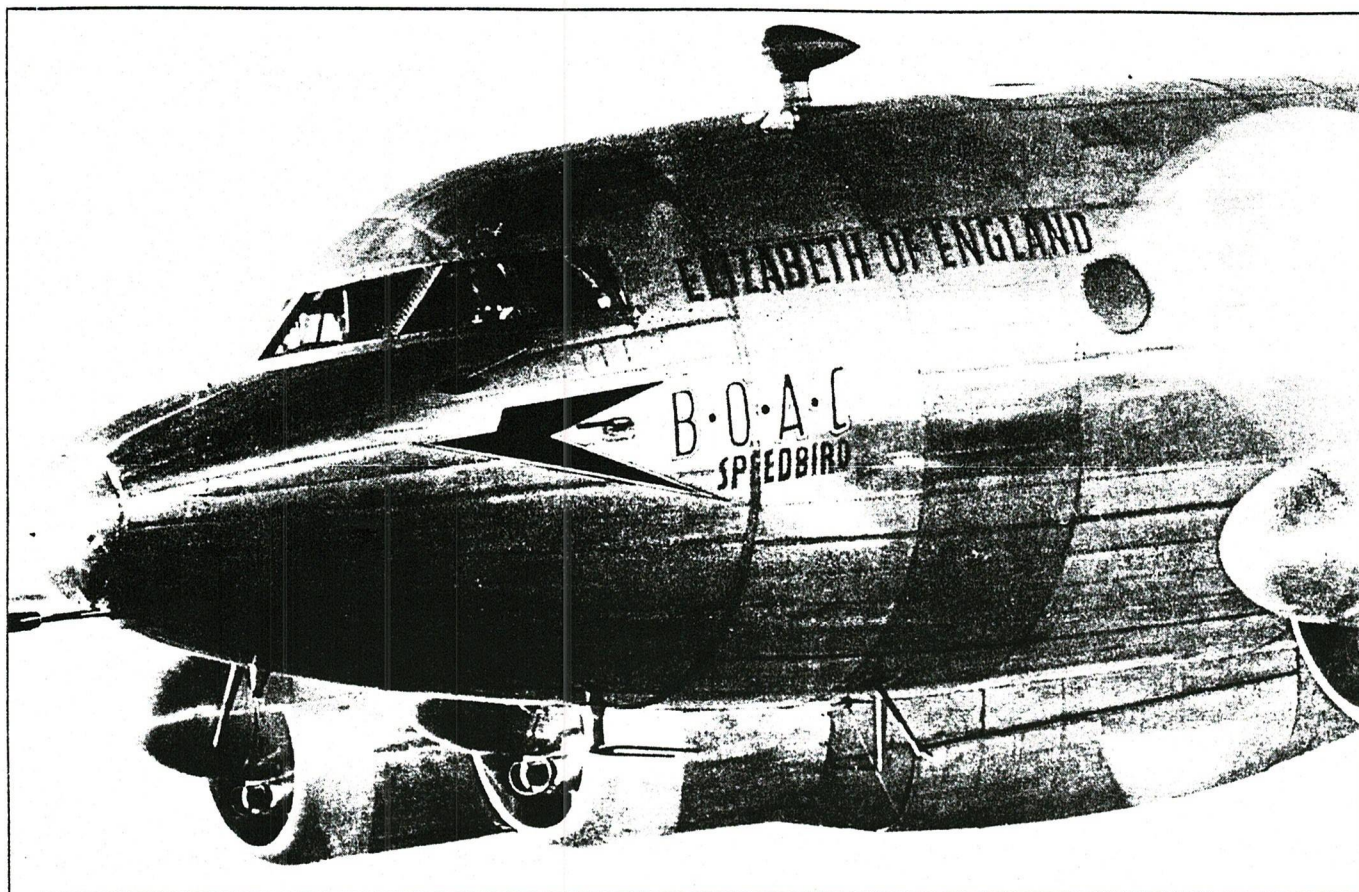


POST-WAR PROPLINERS



John Stroud's series on European post-war piston-engined airliners



AVRO TUDOR

Although Avro's Tudors did eventually do some useful work, on deep reflection I can only conclude that the type was a large-scale failure, and that it never did the work for which it was designed.

On May 25, 1943, the second committee was set up under the chairmanship of Lord Brabazon of Tara to make recommendations for the post-war development of commercial transport aircraft. Between August 1943 and November 1945 this committee recommended the development of nine types. These included an aeroplane capable of non-stop operation between London and New York, a medium- to long-range Empire route aircraft, the Avro 689 Tudor II as an interim type, and a North Atlantic turbojet mailplane.

The first of these, the Type I, appeared as the Bristol 167 Brabazon, but only one was completed and it was never used. The medium- to long-range Empire route aeroplane was the Type IIIA Avro 693 which was cancelled at the design stage; the Tudor II was produced and will be described later; and the Type IV North Atlantic turbojet mailplane was evolved to become the de Havilland D.H.106 Comet 1.

types could be ready, several interim types were produced. These included the Avro Tudor series.

To meet the interim requirements A.V. Roe & Co Ltd decided to build the Avro 687 or Avro XX, as a Lancaster IV/Lincoln bomber with a new circular-section pressurised fuselage. It was to retain the Lincoln's Rolls-Royce Merlin liquid-cooled engines, but was to have a large single fin and rudder in place of the Lincoln's tall twin fins and rudders. To cover the construction of the Avro XX the Air Ministry produced Specification 29/43. Issued in March 1944, this called for an aeroplane capable of carrying a 3,760lb payload for 4,000 miles, cruising at 235 m.p.h. at 25,000ft. Its all-up weight was to be 72,000lb.

During the design stage the idea of a Lancaster IV/Lincoln conversion was abandoned; instead, a new 12-passenger type was schemed as the Avro 688 Tudor I (still the Avro XX), and two prototypes were ordered in September 1944. The

first example, G-AGPF, flew on June 14, 1945, and was the first British pressurised transport aeroplane, although it originally flew unpressurised.

