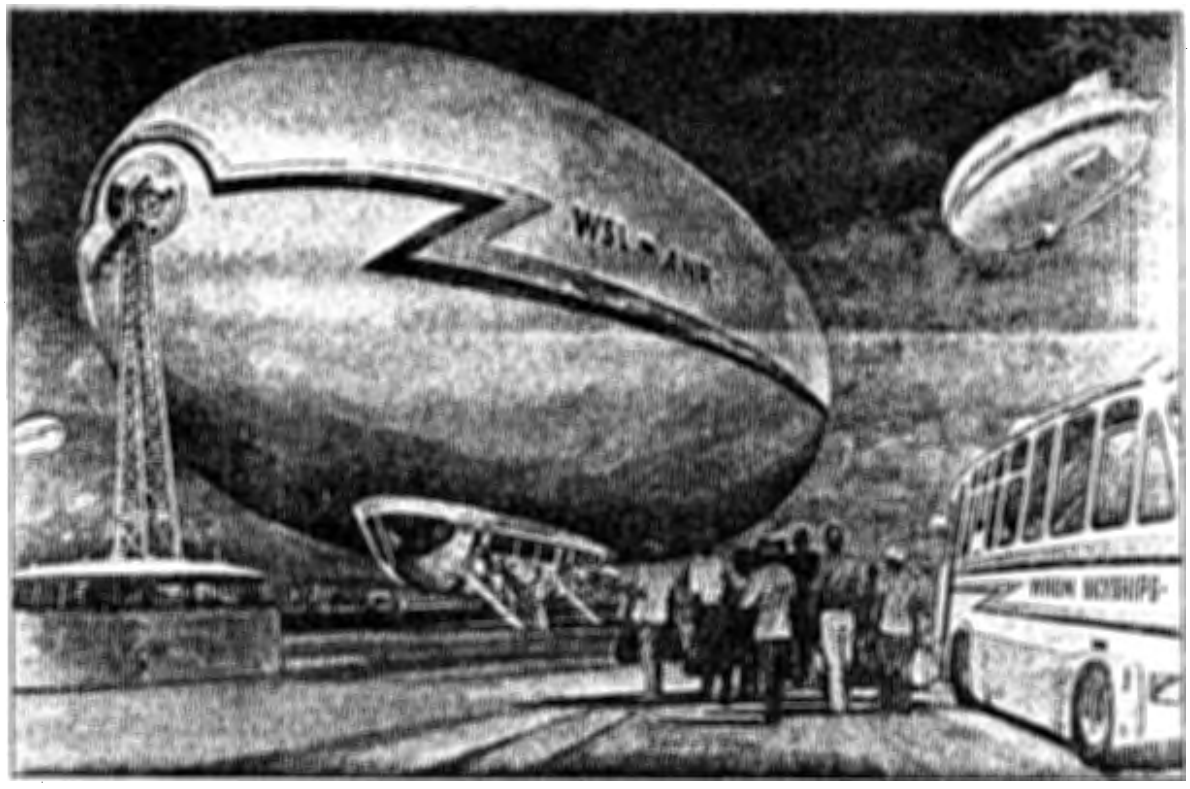
Lift-off for



passenger airship

Fifty years after the *Hindenburg* exploded and crashed at Lakehurst, New Jersey, a small British company is attempting to revive the idea of the passenger airship. Next year Wren Skyships expects to fly the fastest airship ever built, and hopes that a scheduled passenger service will be started soon after, between its Isle of Man base and the British mainland. Thirty passengers would be asked to pay £22 for the 46min flight to Blackpool, and Wren estimates that a pair of airships would earn over £2 million per year on that route alone.

"This airship is going to make a great deal of money. We are taking an utterly commercial approach, and I see my job as one of having to limit sales," Wren's marketing manager Ian Alexander confidently maintains, claiming that he is being realistic, not optimistic.

Realism or not, in two years' time Wren will have built airships and will be trying to sell them to would-be operators. If customers are not immediately forthcoming, Alexander says that Wren will start a service itself.

Indeed, Wren has already escaped categorisation among the lunatic fringe by persuading investors, including Swiss bank Socofi, which owns 47 per cent, to provide £4·3 million for the manufacturing venture. This initial success separates Wren from a number of would-be competitors which have ideas but no cash.

The idea that passenger airships can take to the skies profitably refuses to die. Alan Postlethwaite examines the latest proposals, and discovers that a hard-headed approach and some innovative engineering may prompt a revival.

