



BUCK ROGERS IN THE 20TH CENTURY

A letter recently donated to the Avro Heritage Group set former BAe employee DAVID FILDES thinking about what the Vulcan might have looked like had the original concept been followed

OPPOSITE PAGE

The shape of things to come? Artists IAN BOTT and MARIO LENDVAI collaborated on the fascinating sequence of illustrations of the proposed Avro bomber revealed over the following pages. This one shows Bob Lindley's original concept for a jet bomber at an SBAC show at Farnborough in the mid-1950s, had the idea been developed. **RIGHT** Dated July 16, 1952, Bob Lindley's drawing reveals the initial configuration of what was to become the Avro Type 698 Vulcan.

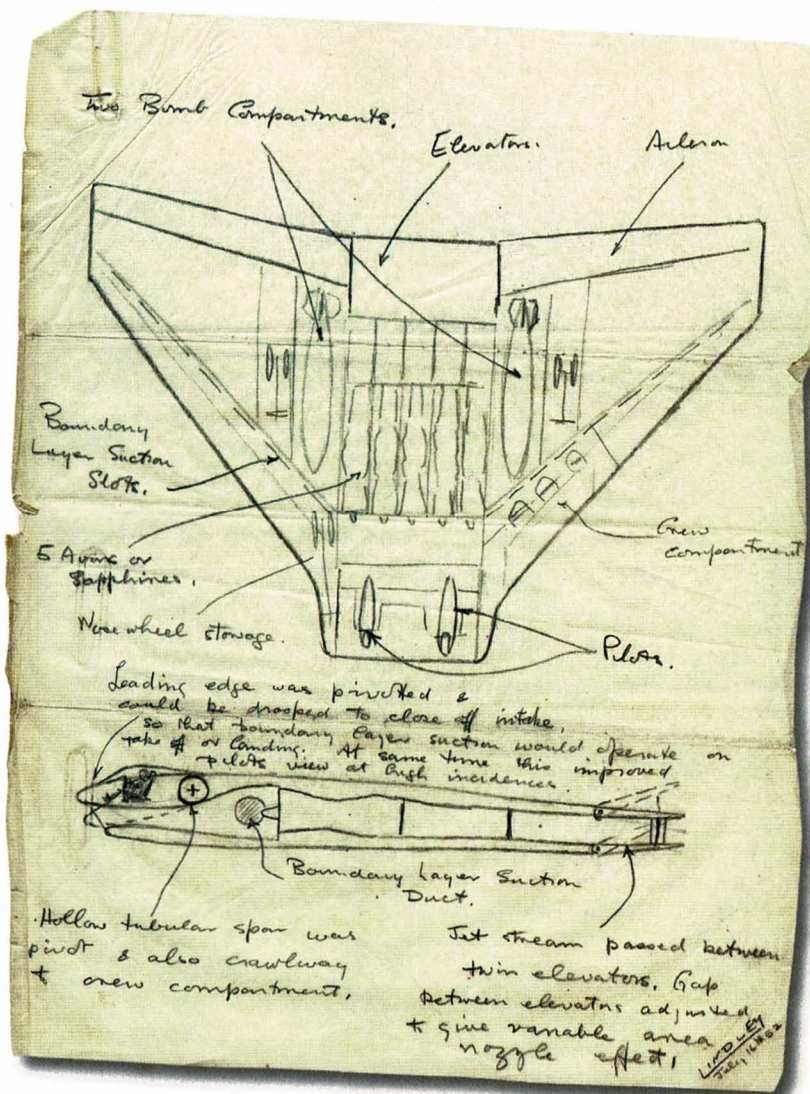


HAVING SPENT more than 25 years working in the Public Relations Department at what are now the BAe Systems factories at Chadderton and Woodford, I developed a keen interest in the many aircraft designed and built by A.V. Roe & Co Ltd. The origins of the Avro 698 Vulcan have always fascinated me, since it marked such a huge change from the company's Lancaster bomber and subsequent equipment that preceded the Vulcan's design.