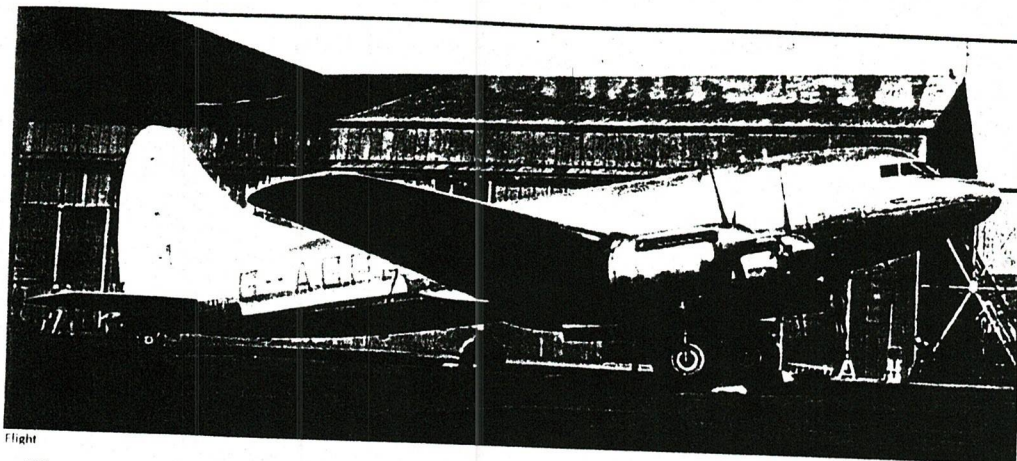
The Tudor I was intended for North Atlantic operation. At the time it was designed the USA had the Douglas DC-4 and Lockheed Constellation, so the less said the better about designing a four-engined pressurised aeroplane of some 70,000lb all-up weight and nearly 7,000 h.p. for 12 passengers.

Nevertheless, in November 1944 the Ministry of Supply ordered 14 Tudor Is for BOAC, and in April 1945 increased the production order to 20!

The Tudor was a low-wing cantilever monoplane with four engines, a single fin and rudder and a retractable tail-wheel undercarriage. The DC-4 and Constellation, of course, both had nose-wheels.

The wing, of NACA 23018 section at the root, was a five-piece all-metal two-spar structure. The untapered centre section without dihedral carried the inboard engines and main undercarriage units. The inner and outer sections were tapered on their leading and trailing edges, and had 2° 4' dihedral on the top of the front spar, with the inner sections carrying the outboard engines.

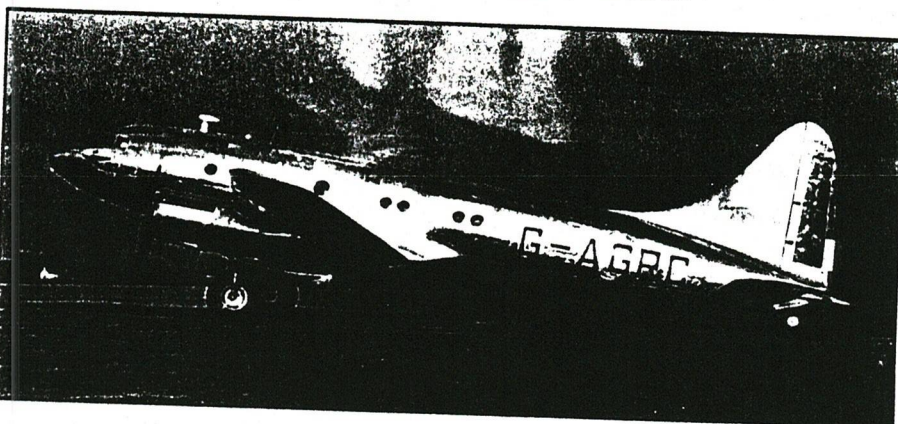
Heading photograph, fourth production Avro Tudor I G-AGRF with BOAC and Speedbird on the nose and the name Elizabeth of England aft of the flight deck windows. KEITH WOODCOCK'S painting shows inflated British South American Airways Avro



Left, G-AGPE, the Avro Tudor I prototype.

Right, the first production Tudor I, G-AGRC.

Below, G-AGRC with original tail surfaces and inboard engine nacelles, at Radlett on February 10, 1946.



The Aeroplane

The spar booms passed through the pressurised fuselage in rubber-sealed shrouds. The ailerons had trim and balance tabs, and there were hydraulically-operated split flaps in three sections on each side at the trailing edges of the centre section and inner wings. Root chord was 16ft, and sweepback at the front spar was $6^{\circ} 18'$. The 3,300 Imp gal fuel capacity was provided by eight crashproof bag tanks, one on either side of the fuselage in the centre section and three in each inner wing.

The circular-cross-section fuselage was an all-metal semi-monocoque structure with 10ft maximum diameter. Above floor level there were inner and outer skins with kapok filling.

The metal tail unit had a dorsal fin built integrally with the fuselage, a 43ft-span two-spar tailplane, a vertical fin and rudder and inset divided elevators. The control surfaces were mass-balanced, and each had controllable trim- and servo-tabs.

The hydraulically-operated main-wheel units were similar to those of the Lancaster, had single Dunlop wheels and retracted rearward into the inboard engine nacelles. The twin tailwheels retracted rearward into the fuselage and, like the mainwheels, were enclosed by twin longitudinal doors.

The prototype Tudor I had 1,750 h.p. Rolls-Royce Merlin 102 12-cylinder

vee liquid-cooled engines. The first production aeroplane originally had these engines, but the standard engines were 1,770 h.p. Merlin 621s. They were enclosed in circular-section nacelles and drove 13ft-diameter Rotol four-bladed constant-speed fully-feathering propellers. There were underslung radiators and large spinners.

The crew section, of 646ft³, was arranged for two pilots, a flight engineer, a radio operator and a navigator — five operating crew for 12 passengers. The passenger cabin had a volume of 1,161ft³ and was divided into sub-compartments with seats for four or eight passengers by day and, in the de Luxe version, upper and lower bunks. In the Standard version the layout could be for 24 passengers by day or 12 at night. Twenty-eight seats were mentioned in an Avro leaflet, but

when I flew in G-AGRC it had only 12 seats.

