

A Century of... Air Navigation

In Part Six of *Aeroplane's* major 12-part series — in which specialist authors summarise a specific aspect of aviation development — former World War Two RAF navigator **ROY NESBIT** charts a partly personal course through the past 100 years

POWERED FLIGHT IN BRITAIN followed the activities of balloonists, initially carried out as private ventures. In 1878 the War Office set up an establishment at Woolwich to develop military ballooning, with Capt J.L.B. Templer as the instructor. The School of Ballooning was formed at Chatham in 1882, where officers and men of the Royal Engineers were trained in air reconnaissance, photography and signalling. The school moved to Aldershot in 1891, but there is no mention in its records of air navigation.

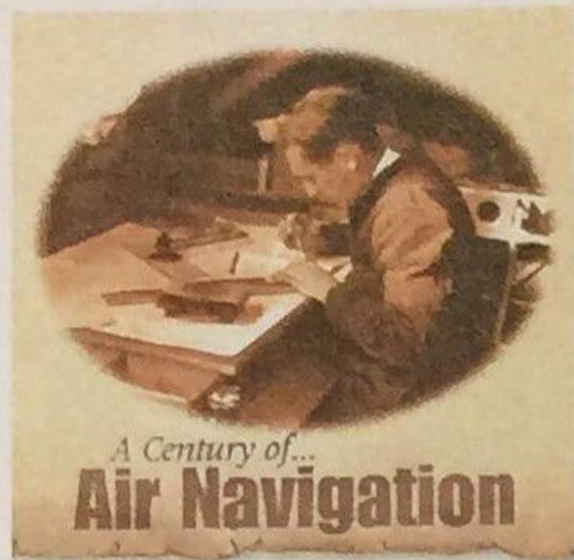
Following their first successful powered flights on December 17, 1903, and their subsequent development of a practical aeroplane, Wilbur and Orville Wright embarked on a sales

campaign, but failed to gain orders from the War Office. Experiments were made with man-carrying kites in 1904, but a far greater threat to Britain's security was considered to be posed by Count Zeppelin's airships, the first of which had made its maiden flight in Germany on July 2, 1900. The British Army's first airship, *Nulli Secundus*, came into service in 1907 and introduced the question of how to navigate over long distances.

Alarm bells rang on July 25, 1909, when Louis Blériot took off in his monoplane from Les Baraques near Calais and landed 37min later near Dover Castle. This was no great feat of navigation, for he had French naval vessels to guide him, but the thought of thousands of

ABOVE The navigator in a Short Sunderland flying-boat, seated at his chart table near the flight deck. A compass is mounted on a bracket over his table, and a Dalton Computer is by his left hand. He is holding a pair of dividers.

RIGHT Pierre Prier in the Blériot monoplane in which he flew non-stop from Hendon to Issy-les-Moulineaux, near Paris, on April 12, 1911. He has a roll map, two instruments and a pulsometer to indicate fuel flow.



Bradshaw's Railway Guide, published annually, was known as "the pilot's friend". Low passes along railway lines might enable pilots to read the names of stations

armed Frenchmen, Britain's traditional enemies, soaring above the Royal Navy to take Britain's coastal defences in the rear, was enough to stir the War Office into action. In April 1911 it formed the Air Battalion of the Royal Engineers, with No 1 Company for airships, balloons and kites, and No 2 Company for aeroplanes.

Air navigation in free balloons was rudimentary, consisting almost entirely of map-reading. At one of my early book launches, a guest speaker was the urbane and witty Air Marshal Sir Edward "Chilly" Chilton. An eminent pilot-navigator, he could remember the days when sapper officers used to train at a School of Free Ballooning at Hurlingham. He described one occasion when two officers found themselves floating above low cloud and had no idea of their whereabouts when it cleared. They came down to hailing distance and spotted two farm labourers in a field. One officer leant over the side and called: "Hullo down there!"

"Ullo!", came the reply.

"Where are we?", shouted the officer. "Why, you be up in a balloon!" was the rather unhelpful response.

Navigation in the Royal Flying Corps (RFC), formed on April 13, 1912, was similarly unprofessional. At that time, throughout the First World War and even afterwards, it involved no more than an ability to read maps and fly compass courses. Unfortunately there was an inad-



Pilots and observers studying maps beside an Armstrong Whitworth F.K.8 in April, 1918.

equate supply of topographical maps. Training was perfunctory. The main method for single-seat aircraft in Britain was the use of *Bradshaw's Railway Guide* to follow the lines which snaked over much of the countryside. This indispensable guide, first written by George Bradshaw and published annually from 1839 to 1961, was known as "the pilot's friend". Low passes along railway lines might enable pilots to read the names of stations.