A letter recently donated to the Avro Heritage Centre at Woodford has brought these origins to light. Sent to Sir Roy Dobson, managing director of Avro, in 1952, by R.N. "Bob" Lindley, it concerns the proposal for a book on the delta project. Bob's recollections of the project were based entirely on memory, as he had no documentary evidence.

Official requirement

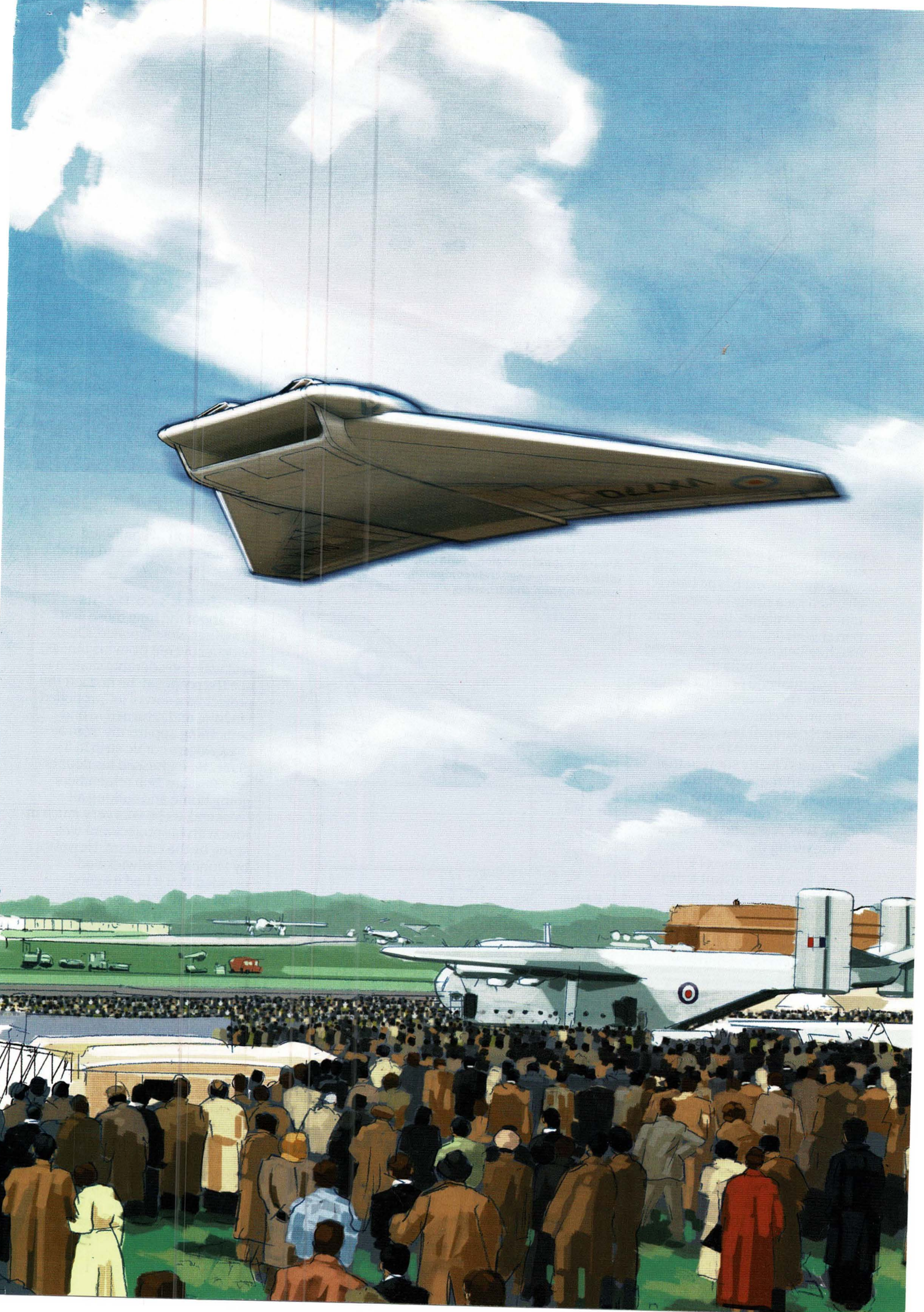
The Operational Requirement (OR) for the aircraft was put to the company in December 1946, together with an invitation to tender with a closing date of February 1947, subsequently

