Fokker Dr.I was shot down by a Camel of No. 209 Squadron, R.A.F. A second Camel variant, designated 2F.1, was evolved specifically as a shipboard fighter. This had a smaller wingspan, detachable rear fuselage (to facilitate stowage) and other structural refinements, and was powered by either the 130 h.p. Clerget or the 150 h.p. Bentley B.R.1. It first flew in March 1917. The 2F.1 Camel had a single synchronised Vickers on the front fuselage and a Lewis gun mounted over the centre-section. A 2F.1 Camel shot down the last Zeppelin of the war in August 1918. Altogether, 5,490 Camels were built. The Camel was also used by Belgium, Canada and Greece, by the A.E.F. in Europe and against the Bolsheviks.

BRIEF TECHNICAL DETAILS (F.1):
Engine: One 130 h.p. Clerget rotary.
Span: 28 ft. 0 in.
Length: 18 ft. 9 in.
Height: 8 ft. 6 in.
Weight Empty: 929 lb. *Loaded:* 1,453 lb.
Max. Speed: 115 m.p.h. at 6,500 ft.
Ceiling: 19,000 ft.
Duration: 2 hr. 30 min.
Armament: Two fixed, forward-firing Vickers machine guns; four 25-lb bombs (optional).

[I.W.M.

Sopwith Pup

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **Sopwith Aviation Co.**
In operational use: **1916/18.**

The most successful Sopwith designs of World War I seemed fated to be remembered by their nicknames rather than their more prosaic official designations. This, the next major design to emerge after the 1½-Strutter, is scarcely ever referred to by its Admiralty or R.F.C. descriptions of Type 9901 or Sopwith Scout; tradition has it that pilots suggested the 1½-Strutter had " pupped ", and Pup it thereafter became, in spite of official endeavours to discourage use of the name. Generally accepted as the most pleasant-to-fly British aeroplane of the whole war period, the Pup also has a number of other claims to historical distinction. The most noteworthy of these occurred on 2nd August, 1917, when a Pup flown by Sqn. Cdr. E. H. Dunning was landed on the flight deck of H.M.S. *Furious*—the first landing of an aeroplane on the deck of a ship under way. The Pup was subsequently used extensively in the development of deck landing techniques and arrester gear. Pups began to enter operational service in the late summer of 1916, and claimed their first enemy aircraft, an L.V.G. two-seater, on 24th September. Their chief fighting attributes were first-class manoeuvrability and an excellent performance at altitude, the latter enabling them to get the better of even the new Albatros fighters in combat. Normal Pup armament comprised a fixed synchronised front gun on the top of the fuselage, but some aircraft were fitted instead with a Lewis firing forward and upward through a centre-section cut-out. The Pup was also one of a small number of types which used Le Prieur rocket projectiles, fired from attachments on the interplane struts, on anti-Zeppelin missions. Later in their career, some Pups (with 100 h.p. Gnome Monosoupape engines) were employed on home defence duties. The total Pup production was 1,770, of which some 290 served with the R.N.A.S. Some of these were Type 9901a's, modified to suit them for operation from aircraft carriers; these had skid undercarriages. Beardmore also developed the W.B.III, with folding wings and retractable undercarriage. Of 100 W.B.III's ordered, 55 were in service by the end of the war.

BRIEF TECHNICAL DETAILS:
Engine: One 80 h.p. Le Rhône rotary.
Span: 26 ft. 6 in.
Length: 19 ft. 3⅜ in.
Height: 9 ft. 5 in.
Weight Empty: 787 lb. *Loaded:* 1,225 lb.
Max. Speed: 111 m.p.h. at sea level.
Ceiling: 17,500 ft.
Duration: 3 hr.
Armament: One fixed, forward-firing Vickers or Lewis machine gun, and/or eight Le Prieur rockets.

Blackburn-built Baby. [I.W.M.

Sopwith Schneider and Baby

Country of origin: **GREAT BRITAIN.**
Purpose: **Scout and light bomber.**
Makers: **Sopwith Aviation Co.**
In operational use: **1914/18.**

The Schneider/Baby series of small, twin-float seaplanes played an important part in the R.N.A.S. war effort, although built in modest numbers compared with other Sopwith products. In April 1914, Howard Pixton won the Schneider Trophy at Monaco in a twin-float version of the little Tabloid biplane, afterwards flying it at 92 m.p.h., the fastest speed then achieved by a seaplane. In November 1914 a first production batch of 12 of these aircraft was ordered by the Admiralty, incorporating modifications such as additional float bracing, an enlarged fin and a cut-out in the top centre-section to permit the upward firing of a Lewis machine gun. Powerplant was the Gnome Monosoupape rotary engine of 100 h.p. Ultimate production of Schneiders reached 136, most of them having conventional ailerons at all wingtips in place of the original warp control system. Carried aboard all manner of surface vessels, they were relatively ineffective in their efforts against Zeppelins over the North Sea, but they carried out much useful reconnaissance and fighting work in the eastern Mediterranean, the Dardanelles and the Red Sea, and in home waters often acted as anti-submarine aircraft, carrying one or two 65 lb. bombs. In an effort to increase performance, the 110 h.p. Clerget rotary engine was adopted. With this powerplant the aircraft was renamed Baby. Production of the Baby was carried out by Blackburn (176), Fairey (50), Parnall (130) and Sopwith (100). Batch differences included a synchronised gun on the Blackburn machines, improved floats and flying controls on the Fairey Hamble Babies, and a wheel-and-skid landing gear in place of floats on the last 74 machines built by Parnall. Withdrawal of the Baby from service had only been under way for a few weeks when the war ended.

BRIEF TECHNICAL DETAILS
(late production Blackburn Baby):
Engine: One 130 h.p. Clerget rotary.
Span: 25 ft. 8 in.
Length: 23 ft. 0 in.
Height: 10 ft. 0 in.
Weight Empty: 1,226 lb. *Loaded:* 1,715 lb.
Max. Speed: 98 m.p.h. at sea level.
Ceiling: 7,600 ft.
Duration: 2 hr.
Armament: One fixed, forward-firing Lewis machine gun; two 65-lb. bombs.

[I.W.M.

Sopwith Triplane

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighter.**
Makers: **Sopwith Aviation Co.**
In operational use: **1917.**

The short but spectacular combat career of the Sopwith Triplane in 1917 made such an impact upon the aeroplane's German adversaries that several German manufacturers were urgently instructed to produce a rival triplane to combat it. As an example of the " Tripehound's " achievements, five aircraft of " B " Flight, No. 10 Naval Squadron, in two months accounted for 87 German aircraft, the flight leader himself accounting for 16 of them in a period of less than four weeks. The purpose of adopting the triplane layout was to try and retain the performance level of the Pup while improving pilot view, general manoeuvrability and rate of climb; and by adopting three wings, of shorter span and much narrower chord, these objects were satisfactorily achieved. Indeed, the Triplane was able to out-climb any of the current German fighters—an advantage which it was not slow to follow up when it entered combat. The prototype Triplane was flown on 28th May, 1916, and in June underwent service trials in France with Naval " A " Fighting Squadron. Despite this, initial orders for the type came from the R.F.C., but when the Admiralty were urgently requested to divert aircraft to the Western Front after the Battle of the Somme they agreed to transfer a number of Spad VII's on condition that the R.N.A.S., in return, should receive the Sopwith Triplanes when they were ready. Thus the R.N.A.S. became the only British service to use the Triplane, which entered service in February 1917. About 140 were received, the last of them in mid-October; but by November the Triplane had been replaced by the newer and even better Camel. Later production aircraft had 130 h.p. Clerget engines and shorter-span tailplanes. Although almost all the Triplane's service was carried out on the Western Front, at least one aircraft is known to have reached Russia, and another operated from the R.N. air base at Mudros in the Aegean theatre.

BRIEF TECHNICAL DETAILS:
Engine: One 130 h.p. Clerget rotary.
Span: 26 ft. 6 in.
Length: 18 ft. 10 in.
Height: 10 ft. 6 in.
Weight Empty: 1,101 lb. *Loaded:* 1,541 lb.
Max. Speed: 113 m.p.h. at 6,500 ft.
Ceiling: 20,500 ft.
Duration: 2 hr. 45 min.
Armament: One (occasionally two) fixed, forward-firing Vickers machine gun.

[I.W.M.

Spad VII

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **Société Anonyme Pour l'Aviation et ses Dérivés.**
In operational use: **1916/18.**

Based on the Spad V tractor biplane designed by Louis Bechereau in 1915, the prototype Spad VII flew for the first time in April 1916, powered by a 140 h.p. Hispano-Suiza engine. It was armed with a single synchronised Vickers gun in front of the pilot and, although rather less manoeuvrable than the Nieuport, was much stronger and faster. Production aircraft, with 150 h.p. Hispano 8 Aa engines, began to be delivered early in September 1916, and by August 1917, 495 had been completed. They were then supplanted by an improved model with the 175 h.p. Hispano 8Ac and slightly-increased wing span; about 6,000 of the latter version were built. The R.F.C. bought some Spad VII's from France, but in addition to these another 200 machines were built in Britain. These were all delivered to the R.F.C.; originally, 100 of them were earmarked for the R.N.A.S., but these were surrendered at the R.F.C.'s urgent request and later replaced by Sopwith Triplanes. Foreign sales included 214 to Italy, 189 to the U.S.A., 15 to Belgium, and others went as far afield as Brazil, Greece, Peru, Portugal, Rumania, Siam, Russia and Yugoslavia. Some of the Russian Spads were flown armed with Le Prieur rockets. Among the first pilots to fly the Spad VII in battle were the French aces René Fonck and Georges Guynemer, and the aeroplane quickly became a popular mount. Despite the appearance of the Spad XIII three months earlier, there were still 445 Spad VII's in service at the beginning of August 1917. By the end of the year the Spad VII had served with every French fighter squadron at the front. Developments included the Spad X, a twin-float variant that appeared in 1916. The Spad XII was essentially a VII modified to have a 200 h.p. Hispano 8 Bc *moteur-canon* engine with a 37 mm. cannon mounted in the engine Vee. The prototype flew on 5th July, 1917 and 300 were built subsequently, but this version was not a great success: the firing rate of the cannon was slow, the recoil uncomfortably strong, and the pilot was often overcome by cordite fumes. The Spad XIV, 40 of which were built in 1917, was essentially the XII mounted on twin Tellier-designed floats, and served with the French Navy in 1918 at naval stations along the Channel coast.

BRIEF TECHNICAL DETAILS:
Engine: One 175 h.p. Hispano-Suiza 8 Ac inline.
Span: 25 ft. 8 in.
Length: 20 ft. 3½ in.
Height: 7 ft. 0 in.
Weight Empty: 1,100 lb. *Loaded:* 1,550 lb.
Max. Speed: 119 m.p.h. at 6,560 ft.
Ceiling: 18,000 ft.
Duration: 2 hr. 15 min.
Armament: One fixed, forward-firing Vickers machine gun.

[H. J. Nowarra

Spad XIII

Country of origin: **FRANCE.**
Purpose: **Fighter.**
Makers: **Société Anonyme Pour l'Aviation et ses Derives.**
In operational use: **1917/18.**

Subject of some of the largest production contracts placed for any single aircraft type during World War I, the Spad XIII was—numerically and in terms of performance—a dominant type during the last year and a half of hostilities. A total of 8,472 were built, and contracts cancelled after the Armistice involved a further 10,000 machines, including 6,000 for the U.S.A. Essentially an improved version of the already-successful Spad VII, the Spad XIII introduced a two-gun armament, more powerful engine, and aerodynamic changes designed to increase control and manoeuvrability. The prototype flew for the first time on 4th April, 1917, and by the end of May the Spad XIII had already begun to enter service. The second production series were fitted with the supercharged Hispano 8 Be engine giving 220 h.p., and had rather less rounded wingtips. At one time or another, Spad XIII's equipped 81 French squadrons, 16 pursuit squadrons of the A.E.F. (893 aircraft), 11 Italian squadrons and 1 Belgian squadron. After the war the type remained in French service until 1923, and was exported to Belgium, Czechoslovakia, Japan and Poland. Final wartime development was the Spad XVII, an enlarged and strengthened variant of the XIII with a 300 h.p. Hispano engine. It did not enter service until the late summer of 1918, when most of the 20 built were allocated to the celebrated *Escadrille Cigognes*.

BRIEF TECHNICAL DETAILS:
Engine: One 235 h.p. Hispano-Suiza 8 Be inline.
Span: 26 ft. 10⅜ in.
Length: 20 ft. 8 in.
Height: 7 ft. 11½ in.
Weight Empty: 1,255 lb. *Loaded:* 1,808 lb.
Max. Speed: 138 m.p.h. at 6,560 ft.
Ceiling: 21,800 ft.
Duration: 2 hr.
Armament: Two fixed, forward-firing Vickers machine guns.

Phönix-built C.I. [I.W.M.

Ufag C.I

Country of origin: **AUSTRO-HUNGARY.**
Purpose: **Reconnaissance and artillery observation.**
Makers: **Ungarische Flugzeugfabrik A.G.**
In operational use: **1918.**

With its compatriot, the Phönix C.I, this Ufag two-seater is thought to have had a common ancestry in the " star-strutted " Hansa-Brandenburg C.II which both manufacturers built and tested during 1916. Ufag's own C.I, evolved by Béla Oravecz, was completed in the latter part of the same year and was evaluated alongside the Phönix design in January 1917, both types subsequently being ordered for the Austro-Hungarian air service. They had a number of design features in common, including separate cockpits for the two-man crew—a departure from earlier Austrian practice. The main points of difference lay in the interplane bracing, the forward-curving wingtips of the Ufag machine, and the shape of the tail surfaces. Early production Ufag C.I's had, like the Phönix machines, a balanced rudder with no fixed vertical fin; but a fixed fin and plain rudder were introduced on later aircraft. Armament of the Ufag C.I consisted of two or three Schwarzlose machine guns, one on a ring mounting in the observer's cockpit and the other one or two installed under the engine cowling and fired by the pilot. The Ufag did not enter service until the spring of 1918, but was a fast, agile and generally efficient type and gave fairly widespread service during the last six months or so of the war. The exact number built is uncertain, but was greater than the output of Phönix C.I's, of which 110 were completed. Ufag are known to have built more than 100 of *their* C.I (in Series 161); in addition to this the Phönix company built the Ufag machine under licence as the Series 123, and it is unlikely that their contribution was less than 50 aircraft.

BRIEF TECHNICAL DETAILS:
Engine: One 230 h.p. Hiero inline.
Span: 35 ft. 2 in.
Length: 23 ft. 7½ in.
Height: 9 ft. 7 in.
Weight Empty: 1,499 lb. approx.
Loaded: 2,315 lb. approx.
Max. Speed: 118 m.p.h. at sea level.
Ceiling: 16,100 ft.
Duration: 3 hr. 30 min. approx.
Armament: One or two fixed, forward-firing and one free-firing Schwarzlose machine guns.

F.B.5.

Vickers F.B.5 and F.B.9

Country of origin: **GREAT BRITAIN.**
Purpose: **Fighting scout.**
Makers: **Vickers Ltd.**
In operational use: **1914/16.**

The Vickers F.B.5, known popularly as the "Gun Bus", was a two-seat "pusher" biplane, designed to a configuration that was adopted—through necessity rather than choice—by several other British fighting aircraft during the early war years, notably the D.H.2 and the F.E.2b. The pusher layout was almost obligatory among British designers, because of the lack of any practical system of synchronising the aeroplanes' guns to fire between the propeller blades. Vickers had foreseen the military potential of the armed aeroplane several years before the outbreak of World War I, and exhibited a Maxim-armed biplane at the Aero Show of 1913. Various improvements on this led to the E.F.B.4 and E.F.B.5 of 1914, mounting a Lewis gun in the front cockpit. Vickers began an initial run of 50 F.B.5's (Fighting Biplane No. 5) on its own initiative before the war started, and after official acceptance in the summer of 1914 both the R.F.C. and R.N.A.S. ordered small batches. These began to equip units in France in ones and twos in February 1915, trouble being experienced at first with the Gnome Mono engines. The first F.B.5 fighter squadron was formed in the following July, and for the next few months the type was reasonably successful. By the end of the year, however, it was out-classed and obsolete. An attempt to improve the performance resulted in the F.B.9, which appeared in December 1915. This had a number of aerodynamic refinements, and some aircraft had the more reliable 110 h.p. Le Rhône engine. It seems doubtful if the F.B.9 saw much, if any, combat service, but it was widely used as a trainer. The F.B.5 did not finally disappear from front-line squadrons until mid-1916, but by then it was mostly being employed for reconnaissance, artillery observation and occasional escort work.

BRIEF TECHNICAL DETAILS (F.B.5):
Engine: One 100 h.p. Gnome Monosoupape rotary.
Span: 36 ft. 6 in.
Length: 27 ft. 2 in.
Height: 11 ft. 6 in.
Weight Empty: 1,220 lb. *Loaded:* 2,050 lb.
Max. Speed: 70 m.p.h. at 5,000 ft.
Ceiling: 9,000 ft.
Duration: 4 hr.
Armament: One forward-firing Lewis machine gun.

Voisin LA (Type 3). [I.W.M.