Aft were separate dressing rooms for men and women, two lavatories and a wardrobe. There was an aft galley and fore and aft baggage holds. The entrance door was aft on the port side.

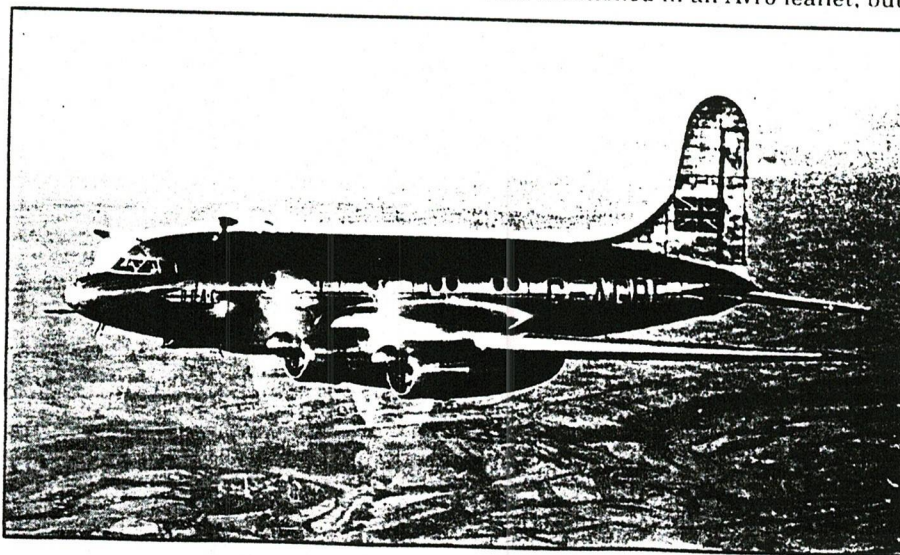
The description of the Tudor I interior layout is academic, because none went into service in this form.

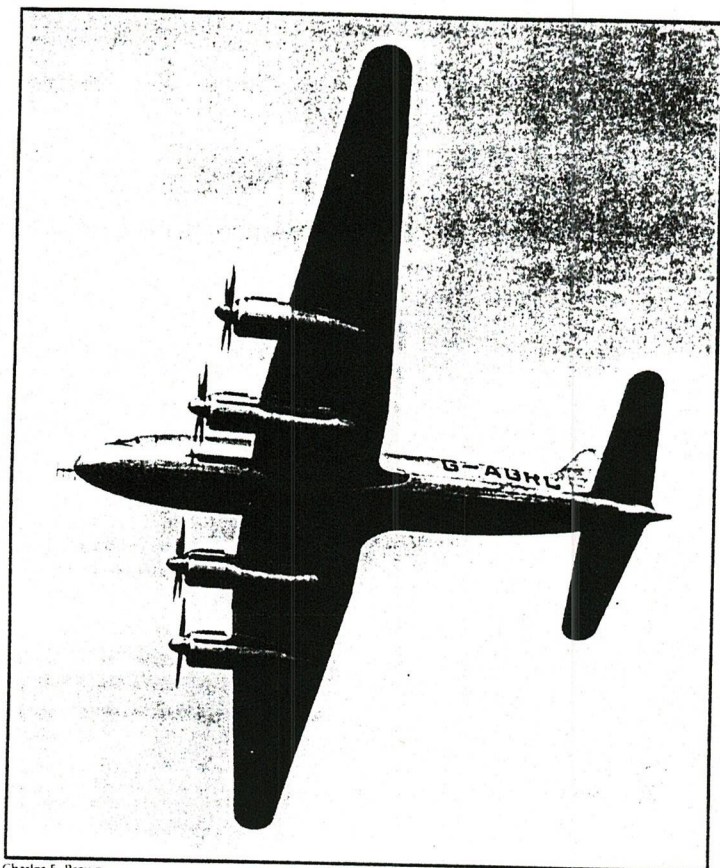
I flew in the first production aeroplane, G-AGRC, during a pressurisation test on May 1, 1946, and at the time wrote: "The Tudor I has accommodation for 12 passengers by day or night in three cabins — it is a luxury airliner. Although there is not a lot of space in which to walk about, its armchairs are some of the most comfortable yet produced, while hot or cold meals can be served from the pantry and set on the neatly stowed folding tables which appear from the cabin walls between each pair of seats". I added that at 25,000ft cabin pressure was equal to 8,000ft. Further mention of pressurisation included: "...the cabin pressure was set to 1,000ft while on the ground, causing a slight popping of the ears, which it was possible to remove immediately by swallowing".

I also wrote that, being served first, I was the first person to have a whisky at 25,000ft in a British transport aeroplane. What I did not write was that I made the descent from 25,000ft to 10,000ft on instruments in a clear blue sky because the windscreens were covered by a film of ice.

At that time, Avro performance figures for the Tudor I were "Maximum all-out level speed 346 m.p.h. at 20,500ft, maximum cruising speed 300 m.p.h. at 22,500ft, sea level rate of climb (78,000lb) 800ft/min, distance to clear 50ft screen

Below, the second production Tudor I, with enlarged tail surfaces and modified wing/fuselage fillet.





Charles E. Brown

800ft/min, distance to clear 50ft screen 1,500 yards, service ceiling (4 engines) 28,000ft, service ceiling (3 engines) 22,700ft, range/payload 24-seat version 3,730 miles with 24 passengers, 50lb of baggage each and 3,300lb of mail, range/payload 12-seat version 4,400 miles with 12 passengers, 100lb of baggage each and 3,300lb of freight".

At the time of my visit to Avro that May, Roy Dobson (later Sir Roy), the managing director, said that BOAC could take immediate delivery of Tudors, but that was not to happen. G-AGRE, the fourth production aeroplane, was named Elizabeth of England by HRH Princess Elizabeth in a ceremony at London Heathrow Airport on January 21, 1947, but the aeroplane never went into service with BOAC.