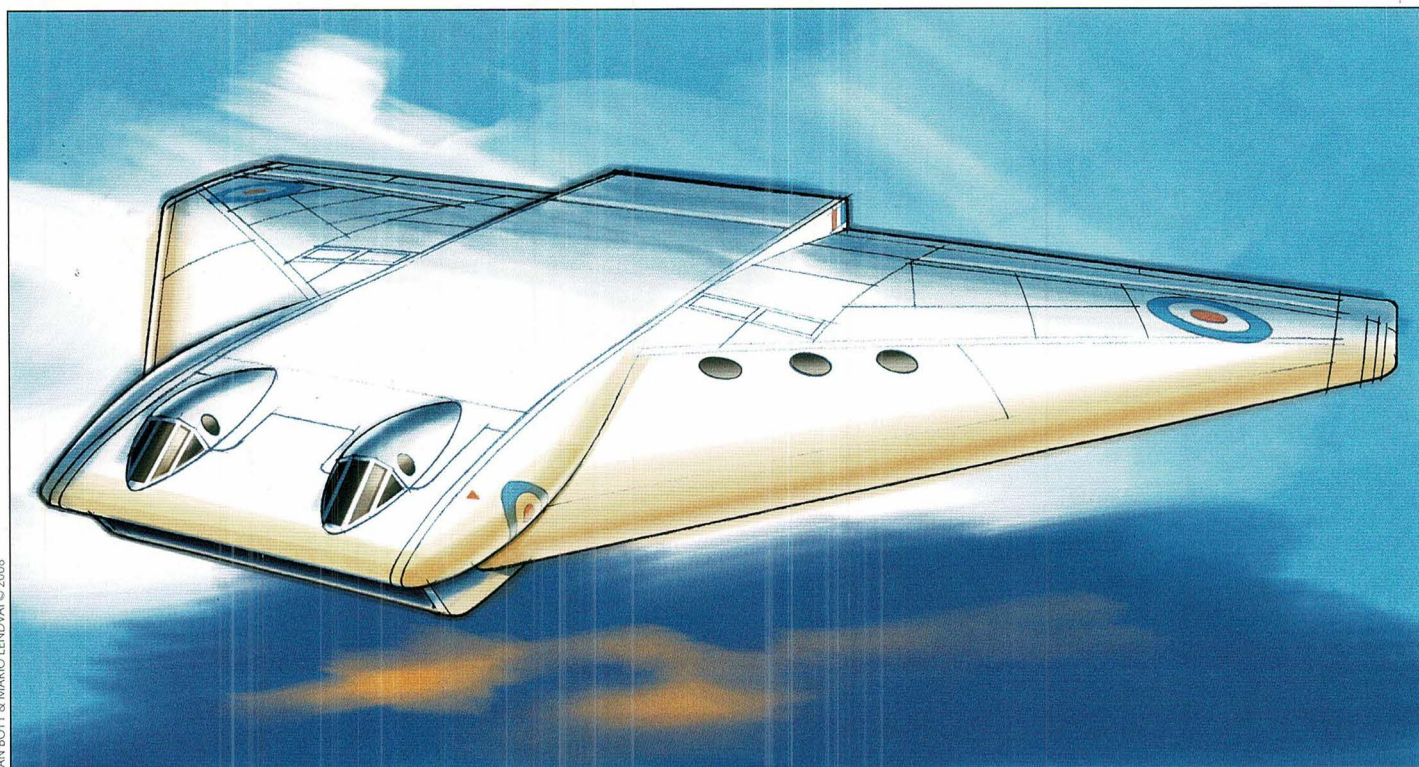


amended to a later date. Project Office staff members received their copy in January 1947, but before they had got very far the great fuel shortage hit the plant, which was closed down. Project engineer Donald Wood and Bob Lindley were able to find an office, which had belonged to the Resident Technical Officer (RTO), to enable them to carry on their study. Another upheaval was also taking place at that time, as chief designer Roy Chadwick was at home suffering from shingles.