Voisin Types I to 6

Country of origin: **FRANCE.**
Purpose: **Bomber and ground attack.**
Makers: **Compagnie Gabriel Voisin.**
In operational use: **1914/18.**

Despite its frail, slender appearance, the Voisin bomber was a strong and serviceable type which already equipped four French Army squadrons when war broke out and which, in its later forms, remained in service until the Armistice. Those in service in August 1914 were Voisin L's, known as the Type 1 when fitted with a 70 h.p. Gnome and Type 2 with an 80 h.p. Le Rhône engine. The Type 3, or Voisin LA, introduced the 120 h.p. Salmson-Canton-Unné 9M water-cooled engine, and an aircraft of this type scored the first French air victory on 5th October, 1914. Some of these early Voisins were equipped with Hotchkiss machine guns, but a more formidable weapon appeared on the Voisin LB (Type 4), which mounted a 37 mm. or 47 mm. cannon on the nose. Another Type 4 feature was the employment of wing stagger for the first time. With the heavy gun, the Type 4 achieved some notable successes in the ground attack role, against trains, armoured convoys and troop concentrations. Towards the end of 1916 appeared a refined version of the Type 3, with increased wing span. The Types 5 and 6 (Voisin LA.S) had, respectively, 150 and 155 h.p. Salmson engines, which were installed asymmetrically. Altogether, some 1,400 Salmson-powered Voisins were built in France; S.I.T. in Italy built a substantial number, with various Italian powerplants; and the types were also constructed in Russia. One Belgian squadron was equipped with Type 3's in 1915, and Voisins were also used in some numbers by several R.F.C. and R.N.A.S. squadrons. After September 1915 the Voisin was used for night instead of day bombing, and later still was also in use for training duties. The bomb load was suspended vertically along the sides of the crew nacelle.

BRIEF TECHNICAL DETAILS (Type 5):
Engine: One 150 h.p. Salmson-Canton-Unné inline.
Span: 48 ft. 4⅜ in.
Length: 31 ft. 3½ in.
Height: 11 ft. 10⅞ in.
Weight Empty: 2,138 lb. *Loaded:* 2,513 lb.
Max. Speed: 65 m.p.h. at sea level.
Ceiling: 11,480 ft.
Duration: 3 hr. 30 min.
Armament: One forward-firing Hotchkiss machine gun.

Voisin Type 8. [*I.W.M.*

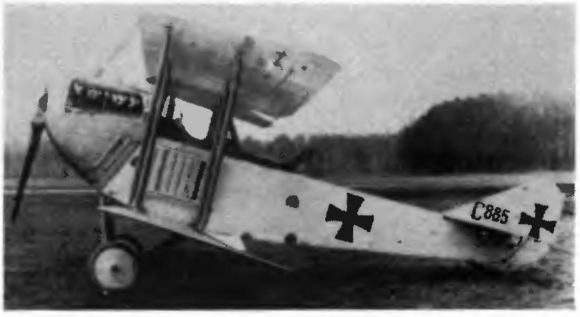
Voisin Types 8 and 10

Country of origin: **FRANCE.**
Purpose: **Bomber.**
Makers: **Compagnie Gabriel Voisin.**
In operational use: **1916/18.**

Despite the structural soundness and good load-carrying abilities of the Salmson-engined Voisin bombers, their poor maximum speed became progressively more embarrassing as the war advanced. An attempt to speed up these otherwise efficient machines was therefore made, resulting in the Type 8 (or Voisin LA.P) which appeared in squadron service at the end of 1916. The letter P in the factory designation signified the use of the 220 h.p. Peugeot, with which was combined an increased-span wing cellule, greater rudder area and an improved fuel system and installation. Compared with the earlier Voisins, the Type 8 could lift a 396 lb. bomb load, which was stowed inside the nacelle and under the wings. More than 1,000 Type 8's were built, these including a small quantity of LB.P's with a 37 mm. nose cannon; at the end of the war about 50 were still with French front-line night bomber squadrons, and eight were being used for training by the A.E.F. This small number of Type 8's is partially accounted for by the use, from April 1918, of the improved Type 10, or LA.R. This was basically similar to the Type 8, except for a further increase in rudder area, but had the more reliable and more powerful 300 h.p. Renault engine which enabled it to carry a maximum warload of 600 lb. The Type 10 continued to be employed chiefly on night bombing, right up to the end of the war, although one or two units were engaged on reconnaissance. Altogether, Voisin 8's and 10's equipped no less than 26 French squadrons.

BRIEF TECHNICAL DETAILS (Type 8):
Engine: One 220 h.p. Peugeot 8Aa inline.
Span: 61 ft. 8½ in.
Length: 36 ft. 1⅞ in.
Height: 11 ft. 5⅝ in.
Weight Empty: 2,893 lb. *Loaded:* 4,101 lb.
Max. Speed: 82 m.p.h. at sea level.
Ceiling: 14,100 ft.
Duration: 4 hr.
Armament: One or two Hotchkiss machine guns.

A.E.G. B.I to B.III and C.I to C.III



C.II. [I.W.M.

Data apply to C.II.
Purpose: Reconnaissance. *Span:* 38 ft. 10⅜ in.
Engine. One 150 h.p. Benz Bz.III inline. *Max. Speed:* 86.25 m.p.h.

This group of two-seat reconnaissance aircraft began with the B.I of 1914, which was built in small numbers and was powered by a 100 h.p. Mercedes D.I engine. A better performance was offered by the B.II, which was somewhat smaller overall and had a 120 h.p. D.II engine; this, too, appeared in 1914 and was likewise used in a limited way for unarmed patrol work in the early months of the war. Only the prototype was completed of the similarly-powered B.III (which had a redesigned fin and rudder), but an armed development of the B.II, with a free-firing Bergmann or Parabellum gun in the observer's cockpit and a 150 h.p. Bz.III engine, became the C.I which was built from March 1915 in moderate numbers. In October 1915 this was replaced in production by the rather smaller C.II, which had provision for carrying four 22 lb. bombs. The C.III remained a prototype only, with a new and cumbersome deep fuselage completely filling the gap between the wings.

A.E.G. J.I and J.II

J.Ia. [I.W.M.

Data apply to J.I.
Purpose: Two-seat close support and patrol. *Span:* 44 ft. 2 in.
Engine: One 200 h.p. Benz Bz.IV inline. *Max. Speed:* 93.75 m.p.h.

The J.I was essentially an interim type evolved in 1917 to equip newly-formed infantry co-operation units pending the delivery of such specially-designed Army support types as the Junkers J.I. Fundamentally, it was the A.E.G. C.IV with some 860 lb. of armour plating around the fuselage and a more powerful engine to cope with this increase of gross weight. The J.Ia featured ailerons on both upper and lower wings, as did the J.II of 1918, in which the upper ailerons, elevators and rudder were horn-balanced. The J.I and J.II normally carried a ring-mounted Parabellum gun in the rear cockpit, plus two forward and downward firing Spandaus in the floor of the same cockpit for strafing ground targets. Altogether A.E.G. built 609 J types, but despite their numbers they were not an outstanding success. One at least experimentally carried no less than six Spandau guns, which, although this machine was flown as a single-seater, must severely have restricted the aircraft's already moderate performance.

C.I-W. [*I.W.M.*

Ago C.I to C.III

Data apply to C.II.
Purpose.. Reconnaissance.
Engine: One 220 h.p. Benz Bz.IV inline.
Span: 47 ft. 6⅞ in.
Max. Speed: 86 m.p.h.

This series of twin-boom pusher biplanes began with the C.I (160 h.p. Mercedes D.III), which was a fairly-often-encountered type on the Western Front in the summer and autumn of 1915 despite a comparatively modest number built. The C.II replaced it in production at the end of the year, being a cleaned-up but heavier development with more engine power and redesigned rudders and triangular vertical fins in place of the "comma" rudders of the C.I. Both types carried out overland reconnaissance, and C.II's were also supplied to some seaplane stations for local defence duties. One manually-operated machine gun was installed in the nose and fired by the observer. Variants of the C.II included the C.II-W floatplane and a 3-bay landplane with a 60 ft. 0½ in. wing span. The C.III was an experimental smaller version of the C.II with a similar powerplant to the C.I.

[*I.W.M.*

Ago C.IV

Purpose: Armed reconnaissance.
Engine: One 220 h.p. Benz Bz.IV inline.
Span: 39 ft. 0⅛ in.
Max. Speed: 119 m.p.h.

The Ago C.IV, completely different from the earlier Ago C types, was evolved during 1916, but only about 70 examples became operational during the last two years of the war. It was a fine design, with plenty of power and an excellent turn of speed for a two-seater, and would probably have appeared in much greater numbers but for its rather complicated construction, brought about by the Ago designers' desire to enhance both the pilot's field of view and the observer's field of fire. The fuselage was a conventional structure, but the wings were sharply tapered from root to tip, so that every rib was different, and this led to an unusually long manufacturing process. In addition to Ago production, 250 C.IV's were ordered from Schütte-Lanz and 10 from Jos Rathgeber, but only a fraction of the overall total were completed before the end of the war. The C.IV was armed with a fully-enclosed Spandau gun on the starboard side of the engine and a manually-operated Parabellum gun in the rear cockpit.

D.H.1. [I.W.M.

Airco D.H.1 and D.H.1a

Data apply to D.H.1A.
Purpose: Escort and patrol.
Engine: One 120 h.p. Beardmore inline.
Span: 41 ft. 0 in.
Max. Speed: 88 m.p.h. at 4,000 ft.

The prototype D.H.1 was flown early in 1915 by Geoffrey de Havilland, for whom it was his first design since leaving the Royal Aircraft Factory in the summer of 1914. This and early production aircraft were fitted with 70 h.p. Renaults owing to the scarcity of Beardmore engines for which they had originally been designed. With the more powerful Beardmore, the type was known as the D.H.1A, and was employed exclusively in the Middle Eastern theatre on escort duties. Savage of Kings Lynn built 100 D.H.1's, and 73 D.H.1A's were also completed, remaining in operational service at least until March 1917. Two-seaters, the D.H.1 and 1A were armed with a single machine gun in the front cockpit.

[I.W.M.

Airco D.H.5

Purpose: Fighter.
Engine: One 110 h.p. Le Rhône rotary.
Span: 25 ft. 8 in.
Max. Speed: 102 m.p.h. at 10,000 ft.

Designed and built in the latter half of 1916, the D.H.5 was an attempt to give a tractor biplane a comparable view forward and upward to that of the pusher types with which the R.F.C. had been largely equipped until then. This was achieved by the marked backward staggering of the wings, which certainly improved the view in these directions but created some unpleasant flying characteristics, especially a tendency to stall at comparatively high speeds. Armed with only a single synchronised Vickers, the D.H.5 could also carry four 25 lb. bombs on under-fuselage attachments. About 550 were built, serving with front-line squadrons between May 1917 and January 1918. After this they were withdrawn to training units, where they were far from enthusiastically received. Despite its shortcomings, however, the D.H.5 was extremely manoeuvrable and could be handled satisfactorily by an experienced pilot. It was at its best at low levels; performance dropped off appreciably above 10,000 ft., to which height it could climb in about 12½ minutes.

[I.W.M.

Airco D.H.6

Purpose: Trainer and anti-submarine.
Engine: One 90 h.p. R.A.F. Ia inline.
Span: 35 ft. 11⅛ in.
Max. Speed: 66 m.p.h. at 6,500 ft.

Designed for safety in the air and ease of production, the D.H.6 was characterised by its extreme angularity, which produced a marked contrast to the customary elegance of de Havilland designs. If anything, it was *too* safe—foolproof but not idiot-proof—and acquired such unwelcome nicknames as "flying coffin" and "clutching hand". As a trainer, the D.H.6 was replaced from late 1917 by the excellent Avro 504K, but then began a new—and effective—career as a submarine hunter with both British and U.S. Navy coastal units until the Armistice. In this form it was flown as a single-seater with a 100 lb. bomb load. At the Armistice, there were 1,050 D.H.6's on strength with the R.A.F. Some production aircraft had 90 h.p. Curtiss OX-5 or 80 h.p. Renault engines.

Phönix-built Series 24.

[H. J. Nowarra

Albatros B types *(Austro-Hungary)*

Data apply to Series 22.
Purpose: Reconnaissance.
Engine: One 160 h.p. Austro-Daimler inline.
Span: 47 ft. 0 in.
Max. Speed: 72 m.p.h. at sea level.

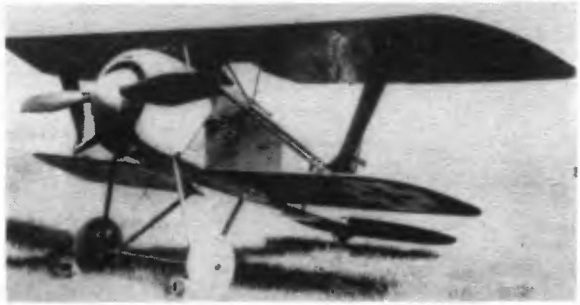
Four series of B-type two-seaters were built by the O.A.W. (later Phönix) company for the Austro-Hungarian air service during the early years of the war. They were based largely on their German counterparts, with local modifications. The Series 21 was very similar to the early Albatros B.I and B.II except for a 145 h.p. Hiero engine. The so-called Knoller Albatros, or Series 22, introduced a larger-span, swept-back wing and Austro-Daimler engine, and was successful enough for a second order (Series 23) to be placed—though not all of these are thought to have been completed. The Series 24 of 1915 (which was actually the second version to enter service) also had the 145 h.p. Hiero, with a relocated radiator, and standard-span wings with some of the modifications later incorporated in the Series 22 and 23. The latter two were the only armed operational variants, having a free-firing Schwarzlose gun in the rear cockpit; but one experimental machine was completed with a 37 mm. cannon in this position.

[H. J. Nowarra

Albatros C.V

Data apply to C.V/17.
Purpose: Reconnaissance, bombing and artillery co-operation.
Engine: One 220 h.p. Mercedes D.IV inline.
Span: 41 ft. 5 in.
Max. Speed: 106 m.p.h. at sea level.

First Albatros C type to break away from the earlier Heinkel-inspired shape as typified in the unarmed B-type Albatros, the C.V was a handsome aeroplane designed early in 1916 by Thelen and Schubert around the powerful new Mercedes D.IV "straight-eight" engine. Described by one authority as a "good, solid, comfortable aeroplane", the C.V was nevertheless heavy on the controls and its career was seriously affected by troubles with the cooling system and the crankshaft of its relatively untried engine. A second version appeared in 1917 with a curved lower wing, balanced ailerons and elevator, and a wing-mounted radiator in place of the earlier "ear" type. The two models were distinguished by the manufacturer as the C.V/16 and C.V/17 respectively. The C.V/17 did show appreciable improvement in handling and performance, but production of the C.V came to a halt when that of the D.IV engine was stopped. No more than 65 C.V's entered operational service, and even these were withdrawn at the end of 1917.



[I.W.M.

Albatros D.XI

Purpose: Fighter.
Engine: One 160 h.p. Siemens-Halske Sh.III geared rotary.
Span: 26 ft. 3 in.
Max. Speed: 119 m.p.h. at sea level.

The D.XI represented an attempt by the Albatros Werke to regain some of the reputation lost through the repeated structural failures of the D.V/Va fighters during 1917: hence the strongly-braced wings of this small, stubby fighter. Although Albatros did regain some prestige with later designs, the D.XI was not a success and was in fact inferior to most other entrants in the second D types competition of 1918. Its one outstanding feature—thanks to its excellent engine—was its rate of climb, which could take it to 16,000 ft. in 15 minutes. Two prototypes were built, but the D.XI never entered production.

G.III.
[*H. J. Nowarra*

Albatros G.II and G.III

Data apply to G.III.
Purpose: Medium bomber.
Engines: Two 220 h.p. Benz Bz.IVa inlines.
Span: 59 ft. 0¾ in.
Max. Speed: 93.75 m.p.h.

The sole G.II, which appeared in 1916, was powered by 150 h.p. Bz.III engines and acted as prototype for the higher-powered G.III which emerged at the end of that year. It was characterised by thick, single-bay wings with the engines strut-mounted between them and driving pusher propellers. The nacelles of the G.III's Benz engines were faired to the lower wing, and production aircraft carried a more typically Albatros vertical tail. The G.III had a duration of some 4 hours, and could carry a bomb load of approx. 700 lb. Armament comprised one Parabellum gun in the nose and a second in the rear cockpit. However, the type was built in limited numbers only: the maximum recorded in service (in Macedonia) at any one time was ten aircraft.

J.II. [*H. J. Nowarra*

Albatros J.I and J.II

Data apply to J.I.
Purpose: Close support.
Engine: One 200 h.p. Benz Bz.IV inline.
Span: 46 ft. 4¾ in.
Max. Speed: 87 m.p.h. at sea level.

The J.I was introduced during 1917 as a *panzer* type for the roles of ground attack and close support of the Army in the field. The wing unit was the same as that of the Albatros C.XII, allied to a new fuselage with armour plating below and each side of the cockpits. Two Spandau machine guns fired obliquely forward and downward through the floor for strafing purposes, while for defence a ring-mounted Parabellum gun was installed in the observer's cockpit. Although not built in great numbers, the J.I's were quite successful, their weak point being the lack of armour protection for the engine. Thus, in the J.II, this fault was rectified. The J.II (220 h.p. Bz.IVa) was slightly smaller than the J.I, but otherwise similar. However, only a handful of J.II's were completed, presumably due to the superiority of the Junkers J.I for the ground attack role.