The Tudor I suffered a number of problems, including longitudinal and directional instability. This led to the fitting of a larger tailplane, and replacement of the finely curved fin and rudder by extremely ugly bigger vertical surfaces. Pre-stall buffet was cured by modifying the wing root fillets and extending the

inboard engine nacelles. Various other shortcomings were revealed. BOAC added to the delays with demands for more than 340 modifications, and finally the airline rejected the Tudor I on April 11, 1947, judging it incapable of North Atlantic operation.

It had been intended that 12 Tudors would be built in Australia for military transport, but this plan was abandoned.

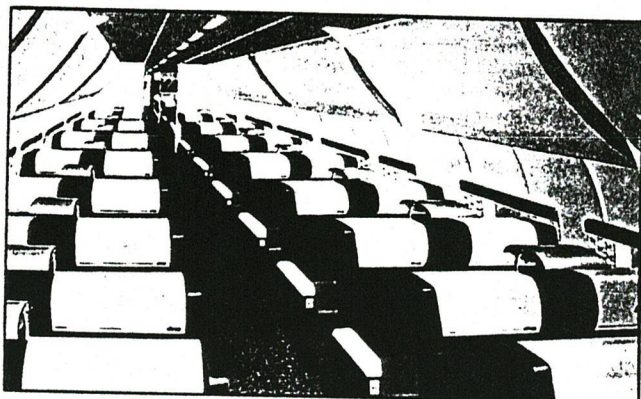
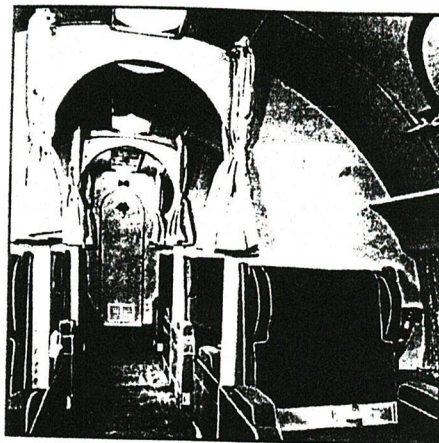
Twelve Tudor Is were built. Of these three were scrapped, G-AGRE became the prototype Tudor 4B, G-AGRF was converted to Tudor 4B, 'RG and 'RH became Tudor Freighter Is (later Super Trader 4 and 4B), 'RI and 'RJ went to Aviation Traders and were used by Air Charter, 'RK and 'RL went to the Ministry of Supply as TS874 and TS875 and were dismantled in December 1950, and G-AGST was rebuilt as a Tudor 4 and eventually became the Tudor 8. The full list of Tudors appears in the table.

The Tudor II*

The story of the Tudor II is even more **Below, G-AGSU, the Tudor II prototype, in its original configuration.**

Right, cabin of a de luxe Tudor I with single seats on each side.

Below, a BOAC publicity picture of the main cabin of a Tudor II.

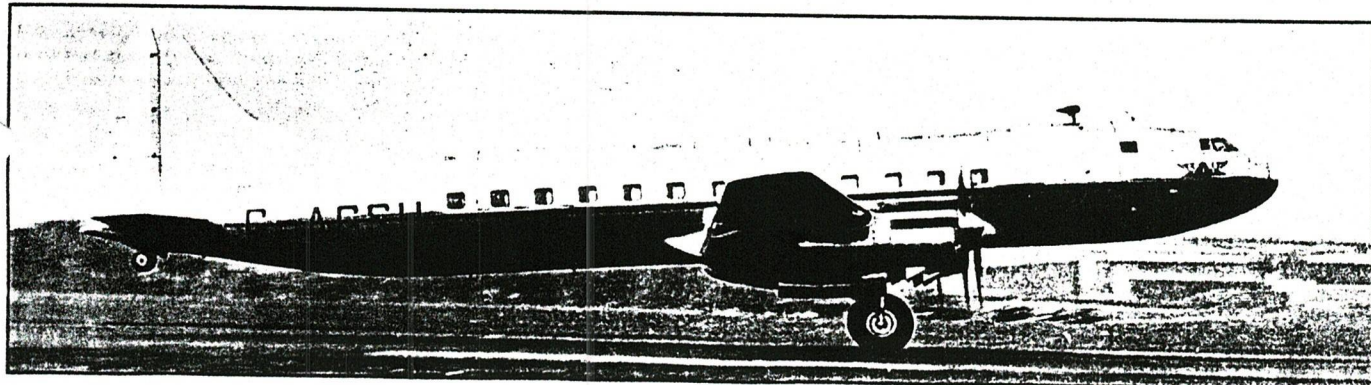


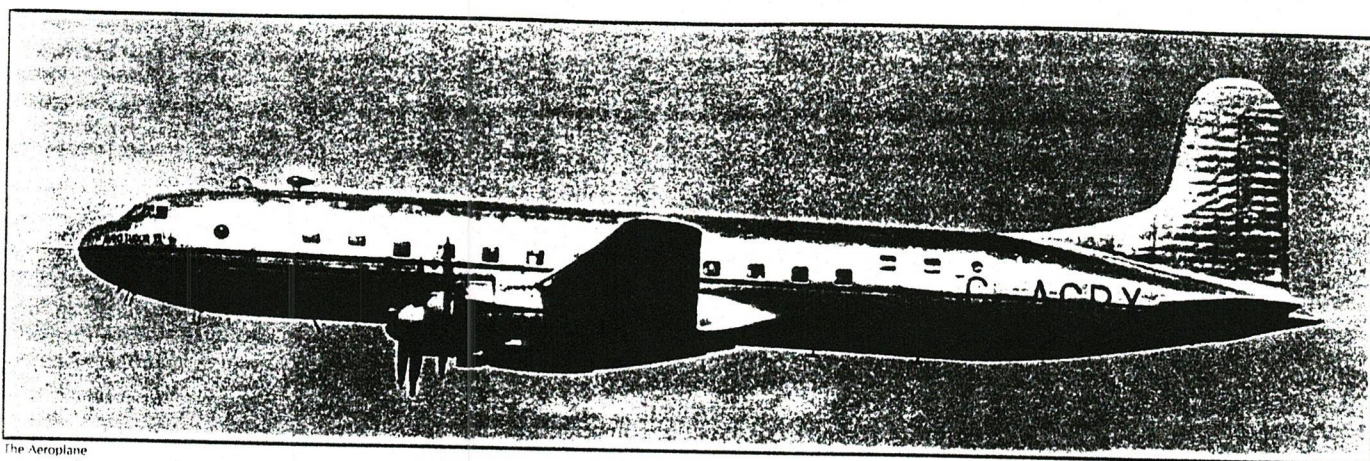
depressing than that of the Tudor I. Bearing Avro type number 689, and also known as the Avro XXI, the Tudor II was designed as a 60-passenger aeroplane for BOAC. It was essentially the same as the Tudor I but the fuselage diameter was increased from 10ft to 11ft and the overall length was 105ft 7in, compared with the Tudor I's 79ft 6in.