The OR's performance requirements were rather startling to people nurtured on piston-engined Lancaster bombers and Tudor airliners, and the only jet investigations made up to that time were for the Tudor 8 and Brabazon 3 projects, the latter being designed for very-high-speed flight.

The original conception of the delta was not a result of spontaneous inspiration, but was arrived at by what seemed at the time to be an honest design study





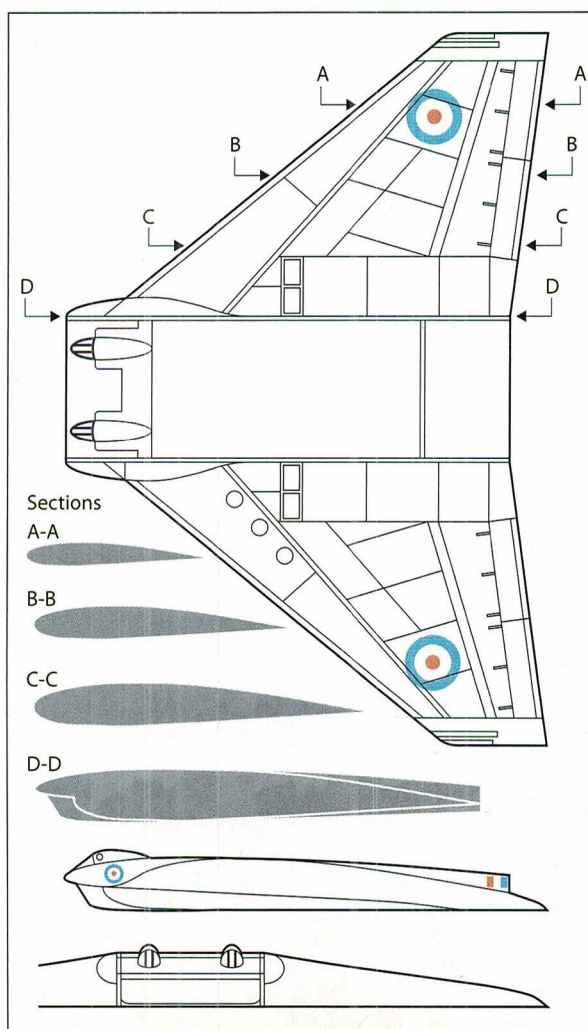
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encompassing a whole series of configurations, some with tails, some without, each type being checked for a range of aspect ratios and weights. In retrospect Bob shuddered to think how much reliance was placed on the wing weight formula used, but the potential end product seemed to justify the means.

The first preliminary study was made for aircraft having aspect ratios of not less than 4:1, and the results clearly showed that the aircraft required would be tailless and would have a much lower aspect ratio; probably about two. A second investigation covering the lower aspect ratios gave a solution of 2.4:1, which inevitably meant a delta wing. Bob knew that aerodynamicist Alexander Lippisch in Germany had been working on a delta fighter, and had seen some reports on his coal-burning ramjet delta design during a trip to Germany in 1945. The possibility of using this configuration for a bomber was most intriguing. More elaborate checks were made, but only served to confirm the delta configuration.

The original arrangement of the aircraft was, of course, somewhat more futuristic than that finally proposed; indeed, it would look advanced today. It had boundary-layer suction and a movable cockpit, so that the pilot could have a good view even when the aircraft was at angles of incidence as high as 30°, and it had a very advanced

ABOVE The initial Lindley design was to be fitted with five Avon or Sapphire engines, twin bomb bays, paired cockpits (plus a leading-edge crew compartment), a boundary-layer suction system and drooping wing leading edges.



ABOVE This three-view was created by Ian Bott from the information on Bob Lindley's original drawing, and includes sections. The proposed dimensions are unknown.