[H. J. Nowarra

Anatra VI

Purpose: Reconnaissance and light bombing.
Engine: One 150 h.p. Canton-Unné radial.
Span: 48 ft. 2 in.
Max. Speed: 78 m.p.h.

The Anatra VI was no more or less than an attempt by the Russian Anatra company to build a locally modified version of the early Voisin biplane, and its designation indicated "Voisin Ivanov", the name of its Russian designer. Unfortunately the Anatra company's constructional methods were highly suspect, and VIs were the subject of several serious crashes while at the front. Of 139 VIs ordered between March 1915 and March 1916, only 16 were in service by the latter date, and the type was subsequently reported "quite unfit for fighting purposes".

F.K.3 prototype.
[I.W.M.

Armstrong Whitworth F.K.3

Purpose: Reconnaissance and Army liaison.
Engine: One 90 h.p. R.A.F. 1a inline.
Span: 40 ft. 1 in.
Max. Speed: 87 m.p.h.

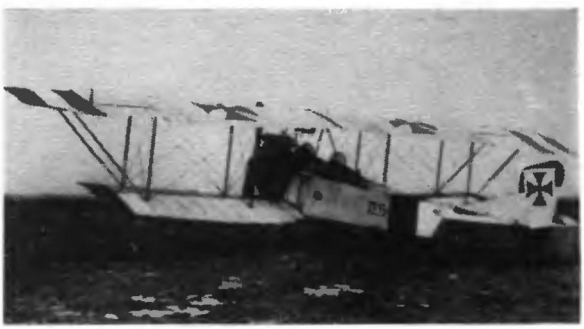
The F.K.3 represented an attempt by Frederick Koolhoven to improve on the R.A.F. B.E.2c which Armstrong Whitworth built under contract early in the war, and the prototype was powered by the same type of engine as the B.E.2c. Major changes on production F.K.3's were the reversal of the crew positions, giving the observer a better field of fire for defence; and a cleaned-up fuselage and larger vertical tail surfaces compared with the B.E.2c. Five hundred F.K.3's were built by the parent company and by Hewlett & Blondeau, the majority of which were limited to training duties. Combat use was limited to the Macedonian theatre, where the type carried out reconnaissance patrols and (as a single-seater) occasional light bombing raids with No. 47 Squadron, R.F.C.

[I.W.M.

Austin-Ball A.F.B.I

Purpose: Single-seat fighter.
Engine: One 200 h.p. Hispano-Suiza inline.
Span: 30 ft. 0 in.
Max. Speed: 138 m.p.h. at sea level.

Designed with the co-operation of 2nd Lt. Albert Ball (later Captain, V.C., D.S.O., M.C.) in the spring of 1916, this fighter incorporated some of the famous R.F.C. pilot's own ideas about what constituted an effective fighter aircraft. In particular, it possessed good pilot view, adequate armament and a first-class performance. One Lewis gun was installed behind the engine, to fire through the propeller shaft, and another was mounted above the upper wing. Only one of two prototypes ordered is known to have been completed (in July 1917), and Ball's death two months earlier, together with Austin's commitments to build the S.E.5a, combined to prohibit production of the fighter.



B.II. [H. J. Nowarra

Aviatik B.II and B.III *(Austro-Hungary)*

Date apply to B.II (Series 32).
Purpose: Reconnaissance and light bombing.
Engine: One 120 h.p. Austro-Daimler inline.
Span: 45 ft. 11⅛ in.
Max. Speed: 68 m.p.h. at sea level.

Not to be confused with the German-built Aviatik B types, those manufactured by the Oesterreichische-Ungarische Flugzeugfabrik Aviatik were built in three series for the Austro-Hungarian forces during the early part of the war. The Series 32 (or B.II) appeared in 1915, having a 120 h.p. Austro-Daimler engine, a crew of two (with the observer at the rear) and two 22 lb. bombs for "nuisance" raids. The B.III, distinguished by its greater span, more powerful 160 h.p. engine and communal cockpit, was armed with a Schwarzlose machine gun and carried three 22 lb. bombs. Built as the Series 33, it served extensively on the Russian front, where its tendency to sway in windy weather earned it such nicknames as "gondola" and "rocking chair". The Series 34 was a developed version of the B.II, with a Schwarzlose gun and three 44 lb. bombs. This was a much more stable aeroplane with a good all-round performance. However, by early 1916 more modern reconnaissance types were available, and the Austrian Aviatiks were transferred to training duties.

F.K. 23
Bantam Mk. I.
[I.W.M.

B.A.T. Bantam

Data apply to F.K.23 Bantam I.
Purpose: Single-seat fighter.
Engine: One 170 h.p. A.B.C. Wasp I radial.
Span: 25 ft. 0 in.
Max. Speed: 128 m.p.h. at 6,500 ft.

The first design by Frederick Koolhoven for the British Aerial Transport Company, which he joined in 1917, was the F.K.22, subsequently named Bantam II and intended originally to be powered by an A.B.C. Mosquito engine. In the event, however, the sole F.K.22 was flown with both the 100 h.p. Gnome Monosoupape and the 110 h.p. Le Rhône. A smaller, redesigned development was designated F.K.23 Bantam I, and this revealed serious spinning faults as originally flown. After further revision, nine F.K.23's were ordered, these having an enlarged wing span, tailplane and rudder and a smaller fin. Performance of the final version was much improved, but the vicissitudes of the Wasp engine precluded any further Bantam production. Armament comprised twin Vickers guns, one on either side of the front fuselage.

[I.W.M.

Blackburn Kangaroo

Purpose: Anti-submarine bomber.
Engines: Two 255 h.p. Rolls-Royce Falcon II inlines.
Span: 74 ft. 10½ in.
Max. Speed: 100 m.p.h. at sea level.

In 1916 Blackburn designed two torpedo-carrying seaplanes, the G.P. and the S.P., and from these developed the Kangaroo landplane bomber. Notable features of the Kangaroo were its folding wings and long, narrow fuselage, in which a crew of four and a 920 lb. bomb load could be accommodated. Additional bomb racks were located under the fuselage, and a single free-firing Lewis gun was mounted in each of the front and rear cockpits. The Kangaroo was officially tested in January 1918, and 16 of an order for 24 were eventually completed, 11 of these being delivered before the war ended. Prime user of the Kangaroo was No. 246 Squadron of the R.A.F. at Seaton Carew, which operated the type with some success against U-boats in the North Sea. Some Kangaroos were converted as civil airliners after the war, serving thus until 1929.

[H. J. Nowarra

Breguet 1913-14 biplane

Purpose: Reconnaissance.
Engine: One 110 h.p. Salmson-Canton-Unné radial.
Span: 44 ft. 4 in.
Max. Speed: 68 m.p.h. at sea level.

Developed from an earlier Breguet biplane known as the AG4, this elegant but frail-looking type was one of several pre-war French designs that were already in limited service before the outbreak of World War I. One French Army unit was equipped with it, 15 had been supplied to the R.F.C.'s Naval Wing (later to become the R.N.A.S.) from 1912, and others were with the R.F.C. and in Italy. No specific designation appears to have been allotted: some sources refer to the French model as U.1, the R.N.A.S. called it the "Breguet de Chasse", and the R.F.C. dubbed it "the tin whistle". It was an attractive and advanced design for its time, but structurally it was not strong enough for the rigours of war service and was soon withdrawn.

BrM4. [I.W.M.

Breguet-Michelin BrM4 and BrM5

Data apply to BrM4.
Purpose: Bomber.
Engine: One 220 h.p. Renault inline.
Span: 61 ft. 9 in.
Max. Speed: 84 m.p.h. at sea level.

This series of two-seat pusher biplanes stemmed from the BU3 prototype of 1915, the first production model being the BrM2 which, like the prototype, was powered by a 200 h.p. Canton-Unné engine. One hundred Breguet bombers were presented to the French Army in 1915 by the Michelin brothers, some being BrM2's and some the later BrM4 type which had a 220 h.p. Renault engine; they entered service from February 1916. The BrM4 B2 could carry forty 16 lb. bombs on Michelin patent bomb racks under the wings. The BrM5 Ca2 was a developed version, Renault-powered and having a 37 mm. Hotchkiss cannon in addition to a fixed machine gun; it also featured a three-mainwheel landing gear and unequal-span wings. The R.N.A.S. bought 25 French-built BrM5's and a further 10, powered by 250 h.p. Rolls-Royce engines, from Grahame-White at Hendon. Owing to troubles (notably engine fires) with the Renault-engined models, many of them were later re-engined with the more reliable Canton-Unné. BrM4's and BrM5's were used on day and night bombing, in France and, to a lesser extent, in the Aegean.

Bristol T.B.8

Purpose: Coastal patrol and training.
Engine: One 80 h.p. Gnome rotary.
Span: 37 ft. 8 in.
Max. Speed: 75 m.p.h. at sea level.

Developed from a series of monoplanes designed by Henri Coanda, the T.B.8 (Tractor Biplane, 80 h.p.) appeared in 1913 and performed better than the monoplanes. The first was bought by the Royal Navy after conversion to a float undercarriage, but the subsequent 45 which served with the R.N.A.S. until 1916 were landplanes; 14 of these were originally scheduled for the R.F.C., but the latter service rejected them. Six other T.B.8's were completed for Rumania. The British T.B.8's served with coastal stations in Britain and north-western Europe; they were fitted with various engines, including 60 or 80 h.p. Le Rhônes, 50 or 80 h.p. Gnomes, or 100 h.p. Gnome Monosoupapes. A gross weight of 1,665 lb. included a possible 120 lb. bomb load.

R.11A.3.
[I.W.M.

Caudron R.4 and R.11

Data apply to R.11.
Purpose: Bomber, reconnaissance and escort.
Engines: Two 180 or 220 h.p. Hispano-Suiza inlines.
Span: 58 ft. 8¾ in.
Max. Speed: 114 m.p.h. at 6,560 ft.

In service from mid-1916, the R.4 first appeared in June 1915 and was an elegant three-seat, three-bay biplane with 130 h.p. Renault engines. These were inadequate for the heavy R.4 in its bomber configuration, but for about a year the R.4 was used quite successfully in the reconnaissance role. Its usefulness was due in no small measure to its effective defensive power of a single ring-mounted Lewis gun in each of the front and rear cockpits. This attribute was increased still further in the much-improved R.11 which began to replace the R.4 in 1918. The R.11 had two-bay wings some 10 ft. less in span, increased engine power, a simplified undercarriage and a total of five guns—two each on the rings over the front and aft cockpits and an extra one under the nose to fire downwards to cover the Caudron's principal blind spot. From the summer of 1918 until the Armistice the R.11 accompanied all French Breguet 14's and other day bombers as a valuable and highly effective escort aircraft.

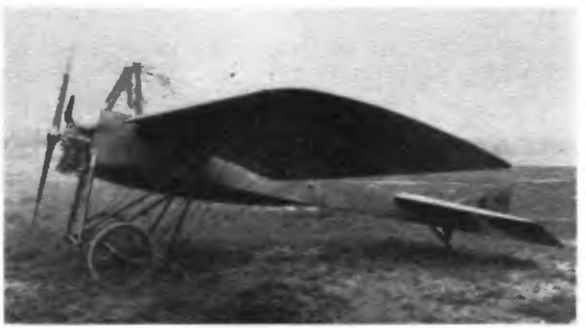
N-9H.

[*H. J. Nowarra*

Curtiss N-9

Purpose: Floatplane trainer.
Engine: One 100 h.p. Curtiss OX-6 inline.
Span: 53 ft. 4 *in.*
Max. Speed: 70 m.p.h. at sea level.

The N-9 was, essentially, a floatplane version of the celebrated JN-4, and like its landplane counterpart was a standard trainer aircraft during World War I. In place of the JN-4's wheel undercarriage, the N-9 was mounted on a large centre float with small stabilising floats under the lower wingtips. The wings themselves were of three-bay configuration, extended to nearly 10 ft. greater than the JN-4, and the OX-5 engine was replaced by the more powerful OX-6. Some aircraft, designated N-9H, were built with licence-built 150 h.p. Hispano engines. Curtiss built 100 N-9's, and a further 360 were completed by Burgess in Massachusetts. Most of these went to the U.S. Navy, but substantial numbers were also supplied to the U.S. Army and the R.N.A.S. A development of the N-9, the R-6, became U.S. Navy's first torpedo bomber; 36 of these were built with 200 h.p. Curtiss V-2 engines, followed by 162 R-6L's which had 400 h.p. Libertys and twin floats.



[*I.W.M.*

Deperdussin TT

Purpose: Observation and Army patrol.
Engine: One 80 h.p. Gnome rotary.
Span: 36 ft. 0 in.
Max. Speed: 71 m.p.h.

The initials S.P.A.D., well known in relation to the celebrated French fighters of the later war years, stood originally for the *Société des Productions Armand Deperdussin.* This company collapsed financially in 1913, but was re-formed on the outbreak of war under the direction of Louis Bechereau. The Type TT, a two-seater, was built for the French Army, and bore a strong resemblance to the contemporary Blériot monoplanes. Some early machines, such as those bought pre-war by the R.N.A.S., featured a large bicycle-wheel type of landing gear, but later aircraft were fitted with smaller wheels of a more conventional nature. One TT was tested with a single machine gun in the front (observer's) cockpit, firing above the propeller disc. The TT's wartime career was limited and brief. Some aircraft were fitted with Anzani or Gnome radial engines in place of the standard Gnome rotary.

B.I.

[H. J. Nowarra

D.F.W. B.I, B.II, C.I and C.II

Data apply to C.I.
Purpose: Reconnaissance and training.
Engine: One 150 h.p. Benz Bz.III inline.
Span: 45 ft. 11½ in.
Max. Speed: 78 m.p.h. at sea level.

Designed and built (as the MD 14) just before the outbreak of World War I, the D.F.W. B.I soon acquired the nickname "flying banana"—a fair description of its graceful backward-curving wings. Powered by a 100 h.p. Mercedes D.I, it was used in modest numbers during 1914–15 on the Eastern and Western Fronts in conjunction with the generally similar B.II. Both aircraft were unarmed except for small-arms carried aloft by the observer, who occupied the front cockpit. The C.I of 1915 was essentially an armed and more powerful version of the B.I with the observer (still in the front seat) provided with a ring-mounted Parabellum machine gun above the upper centre-section. This type was also employed on both fronts, a total of 130 being built. The C.II, which appeared later in 1915, had a more orthodox seating arrangement but did not go into production.

R.II.

[H. J. Nowarra

D.F.W. R.I and R.II

Data apply to R.II.
Purpose: Heavy bomber.
Engines: Four 260 h.p. Mercedes D.IVa inlines.
Span: 114 ft. 10⅛ in.
Max. Speed: 82.5 m.p.h.

The Deutsche Flugzeug-Werke built only one example of the **R.I**, starting work in September 1915 and flight testing the machine a year or so later. All four engines were installed inside the fuselage, driving two tractor and two pusher propellers by means of a complicated transmission gear. Troubles with the gear linkage and with failing crankshafts beset the aeroplane, but eventually it was despatched to the Eastern Front where it gave some five months active service before being totally destroyed after a crash landing. Six examples of the improved **R.II** were ordered, though only two of these are known for certain to have been completed. They carried a six-man crew, some 3¼ tons of bombs and had a duration of 6 hours. Defensive armament consisted of 4 or 5 machine guns.

Letord-built ARL.1.

[I.W.M.

Dorand AR.1 and AR.2

Data apply to AR.2.
Purpose: Reconnaissance and training.
Engine: One 200 h.p. Renault inline.
Span: 39 ft. 4 in.
Max. Speed: 92 m.p.h. at 6,560 ft.

Designed by Colonel Dorand of the S.T.A., the AR.1 and AR.2 bore the distinctive " trademark " of back-staggered wings that also characterised the biplanes which he designed for the Letord company. Dorand's earlier DO.1, an unremarkable pre-war two-seater (which equipped the first French military flying unit of the war), had quickly been replaced by the Maurice Farman biplane. The AR.1, in turn, was designed as a Farman replacement. Although bearing a superficial resemblance to the DO.1, the AR.1 was more sturdily built, had more engine power, and defensive armament in the form of a synchronised Vickers for the pilot and single or twin Lewis guns for the observer. It entered service in April 1917, being joined shortly by the more streamlined AR.2 which was usually powered by a 200 h.p. Renault engine. The career of the two types was comparatively brief, but during their nine months or so of service they equipped 18 artillery observation squadrons of the French air force, serving on the Western Front and in Italy. They were also used in the training role by the A.E.F., which bought 22 AR.1's and 120 AR.2's in 1918. Batches built by Letord were designated ARL.1 and ARL.2.

F.22 Campania

[I.W.M.

Fairey Campania

Data apply to F.22.
Purpose: Coastal or carrier-based reconnaissance.
Engine: One 250 h.p. Sunbeam Maori II inline.
Span: 61 ft. 7½ in.
Max. Speed: 85 m.p.h. at sea level.