Towards the end of 1944, while the aircraft was still in the design stage, BOAC, Qantas and South African Airways decided to standardise on the type for Commonwealth routes, and the original BOAC order for 30 was increased to 79. However, none of the three airlines ever operated Tudors, and nor did BEA operate the Type 699 version planned for it.

The prototype, G-AGSU, first flew on March 10, 1946, with Rolls-Royce Merlin

*There is some confusion over Tudor model numbers. Jane's switched from Roman to Arabic; A.J. Jackson in his *Avro Aircraft since 1908* used Arabic figures; Avro photographs bear Roman numerals for the Tudor I, II, IV and V, and Arabic for the Tudor 8; the Tudor VII bore this form on its nose. The Tudor 4 seems to have been generally referred to with Arabic numerals except by Avro. I have found only Arabic numerals for the 4B and Freighter 4s and 4Bs.





The Aeroplane

Above, G-AGRX, the sole Tudor VII. Right, G-AGSU after receiving its modified tail surfaces and enlarged wing/fuselage fillet.

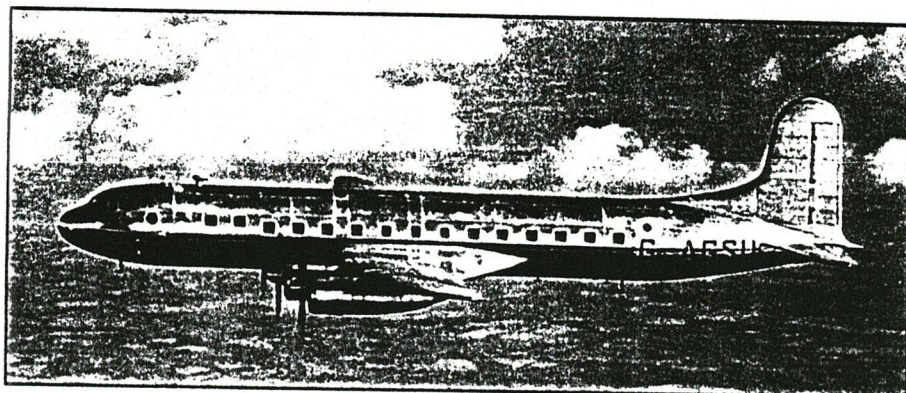
102s and the curved vertical tail surfaces originally used on the Tudor Is.

The aeroplane went to Boscombe Down for its certification trials and the engines were changed to 1,740 h.p. Merlin 600As. The trials showed up problems similar to those encountered with the Tudor I, and G-AGSU was returned to Avro for extension of the inboard engine nacelles and fitting of the larger fin and rudder. Increased weight owing to the bigger fuselage and the other necessary modifications reduced performance so much that the type could only operate Eastern routes as far as Calcutta and the African routes not beyond Nairobi. Qantas and South African Airways could not use the Tudor II and the order was cut back to 50 aircraft.

The type's chances of success were not enhanced when G-AGSU crashed just after take-off on August 23, 1947, after incorrect assembly of the aileron controls. The Tudor ended up with its nose in a pond, and among those killed were Avro's chief designer, Roy Chadwick, and chief test pilot Bill Thorn.

An undated Avro leaflet on the Tudor II — but showing it with the original tail unit — quoted the following performance figures: "Maximum all-out level speed 330 m.p.h. at 20,500ft, maximum cruising speed 285 m.p.h. at 22,500ft, sea level rate of climb (80,000lb) 870ft/min, distance to clear 50ft screen 1,500 yards, service ceiling (4 engines) 28,600ft, service ceiling (3 engines) 22,400ft, range/payload 2,000 miles with 60 passengers and baggage, 2,600 miles with 40 passengers and baggage and 1,000 miles with 9 tons of freight". The same leaflet contained a cutaway drawing showing the layout for 40 day passengers or 22 in sleeping berths. This was described as the BOAC layout.

BOAC gave a lot of publicity to its planned Tudor II fleet. A special committee was formed to cover all aspects and Richard Lonsdale-Hands, an industrial designer, was commissioned to undertake the styling and decoration of the aircraft. In a special leaflet BOAC stated that accommodation was for 36 passengers by day and 22 at night. In addition to the styling of the interior, all



catering equipment was specially designed. There was even a new symbol combining the Speedbird with the Tudor lion, and this was to appear on the curtains.

A launching of these designs was staged in a London hotel, but all this came to nothing in spite of the closing paragraph of a leaflet entitled *The BOAC Tudor II*. It stated: "Wherever the Tudor II flies the streamlined simplicity, elegance and character of her interior decoration will make the aircraft a flying ambassador of sound British design executed with consummate craftsmanship". Well, it never did.

The second Tudor II completed, G-AGRY, went to Nairobi for tropical trials as VX202, but these were considered unsatisfactory and Tudor II orders were then reduced to 18. These should have been produced as two Tudor IIs for experimental work, ten with nosewheel undercarriages as Type 711A Traders to Specification 23/48, and six as Tudor Vs to meet British South American Airways' (BSAA) requirements and covered by Specification 39/46.