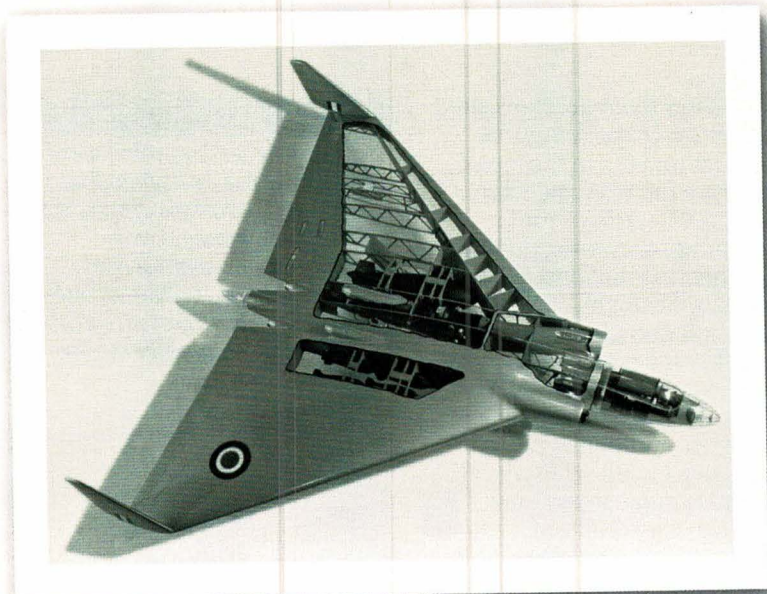
arrangement of combined elevator, air brakes and variable-area jetpipe nozzle.

Chadwick's concerns

Just about the time these first drawings were finished, Chadwick recovered from his illness, and was considerably shaken to see the proposal; he had left the project as a sort of jet-propelled Lincoln, and returned to find something apparently from a *Buck Rogers* comic strip in its place. He expressed his doubts very forcibly. Bob remembers going home and sulking all weekend, as he was very much in love with his project and was stung by the criticism. However, by Monday Chadwick had decided that it had its good points, and from there on he waded in with great enthusiasm and did much to make it a practical aircraft.

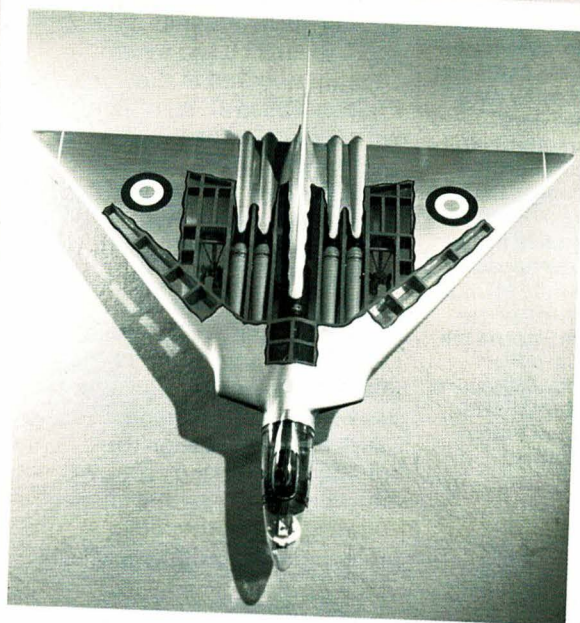
During this early development period the aircraft underwent a number of changes. One proposal had five Rolls-Royce Avon or Armstrong Siddeley Sapphire jet engines; indeed, Avons were used on VX770, the first prototype Vulcan. In the interests of simplicity it was decided to go for a twin-engined version, and this required an engine of around 20,000lb static thrust. Chadwick had written to various companies in Britain's aero-engine industry, seeking proposals for such an engine. The replies were interesting, ranging from supreme optimism from Armstrong

THE ORIGINS OF THE VULCAN



ABOVE This 1/24th-scale plastic model of the proposed twin-engined bomber concept was destroyed in a fire at Avro's Chadderton factory in 1959.

RIGHT A project model of the four-engined version from late 1948. This was prepared after Avro had received a prototype contract for the Type 698.



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Siddeley to complete pessimism from Metropolitan-Vickers. Bob recalls Chadwick taking a 1/48th-scale model of the twin-engined version to London, where it was left with Air Marshal Sir John Boothman. Chadwick described how Boothman had "flown" it round the office, presumably making appropriate noises.