But Wren's venture still seems risky, particularly since a number of earlier airship ventures in the UK and overseas have collapsed. Leading UK airship expert Dr Edwin Mowforth, of the University of Surrey, believes that the commercial Zeppelins probably never made a profit, in spite of completing more than 2,300 flights, and that the technical and commercial evaluation of new passenger airships is a highly uncertain process. Other airships are flying, but are used mainly for advertising or short "sightseeing" flights.

There is no shortage of passengers in Wren Skyships' vision of an airship port.

Alexander contends that technological advance, combined with disregard for nostalgia and dismissal of blind revivalism, will secure success for the proposed new type of service. His ideas focus on passenger services between the small island and the UK, and many other similar routes, but no type of operation is being ignored. Even the smooth swift transport of valuable but easily upset racehorses is contemplated. Alexander refuses to define markets, arguing that they are as broad as the imagination.

In each case, a sale would hinge on exploitation of some of the airship's inherent advantages. These include a lower capital-cost-per-tonne payload than a helicopter, a lower fuel cost per tonne-mile than a fixed-wing aircraft, great endurance and range, and improved chances of environmental acceptance in city-centre/city-centre work, Wren alleges.

On the airship's design he is open and specific. It is to be 200ft long, will have a hull volume of 256,000ft^3, and an endurance of seven hours. Alexander says that his confidence in the ANR is based on improvements over earlier airships, including the Airship Industries Skyship 600, in the areas of bouyancy control,

position control when mooring at the mast, control surface balancing, drag reduction, materials, and structural design. Pat Monk, the airship's designer, agrees.

Non-rigid airships depend for their shape on pressurisation of a flexible envelope. The ANR has cruciform tail surfaces and a passenger gondola suspended by cables from curtains attached to the inside of the envelope. Two 420 s.h.p. Allison turboprop engines mounted at the tips of stub wings on the gondola can have their thrust vectored for manœuvering.

The ANR's size and configuration is a result of numerous trade-offs, many not encountered in aeroplane design. Its size was a balance between certain inherent economic advantages of large airships and the dimishing chances of raising large amounts of capital for building the airship, combined with the high cost of large ground facilities. Its speed is a balance between airship productivity and the rapidly soaring weight of an envelope needed to withstand the pressure differential that ensures rigidity. Alexander believes that the investors will recover their money after four airships are sold.

The ANR's bouyancy will be controlled by an engine-driven fan, mounted between the gondola and envelope, which pumps air into ballonets. Ballonets inside the nose and tail of the envelope squeeze the helium charge in the envelope to the preserve the envelope's shape.

The extreme location of the ballonets gives better trim control than those in the traditional positions closer to amidships, Alexander says. The fan does away with the drag-inducing scoop found on some earlier airships, he adds.

A safety feature is a valve able to vent helium should the airship be swept to an abnormally high altitude by an updraught. Here, the atmospheric pressure would be so low that, even with the ballonets empty, the pressure differential across the envelope would exceed safe margins. The valve cannot ice up, Alexander says, though Monk does not rule out the fitting of a ripping panel to prevent wholesale rupture of the envelope should the valve fail.

The cruciform tail surfaces are mounted in X-fashion to reduce the necessary hangar height clearance and increase the take-off angle possible without danger of the tail fouling the ground. Since control forces on earlier airships have been criticised as excessive by airship pilots, Wren has designed a patented mechanism to provide assisting forces that increase with airspeed and control deflection. The mechanism is, in effect, an air spring. Air at over 30 p.s.i. collected from a pitot tube and venturi is piped into a cylinder whose piston presses on a supplementary control horn via a series of links. When the pilot deflects the control surface via a cable and primary control horn, the supplementary control horn moves the links out of line and the spring force acquires a moment arm, and helps deflect the control surface.

The control surfaces give pitch and yaw control at speed. Differential inflation of the ballonets provides trim. However, there will also be small reciprocating engine-driven fans which puff air out of nose-mounted thrusters. These thrusters will allow more precise control as the airship approaches the mooring mast. Control surfaces are useless at airspeeds below 20kt.

The ANR could be flown "light" or "heavy". A heavy airship needs either aerodynamic lift from the envelope (which is quite feasible) or a vertical component of engine thrust to sustain altitude, and has the advantage of being able to make a relatively fast descent for landing. If both engines fail on take-off, a heavy ANR would sink to the ground, but not fast enough to cause injury, Alexander says. A light airship (with a heavy fuel load expended) could land vertically by vectoring the engines straight up and using reverse pitch.

The ANR is only the second airship to employ gas turbines. (The familiar Skyship 600s use Porsche reciprocating engines). They are unducted for reduced weight and improved cruise efficiency, though this means less static thrust and more noise.