The Royal Naval Air Service (RNAS) was formed in April 1912 as the Naval Wing of the RFC but refused to be known under this name, assuming its new title officially on July 1, 1914. There may have been some justification for this obduracy, for its prowess in the art of air navigation was vastly superior to that of the RFC. Pilots who flew over the sea could not rely on topographical maps or railway stations to ascertain their positions, although map-reading of coastlines was of great importance.

The Royal Navy had accumulated centuries of experience and skill navigating the world's oceans, and adapted this knowledge and its instruments to its new flying branch. The concept of a "triangle of velocities" (formed by the speeds and directions of wind, course and track) presented no problem to a marine navigator. The marine sextant was in general use, as was a chronometer accurate to the second. Thus the marine navigator could determine the angles of heavenly bodies above the horizon, provided the sky was clear enough, use tables to convert these into position lines, then plot their intersection on a chart.

The RNAS air observer was taught the principles and practice of dead-reckoning and astro-navigation, and the use of maps, charts and compasses, as well as wireless telegraphy and bomb aiming. The development of navigation instruments for aircraft was fostered by the Admiralty, such as the course and distance indicator, the Douglas protractor and the drift indicator. The RNAS was also the first to use wireless telegraphy for direction finding. Trials began in December 1916, and the first wireless receivers were installed in RNAS aircraft at Dunkirk early in the following year. New equipment was also introduced, such as the gyro compass, which was unaffected by the Earth's magnetic variation or by magnetic deviation from the aircraft itself. This type of compass had been invented before the First World War, primarily for naval purposes.

The Independent Bombing Force, created in June 1918 after the formation of the new RAF from the RFC and the RNAS, tended to revert to dependence on topographical maps. The air observer was encouraged to memorise major landmarks and thus avoid using a torch at

RIGHT Pilots and observers of the newly-created RAF study topographical maps beside an Armstrong Whitworth F.K.8 in April 1918.



1890s Colonel James Templer, a pioneer of British military ballooning from 1878 to 1905, in the wicker basket of an observation balloon



1906 A man-carrying kite designed by S.F. Cowdery ("Cody") is sent aloft by Royal Engineers at Aldershot



1910-14 The British military airship *Gamma* was used by the army from early 1910, passing to the RNAS in 1914



1918 Visible at lower centre of this Sopwith Dolphin's instrument panel is a Sperry gyro compass



1919 Willing hands help to push Alcock and Brown's Vickers Vimy into position for take-off at Quidi Vidi, Newfoundland

night. He was also advised to fly along white roads if possible, since these were more visible. There was a shortage of equipment such as protractors, compasses and navigation instruction manuals, which for the most part had to be obtained from the former RNAS. The War Office also rejected the use of wireless telegraphy for navigational purposes, on the grounds that it could be jammed by the enemy.

The early inter-war years were marked by a steep decline in RAF strength. The Chief of Air Staff, Air Chief Marshal Sir Hugh Trenchard, decreed that all commissioned aircrew must be capable of flying an aircraft. Thus the function of navigation was carried out by a handful of pilots who specialised in the subject. These spent a year at the Air Pilotage School, formed in 1919. The course was known as the "Long N", and those who qualified were entitled to the annotation "n" against their names in the *Air Force List*. Most were then employed in staff positions, but some entered squadron service in long-distance aircraft, such as flying-boats or the heavy transports based in the Middle East.

But the RAF fell to a strength of 27 squadrons by April 1920. Three years later there was only a single maritime squadron in the Service. It was proposed in 1924 that the RAF be expanded to 52 squadrons, but ten years later the number was only 42. There were few qualified navigators serving in the RAF in this period.

Yet the basic theories of air navigation developed apace in the interwar years, for both civil and military purposes. This was the era of epic pioneering long-distance flights, and there was tremendous public interest and enthusiasm for these dangerous ventures. I have a copy of *Air Navigation*, by American Lt-Cdr Philip V.R. Weems, published in 1931. This demonstrates that a very high degree of proficiency had been achieved, not only in theory but with the equipment already employed or being developed. Similarly, my copy of the *Manual of Air Navigation* (AP 1456), published by the Air Ministry in 1933, is very advanced, concentrating on the theory and practice of astro-navigation, with examples of spherical trigonometry and accompanying logarithms. The marine sextant was adapted to become a bubble sextant, providing an artificial horizon for the air navigator instead of the sea horizon used by his marine counterpart.