The Campania was not used especially widely during World War I, but is important historically as the first aeroplane designed expressly for operation from a carrier vessel. It originated as the Fairey F.16 in 1916, powered by a 250 h.p. Rolls-Royce IV engine; a second prototype had the 275 h.p. Rolls Royce Mk.I, improved wing design and a larger vertical tail. As the F.17, this entered production, taking its name from the former Cunard liner *Campania* which the Admiralty had bought in 1914 and converted into an aircraft carrier. Ninety Campanias were ordered, 40 from Fairey and 50 from Barclay, Curle & Co. of Glasgow, though not all of these were completed. Shortage of Rolls-Royce Mk.I (Eagle V) engines led to an alternative installation of the Maori II, with which the type was designated F.22. In general the Eagle-engined Campanias served at sea (with the carriers *Campania, Nairana* and *Pegasus*), while the Maori-engined machines operated from coastal bases. At the end of the war, 26 F.17's and 16 F.22's were still in service. The Campania could carry two 65 lb. bombs under the fuselage, and had a single defensive Lewis gun on a ring mounting in the rear cockpit.

F.40. [I.W.M.

Farman F.40 series

Data apply to F.40.
Purpose: Reconnaissance and bomber.
Engine: One 160 h.p. Renault inline.
Span: 57 ft. 8⅝ in.
Max. Speed: 84 m.p.h. at 6,560 ft.

The F.40 resulted from a pooling of the better aspects of earlier designs by both Henri and Maurice Farman, which explains the nickname "Horace" Farman given it by the British. Following a similar layout to the H.F.20 series, the F.40 was better powered and aerodynamically refined. A plethora of variants was evolved; only the F.40, 41, 56, 60 and 61 achieved major production status but these were built on a far larger scale and retained on operations much longer than their combat worth justified. They were issued to nearly fifty French squadrons and were not withdrawn from front line use until 1917; some Belgian Farmans were still in use when the war ended. The R.N.A.S. also employed 50 F.40's, often fitting them with Le Prieur rockets, and the A.E.F. had 30 for training. The F.41 had a modified nacelle and shorter wings than the F.40, the F.56 was similar except for a 170 h.p. Renault engine, and the F.60 and F.61 were counterparts to the F.40 and F.41 with the 190 h.p. Renault. The Imperial Russian Air Service used a licence-built variant in 1916–17 called the F.30. This was actually a later model than the F.40, having a simpler undercarriage and 160 h.p. Canton-Unné engine.

[I.W.M.

Farman F.50

Purpose: Bomber.
Engine: Two 265 h.p. Lorraine-Dietrich inlines.
Span: 75 ft. 0 in.
Max. Speed: 87 m.p.h. at 6,560 ft.

Bearing some superficial resemblance to the German twin-engined Gotha bombers, the Farman F.50 was the first true Farman bomber. It was designed to fulfil a BN2 (*Bombardement de Nuit*, 2-seat) specification and appeared for the first time in 1918. Comparatively few were built, but at least two French bomber units had F.50's during the last months of the war. The type was not notably successful, and was quickly abandoned after the Armistice; but it laid the foundations for the later and much better F.60 Goliath which was a standard post-war type. The F.50 could carry a maximum load of eight 165 lb. bombs, had a 4-hour endurance and a defensive armament of one or two free-firing machine guns.

H.F.22. [*I.W.M.*

Farman H.F.20 series

Data apply to H.F.20.
Purpose: Bombing and reconnaissance.
Engine: One 80 h.p. Gnome rotary.
Span: 44 ft. 10 in.
Max. Speed: 65 m.p.h. at sea level.

This range of two-seat Henri Farman pusher biplanes stemmed from the pre-war F.16, and differed principally in wing span and area, and in powerplant. At the outbreak of World War I the 1913 H.F.20 was already in service in France and Belgium, and with the R.F.C. and R.N.A.S. in England. Early attempts were made to use them as armed scouts or light bombers, but the Farmans were so light that the extra weight of such installations seriously affected their performance, resulting in heavy losses. They were little better for unarmed reconnaissance, and by mid-1915 had reverted to training duties. The H.F.21 (80 h.p. Le Rhône, 52 ft. 8 in. span) and H.F.22 (80 h.p. Gnome, 51 ft. 0 in. span) had an even poorer performance than the H.F.20. The H.F.27, with a 140 or 160 h.p. Canton-Unné engine and 53 ft. 0 in. equal-span wings, was somewhat more efficient, and appeared in Africa, the Dardanelles and Mesopotamia.

A.I.
[*H. J. Nowarra*

Fokker A.I to A.III

Data apply to A.I.
Purpose: Single-seat scout.
Engine: One 80 h.p. Oberursel rotary.
Span: 31 ft. 4 in.
Max. Speed: 84 m.p.h.

These machines, the precursors of the Fokker E types (page 53), stemmed from the Fokker M.5 of early 1914, which in turn was based on the Morane-Saulnier Type H, and the M.6 of June 1914. Production version of the M.6 was the M.8 (80 h.p. Oberursel), of which 30 or so were built and later designated A.I. The A.II was a long-span version (31 ft. 4 in.) of the M.5, the A.III a short-span version (28 ft. 0 in.), the two types being otherwise similar. About 20 A.II's and 10 A.III's were completed. One A.III, fitted with Fokker interrupter gear, formed the basis of the Fokker E.I.

B.III.

[H. J. Nowarra

Fokker B types (Austro-Hungary)

Data apply to B.I.
Purpose: Reconnaissance.
Engine: 80 h.p. or 100 h.p. Oberursel rotary.
Span: 28 ft. 9 in.
Max. Speed: 85 m.p.h. approx.

A number (probably just under 100 all told) of two-seat unarmed reconnaissance Fokker biplanes were used by the Austro-Hungarian forces from 1915. These included the M.7 (called simply B type), M.10E (B.I), M.10Z (B.II) and M.17E/2 (B.III). Delivery included 12 M.7's, 40 M.10E's and 30 M.17E/2's, and some M.17E/2's were also built in Budapest. These aircraft were also employed for training duties in a limited capacity.

Austro-Hungarian D.I.

[I.W.M.

Fokker D.I and D.IV

Data apply to D.IV.
Purpose: Fighter.
Engine: One 160 h.p. Mercedes D.III inline.
Span: 31 ft. 10 in.
Max. Speed: 100 m.p.h. at sea level.

Developed from the M.18z prototype as a potential replacement for the Fokker E type fighters, the D.I appeared for the first time in the summer of 1916 and was powered by a 120 h.p. Mercedes D.II engine. It was armed with a single Spandau machine gun, and for a brief period served with moderate success on the Western Front, but its manoeuvrability and performance were not high and it was shortly transferred to fighter training duties. Only 25 D.I's were built: these were followed by 33 examples of the D.IV, which was slightly modified and enlarged and had a more powerful engine. The D.IV did not, however, represent an appreciable improvement over the D.I and neither was used widely. A few D.I's were supplied to Austro-Hungary.

Fokker D.II, D.III and D.V

Data apply to D.III.
Purpose: Fighter.
Engine: One 160 h.p. Oberursel U.III rotary.
Span: 29 ft. 8⅞ in.
Max. Speed: 100 m.p.h. at sea level.

Apparently preceding the D.I, since it was evolved from the M.17z prototype, the Fokker D.II utilized much the same airframe as the D.I. Chief points of difference were shorter-span wings, a slightly longer fuselage and a rotary engine—the 100 h.p. Oberursel U.I—instead of the inline powerplant of the D.I. The D.II entered service in the spring of 1916 as an escort and defensive fighter, having a roughly comparable performance to the D.I but slightly better manoeuvrability. With a strengthened fuselage, twin Spandau guns, a D.I wing and U.III two-row rotary engine, the type was developed into the D.III, but overall performance was still below expectations, although 291 D.II/D.III were completed. Their operational life was short, and they were quickly relegated to training duties. A few D.III's were sold to the Dutch government and others supplied to Austro-Hungary, where the MAG works also built D.II's and D.III's under licence. The final rotary-engined member of this line was the D.V, 216 of which were built. This reverted to the less troublesome U.I rotary engine, more neatly installed in a circular cowling and with a domed spinner; and had modified wings with slight sweepback. But the D.V, like its predecessors, was used mainly for training because of its relatively inadequate performance.

D.II. [*H. J. Nowarra*

Fokker D.III. [H. J. Nowarra

Fokker D.V. [H. J. Nowarra

[I.W.M.

Fokker D.VI

Purpose: Fighter.
Engine: One 110 h.p. Oberursel UR.II rotary.
Span: 25 ft. 1¾ in.
Max. Speed: 122 m.p.h. at sea level.

The Fokker D.VI is an example of a good aeroplane overshadowed by an even better one. It was probably built mainly as an insurance against failure of the celebrated D.VII, an insurance that events proved unnecessary. But for this, its career might well have been longer and more eventful. Two prototypes, one with a UR.III and the other with an Sh.III rotary engine, competed in the January 1918 fighter competition, and subject to a switch to the more reliable (though lower-powered) UR.II, a modest production order was placed in the spring. Between April and August 1918, Fokker built 59 D.VI's, a dozen of which were fitted with 160 h.p. Goebel Goe.III engines; seven Oberursel-powered machines were supplied to Austro-Hungary in August. The D.VI served with a few German *Jastas* during the summer, but with the highly successful debut of the D.VII (which was actually slower than the D.VI at low level) it became employed chiefly on fighter training duties for the remainder of the war. Armament consisted of twin forward-firing Spandaus, although Schwarzlose guns may have been substituted on those D.VI's in Austrian service.

[I.W.M.

Fokker D.VIII

Purpose: Fighter.
Engine: One 110 h.p. Oberursel U.II rotary.
Span: 27 ft. 6⅜ in.
Max. Speed: 115 m.p.h. at sea level.

Appearing too late in 1918 to make a large contribution to the fighting, the Fokker D.VIII would almost certainly have enjoyed a successful career had hostilities been prolonged. After a D.VII had been test-flown with its bottom wing removed, Reinhold Platz evolved a parasol-winged prototype designated V.26, and a modified form of this competed in the April 1918 fighter trials with the *Eindecker* designation E.V. It had great agility, and excellent take-off, climbing and diving qualities, and was immediately ordered into production. The first six E.V's were rushed to the front for operational proving, where they were soon joined by other E.V's. A suspect wing structure and minor lubrication difficulties caused production to be suspended temporarily, but with the elimination of these troubles it was restored to production as the D.VIII. By now, however, the war was almost over and, although it equipped both air force and naval fighter squadrons, the D.VIII had little opportunity to show its worth. Final production is not known, but about 60 had been completed up to the time of the temporary suspension in the autumn of 1918.

G.I.

[*H. J. Nowarra*

Gotha G.I and UWD

Data apply to G.I.
Purpose: Bomber.
Engines: Two 150 h.p. Benz. Bz.III inlines.
Span: 66 ft. 7½ in.
Max. Speed: 81.25 m.p.h.

Bearing no relation to the later Gotha G types, the G.I (originally GUH) was a product of the ingenious engineer Oscar Ursinus, and flew for the first time on 27th July, 1915. Comparatively few were built, eight being recorded in service in October 1916. Armed with two Parabellum guns, the G.I had a 4-hour duration and could carry a fairly heavy load. One seaplane example, the UWD, was completed in 1916, and later used as a torpedo training aircraft. Both versions carried a three-man crew.

GL.VIII.

[*I.W.M.*

Gotha G.VII, G.VIII and G.IX

Data apply to G.VII.
Purpose: Long range bombing and reconnaissance.
Engines: Two 260 h.p. Mercedes D.IVa inlines.
Span: 63 ft. 2⅜ in.
Max. Speed: 112 m.p.h. at sea level.

This series of short-nosed, twin-engined aircraft all appeared in 1918, and none was built in very large numbers. The first two types had variants with "GL" prefixes, indicating that they were generally smaller and lighter than most G-type aircraft. The production G.VII, differing extensively from its prototype, was a two-bay biplane with wide interplane struts, balanced control surfaces at all four wingtips, and a single dorsal Parabellum gun for rearward defence. With a gross weight of 6,906 lb., it had a duration of 3 hours. The G.VIII was similar to the prototype G.VII but was a three-bay aircraft with a 71 ft. 3⅜ in. wing span, two 245 h.p. Maybach Mb.IV engines and single tail; the GL.VIII had a multiple tail unit. The G.IX, a four-bay machine, appears to have been otherwise similar in configuration to the GL.VIII, but was built by L.V.G.; and a smaller, trainer version, with 160 h.p. Mercedes D.III engines, was designated G.X.

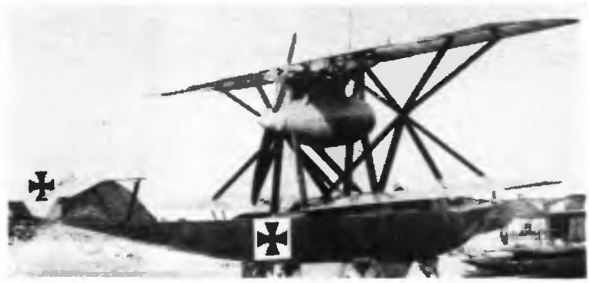
W.D.14 prototype.

[I.W.M.

Gotha W.D.11 and W.D.14

Data apply to W.D.14.
Purpose: Torpedo attack.
Engines: Two 200 h.p. Benz Bz. IV inlines.
Span: 83 ft. 8 in.
Max. Speed: 84 m.p.h. at sea level.

Although the Gothaer Waggonfabrik produced nearly a score of different floatplane designs during World War I, only two of these achieved production status, both of them torpedo attack aircraft. The W.D.11, appearing in the spring of 1917, was developed from the experimental W.D.7 and was a three-bay biplane spanning 73 ft. 10⅜ in. Power was provided by two 160 h.p. Mercedes D.III engines driving pusher propellers, and a single 1,600 lb. torpedo could be slung under the fuselage. Thirteen W.D.11's were built. The W.D.14 was a progressive development, larger and with more powerful tractor engines and armed with Parabellum machine guns in the nose and rear cockpits. Despite the power increase over the W.D.11, the W.D.14 was still insufficiently powered for a full load; torpedo attack techniques needed long and comprehensive training; and the aircraft's vulnerability in action outweighed the limited results achieved. Sixty-six W.D.14's were built, the surviving examples being transferred to reconnaissance work late in 1917 after the abandonment of airborne torpedo attacks. Some were also used for mine-laying, but again without any great success.



[H. J. Nowarra

Hansa-Brandenburg CC

Purpose: Flying boat fighter.
Engine: One 150 h.p. Benz Bz.III inline.
Span: 30 ft. 6½ in.
Max. Speed: 109 m.p.h. at sea level.

Designed by Ernst Heinkel early in 1916, the CC received its designation from the initials of Camillo Castiglione, owner of the Hansa-Brandenburg company. The first of 36 of these water-borne fighters was ordered by the German Navy in May 1916, and the last was delivered exactly a year later. With the same "star" strut arrangement that distinguished Brandenburg's D.I land fighter, the CC was a trim single-seater with a pusher engine and a single machine gun in front of the cockpit: probably a Spandau gun on the German machines and a Schwarzlose in the case of Austrian Navy aircraft. The latter aircraft were widely used for the air defence of ports and naval bases in the Adriatic and Aegean, and were powered either by 185 h.p. Austro-Daimler or 200 h.p. Hiero engines. The final production batch for the German Navy had lengthened hulls, improved engine installations and twin machine guns.

[H. J. Nowarra

Hansa-Brandenburg G.I

Purpose: Bomber.
Engines: Two 160 h.p. Austro-Daimler inlines.
Span: 59 ft. 1 in.
Max. Speed: 87 m.p.h.

Although designed by Ernst Heinkel of the Hansa und Brandenburgische Flugzeug-Werke, the G.I was built only by Ufag in Austro-Hungary. This company is known to have completed 12 G.I's, although it is possible that more than this number may have been built. During production, various modifications were made, including revision of the tail assembly and shortening of the nose to improve the forward view. The G.I was not used extensively, and then only with a strong fighter escort.

Hansa-Brandenburg GDW.
[H. J. Nowarra

Hansa-Brandenburg GW and GDW

Data apply to GW.
Purpose: Torpedo attack.
Engines: Two 160 h.p. Mercedes D.III inlines.
Span: 70 ft. 8⅜ in.
Max. Speed: 64 m.p.h.

Evolved from the GF Army bomber designed by Ernst Heinkel, the GW seaplane prototype completed its acceptance trials at Warnemünde in January 1916. This machine had a triple tail assembly, but a single fin and rudder was preferred for production GW's of which 20 were built between April 1916 and November 1917. They were used mostly from the seaplane base at Angersee. One example was built in 1916 of the GDW, a scaled-up version to carry a 4,015 lb. torpedo (the GW carried a 1,595 lb. weapon), but there is no record of this variant being used operationally. The GW carried a single free-firing Parabellum gun for defence.

Hansa-Brandenburg NW.
[H. J. Nowarra

Hansa-Brandenburg W, NW and GNW

Data apply to NW.
Purpose: Reconnaissance and patrol.
Engine: One 160 h.p. Mercedes D.III inline.
Span: 54 ft. 1¾ in.
Max. Speed: 56.25 m.p.h.

The Brandenburg W, designed some months before the outbreak of war, was supplied to the German Navy (27) for reconnaissance and general duties. It was a conventional-looking two-seater, and was powered by a 150 h.p. Benz Bz.III engine. An improved version, the NW, made its appearance in 1915 and bore a strong likeness to the Albatros B.I except for its twin-float landing gear. Thirty-two NW's were built for the German Navy up to early 1917, together with 16 of the generally similar GNW, most of these aircraft carrying radio equipment. None of the three types carried a defensive armament, but some early NW's were fitted with racks for ten 11 lb. bombs as anti-shipping aircraft off the North Sea coast of Germany.

[I.W.M.