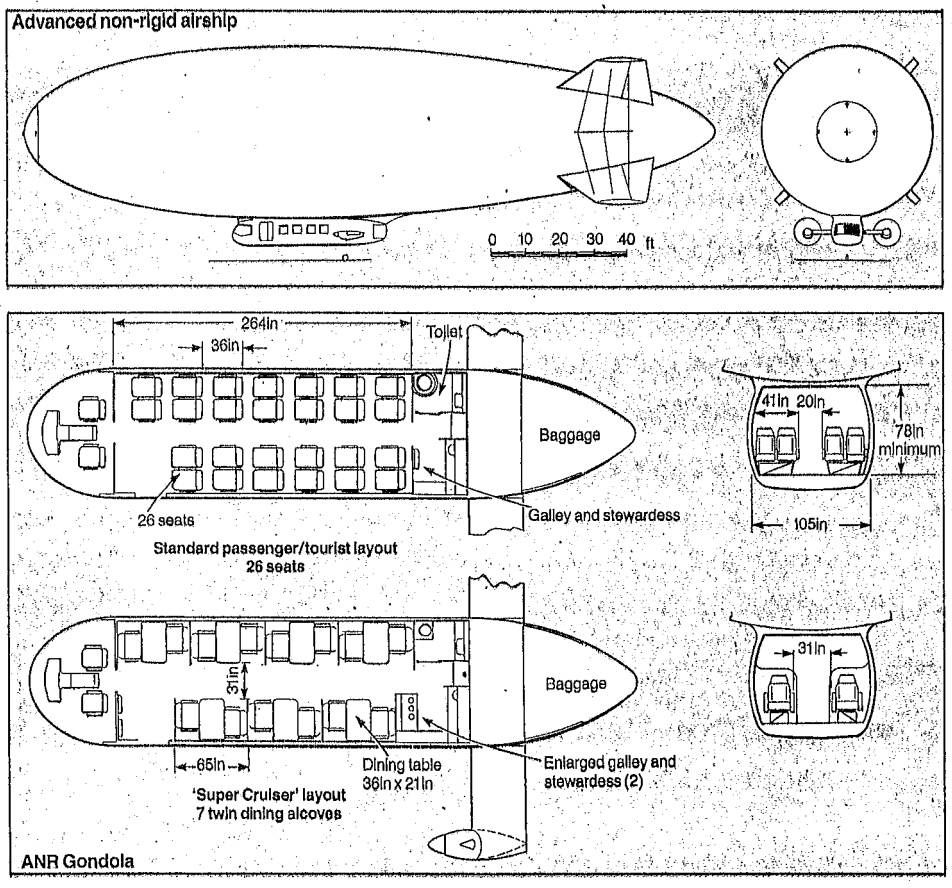
Advanced composites will be used in the structure of the airship, notably in the tail surfaces, where honeycomb-cored panels will be employed, and in the smooth monocoque nose section, reinforced for secure mooring. The gondola will be of aluminium alloy construction.

An ample power reserve and high cruising speed make year-round operations feasible, and schedules could be maintained with a 50kt crosswind or 39kt headwind, Alexander says. Rain, even four inches per hour, is not expected to be a problem because it would run off quickly, but snow could be a problem for a moored airship. Clearance methods need developing, Monk admits. Engines and propellers will be de-iced, and ice on the envelope should break off because of its expansion or contraction with change in altitude. "We have the world's largest deicing boot."

Ground handling, not flying, could be critical in high winds. Wren envisages a fixed mast with a circular track around it, allowing the airship to weathercock while secured by its undercarriage. Hangaring in winds above 40kt could prove difficult. The thrusters would ease mooring, and after the approach the groundcrew would hook up cables, after which a winch would pull the craft to the mast. Three ground facilities should cost £400,000, Monk says.

Roll-out of the first ANR is scheduled for next October. Flight tests will take one year, during which time two more airships will be built. Certification is hoped for in October 1989, when scheduled services could be started. The optimum sector length is 80 n.m., and over-water routes are preferred because of the ANR's predicted superior weather tolerance or speed advantage over ships, hovercraft, and hydrofoils. Talks between Wren and Manx Airlines, an Isle of Man operator, have yet to lead to an agreement on services, but Alexander says that the ANR would undercut the airline's fares and in some circumstances match its route times. This last claim has raised bewilderment among critics.

Wren's Jurby factory, completed this month, has a production capacity of one airship every seven weeks. Alexander says it may be needed to the full. "In the 1970s people thought airships were just silly, but now they have street credibility." ◀



More ideas than money

Engineers worldwide are working on lighter-than-air projects, and the variety of ideas indicates that they are far from agreed on the optimum approach.

A massive stimulus to airship development is coming from the £106 million being pumped by the US taxpayer into the Sentinel 5000 project under construction for the US Navy by Airship Industries of the UK, teamed with Westinghouse of the USA.