G-AGSV, which was intended to be the prototype 711A Trader, was not completed. G-AGRY received a C of A in September 1948, went to Airflight and was later used by Fairflight and Air Charter before being scrapped in July 1959. G-AGRZ went to Flight Refuelling and then Aviation Traders, and G-AGSA was lent to Rolls-Royce. Including the prototype, only four Tudor IIs were completed; however, the six Tudor Vs were built, and are described under Tudor V.

Tudor III

Two Tudor I-sized aircraft, G-AIYA and G-AJKC, were sent to Armstrong

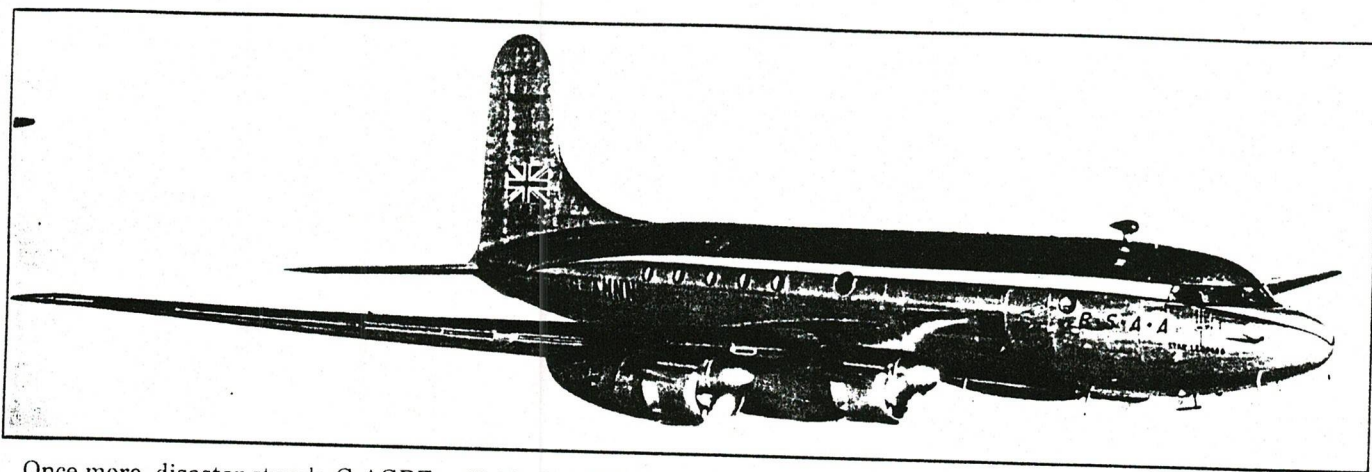
Whitworth to be completed as luxury transports for Cabinet Ministers. They accommodated nine or ten passengers by day and had nine berths. They became VP301 and VP312, and both were acquired by Aviation Traders in September 1953, VP301 being converted into a Tudor I.

Tudor IV

To meet a BSAA requirement, some of the Tudor Is were lengthened by 5ft 9in and powered by 1,770 h.p. Merlin 621s and 1,760 h.p. Merlin 623s. With 32 seats and no flight engineer's position, these were known as Tudor 4s (IVs to Avro), and with flight engineer's position and 28 seats Tudor 4Bs. These conversions were covered by Specification 28/46B and the first example, G-AHNJ *Star Panther*, first flew on April 9, 1947.

The Tudor 4 received its C of A on July 18, 1947, and on September 29 BSAA took delivery of its first aeroplane, G-AHNK *Star Lion*. The next day, under the command of D.C.T. Bennett, it left Heathrow on a proving flight to South America. On October 31 *Star Lion* inaugurated Tudor services from London to Havana via Lisbon, the Azores, Bermuda and Nassau.

But on the night of January 29–30, 1948, G-AHNP *Star Tiger*, with 31 on board, disappeared between the Azores and Bermuda and the type was temporarily grounded. Although the cause of the loss was not established, Tudors went back into service and on December 3, 1948, began operating a weekly London—Keflavik—Gander—Bermuda—Kingston—Barranquilla—Lima—Santiago—Buenos Aires service, returning via the Azores instead of by the northern route.



Above, BSAA's Tudor IV G-AHNN Star Leopard.

Once more, disaster struck. G-AGRE *Star Ariel* disappeared on January 17, 1949, between Bermuda and Kingston with the loss of its 20 occupants, and the Tudor was again grounded. The subsequent fleet shortage led to the merger of BSAA with BOAC.

I believe that the cause of the Tudor losses was never established, but pressurisation problems were suspected, and the remaining aircraft were flown as unpressurised freighters under the designations Tudor Freighter 4 and 4B.

The last BSAA operation of Tudors was on the Berlin Airlift, when, between September 23, 1948, and August 10,

1949, G-AGRH and G-AGRJ and the Tudor Vs G-AKBZ, 'CA, 'CB, 'CC and 'CD flew 2,562 sorties in 6,973hr, carrying 22,125 tons into the city.

Of the 13 Tudor 4s built, eight were acquired by Aviation Traders at the beginning of September 1953.

Tudor V

The Tudor V was a modification of the Tudor II to Specification 39/46 for BSAA, which acquired five powered by 1,770 h.p. Merlin 621s and equipped with 44 seats. However, these aircraft never went into passenger service with BSAA. Instead, they were stripped of furnish-

ings and used as fuel tankers on the Berlin Airlift as already mentioned.

The first example, G-AKBY, went to Airlift and was also used on the Berlin Airlift as a tanker. After the Berlin operation the Tudor Vs were fitted out for passenger carrying. G-AKBY, still operated by Airlift, crashed at Llandow on March 12, 1950, killing 80 of its occupants. G-AKCA was sold to Surrey Flying Services and then loaned to Lome Airways in Canada as CF-FCY. G-AKCC and G-AKCD went to William Dempster and were converted to 52-seaters for London-Johannesburg tourist flights. G-AKCC was named *President Kruger*, but was damaged beyond repair at Bovingdon on October 26, 1951, after which 'CD was used for spares.