Junkers CL.I

Purpose: Ground attack and escort.
Engine: One 180 h.p. Mercedes D.IIIa inline.
Span: 39 ft. 6⅜ in.
Max. Speed: 105 m.p.h. at sea level.

The CL.I (Junkers J.10) was perhaps the best CL type of the war period, and would doubtless have been met in increasing numbers had the war continued; but it did not appear until the second half of 1918, and only 47 had been delivered before the Armistice. Strongly built, with cantilever monoplane wings and corrugated metal skinning, it was fast and nimble at low levels and a promising type in all respects. The built-up rear cockpit afforded the observer an excellent field of fire, and twin Spandaus were mounted in front of the pilot's cockpit. The CL.I was slightly larger than the Junkers D.I single-seater, of which it was essentially a scaled-up version. The German Navy received three float-mounted CLS.I's with fixed vertical fins and 200 h.p. Benz engines, but no production order was placed for this version.

[I.W.M.

Junkers D.I

Purpose: Fighter.
Engine: One 185 h.p. BMW.IIIa inline.
Span: 29 ft. 6¾ in.
Max. Speed: 116 m.p.h. at sea level.

Developed from the J.7 prototype of 1917, the D.I (Junkers J.9) was the first all-metal operational warplane in the world, appearing for the first time in March 1918. Armed with twin Spandau guns in front of the cockpit, it was a fast and manoeuvrable single-seat fighter with the now-characteristic Junkers corrugated metal skinning. It performed well in the second and third fighter competitions of 1918 (originally with a Mercedes D.III engine), and was ordered into production in the late summer, but only 41 aircraft were completed before the Armistice. These served in ones and twos with various *Jastas*. Excellent though the D.I was constructionally, this very factor made it difficult to build in comparison with such types as the Fokker D.VII, otherwise more might have been heard of the D.I in the closing months of the war.

C.II. [I.W.M.

Knoller C.I and C.II

Data apply to C.II.
Purpose: Reconnaissance.
Engine: One 185 h.p. Austro-Daimler inline.
Span: 32 ft. 9 in.
Max. Speed: 94 m.p.h. at sea level.

These two-seat observation biplanes, designed by Professor Richard Knoller of the Viennese Royal Technical College, were ordered "off the drawing board" in 1916, but as events turned out very few were completed and even these were not used in the front line. Seventy-five were to have been built in equal batches by Aviatik (Series 36 and 136), Lohner (Series 19 and 119) and W.K.F. (Series 81), some with 160 h.p. Austro-Daimler engines as the type C.I and the remainder as C.II's with more powerful engines. Testing of the first Series 36 aircraft began in September 1916, but following a fatal crash in the following February production was stopped and all outstanding orders cancelled. Thöne und Fiala completed 12 Series 35.8 aircraft as unarmed B.I's, but these were used only in a training role.

Lebed 12.
[*H. J. Nowarra*

Lebed 11, 12 and 13

Data apply to Lebed 12.
Purpose: Reconnaissance.
Engine: One 150 h.p. Canton-Unné radial.
Span: 43 ft. 1 in.
Max. Speed: 83 m.p.h. at 6,500 ft.

The Lebed 11, which first appeared in 1915, was a two-seat reconnaissance aircraft for the Imperial Russian Air Service, and was based closely on the German Albatros B.II. Ten were built for the I.R.A.S., most of them with 150 h.p. Canton-Unné engines. On 28th December, 1915 the Lebed 12 made its first flight: this was broadly similar to the Lebed 11 but with some 4½ feet less wing span. The Lebed 12 was armed with one or two Colt machine guns and fitted with racks for up to 200lb. of bombs. It entered service late in 1916, and 214 of an order for 225 were completed before the Armistice. The Lebed 13 was a further development in 1917 which is not thought to have entered production.

Letord Type S.
[*I.W.M.*

Letord biplanes

Data apply to Type 5.
Purpose: See text.
Engines: Two 220 h.p. Lorraine 8 Fb inlines.
Span: 59 ft. 3 in.
Max. Speed: 97 m.p.h. at 6,560 ft.

The series of twin-engined tractor biplanes built by Letord were the work of Col. Dorand, former chief of the company's engine department and later of the S.T.A. research section, and all bore a characteristic " trademark " of pronounced back-staggered wings. The Types 1, 2 and 4 were reconnaissance types, the Type 6 was a fighter/escort project, and the Types 3, 5, 7 and 9 were three-seat bombers. They were built in small batches during 1917–18, the largest production apparently being of the Type 5, of which 51 were completed. They had a 440 lb. bomb load and two defensive machine guns. The Type 7, first flown in 1918, had 275 h.p. Lorraine engines and a scaled-up version of the Type 3's wing. Largest of all was the Type 9, which was comparable in size to the British Handley Pages. It had two 400 h.p. Liberty engines, 85 ft. wing span and a biplane tail unit. The prototype appeared shortly before the Armistice, but the type did not enter production, the Farman F.60 Goliath being preferred to equip post-war French bombing units.

C.I. [*I.W.M.*

Lohner B types and C.I

Data apply to C.I.
Purpose: Armed reconnaissance.
Engine: One 160 h.p. Austro-Daimler inline.
Span: 44 ft. 1½ in.
Max. Speed: 85 m.p.h. at sea level.

A wide variety of Lohner-designed B types appeared between 1913 and 1917, but none was apparently built in any quantity and none was particularly successful. All were based on virtually the same wing cellule, swept back in typical Lohner style, but the interplane bracing varied from one design to another. Performance generally was poor, especially above heights of about 8,000 ft. Only the C.I was designated in the "armed" category, although the later B types also were fitted with a rear-mounted machine gun.

Lohner type letter	*Mil. designation*	*Powerplant*	*Series No. and manufacturer*
B	B.I	100/120 h.p. Austro-Daimler	11 (Lohner) and 73 (Fischamend)
C	B.II	85 h.p. Hiero	12 (Lohner) and 74 (Fischamend)
E	B.IV	100 h.p. Mercedes	15 (Lohner) and 15.5 (Ufag)
H	B.VI	145 h.p. Rapp	16.1 (Lohner)
I	B.VII	160 h.p. Austro-Daimler	17 (Lohner) and 17.5 (Ufag)
K	C.I	160 h.p. Austro-Daimler	18 (Lohner)

Macchi Parasol

Purpose: Reconnaissance and artillery observation.
Engine: One 80 h.p. Gnome rotary.
Span: 42 ft. 8 in.
Max. Speed: 78 m.p.h. at sea level.

These frail-looking single-seaters were probably not used on a wide scale by the Italian Army air service, although at least two squadrons were equipped with them as late as October 1915. During the first 1½–2 years of the war they carried out some useful work as artillery observation aircraft, for which their design made them eminently suitable. Of obvious Nieuport descent, the broad parasol wings were approximately at the pilot's eye level, and thanks to the generous centre-section cut-out an excellent view was afforded in almost every direction above and below the aeroplane. The Parasol's main drawbacks were its frailty, tendency to stall, and very slow climb rate—it took more than half an hour to reach 2,000 m.—but at low level it had a creditable turn of speed for its day.

[I.W.M.

Martinsyde Buzzard

Data apply to F.4.
Purpose: Fighter.
Engine: One 300 h.p. Hispano-Suiza inline.
Span: 32 ft. 9⅜ in.
Max. Speed: 145 m.p.h. at sea level.

Fastest Allied fighter to appear during the war period, the F.4 Buzzard was too late to see active service, although about 65 had been built by the time of the Armistice. It was a development of the earlier F.3 (the F.1 and F.2 were two-seat projects), and in overall appearance resembled a scaled-down version of the same company's "Elephant". Four of the six F.3's built served at home defence stations in 1918. The F.4 differed principally in having the cockpit further aft to improve pilot view, and plans were made for large-scale production in Britain and the U.S.A.; the latter country alone was to have built 1,500, but this and British contracts were cancelled after the Armistice. Those that did enter R.A.F. service were used chiefly for high-speed communications, having been ousted by the slower Sopwith Snipe as the standard post-war fighter. Several other Buzzards were dispersed to Eire, Japan and Spain in small numbers, and others became civil racers.

[I.W.M.

Martinsyde S.1

Purpose: Scout and trainer.
Engine: One 80 h.p. Gnome rotary.
Span: 27 ft. 8 in.
Max. Speed: 87 m.p.h. at sea level.

Despite a close resemblance to the Sopwith Tabloid, the S.1 was inferior to both this and the Bristol Scout, of which it was a contemporary. Only about 60 were built, and although these were distributed to several R.F.C. squadrons at the Western Front their front-line service amounted to little more than six months before they were withdrawn in mid-1915 to training duties. Even here they were barely satisfactory, being unstable both laterally and longitudinally, and their performance was no more than moderate. Early production S.1's had a clumsy 4-wheeled undercarriage; this was replaced on later aircraft by a neater and more conventional Vee type and a sprung tail skid.

[I.W.M.

Morane-Saulnier AI

Data apply to Type XXVIIC.1.
Purpose: Fighter.
Engine: One 160 h.p. Le Rhône rotary.
Span: 27 ft. 10 in.
Max. Speed: 130 m.p.h. at 6,560 ft.

The AI parasol monoplane fighter, preferred to its biplane counterpart the AF, appeared in 1917 and began to enter service towards the end of the year. Its flying qualities were good, but the aircraft appears to have been structurally suspect, despite an unusually complex arrangement of wing bracing struts. Moreover, the major production version, which had the military type designation XXVIIC.1, was only armed with a single forward-firing gun. The twin-gun Type XXIXC.1 was also produced in some numbers, and by the early spring of 1918 the AI had been withdrawn from front-line duties. It served out the war as an advanced trainer, being known in this guise as the Type XXXE.1. Trainer AI's were usually fitted with 120 h.p. Le Rhône or 130 h.p. Clerget engines; 51 of this version were bought by the A.E.F. in 1918. Three Type XXVIIC.1's were supplied to Belgium. Total AI production, of all models, reached 1,210 machines.

[I.W.M.

Morane-Saulnier BB

Purpose: Reconnaissance and escort.
Engine: One 110 h.p. Le Rhône rotary.
Span: 28 ft. 5 in.
Max. Speed: 91 m.p.h.

With much the appearance of a two-seat, biplane version of the Type N fighter, the BB or M.S.7 saw no service with the forces of its native country. The limited production that was undertaken was mostly on behalf of the R.F.C., whose No. 1, 3, 4 and 60 Squadrons were partially equipped with BB's; No. 4 Squadron of the R.N.A.S. also received a few. Normal armament consisted of a single Lewis machine gun mounted behind the rear cockpit, although some aircraft had a second gun installed to fire over the upper wing.

[H. J. Nowarra

Morane-Saulnier T

Purpose: Reconnaissance.
Engines: Two 80 h.p. Le Rhône rotaries.
Span: 57 ft. 11 in.
Max. Speed: 97 m.p.h. at 6,500 ft.

Appearing for the first time a month before the outbreak of the war, the Type T, or M.S.25, was an extremely well designed and constructed aeroplane. Its technical lead over other aircraft of the period was unfortunately wasted, since it was not ordered into production until two years later and was then used only as a reconnaissance type. A three-seater, the Type T was equipped with ring-mounted Lewis guns for the observer and the rear gunner. One hundred Type T's were ordered, partially equipping several squadrons of the French Air Force. The Type S, which appeared in 1915, was a scaled-up bomber version with twin 250 h.p. Renault engines, but did not achieve production status.

[I.W.M.

Nieuport 14

Purpose: Bomber.
Engine: One 150 h.p. Hispano-Suiza inline.
Span: 39 ft. 8 in.
Max. Speed: 68 m.p.h. at sea level.

The Nieuport company justly had a fine reputation for its World War I fighter designs; its one venture into producing a bomber was much less successful. The two-seat Nieuport 14 had typical lines, except that it used an inline engine in place of the fighters' rotaries; an unusual feature was the positioning of the tailskid only about two-thirds back along the fuselage. The Nieuport 14 was essentially a stop-gap type, taking over the day bombing mantle from the unduly slow Voisins until the faster Sopwith 1½-Strutters became available. Their combat career was confined virtually to the last few months of 1916; after this they were transferred to training duties under the designation Nieuport 82, conversion including the fitting of a clumsy four-wheel main undercarriage and an 80 h.p. Le Rhône rotary engine. Variants of the Nieuport 14 which did not enter production were the Nieuport 15 and 26.

[I.W.M.

Nieuport 28

Purpose: Fighter.
Engine: One 160 h.p. Gnome Monosoupape rotary.
Span: 26 ft. 8⅞ in.
Max. Speed: 122 m.p.h. at 6,560 ft.

First completely new Nieuport design since the *Bébé*, the Nieuport 28C.1 was one of the most handsome aircraft to appear during World War I. It broke away entirely from the former Vee-strutted sesquiplanes, having untapered wings with gracefully-curved tips, parallel interplane struts and a slender, circular-section fuselage terminating in a rounded empennage similar to that of the Nieuport 27. A twin-gun synchronised armament was fitted as standard. The maiden flight took place on 14th June, 1917, but by the time it was ready for series production the French air force was heavily committed to Spads, and orders were only modest. Prime user was therefore the American Expeditionary Force, which received 297 from March 1918 to equip its first fighter squadrons in Europe. For a while it was quite a successful fighter, but it became necessary to reinforce the wing leading-edge fabric and by the time this problem had been overcome the A.E.F. too had gone over to the Spad XIII.

[I.W.M.

Nieuport 29

Data apply to Nieuport 29C.1.
Purpose: Fighter.
Engine: One 300 h.p. Hispano-Suiza inline.
Span: 32 ft. 0 in.
Max. Speed: 143 m.p.h. at sea level.

First Nieuport fighter to use a stationary engine, the Nieuport 29C.1 was another design of the talented Gustave Delage which made its appearance in 1918. It differed radically from the earlier Nieuports, having equal-span, equal-chord wings, a circular-section monocoque fuselage and prominent twin Lamblin radiators beneath the lower wing roots. During official trials the Nieuport 29C.1 showed an extremely fast speed and excellent manoeuvrability, and production orders were placed. It was, however, too late for operational war service, although it became a standard type with the French and many foreign air forces until well into the 1920s. Modified aircraft were responsible for new world air speed and altitude records in 1919–20. A variant with a 180 h.p. Le Rhône rotary engine, the Nieuport 29G, was built for the French Ministry of Marine in 1918, but this version was not adopted.

[H. J. Nowarra

Nieuport monoplane

Data apply to Type VIM.
Purpose: Scout.
Engine: One 80 h.p. Gnome rotary.
Span: 36 ft. 0 in.
Max. Speed: 70 m.p.h. at sea level.

A military derivative of the 70 h.p. Gnome-powered machine in which Edouard de Niéport set up a world speed record of 82·6 m.p.h. in June 1911, this attractive monoplane was already in service in France and Italy when World War I commenced. Later it was used also in Russia for a short time. In French service the aircraft was designated Type VIM (= *militaire*). Licence production was undertaken by several Italian manufacturers, among whom Macchi built 56 with 80 h.p. Gnome engines. (Early versions had had a 50 h.p. Gnome). The Nieuport was strongly built, and contained many advanced features for its time, but by the outbreak of war it was too vulnerable a type to remain in service for long, and (except in Russia) was withdrawn by mid-1915. About a dozen of a twin-float variant were used by the R.N.A.S. as seaplane trainers.

C.II. [I.W.M.

Oeffag C.I and C.II

Data apply to C.II.
Purpose: Reconnaissance.
Engine: One 160 h.p. Austro-Daimler inline.
Span: 45 ft. 0 in. approx.
Max. Speed: approx. 75 m.p.h. at sea level.

Little is known about this native Austrian design, which first appeared in C.I form in 1915. It was built as the Series 51 for two-seat reconnaissance work, but was not a great success and the 18 or so completed aircraft were quickly transferred to a training role. There is then a gap of 1½–2 years until the appearance in 1917 of the C.II, built as the Series 52 with Austro-Daimler engines of 160 or 185 h.p. About 100 C.II's were completed, being more or less equally divided between these two kinds of powerplant, and were used mostly in Russia. A ring mounting was installed for a Schwarzlose machine gun in the rear of the communal cockpit.

[H. J. Nowarra

Packard-Le Père LUSAC-II

Purpose: Fighter.
Engine: One 425 h.p. Liberty 12 inline.
Span: 41 ft. 7 in.
Max. Speed: 136 m.p.h. at sea level.

This fast, well-armed two-seater was designed for the U.S. Army by Capitaine Le Père of the French Aviation Mission to the U.S.A. and was scheduled for large-scale production when the Armistice cut short its career. Three contracts totalling 3,495 aircraft were then cancelled, and of the 30 LUSAC-11's that were built only two reached the Western Front, in September 1918. Shortly after the war three LUSAC-21's were completed, which were basically the same except for 420 h.p. Bugatti 16 engines. Armament of the LUSAC-11 comprised two fixed Marlin machine guns synchronised to fire between the propeller blades and two Lewis guns on a ring mounting in the rear cockpit.

[I.W.M.

Paul Schmitt 7

Data apply to PS7B.2.
Purpose: Bomber.
Engine: One 265 h.p. Renault inline.
Span: 57 ft. 11 in.
Max. Speed: 84 m.p.h. at 6,560 ft.