With the threat of war with Germany and its growing Luftwaffe, the expansion of the RAF to 125 squadrons was authorised in 1935. The division of the Service into Bomber, Fighter, Coastal and Training Commands followed a year later. In addition, there were the overseas commands. A School of Air Navigation was set up, providing three-month courses for pilots

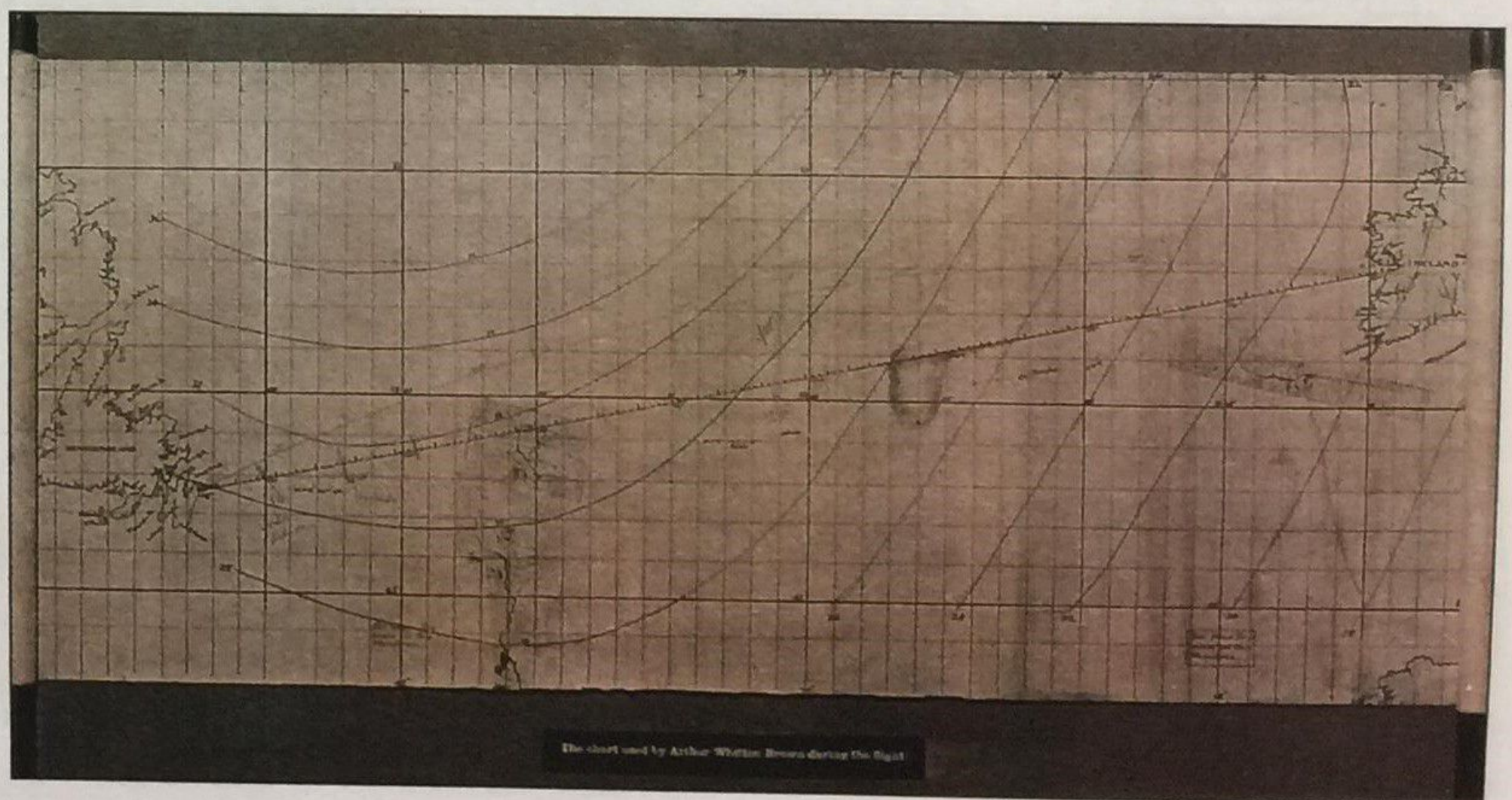
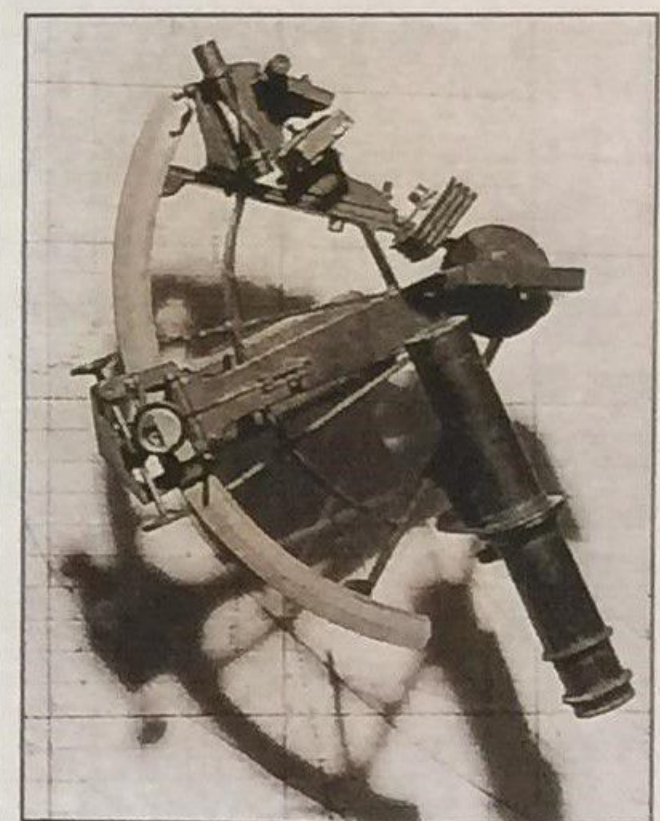