Origin of the Fire-God

At this stage the project department heard of the Bristol T.E.1/46 jet engine being designed for the Aircraft Division of the Bristol Aeroplane Company to power the projected Type 172 long-range high-altitude bomber. The general specification of the Type 172 was to the same Ministry of Supply (MoS) specification that was later responsible for the Vulcan and Handley Page Victor. Bristol's project office prepared a brochure that was submitted to the MoS in March 1946, and in July of that year the T.E.1/46 engine specification was issued. This evolved into the BE.10, later to be named Olympus.

The T.E.1/46 was examined by the Initial Projects Department at Woodford and a four-engined aircraft using this powerplant was designed. This was adopted for the tender brochure on the Avro Type 698, which was submitted to the MoS in May 1947, just six months after the initial MoS B.35/46 requirement.

The other feature that was kicked around considerably was crew accommodation. The first

proposal had the crew compartment inside the wing, with the pilots under two fighter-type canopies. Then the requirement for a jettisonable crew compartment was emphasised, and much effort was devoted to getting the crew into a minimal nacelle, demountable just aft of the pressure bulkhead and with multiple parachutes packed into the fairing aft of the canopy. This design was put forward in the brochure. This requirement was later dropped owing to the considerable research time



ABOVE Initially sceptical of the concept, Roy Chadwick later championed the delta-wing bomber drafted in his absence.

required to solve the technical problems posed by such a system. The radar scanner was also to be fitted inside the wing.

The first issue of the brochure was finished in April 1947. After its completion, drawings were produced for a 1/24th-scale model.

A commercial delta?

Some work went into a civil version of the aircraft, with a slightly higher wing loading and operating at a lower altitude than the bomber project. It would have made an attractive transatlantic



Back to the drawing board: Avon-powered Avro 698 prototype VX770 adopted the wing leading edge engine intakes tested by the "high-speed" Avro 707A. The planned Olympus powerplant was not yet available.

THE ORIGINS OF THE VULCAN

BELOW Imagined cruising over Lincoln Cathedral – as many Avro types were photographed – this is the “final” version of the Avro 698 as it appeared in the tender brochure of April 1947. It is in the markings of 44 Sqn and the “wraparound” camouflage worn during the later years of Vulcan operations.

IAN BOTT & MARIO LENDVAI

airliner, as headwinds did not seem to affect it too much.

Lindley worked in the Initial Projects Office at Avro, along with colleague Jim Floyd, who was appointed chief project engineer by Stuart “Cock” Davies in 1944. Along with William S. Farren (later Sir William), Davies went on to champion the Vulcan when Chadwick was killed in the crash of Tudor 2 prototype G-AGSU on August 23, 1947. Bob left England in 1949 and later worked for Avro Canada.

Bob had a reputation for solving engineering problems, and went on to become chief engineer on another delta project, the Avro Canada CF-105

Arrow. After the much-lamented cancellation of the Arrow, he then went to work in the space industry in the USA and later joined NASA on the Shuttle programme, becoming director of engineering and operations for manned spaceflight.

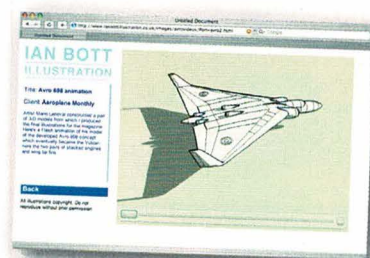
Although Bob Lindley’s radical proposal suggested the shape of things to come, it was — perhaps sadly — destined to remain just an idea on a yellowing piece of paper. Had it been otherwise, the Vulcan’s familiar shape may have been very different.



■ The author would like to thank Harry Holmes for his help with the preparation of this article

Now see it in 3-D...

Fascinated? To see three-dimensional animations of Bob Lindley’s original concept for the Avro Type 698, log on to the Aeroplane website at www.aeroplanemonthly.com. For more information and to see more examples of Ian Bott’s highly-regarded technical illustrations, visit his website at www.ianbottillustration.co.uk



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