The PS7 was a remarkable piece of engineering ingenuity, but unfortunately its combat value did not come up to the same high standard. Based on Schmitt's record-breaking Aérobus of 1913–14, the PS7 utilised the same principle whereby the entire wing cellule could be pivoted through 12° to alter the angle of incidence as required for lift or speed. The wide-span wings needed 12 bays of interplane struts. The PS7 was, on paper, capable of carrying a 330 lb. bomb load, but it was so vulnerable that much of this usually had to be sacrificed to permit extra defensive guns to be installed. The prototype appeared in the autumn of 1915, but it was April 1917 before the first operational unit received the type, and only four squadrons altogether operated the PS7. By January 1918 they had all re-equipped with Sopwiths or Breguet 14's. The PS7/4 was a variant with a four-wheel landing gear.

A.II.

[*H. J. Nowarra*

Pfalz A.I and A.II

Data apply to A.I.
Purpose: Reconnaissance.
Engine: One 80 h.p. Oberursel U.0 rotary.
Span: 36 ft. 9 in.
Max. Speed: 84 m.p.h. at sea level.

The A.I and A.II were slightly enlarged licence-built versions of the Morane-Saulnier Type L monoplane, built before and during the first part of the war by the Pfalz company. Only difference between them was that the A.II had the more powerful 100 h.p. Oberursel rotary engine. Although used primarily for reconnaissance, some A.I's were employed for " nuisance " raids with containers for small bombs attached to the fuselage sides. Some aircraft were experimentally given celluloid side-panels to improve downward view. The Pfalz A types served with Bavarian, Austrian and German units in small numbers on several fronts, and some were reported in action as late as 1916. The Pfalz E.III was a single-seat version of the A.II, fitted in 1915 with a Spandau gun and Fokker-developed interrupter gear.

[*I.W.M.*

Pfalz D.VIII

Purpose: Fighter.
Engine: One 160 h.p. Siemens-Halske Sh. III rotary.
Span: 24 ft. 8⅛ in.
Max. Speed: 120 m.p.h. approx.

This neat little rotary-engined biplane appeared during the first half of 1918 and was one of the types to take part in the second D types competition at Adlershof in May/June that year. Two examples participated, one with a 160 h.p. Sh.III engine and the other with an Oberursel Ur.III of similar power. A third variant was also completed, this having a 140 h.p. Goebel Goe.III engine, but it was the Siemens-engined D.VIII which was ordered into production. Forty D.VIII's were built, of which about half were still undergoing front-line operational trials when the war came to an end. Armament consisted of twin Spandau machine guns mounted in front of the cockpit; the production D.VIII could climb to 3,280 ft. in just over 2 minutes, and to 16,400 ft. in 25½ minutes.

E.V.

[I.W.M.

Pfalz E types

Data apply to E.I.
Purpose: Reconnaissance and escort.
Engine: One 80 h.p. Oberursel U.0 rotary.
Span: 30 ft. 4⅝ in.
Max. Speed: 91 m.p.h. at sea level.

Visually, the Pfalz monoplanes were often confused with the Fokker E types, from which they could be distinguished mainly by their different cowling and rudder shapes and their much greater wing curvature. Operationally, they were less significant than the Fokkers, rather less than 150 being built of all variants. This total includes about 60 E.I's, basically the Morane-Saulnier Type H licence-built with an 80 h.p. Oberursel rotary engine. With a 100 h.p. Oberursel this became the E.II. The E.III did not really belong to the same family, being simply the A.II parasol monoplane with a machine gun and Fokker-type interrupter gear. The lineage was resumed with the E.IV, enlarged to accommodate the 160 h.p. Oberursel twin-row rotary, but this installation proved highly troublesome and only about two dozen E.IV's were completed. The line ended with the E.V, a much better machine with a 100 h.p. Mercedes D.I inline engine, but only 20 were ordered and the last few of these may not have been completed. Thus the major service was given, in the opening stages of the war, by the unarmed E.I and E.II on reconnaissance and photographic missions. The later versions were inferior to the Fokker monoplanes and were in any case obsolescent by 1916.

[H. J. Nowarra

Phönix C.I

Purpose: Reconnaissance.
Engine: One 230 h.p. Hiero inline.
Span: 36 ft. 1⅛ in.
Max. Speed: 110 m.p.h. at sea level.

The prototype Phönix C.I, which underwent its official trials in January 1917, was a roomy two-seater whose design probably owed much to the Brandenburg C.II which Phönix had built experimentally during the previous year. About 110 production C.I's were built, as Series 121, and they gave useful service to the Austro-Hungarian air arm in 1917–18 as reconnaissance and photographic aircraft. The Phönix could take off in less distance than its compatriot, the Ufag C.I, and had a ceiling some 1,500 ft. higher, but otherwise performance of the two types was comparable. The Phönix C.I was armed with two Schwarzlose machine guns, one beneath the port engine cowling for the pilot and one on a ring mounting for the observer. The latter—unusually, in an aircraft of Austrian design—had a separate cockpit behind the pilot. Some C.I's were used as "nuisance" raiders with a modest bomb load (about 110 lb.) under the wings.

[*I.W.M.*

R.E.P. Type N

Purpose: Reconnaissance.
Engine: One 80 h.p. Gnome or Le Rhône rotary.
Span: 36 ft. 0 in.
Max. Speed: 72 m.p.h. at sea level.

Only two squadrons of the French air service appear to have been equipped with this shoulder-wing monoplane, one being in existence at the outbreak of World War I and the other being formed shortly afterwards. It originated several years before the war, when it was quite an advanced design for its time, but by 1914 it was too slow and defenceless to be of much value as a scout and was withdrawn early in 1915. The illustration shows an R.E.P. that fell into German hands in December 1914.

[*Courtesy*
Peter L. Gray

R.E.P. Parasol

Purpose: Observation.
Engine: One 80 h.p. Le Rhône rotary.
Span: 36 ft. 0 in.
Max. Speed: 68 m.p.h. at sea level.

The operational record, if any, of this R.E.P. design is obscure. The only service known positively to have used it is the R.N.A.S., which bought 12 before the outbreak of World War I and may have used these in a limited reconnaissance role overseas during the first few months of hostilities. It may also have served briefly with the French forces. The two-seat Parasol was, fundamentally, a modified version of the Type N shoulder-wing monoplane described above, having warp-controlled wings braced from twin pylons above the centre-section in front of the large cut-out.

[I.W.M.

Royal Aircraft Factory B.E.8

Data apply to B.E.8.
Purpose: Scout and light bomber.
Engine: One 80 h.p. Gnome rotary.
Span: 39 ft. 6 in.
Max. Speed: 70 m.p.h. at sea level.

The B.E.8 was the next B.E. type of Farnborough design, after the B.E.2, to be produced in quantity, and bore some superficial resemblance to the B.E.2 except for its rather clumsily cowled rotary engine. The first few B.E.8's appeared in 1912, but the Factory completed only the prototypes. Seventeen production machines were built by Vickers and the British & Colonial Aeroplane Company. They were followed by 38 B.E.8a's, built by the Factory and the Coventry Ordnance Works; these had B.E.2c-pattern wings and lower-set tailplanes. Familiarly known as the " Bloater ", the B.E.8/8a served in small numbers with several R.F.C. squadrons in 1914–15, initially on scout/reconnaissance duties and subsequently as trainers. Some carried out light bombing raids over the Western Front in the spring of 1915, carrying a single 100 lb. bomb in place of the observer.

[I.W.M.

Royal Aircraft Factory F.E.8

Purpose: Fighter.
Engine: One 100 h.p. Gnome Monosoupape rotary.
Span: 31 ft. 6 in.
Max. Speed: 94 m.p.h. at sea level.

Lack of a suitable interrupter gear for forward-firing guns led British aircraft manufacturers to cling to pusher-type fighter configurations long after the other major combatants had abandoned this layout as slow and obsolete. Thus the F.E.8, which did not arrive on the Western Front until August 1916, was already outdated and was soon outclassed by the faster and better-armed German fighters then in service. The R.F.C. had 182 F.E.8's in service, although the total built was probably somewhat higher, but in the spring of 1917 they began to be withdrawn and replaced by Nieuport 17's and D.H.5's.

[I.W.M.

Royal Aircraft Factory R.E.5

Purpose: Bombing and reconnaissance.
Engine: One 120 h.p. Austro-Daimler inline.
Span: 44 ft. 6 in.
Max. Speed: 78 m.p.h. at sea level.

The R.E.5 was the first of the Royal Aircraft Factory's R.E. (Reconnaissance Experimental) types to achieve production status, and although only 24 were completed they performed useful reconnaissance and bombing work with a small number of R.F.C. squadrons in France in 1914–15; Captain J. A. Liddell of No. 7 Squadron was awarded the V.C. for his courage in flying his R.E.5 back to Allied lines despite appalling wounds. One R.E.5 reached the R.N.A.S., and others were used for various experiments including high altitude flying and development of air brakes. The 24 aircraft were bought by the War Office with the £25,000 paid them by the Admiralty when the latter department took over all existing Army airships in the autumn of 1913.

[I.W.M.

Royal Aircraft Factory R.E.7

Purpose: Bomber.
Engine: One 150 h.p. R.A.F. 4a inline.
Span: 57 ft. 0 in.
Max. Speed: 85 m.p.h. at sea level.

The R.E.7 was evolved as a two-seat day bomber with good load-carrying capabilities, with particular reference to the new (in 1915) 336 lb. bomb also designed by the Royal Aircraft Factory. This capability it certainly had, and it carried out some useful work on the Western Front during the greater part of 1916. Of the 250 built, 224 were delivered to the R.F.C., mostly in small numbers to several squadrons; only one squadron—No. 21—was fully equipped with R.E.7's. Defensive armament was limited to small arms or a Lewis machine gun which the observer, in the front cockpit, could do little with. It was this defensive weakness that was the R.E.7's main drawback, and a few were converted to three-seaters with a ring-mounted Lewis in the third cockpit. This arrangement was not very successful, however, and by the end of 1916 the R.E.7 had been replaced by more efficient types. Six R.F.C. R.E.7's were later handed over to the R.N.A.S.

[I.W.M.

Royal Aircraft Factory S.E.2a

Purpose: Experimental scout.
Engine: One 80 h.p. Gnome rotary.
Span: 27 ft. 6 in.
Max. Speed: 96 m.p.h. at sea level.

Origin of the S.E.2a lies in the B.S.1 tractor biplane produced by the Royal Aircraft Factory in 1912, which may be regarded as the true ancestor of all single-seat fighting aircraft. Years ahead of its time, the B.S.1 was a neat, streamlined aeroplane with a wooden monocoque fuselage and a 100 h.p. Gnome two-row rotary engine, and had already flown at 92 m.p.h. before it crashed in March 1913. It was rebuilt in improved form as the B.S.2, later renamed S.E.2, with a single-row Gnome of 80 h.p.; and further modified into the S.E.2a later in 1913. Although not produced in quantity, the S.E.2a prototype did see R.F.C. service, being allocated to No. 5 Squadron in early 1914 and transferred to France with No. 3 Squadron in October of that year; it was recalled from front-line service in March 1915. If a suitable forward-firing machine gun could have been fitted to the S.E.2a it would have given the R.F.C. a valuable and much-needed weapon at this crucial period, and would doubtless have resulted in a substantial production order.

Rumpler 6B1.
[I.W.M.

Rumpler 6B

Data apply to 6B1.
Purpose: Fighter.
Engine: One 160 h.p. Mercedes D.III inline.
Span: 39 ft. 6⅜ in.
Max. Speed: 95 m.p.h. at sea level.

A contemporary of the Albatros W.4 and the Hansa-Brandenburg KDW, the twin-float Rumpler 6B achieved rather less prominence, although it was in service from July 1916 and the last machine was not delivered until January 1918. Fundamentally it was a single-seat, float-mounted version of the Rumpler C.I reconnaissance aircraft, with forward (instead of inverse) wing stagger and a larger rudder. It was built in two versions, the 38 Rumpler 6B1's having a triangular tailplane and the 50 6B2's having horizontal tail surfaces of " wing-nut " shape similar to those on the C.IV landplane. The type was used as a defensive fighter for German seaplane bases on the Flanders coast and in the Black Sea area. Armament consisted of one synchronised Spandau machine gun part-buried in the port side of the engine cowling.

[*I.W.M.*

Rumpler C.VIII

Purpose: Operational trainer.
Engine: One 180 h.p. Argus As.III inline.
Span: 39 ft. 11½ in.
Max. Speed: 87 m.p.h. at sea level.

Specialised training aircraft were few and far between during World War I, the majority of operational training being carried out on converted and/or obsolescent reconnaissance two-seaters. One exception was the Rumpler C.VIII, conceived from the outset for the combat training role and put through official acceptance trials in November 1917. It was a somewhat simplified continuation of the design of earlier Rumpler C types, and the wings in particular were more akin to those of the C.I than to the *Libelle* form of the later Rumplers. Emphasis was on simplicity and economy of operation, yet with a full range of equipment for training in reconnaissance, photography, gunnery and radio operation and with a performance not too far short of that of operational two-seaters. The C.VIII entered service at the end of 1917, and a training programme of some intensity was carried out during the first few months of 1918. Total production of the type is not known.

[*H. J. Nowarra*

Rumpler D.I

Purpose: Fighter.
Engine: One 180 h.p. Mercedes D.IIIa inline.
Span: 27 ft. 7½ in.
Max. Speed: 112 m.p.h. at 16,400 ft.

Although begun in 1917 (with the 7D1 prototype), this dumpy little single-seater did not reach a definitive form until the war was nearly over. The allocation of a military designation suggests that it may then have been considered acceptable for service, but it was a complex aircraft to produce quickly and in quantity and probably did not enter production. The 7D1, 7D2, 7D4 and 7D7 prototypes all utilised the standard Mercedes D.III of 160 h.p., and differed chiefly in interplane bracing and vertical tail surfaces. The 7D8 introduced the D.IIIa engine adopted for the 8D1 (D.I). Two D.I's took part in the May/June fighter competition of 1918, and a third, with 185 h.p. BMW.IIIa, was included in the October competition. Armament was two synchronised Spandau machine guns, and like all Rumpler aircraft the D.I had good ceiling and climbing power.

G.I. [I.W.M.

Rumpler G types

Data apply to G.I.
Purpose: Bomber.
Engines: Two 150 h.p. Benz Bz.III or 160 h.p. Mercedes D.III inlines.
Span: 63 ft. 3½ in.
Max. Speed: 91 m.p.h. at sea level.

All Rumpler aircraft, from the *Taube* onwards, were good-looking aeroplanes. The G type bombers were no exception, though their lines were somewhat marred by a rather ungainly rudder outline. The G.I entered service in mid-1915, being a three-seat, two-bay biplane with twin pusher engines in deep, narrow nacelles faired to the lower wings. It had a 4-hour endurance with a modest bomb load, and remained in service until August 1916, a total of 58 being built. The G.II which replaced it appears to have been similar except for its 220 h.p. Bz.IV engines, but was not built in the same numbers and was comparatively short-lived: by February 1917 it had been withdrawn. Final version was the G.III, with 260 h.p. Mercedes D.IVa engines more neatly installed, slightly sweptback wings and a smaller fin. By October 1917 there were 20 G.III's in service, and they remained operational—chiefly as night bombers—at least until the following August.

[I.W.M.

Salmson-Moineau SM-1

Data apply to SM-1A.3.
Purpose: Long range reconnaissance.
Engine: One 160 or 240 h.p. Salmson-Canton-Unné radial.
Span: 57 ft. 4 in.
Max. Speed: 81 m.p.h. at 6,560 ft.

First aeroplane produced by the engine-manufacturing Salmson company, the SM-1, unlike the later Salmson 2, was not a success. The Canton-Unné engine was buried in the fuselage; driving two tractor propellers mounted on the X-pattern inner interplane struts by means of a transmission gear, and cooled by prominent annular radiators on each side of the fuselage abreast of the front (observer's) cockpit. The SM-1 carried a three-man crew and up to four defensive guns, and was intended as a long range reconnaissance aircraft in the A.3 category. Ten were built in 1916–17, but only four were issued for squadron use, in December 1917, and these were withdrawn four months later.

S.P.2.
[*H. J. Nowarra*

Savoia-Pomilio S.P. series

Data apply to S.P.2.
Purpose: Reconnaissance and artillery observation.
Engine: One 260 h.p. Fiat A.12 inline.
Span: 48 ft. 3 in.
Max. Speed: 91 m.p.h. at sea level.

The Savoia-Pomilio S.P. series of two-seat pusher biplanes produced for the Italian air service had a long but comparatively undistinguished career, despite the fairly substantial numbers in which they were built. They were evolved, mainly at the instigation of the Fiat company, to replace the Farman pushers which were in widespread service with Italian squadrons in 1915–16, and displayed an obvious Farman heritage. First production model was the S.P.2 (the S.P.1 being the prototype), of which 402 were built. They were replaced from mid-1917 by 300 S.P.3's with 300 h.p. A.12 *bis* engines and aerodynamically improved nacelles. Final version was the S.P.4 with twin tractor engines of the 200 h.p. SPA type mounted between the wings. The S.P.4 was a bomber/reconnaissance type, with a 780 lb. bomb load, crew of three and two defensive machine guns; 152 were built. The S.P. types served with no less than 23 Italian squadrons, but they were slow, vulnerable aircraft and losses were high. Some of their crews suggested that S.P. really stood for *siamo perduti:* " we are lost "!

Short Bomber

Purpose: Long range bomber.
Engine: One 250 h.p. Rolls-Royce Eagle III inline.
Span: 85 ft. 0 in.
Max. Speed: 77 m.p.h. at 6,500 ft.