The Sentinel is a large military surveillance/early warning craft, but a 200-passenger commercial version could be developed at a viable cost, the UK company says. Meanwhile, the much smaller Airship Industries Skyship 600s continue their advertising work and tourist trips.

Wren is building a prototype airship called the advanced non-rigid (ANR), pressurised with helium to ensure that its nylon-based envelope retains its shape. The claim is that the ANR could compete with fixed-wing aircraft on price, and with other transport modes on speed. Critics are sceptical that business travellers would switch from the more familiar commuter aircraft. Its 80kt cruise speed cannot match that of a commuter aircraft, but operating costs are predicted to be low enough to permit significantly cheaper fares.

Wren Skyships was started by Maj Malcolm Wren, the founder of failed airship company Thermoskyships and a founder of Airship Industries. Wren's marketing manager, Ian Alexander, acknowledges Airship Industries' pioneering work, admitting that it can capitalise on the other company's slogging.

Wren, meanwhile, is planning a craft of similar size to the Sentinel 5000 and called the RS.1. The 25 tonnes-payload craft is aimed at surveillance, search and rescue, resource development, and relief work but, unlike all other airships now flying, would be a rigid, metal-clad design. The rigidity permits a high (120kt) airspeed, but the idea has been dubbed a "flying eggshell" by critics, who doubt the RS.1's resilience in service on the grounds of the extremely thin metal cladding required for lightness.

Wren contends that a fleet of RS.1s would have saved £2 billion in constructing the trans-Alaskan pipeline, because of the simplified transport of men and materials and the time saved by the feasibility of multiple starts.

Reduced infrastructure is a commonly-claimed advantage for airships, and in the Soviet Union a Moscow-based engineer, Vladimir Andreichenko, is proposing an airship connected by cables to trolleys that run along raised wires, so combining some of the advantages of surface and air travel. The 290ft-long ellipsoidal craft would be faster than a coach but cost a fraction of the new railway system. Suburban rush-hour "flights", as well as work in virgin regions, are proposed.

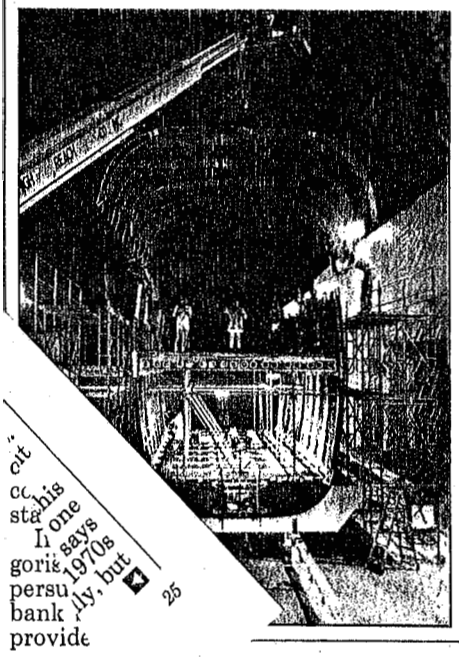
A disadvantage of untethered airships is their poorer manœuvrability compared with helicopters. This makes accurate placing of loads trickier, and causes difficulties in buoyancy control when a heavy load is released.

North American company Aerolift thinks it has overcome the problem with a patented hybrid craft known as the Cyclo-Crane. The helium-filled envelope supports the airframe's empty weight and half the payload, while aerodynamic forces created by flying surfaces mounted on the revolving envelope lift the remaining payload and permit a high degree of control, the company says. The control forces are much greater than could be economically produced by engine thrust alone, the craft is more efficient than a helicopter, and can be built for a fraction of a helicopter's price, it is claimed.

A version able to lift 2 tonnes has flown successfully, and a study by Aerolift for the US Army confirms that the concept is feasible for a 35-tonne payload. It would be 350ft long and 175ft in diameter. Everything is big in the lighter-than-air field.

A decision to build could be years away, so Aerolift aims to build a 12-tonnes-payload version for the Canadian logging industry. Logging firms have expressed interest in funding development and construction, attracted by the reduced capital and operating costs over the helicopters and other machines they now use. Four timber firms put up the money for the smaller prototype machine several years ago.

Engineers have plenty of ideas, but as long as memories linger of the *Hindenburg* and the ill-fated Piasecki Helistat (a brave attempt to link four helicopters with a huge envelope for heavy-lift work) which crashed just last year, there will be scepticism.



The Sentinel 5000, **far left**, *has financial backing, but the Wren RS.1* **below**, *and the extraordinary Aerolift Cyclo-Crane do not*