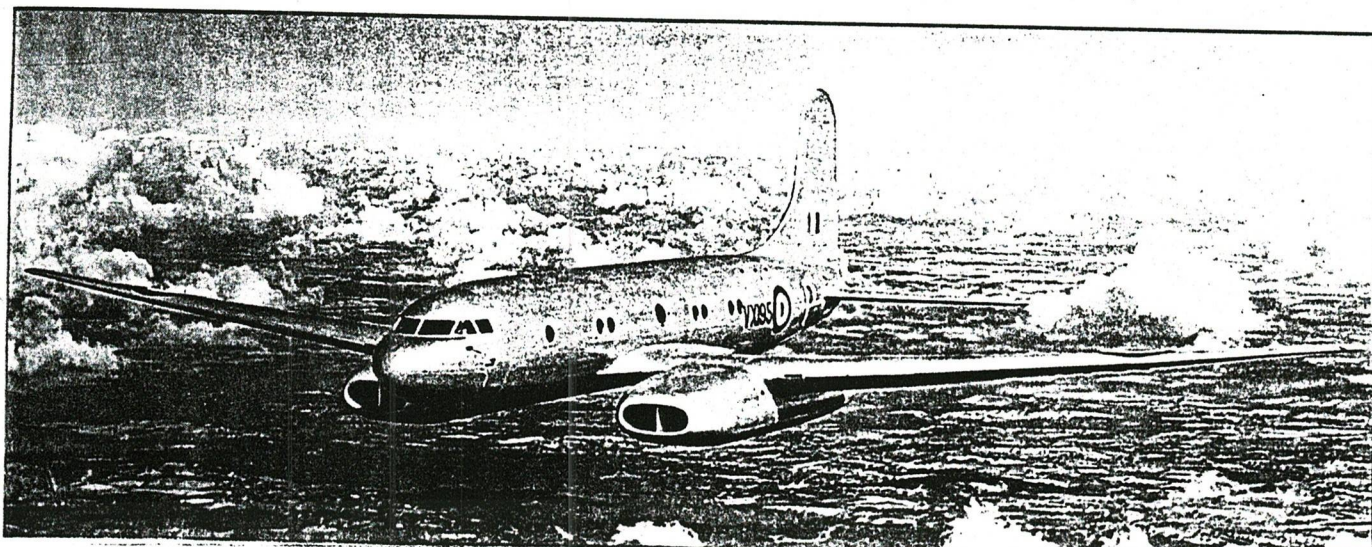
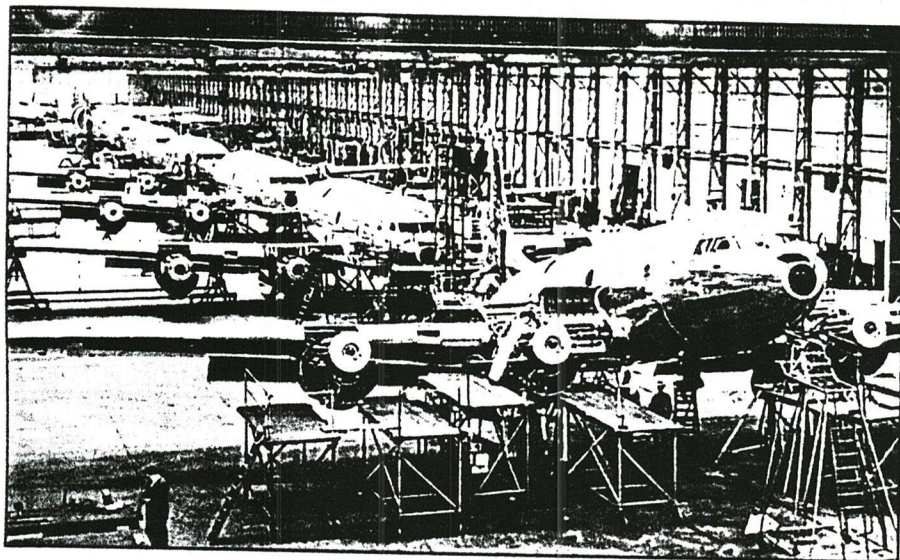
Tudor VI

Six of this version of the Tudor II were to have been used by Flota Aerea Mercante Argentina (FAMA) for services across the South Atlantic, with 32-38 seats for daytime or 22 sleeping berths. None was built.

Tudor VII

One example, G-AGRX, was built. This was the first production Tudor II

Left, Tudor I production at Woodford. Below, the second prototype Tudor I, G-AGST, after conversion to the Tudor 8 VX195 with Rolls-Royce Nene 5 turbojets.



powered by 1,750 h.p. Bristol Hercules 120 air-cooled radials in an attempt to give the Tudor II more satisfactory performance. It first flew on April 17, 1946, and appeared at that year's SBAC display at Radlett. In June 1948 this aeroplane was fitted with a shorter undercarriage and the engines were inclined to provide greater ground clearance for the propellers.

The Tudor VII was used for cabin temperature trials, passed on to the Telecommunications Research Establishment as VX199, and then went to Flight Refuelling in November 1953 under its civil registration. In March 1954 it was acquired by Aviation Traders for spares.

Tudor 8

This was the second prototype Tudor I rebuilt to Tudor 4 standard and fitted with four 5,000lb thrust Rolls-Royce Nene 5 turbojets. It exchanged its civil registration G-AGST for military service serial VX195, made its first flight on September 6, 1948, and was used for high-altitude studies before being broken up at Farnborough in 1951.

Tudor 9

As a result of tests with the Tudor 8, the Ministry of Supply ordered six Tudor 9s based on the Tudor II but with four Rolls-Royce Nenes and nosewheel undercarriages. The original design was modified and the type then produced as the Avro 706 Ashton. The first example flew on September 1, 1950, and the type remained in service for several years, but its development and history is outside the scope of this article.