ABOVE Airco D.H.9 C1263, built by G. & J. Weir of Glasgow, has its compass swung on the compass base at Renfrew in 1918.

proceeding to Bomber Command and six-month courses for those destined for Coastal Command. These qualifications were known as the "Spec N" and the "Short N". Larger aircraft usually carried two pilots, one of whom did the navigating, though they could change places. With the introduction of the short-service commission in 1938, the category of air observer was restored. Entrants in the new RAF Volunteer Reserve could also train as air observers.

My recollection in joining the RAFVR on the outbreak of war, shortly after my 18th birthday, was that the flying-training courses were completely clogged up. Ground instruction was available at Initial Training Wings, but we went over the same subjects repeatedly, and were even employed as ground gunners on RAF stations for some periods. I was considered proficient in theoretical matters and eventually passed through an Air Observers Navigation School, followed by a Bombing and Gunnery School. These courses covered dead reckoning, maps and charts, magnetism and compasses, astro-navigation, meteorology, air photography, the theory and practice of bomb aiming, and the use of machine-guns. The qualification in my logbook records "Credit Class A".

BELOW The marine-type sextant used by Lt Arthur Whitten-Brown, navigator for the first non-stop transatlantic flight. Below that is the actual chart used by Brown to plot the route taken by pilot Jack Alcock and himself.

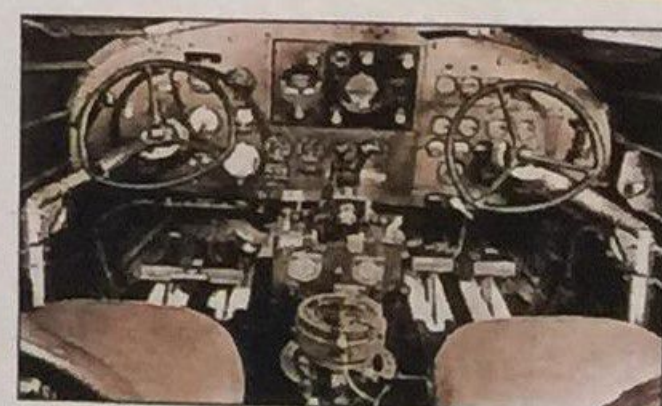


1922 In an epic feat of navigation and endurance, Cdr Cabral and Capt Coutinho of Portugal make the first crossing of the South Atlantic by air



1925-30 The Bubble Sextant Model B for aircraft is developed in the USA

1930 Kingsford Smith in the Fokker F.VIIb/3m *Southern Cross* reaches New York via Newfoundland on June 27, having left Eire two days earlier



1935 The instrumentation in this KLM Douglas DC-2 includes the latest navigational aids

1936 Sperry's Gyro Horizon and Directional Gyro makes blind flying with accurate navigation on commercial air routes a practical proposition



1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940