The Short Bomber—it had no official type designation—was an adaptation as a land bomber of the highly successful Type 184 seaplane, and served in comparatively limited numbers in an interim capacity until replaced by the Handley Page O/100 in the spring of 1917. Eighty-three were built—by Shorts (36), Mann, Egerton (20), Sunbeam (15), Parnall (6) and Phoenix (6)—all with the Eagle engine except those by Sunbeam, who fitted their own 225 h.p. engine. The Short Bomber had a maximum bomb load of 920 lb. and a maximum endurance of six hours. It carried a crew of two and only a single movable Lewis gun for defence. It was characterised by its extremely large, high aspect ratio wings, whose effect was enhanced even more by some aircraft which had shorter fuselages than the standard one of 45 ft. length. The type served first with No. 7 Squadron, R.N.A.S. and later with No. 3 Wing at Luxeuil. Fifteen of the latter's aircraft were transferred at urgent request to the R.F.C. in preparation for the Battle of the Somme in 1916.

[I.W.M.

Siemens-Schuckert D.I

Purpose: Fighter.
Engine: One 110 h.p. Siemens-Halske Sh. I rotary.
Span: 24 ft. 7⅜ in.
Max. Speed: 97 m.p.h. at 6,560 ft.

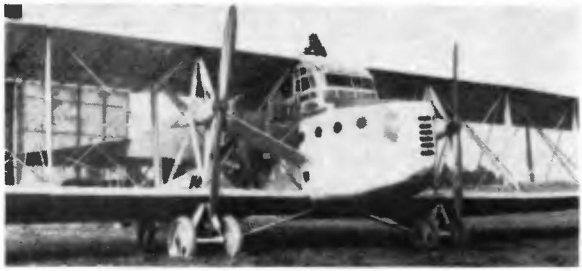
Along with several other German manufacturers, the Siemens-Schuckert Werke was asked in 1916 to produce a copy of the French Nieuport fighter that was largely responsible for the Allied air superiority at that time. The SSW's product was the closest copy of all, being virtually indistinguishable from the French original apart from the installation of its German engine and wing bracing. Up to the spring of 1917, 250 SSW D.I's had been ordered, but by then the superior Albatros D types were in service. As a result the final 100 on order were cancelled, and only 94 of the original order for 150 were completed. At first these were provided with only a single forward-firing gun, but twin Spandaus were fitted to later production aircraft. The D.I served mainly on the Russian front, but others were encountered on the Western Front and later several were used in a training capacity. One D.Ia and two D.Ib's were produced experimentally, with increased wing areas of 15·7, 16·2 and 19·2 sq. m. respectively (the D.I's wing area was 14·4 sq. m.); one of the D.Ib's was powered by a boosted Sh.I engine producing some 140 h.p.

E.I. [I.W.M.

Siemens-Schuckert E types

Data apply to E.I.
Purpose: Fighter.
Engine: One 100 h.p. Siemens-Halske Sh. rotary.
Span: 32 ft. 9¾ in.
Max. Speed: 85 m.p.h. approx.

Designed by Franz and Bruno Steffen, the SSW E.I single-seat monoplane appeared for the first time in the autumn of 1915. Of similar basic configuration to the Fokker and Pfalz E types, it was powered by a geared rotary engine in which the propeller rotated in the opposite direction to the cylinders to offset the torque. A pointed spinner was fitted on the prototype, but this feature was omitted from the 20 production aircraft ordered in November 1915. The E.I was armed with a single Spandau machine gun and had a duration of about 1½ hours. The E.II was an experimental version with a 120 h.p. Argus As.II inline engine; the sole prototype crashed in June 1916, killing Franz Steffen. Six E.III's were completed in 1916, and were virtually identical to the E.I except in having 100 h.p. Oberursel U.I rotary engines.

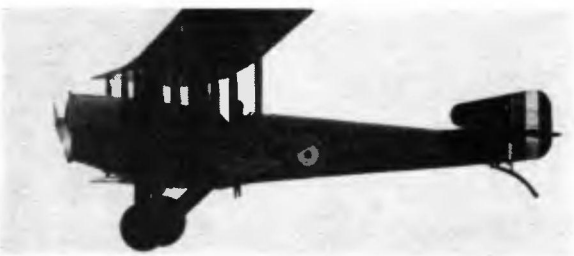


R.V. [I.W.M.

Siemens-Schuckert R types

Data apply to R.VII.
Purpose: Heavy bomber.
Engines: Three 260 h.p. Mercedes D.IVa inlines.
Span: 126 ft. 1⅛ in.
Max. Speed: 81 m.p.h.

Shortly after the *Riesenflugzeng* (giant aeroplane) category was introduced in November 1915, work began on the construction of seven Steffen-designed R types numbered R.I to R.VII. The layout of all seven was similar, three engines being mounted inside the front fuselage and geared to drive two tractor propellers mounted on the inboard wing struts. The rear fuselage was a unique design of two triangular booms mounted one above the other and tapering towards the rear to give a "forked" appearance in side elevation. The upper boom terminated in a large triangular horizontal tail unit, below which was a tall, narrow fin flanked by small twin rudders. The R.I was powered by 150 h.p. Bz.III engines, the R.II and R.VII by 260 h.p. Mercedes, and the remainder by 220 h.p. Bz.IV's; apart from this the major differences were dimensional ones, and all except the R.I spanned more than 100 ft. The first three aircraft were eventually employed only as trainers, but the R.IV to R.VII became operational in 1916/17 with a bomber squadron on the Russian front. Two examples were projected of the more ambitious R.VIII, with six 300 h.p. engines and a 157 ft. 6 in. wing span; but only one was completed, and this never flew, being damaged during ground trials after the war had ended.



Sopwith Cuckoo

Data apply to Mk.I.
Purpose: Torpedo-bomber.
Engine: One 200 h.p. Sunbeam Arab inline
Span: 46 ft. 9 in.
Max. Speed: 103 m.p.h. at 2,000 ft.

As the first landplane torpedo-bomber designed to operate from a carrier deck, the Cuckoo was aptly named. It was evolved to a 1916 Admiralty requirement, the prototype appearing in June 1917. Features of this three-bay single-seat biplane included folding wings, and a wide-track divided undercarriage between the legs of which an 18 in. torpedo could be attached beneath the fuselage. An initial 100 were ordered, powerplant being the 200 h.p. Arab in place of the Hispano-Suiza of the prototype. Total orders later increased to 350 Cuckoos, but only about 90 of these had been delivered by the Armistice, although limited production continued for a short while afterwards. Some aircraft, with Wolseley Viper engines, were designated Mk. II, and the 275 h.p. Rolls-Royce Falcon III was also fitted. The Cuckoo's service career was brief: the first examples were not delivered until July 1918, and the first operational squadron did not embark (in H.M.S. *Argus*) until mid-October. The last Cuckoo unit was disbanded in 1923.

Sopwith Dolphin

Data apply to Mk.I.
Purposes: Fighter and ground attack.
Engine: One 200 h.p. Hispano-Suiza inline.
Span: 32 ft. 6 in.
Max. Speed: 131 m.p.h. at sea level.

Of about 1,500 Dolphins built, only 600 or so had been issued at the Armistice to the R.A.F., with whom it then equipped five front-line squadrons. This restriction was due largely to troubles experienced with the geared 200 h.p. Hispano engine. The later Mks.II and III, with 300 h.p. geared and direct-drive versions of this engine, were too late for war service. The first R.F.C. Dolphins reached France in January 1918, and during the fierce fighting that followed from the spring onwards played quite an active part. They were most effective as escorts or when used for ground strafing. On paper, the Dolphin was heavily armed, having twin synchronised Vickers front guns and two Lewis guns firing forward and upward from the wing centre-section. In practice, however, the second pair of guns was often removed, although one squadron at least had them mounted on the lower wings, outside the propeller arc, where they contributed to the aeroplane's effectiveness as a ground attack machine.

[I.W.M.

Sopwith Salamander

Purpose: Ground attack.
Engine: One 230 h.p. Bentley B.R.2 rotary.
Span: 31 ft. 2⅛ in.
Max. Speed: 125 m.p.h. at 500 ft.

The Salamander was a ground-attack variant of the Snipe, and was designated T.F.2 following earlier experimentation with a T.F.1 (modified Camel) for a similar role; the designation indicated "Trench Fighter". Some 650 lb. of armour plating protected the forward fuselage from ground fire, and twin synchronised Vickers guns were mounted in front of the cockpit with 2,000 r.p.g. Various multi-gun installations were tried experimentally. Only 37 Salamanders had been delivered to the R.A.F. by the Armistice, and a mere handful had reached France; it is doubtful if these saw combat service. Production continued after the war until 882 had been built, but the Salamander was not considered a necessary part of the peacetime establishment.

[Air-Britain

Sopwith Snipe

Data apply to Mk.I.
Purpose: Fighter.
Engine: One 230 h.p. Bentley B.R.2 rotary.
Span: 30 ft. 0 in.
Max. Speed: 121 m.p.h. at 10,000 ft.

The Snipe was a development of the famous Camel, evolved to take advantage of the new B.R.2 (Bentley Rotary) engine developed from the B.R.1 that powered some production Camels. After much prototype modification, orders for 1,900 Snipes were placed with six contractors early in 1918, and some 200 of these had been completed by the end of the war. The Snipe is best remembered as the first standard post-war R.A.F. fighter; its wartime career was limited to service with only three squadrons, to whom deliveries began in the summer of 1918. This was time enough, however, for Major W. G. Barker to win the Victoria Cross for his phenomenal fight in a solitary Snipe against 15 Fokker D.VII's only a fortnight before the Armistice.

Sopwith Tabloid

Purpose: Scout and light bomber.
Engine: One 100 h.p. Gnome Monosoupape rotary.
Span: 25 ft. 6 in.
Max. Speed: 92 m.p.h. at sea level.

A pre-war racing biplane of excellent design and performance. the Tabloid was admirably suited to fast scouting duties after the outbreak of the war, and it was only the impossibility of arming it adequately—or any other scout at that time—that prevented it being an extremely useful fighter in the early days of the war. In the event it was most successful in the "nuisance bomber" role, for which it carried a small load of 20 lb. bombs. Two R.N.A.S. Tabloids made the first air raid on Germany when they attacked airship installations at Cologne and Dusseldorf on 8th October, 1914. Production Tabloids, unlike the prototype, were single-seaters, and were supplied to both the Naval and Military Wings of the R.F.C., a total of 39 being delivered up to June 1915. Some served in Belgium and France, others in the Dardanelles and the Aegean.

A.2.

[*H. J. Nowarra*

Spad A.2 and A.4

Data apply to A.2.
Purpose: Fighter.
Engine: One 110 h.p. Le Rhône rotary.
Span: 31 ft. 4 in.
Max. Speed: 81 m.p.h. at sea level.

Prototypes of the A.2 and A.4 were flown on 21st May, 1915 and 22nd February, 1916 respectively, and were essentially similar except that the later type had the 110 h.p. Le Rhône engine. This freakish design was, in effect, a tractor biplane, but the observer's cockpit nacelle was a separate structure *in front* of the propeller, and pivoted from a point in front of the axle of the main landing wheels so that it could be hinged down to give access to the engine. A pylon-mounted Lewis gun in this front cockpit provided the only armament. The aircraft was quite fast for its time, but its structural peculiarity precluded strenuous combat manoeuvres and with observers at least it was thoroughly unpopular. The French air force, which received 42 A.2's and one A.4, soon abandoned the type, but it served rather longer (through necessity rather than choice) in Russia, to which country 57 A.2's and 10 A.4's were supplied. Some of the Russian machines were fitted with a ski undercarriage.

[*I.W.M.*

Spad XI

Purpose: Reconnaissance and light bomber.
Engine: One 235 h.p. Hispano-Suiza inline.
Span: 36 ft. 10⅛ in.
Max. Speed: 109 m.p.h. at 6,560 ft.

Although bearing a superficial resemblance to the Spad VII fighter, this two-seat corps aircraft was far from being as successful as its famous stablemate. Apart from the stretched fuselage, the most noticeable points of difference in the Spad XI were the staggered and sweptback wings. A synchronised Vickers gun was situated in front of the pilot, while the observer had a ring-mounted Lewis in the rear cockpit. The prototype appeared in the autumn of 1916, and because of engine development troubles production did not get fully under way until about a year later. During its early months of service the Spad XI exhibited poor flying and climbing qualities, and in July 1918 it was withdrawn from French service. It remained in service until the Armistice with three Belgian and two A.E.F. squadrons. Belgium and the U.S.A. also had six and one examples respectively of the equally unsuccessful Spad XVI, which was similar except for a 220 h.p. Lorraine engine.

[H. J. Nowarra

Standard E-1

Purpose: Advanced trainer.
Engine: One 100 h.p. Gnome or 80 h.p. Le Rhône rotary.
Span: 24 ft. 0 in.
Max. Speed: 120 m.p.h. at sea level (with Gnome engine).

The Standard E-1 appeared in prototype form (2 were built) in 1917, and was originally conceived as a single-seat fighter. It was, however, inadequately powered for such a role, but its general performance was considered sufficient for a modest number to be built for single-seat advanced training. The first of 33 Gnome-powered E-1's began to be delivered in August 1918, and these were followed from November by the first of 75 similar but Le Rhône-powered aircraft. The E-1 was unarmed.

T.C.6.
[H. J. Nowarra

Tellier T.3

Purpose: Convoy escort and anti-submarine.
Engine: One 200 h.p. Hispano-Suiza inline.
Span: 51 ft. 2 in.
Max. Speed: 81 m.p.h. at 6,560 ft.

Alphonse Tellier's first flying boat was the prototype T.2, which crashed into the Seine only a short while after its first flight in June 1916. A second prototype was built with private backing, and when this passed acceptance trials in February 1917 an initial order was placed for 10 similar 'boats designated T.3. These were followed by 47 Nieuport-built T.3's and a further 39 built by Tellier, Georges Levy, Henri Fabre, S.A.C.A. and the State Arsenal, bringing overall T.3 production to 96 aircraft. Most of these were used by the French Navy as convoy escorts in the Mediterranean and Atlantic, though some served with the U.S. Navy in 1917–18 and two were evaluated by the R.N.A.S. An improved convoy protection version, the T.C.6 (= Tellier *Canon*) was armed with a 47 mm. cannon, and 55 of an order for 110 of this version were completed.

[*H. J. Nowarra*

Thomas-Morse S-4

Data apply to S-4C.
Purpose: Advanced trainer.
Engine: One 80 h.p. Le Rhône rotary.
Span: 26 ft. 6 in.
Max. Speed: 95 m.p.h. at sea level.

Like the Standard E-1, the Thomas-Morse S-4 was designed originally as a low-powered single-seat fighter powered by the 100 h.p. Gnome rotary engine, which was being built under licence in the U.S.A. In 1917, however, the U.S. Army adopted a policy of selecting its fighters from among proven foreign designs, but decided to place the S-4, among others, into production as an unarmed single-seat advanced trainer. First production model was the S-4B, 100 of which were delivered from November 1917 with the Gnome engine. They were followed from May 1918 by 50 S-4C's, with modified ailerons and controls, but after the 50th S-4C the somewhat troublesome Gnome was replaced by the more reliable, though less powerful, Le Rhône rotary. A further 447 Le Rhône-powered S-4C's were built up to the Armistice, when outstanding orders for a further 553 were cancelled.

F.B.19 Mk. II.
[*I.W.M.*

Vickers F.B.19

Data apply to Mk. II.
Purpose: Fighter.
Engine: One 110 h.p. Clerget or Le Rhône rotary.
Span: 24 ft. 0 in.
Max. Speed: 109 m.p.h. at sea level.

A fighter that, in 1915, could do more than 100 m.p.h. at 5,000 ft., would seem to have had a promising future, but after studying the E.S.1 and E.S.2 prototypes the R.F.C. declined to accept the original design. It re-emerged in August 1916 as the F.B.19 Mk.I, with a 100 h.p. Gnome Mono engine, and although it still did not impress a small batch was ordered. These included the Mono-engined Mk.I with unstaggered wings, and the Mk.II with more powerful engine and marked forward stagger. Apart from limited numbers in Macedonia, Palestine and Russia, the F.B.19 was used only in Britain for home defence or training duties. A total of 36 were delivered to the R.F.C. Armament was a single Vickers machine gun fitted with a Challenger interrupter gear, and the view from the cockpit was no more than adequate, despite the generous cut-out in the top centre-section.

Zeppelin (Lindau) D.I

Purpose: Fighter.
Engine: One 185 h.p. BMW.IIIa inline.
Span: 25 ft. 7⅛ in.
Max. Speed: 124 m.p.h.

Although not an operational type, the Zeppelin D.I is of interest from historical and engineering viewpoints as one of the early designs of Dr. Claude Dornier and as an attempt to produce a cantilever-wing biplane. A single-seat fighter with twin Spandau machine guns, it flew for the first time on 4th June, 1918 with a 160 h.p. Mercedes D.III engine. On 3rd July both aircraft and pilot were lost when the top wing broke off. In October a D.I with the BMW.IIIa engine took part in the third "D types" competition at Adlershof. It proved slower than many of the other entrants and was found to be rather heavy on the controls, hence no production order resulted. One D.I was evaluated by the U.S. Army and another by the U.S. Navy after the war.