Some success

Although BOAC never operated a Tudor and BSAA suffered the unexplained loss of two over the Atlantic, there is no doubt that Tudors did good work on the Berlin Airlift. It says much for the aeroplane that D.C.T. Bennett managed to land one using only the elevator trim tabs after taking off with the elevators locked.

Before ending this complicated history of the Tudor, mention must be made of Air Charter's operation of the type. I have already stated that Aviation Traders acquired a number of Tudors, and some of them were put into service to replace Air Charter's Yorks.

Major modification to Tudor I G-AGRI

Avro Tudor production

Avro 688 Tudor I		
G-AGPF	c/n 1234	TT176 prototype, to VX192, MoS&AP. Scrapped 12/50
G-AGRC	1251	MoS&AP. Scrapped 12/48
G-AGRD	1252	MoS&AP. Scrapped 3/49
G-AGRE	1253	BOAC, MCA, converted to Tudor 4B prototype
G-AGRF	1254	BOAC Elizabeth of England, to Tudor 4B
G-AGRG	1255	MCA, BSAA Freighter 1, Star Cressida, to Super Trader 4
G-AGRH	1256	MCA, BSAA Freighter 1, to Super Trader 4B
G-AGRI	1257	MCA, Aviation Traders used by Air Charter (XF739)
G-AGRI	1258	MCA, Aviation Traders, Air Charter
G-AGRK	1259	MoS&AP, MoS TS874
G-AGRL	1260	MoS&AP, MoS TS875
G-AGST	1249	TT181 MoS, to Tudor 4, later Tudor 8 VX195
Avro 689 Tudor II		
G-AGRY	1262	VX202 MoS&AP, Airflight, Fairflight, Air Charter (XF537)
G-AGRZ	1263	MoS&AP, MoS VZ366, Flight Refuelling, Aviation Traders
G-AGSA	1264	MoS&AP, on loan to Rolls-Royce VZ720
G-AGSU	1235	Prototype MoS. Crashed Woodford 23/8/47
G-AGSV	1250	MoS. Construction not completed
Avro 688 Tudor III		
G-AIYA	1367	VP301 MCA, Aviation Traders, to Tudor J, Air Charter
G-AJCK	1368	VP312 MCA, Aviation Traders, Air Charter
Avro 688 Tudor 4 and 4B		
G-AGRE	1253	BSAA Star Ariel, lost in the West Atlantic 17/1/49
G-AGRF	1254	BSAA, Aviation Traders
G-AGRG	1255	Aviation Traders, to Super Trader 4B El Alamein, Air Charter, burned out Brindisi 27/1/59
G-AGRH	1256	Aviation Traders, to Super Trader 4B Zephyr, Air Charter, crashed in Turkey 23/4/59
G-AHNN	1341	Not completed
G-AHNI	1342	BSAA Star Olivia, Aviation Traders, to Super Trader 4B Trade Wind, Air Charter
G-AHNI	1343	BSAA Star Panther
G-AHNN	1344	BSAA Star Lion
G-AHNL	1345	MCA, Aviation Traders, to Super Trader 4B, Air Charter
G-AHNM	1346	MCA, Aviation Traders, to Super Trader 4B Cirrus, Air Charter
G-AHNN	1347	BSAA Star Leopard, MCA
G-AHNO	1348	MCA, Aviation Traders, to Super Trader 4B Conqueror, Air Charter
G-AHNP	1349	BSAA Star Tiger, lost in West Atlantic 30/1/48
G-AHNR	1350	Not completed
Avro 689 Tudor V		
G-AKBY	1417	Airflight, crashed Llandow 12/3/50
G-AKBZ	1418	BSAA Star Falcon
G-AKCA	1419	BSAA Star Hawk, Surrey Flying Services, loaned to Lome Airways CF-FCY
G-AKCB	1420	BSAA Star Kestrel
G-AKCC	1421	BSAA Star Swift, William Dempster President Kruger, damaged beyond repair Bovingdon 26/10/51
G-AKCD	1422	BSAA Star Eagle, William Dempster
Avro 689 Tudor VII		
G-AGRX	1261	MoS&AP, MoS VX199, Flight Refuelling, Aviation Traders for spares
Avro Tudor 8		
VX195	1249	MoS, formerly Tudor I and 4 G-AGST

MoS&AP = Ministry of Supply and Aircraft Production; MoS = Ministry of Supply; MCA = Ministry of Civil Aviation

resulted in a passenger-carrying C of A being granted, and several were fitted with 42 seats. In 1955 G-AGRG (Tudor I) and G-AIYA (Tudor III) were lengthened to Tudor 4 standard, and with G-AGRI they were used on Colonial Coach services between the UK and Tripoli and Lagos.

In addition, G-AGRH, G-AHNI, 'NM and 'NO were given 6ft 10in x 5ft 5in

cargo doors aft on the port side. With the all-up weight increased to 83,600lb, these aircraft were designated Super Traders 4 or 4B, and they received their C of A in March 1955. Some remained in service until 1959.

The total number of Tudors completed was 33, and a further 36 constructor's numbers were allocated to unbuilt aircraft.

Avro Tudor data

	Tudor I	Tudor II & IV	Tudor III	Tudor 4	Tudor VII	Tudor 8
Dimensions						
Wing span	120ft	120ft	120ft	120ft	120ft	120ft
Length	79ft 6in	105ft 7in	79ft 3in	85ft 3in	105ft 7in	79ft 3in
Wing area	1,421ft ²	1,421ft ²	1,421ft ²	1,421ft ²	1,421ft ²	1,421ft ²
Weights						
Empty	47,977lb	46,300lb	38,923lb	49,441lb	51,625lb	34,724lb
Loaded	71,000lb	80,000lb	78,761lb	80,000lb	80,000lb	80,000lb
Performance						
Maximum speed	260 m.p.h.	295 m.p.h.	282 m.p.h.	282 m.p.h.	270 m.p.h.	385 m.p.h.
Ceiling	26,000ft	25,550ft	27,400ft	27,400ft	25,100ft	44,000ft
Range	3,630 miles	2,330 miles	4,000 miles	4,000 miles	2,800 miles	1,720 miles