R.III.
[H. *J. Nowarra*

Zeppelin (Staaken) R types

Data apply to R.VI.
Purpose: Heavy bomber.
Engines: Four 245 h.p. Maybach Mb.IV or 260 h.p. Mercedes D.IVa inlines.
Span: 138 ft. 5⅜ in.
Max. Speed: 81 m.p.h. at sea level.

The small but remarkable production series of Zeppelin giant bombers were built initially at the Versuchsbau Gotha-Ost and given V.G.O. designations. The V.G.O.I (later R.M.L.1) was flown on 11th April, 1915 with three 240 h.p. Maybach engines. In October it was followed by the similar V.G.O.II (R.II), but both were seriously underpowered for their 9-ton weight and six 160 h.p. Mercedes D.III's were installed in the V.G.O.III (R.III)—tandem pairs in port, starboard and nose positions. The R.IV of 1917 followed a similar installation, using 220 h.p. Benz engines in place of the four wing-mounted D.III's, and was armed with six or seven machine guns. The R.V (September 1917) had two paired and one single Maybach engine, and only five guns. Eighteen R.VI's were built, with tandem pairs of Maybach or Mercedes D.IVa engines, four guns and up to eighteen 220 lb. bombs. Eighteen was also the number of wheels in its landing gear! Some R.VI's took part in raids over France and Great Britain. Further variants included the R.VII (similar to the R.IV), the five-Maybach-engined R.XIV, R.XIVa and R.XV, and finally the R.XVI with two 220 h.p. and two 550 h.p. Benz engines. Apart from the R.VI, only single examples were built of the other R types with the exception of the R.XIV (three) and R.XV (three). One seaplane R.VI was built but lost on test; and three other seaplanes incorporating features of the R.VI, R.XIV and R.XV.

Other types

(Experimental or less important operational aircraft)

FRANCE

Borel Seaplane. Two-seat ship-spotter floatplane with 80 h.p. Gnome engine. About eight to R.N.A.S. in 1912, some still in service on outbreak of war.

Donnet-Denhaut DD types. Two/three-seat anti-submarine patrol flying boat series including DD2, DD8, DD9 and DD10; first two variants, with single 200 h.p. Hispano-Suiza pusher engines, were most numerous. Prime user was French Navy in Mediterranean, though some DD8's were supplied to the U.S. Navy.

Levy GL40. Two-seat pusher seaplane bomber, 300 h.p. Renault engine; 100 built 1918, serving at French coastal bases in the Aegean and North Africa.

Morane Saulnier Type H. Single-seat monoplane developed from the Type I in which Garros crossed the Mediterranean in 1913. Became Military Type I (with 14 sq. m. wings) and Type XII (with 16 sq. m. wings), and 25 of the two versions were the first French fighters. One supplied to R.F.C. for evaluation.

Gotha-Ursinus floatplane. [I.W.M.

GERMANY

A.E.G. DJ.I. Single-seat ground attack biplane (195 h.p. Bz.IIIb), flown in September 1918 but developed too late for war service. Derived from earlier P.E. triplane with twin Spandaus and light bomb load.

A.E.G. R.I. Giant bomber, built 1918 with four 260 h.p. Mercedes D.IVa, span of 118 ft. 1¼ in. One only, destroyed September 1918.

Albatros C.IX. Two-seat reconnaissance biplane with marked sweep on upper wings; fuselage and tail similar to D type fighters; 160 h.p. Mercedes D.III. Three only, one of which may have been flown by von Richthofen.

Albatros C.XV. Armed two-seater with 220 h.p. Bz.IVa, for which the C.XIV (flown spring 1918) acted as prototype. Production commenced, but few actually in service before Armistice.

Albatros W.5. Two-seat torpedo attack seaplane with two 150 h.p. Benz engines; derivative of W.3. Five to German Navy 1917–18.

Daimler L.6 and L.9. Single-seat fighter biplanes, 185 h.p. Daimler D.IIIb engine and twin Spandaus. Six L.6 (also known as D.I) built early 1918, followed by one L.9 with " I " struts and modified tail.

Fokker M.7. Two-seat unarmed sesquiplane for coastal patrol, 80 h.p. Oberursel engine. Twenty built early 1915 for German Navy, and one completed as twin-float W.4.

Fokker M.16. Two-seat armed reconnaissance biplane with 200 h.p. Austro-Daimler engine. Thirty M.16Z's built for Austro-Hungary following smaller, single-bay M.16E prototype (120 h.p. Mercedes D.II) in 1915.

Friedrichshafen FF29. Two-seat coastal patrol seaplane used in limited numbers by German Navy in early months of war. FF29A had improved float and tail design; both versions powered by 120 h.p. Mercedes D.II.

Friedrichshafen FF41. Three-seat, twin-float torpedo attack biplane with two 150 h.p. Bz.III engines. Nine in German Navy service from February 1916; tail units varied.
Gotha LD.1a and LD.2. Two-seat unarmed reconnaissance biplanes, the LD.2 (100 h.p. Mercedes D.I) appearing autumn 1914 and the LD.1a (100 h.p. Oberursel Ur.I) in 1915. Limited use in early part of war.
Gotha LE types. Generally-similar series of pre-war *Taube*-type monoplanes (LE.1, 2, 3 and 4), built in small numbers and used early on for scouting duty.
Gotha WD.1 and WD.2. Two-seat coastal patrol floatplanes with 100 h.p. Gnome (WD.1) or 150 h.p. Bz.III (WD.2) engines. Few of each with German Navy, and some LD.2's with Turkish Navy 1914–15.
Gotha WD.7. Two-seat torpedo trainer floatplane with two 120 h.p. Mercedes D.II engines; eight with German Navy in 1916. One completed late 1915 as WD.8 recce prototype with single 240 h.p. Maybach and Parabellum defensive gun.
Gotha (Ursinus) Floatplane. Twin retractable-float seaplane fighter, single-seat, one 150 h.p. Benz Bz.III. One only, built by Gothaer Waggonfabrik in 1916, but destroyed during trials.
Hannover CL.V. Armed reconnaissance two-seater, 185 h.p. BMW.IIIa. About 50 built late 1918, some with monoplane tail. Unlikely to have seen much war service.
Hansa-Brandenburg D. Two-seat unarmed scout biplane with 110 h.p. Benz Bz.II. Twelve built, plus a further 12 FD's, a development with Bz.III and redesigned tail unit.
Hansa-Brandenburg FB. Two-seat light observation flying boat, 165 h.p. Austro-Daimler, used by German Navy (6) and Austro-Hungarian Navy from 1915.
Hansa-Brandenburg W.13. Two-seat patrol flying boat with 350 h.p. Austro-Daimler. Few only, built by Oeffag, Phönix and Ufag for Austro-Hungarian Navy as Type K.
Hansa-Brandenburg W.16. Single-seat twin-float fighter, 160 h.p. Oberursel U.III rotary and twin Spandaus. Three built 1916 for German Navy.
KW floatplanes. Series of unarmed two-seaters, mostly with 150 h.p. Bz.III, built by the Kaiserlicht Werft (Imperial Naval Yards) at Danzig, Kiel and Wilhelmshafen. About 20 completed for German Navy.
Lübeck-Travemünde F.2. Two-seat armed reconnaissance floatplane, 220 h.p. Mercedes D.IV; 17 completed for German Navy.
L.V.G. B types. Two-seat unarmed scout and training biplanes, powered by 110 h.p. Benz (B.I), 100 h.p. Mercedes (B.II) or 120 h.p. Mercedes D.II (B.III) and used in small numbers during early months of the war.
L.V.G. E.VI. Two-seat monoplane, 120 h.p. Mercedes D.II. Prototype only, completed 1915 and crashed soon after first flight, but noteworthy as the first German two-seater to have both a ring-mounted machine gun for the observer as well as a fixed gun for the pilot.
Otto B and B.I. Two-seat observation biplanes (100 h.p. Rapp) used in small numbers at the beginning of the war.
Pfalz D.XV. Single-seat fighter biplane with 180 h.p. Mercedes D.IIIa or 185 h.p. BMW.IIIa and twin Spandau guns. Official trials on 4th November, 1918 successful, it was intended for substantial production.
Pfalz Dr.I. Single-seat fighter triplane, developed from earlier biplane D.VII with 160 h.p. Siemens-Halske Sh.III and twin Spandaus. About 10 built, official trials during October 1917, but no further production.
Rumpler 4A. Two-seat unarmed biplane, 100 h.p. Mercedes D.I. Used in 1914 and early 1915 for reconnaissance and training as B.I. Navy 4B was Benz-powered and had twin floats.
Sablatnig SF8. Two-seat twin-float trainer with 150 h.p. Bz.III engine and dual controls. Delivery began January 1918 of an order for 41, but some may not have been delivered.
Siemens-Schuckert Dr.I. Ingenious but unsuccessful fighter triplane with tandem-mounted 120 h.p. Sh.I engines (one tractor, one pusher) in central nacelle. Prototype only, which crashed during first flight in November 1917.
Zeppelin (Lindau) Rs types. Series of four giant flying boats designed by Claude Dornier. Rs.I biplane (three 240 h.p. Maybach Mb.IV) was completed autumn 1915 but destroyed before it flew. Rs.II sesquiplane, originally similarly powered, later had twin pairs of Mb.IV engines; maiden flight 30th June, 1918. Rs III (first flown 21st October, 1917) was a monoplane with four 245 h.p. Mb.IVa's in tandem pairs. Rs.IV was a further refinement of the Rs.III, launched a month before the Armistice.

GREAT BRITAIN

A.D. Flying Boat. Two-seat patrol flying boat, 150 or 200 h.p. Hispano-Suiza; R.N.A.S. had 27 in service from 1917.
Alcock Scout. Hybrid single-seat fighter biplane with fuselage, undercarriage and lower wing from a Sopwith Triplane, upper wing from a Pup, and a 100 h.p. Gnome Mono (later a 110 h.p. Clerget) engine. One only, which served operationally with the R.N.A.S. in the Aegean.
Armstrong Whitworth F.K.10. Two-seat fighter/light bomber quadruplane of 1916. Eight built for R.N.A.S. with 130 h p. Clerget or 110 h.p. Le Rhône; mostly scrapped before the war ended.
Avro 500. Two-seat training biplane, 50 h.p. Gnome. In service in small numbers pre-war with R.F.C. Military and Naval Wings.
Avro 503. Two-seat training seaplane, 100 h.p. Gnome. Few to R.N.A.S. pre-war.

Avro 510. Two-seat patrol floatplane, 150 h.p. Sunbeam. Five with R.N.A.S. in 1914.
Beardmore W.B.III. Pup development for shipboard use; 100 ordered, 55 being delivered before the Armistice as SB.3D (" ditchable " undercarriage) and SB.3F (folding undercarriage).
Bristol " Boxkite ". Two-seat trainer of 1910 design with 50 h.p. Gnome engine. In small numbers with R.F.C. from 1912 and R.N.A.S. until mid-1915.
British Nieuport Nighthawk. Single-seat fighter biplane (325 h.p. Jaguar II or 385 h.p. Jupiter II) to 1918 specification, but not in service until post-war.
De Havilland D.H.10. Three-seat heavy bomber biplane with two 400 h.p. Liberty engines. Eight only in service before the Armistice, of 1,295 ordered. Unofficially known as the Amiens.
Fairey IIIA and IIIB. Two-seat reconnaissance landplane (IIIA) and bomber seaplane (IIIB), both powered by 260 h.p. Sunbeam Maori II. Fifty IIIA's and 25 IIIB's built, but only a few of each type saw active service.
Felixstowe F.5. Continued development of F.2A and F.3 (see main text) with two 345 h.p. Eagle VIII engines. Ordered in quantity but not in service until after the Armistice.
Grahame-White XV. Two-seat Farman-type pusher biplane, 80 h.p. Gnome or Le Rhône engine. Quite widely used as trainer (R.N.A.S. had 80) early in the war.
Handley Page V/1500. Largest and first four-engined British bomber of the war, with 375 h.p. Eagle VIII engines; the only three in service before the Armistice were standing by to bomb Berlin.
Norman Thompson N.T.2B. Two-seat flying boat trainer, various powerplants. The R.N.A.S. used many 1917–18, and 79 remained in service at the end of the war.
Norman Thompson N.T.4. Four-seat anti-submarine patrol flying boat, two 150 h.p. Hispano-Suizas. Six N.T.4 and 44 N.T.4A (200 h.p. Hispanos) to R.N.A.S. 1916–18.
Parnall Panther. Two-seat carrier-borne fighter, 230 h.p. B.R.2 rotary. Six prototypes flown 1917–18, and 300 ordered; order cut to 150 in November 1918 and these were delivered post-war.
Pemberton-Billing P.B.25. Single-seat pusher fighter, 100 h.p. Gnome or 110 h.p. Clerget engine. Twenty built for R.N.A.S. 1916.
Porte Baby. Tri-motor patrol flying boat: 11 built for R.N.A.S., mostly with Eagle VII or VIII engines.

Short 320.

Short 74. Two-seat ship-borne floatplane with 100 h.p. Gnome. Eighteen built for R.N.A.S. in 1914; some in Cuxhaven raid of 25th December, 1914.
Short 166. Two-seat torpedo attack seaplane, 200 h.p. Salmson, used by R.N.A.S. at shore bases and on carrier *Ark Royal.* Total of 26 built.
Short 320. Developed version of Short 184 (see main text) with 320 h.p. Sunbeam; 110 delivered to R.N.A.S., and 50 of these still in service with R.A.F. in October 1918.
Short 827 and 830. Two-seat reconnaissance/bomber seaplanes with 150 h.p. Sunbeam and 200 h.p. Salmson engines respectively. Production approximately 100 Type 827's and 20 Type 830's.

Short T.5. Two-seat training biplane, produced for R.N.A.S. pre-war in both landplanes and seaplane forms; 70 h.p. Gnome engine.
Sopwith 807. Two-seat folding wing seaplane for ship- and shore-based reconnaissance; 100 h.p. Gnome Mono engine. Twelve for R.N.A.S. from 1914.
Sopwith 860. Two-seat coastal patrol and torpedo seaplane, 225 h.p. Sunbeam; 18 to R.N.A.S.
Sopwith B.1. Single-seat bomber biplane of 1917, similar to later Cuckoo with 200 h.p. Hispano-Suiza. One only, served with No. 5 Naval Wing at Dunkirk.
Sopwith " Spinning Jenny ". Basically a landplane counterpart of the Type 807; some 24 used by R.N.A.S. in anti-Zeppelin role 1914–15.
Vickers F.B.12. Single-seat pusher fighter. Fifty F.B.12c's ordered, but only 18 known to have been completed, with various powerplants. A few may have been used by the R.F.C. for home defence in 1917.
Vickers Vimy. Three-seat heavy bomber biplane, two 360 h.p. Eagle VIII engines. First flown November 1917, but only three in service by the Armistice. Became a standard post-war type.
White and Thompson No. 3. Two-seat anti-submarine flying boat, 120 h.p. Beardmore pusher engine; eight to R.N.A.S. in 1915.
White and Thompson " Bognor Bloater ". Two-seat coastal patrol landplane with 70 h.p. Renault engine and wooden monocoque fuselage; 10 to R.N.A.S. in 1915.
Wight 840. Two-seat torpedo seaplane, 225 h.p. Sunbeam. About 70 to R.N.A.S. in 1915–17.
Wight " Converted " Seaplane. Two-seat anti-submarine patrol seaplane, 320 h.p. Eagle VI or 265 h.p. Sunbeam Maori engine. Thirty-seven in R.N.A.S. service from early 1917.
Wight Pusher. Two/three-seat reconnaissance seaplane, 200 h.p. Salmson pusher engine. Two aboard *Ark Royal* in 1915, plus nine others in R.N.A.S. service.

Sopwith B.1. [*I.W.M.*

ITALY

S.I.A.I. S.8. Reconnaissance and anti-submarine flying boat biplane with 170 h.p. Isotta-Fraschini V4B or 120 h.p. Colombo F.150 engine; 172 built for Italian Navy.

RUSSIA

Grigorovitch M.9. Two-seat reconnaissance/bomber flying boat, 150 h.p. Canton-Unné pusher engine; in fairly widespread use by Russian Navy in Baltic and Black Sea areas.

U.S.A.

Curtiss 18. Two-seat fighter, evolved in 1918 with 400 h.p. Kirkham K-12 engine and four to six guns. One biplane and one triplane prototype (which flew at 163 m.p.h.) completed before the Armistice halted production plans.
Curtiss F and MF. Two-seat training flying boat, 100 h.p. Curtiss OXX pusher engine. About 150 completed, mostly for U.S. and Russian Navies.
Curtiss HS-1L and HS-2L. Three-seat anti-submarine and escort flying boat, 400 h.p. Liberty 12 pusher engine. Only U.S.-built aircraft to serve with U.S. Navy in Europe (from June 1918). Both were subject of large orders, but only small numbers of the HS-1L saw active service.
Curtiss R-4. Heavy two-seat biplane, 200 h.p. Curtiss V-2 engine. Some used as bombing trainers by U.S. Army and a few by the R.N.A.S.
Martin S. Development of Martin T, with 125 h.p. Hall-Scott A-5 engine. Fourteen to U.S. Army 1915–16 for observation duties.
Martin T and TT. Two-seat training seaplanes, various engines from 90 h.p. OX-5 to 135 h.p. Sturtevant. Seventeen to U.S. Army 1914–15.

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