CORBIS

IN THE SKIES above San Francisco, USA, a Zeppelin airship glides almost silently over the Golden Gate bridge. On board, 12 passengers ooh and aah over the panoramic view. On the ground, hundreds of tourists and locals cast curious gazes aloft. No one is screaming. No one runs for cover. The humanity is, if anything, envious rather than scared.

It was not always thus. The last time a Zeppelin passenger airship flew over an American city, it exploded in front of the world's cameras. On 6 May, 1937, the German airship Hindenburg burst into flames after landing at Lakehurst, New Jersey, killing 36 people and ending the dream of lighter-than-air (LTA) aviation for generations.

At 245m long, the Hindenburg still is the largest flying machine ever made, boasting kitchens, rainwater guttering, promenades and even an aluminium baby grand piano to entertain its 70 passengers. Its designers were well aware of the dangers of using hydrogen gas for lift, but were unable to source non-flammable helium due to an export ban from the world's largest producer, the USA.

Instead, they used the latest safety technology: odorising the gas with garlic to alert crew members to leaks, and painting the Hindenburg's exterior cotton skin with chemicals to protect it from ultraviolet light and solar heating. Naturally, no passenger craft intended for wealthy voyagers would be complete without a smoking room, but the Hindenburg's *fumoir* had just a single electric lighter and was kept under positive pressure to prevent hydrogen from entering.

For over a year, the precautions worked. The Hindenburg scattered pro-Hitler leaflets on propaganda flights over Germany, opened the Berlin Olympics and completed dozens of non-stop transatlantic voyages, ferrying over 1,700 passengers to Rio and North America. It seemed as if airships would become the cruise liners of the skies, floating palaces for the rich and powerful. And then it was all ended by (probably) a simple spark of static at Lakehurst.

Despite the speed of the Hindenburg's demise (it was consumed within 40 seconds), two-thirds of its passengers and crew survived. Many of the victims died as they jumped from the airship when it burst into flames, in contrast to survivors who rode it to the ground.

But with newsreel cameras rolling, the destruction of the giant aircraft was seared into the world's consciousness. It was the first major disaster captured live on film, a public relations disaster that the airship industry never recovered from.

NON-FLAMMABLE

Seven decades later, the cultural resonance of the Hindenburg remains so strong that passengers travelling on the 75m, aluminium and carbon fibre Zeppelin NT in San Francisco are welcomed with such reassuring words as 'tear-proof', 'unmatched safety record' and, naturally, 'non-flammable'. "We often mention the Hindenburg ourselves to get that out of the way and talk about helium instead of hydrogen," says Alex Hall of Airship Ventures.

But the days of looking backwards could be nearly over. Crowded skies, erratic oil prices and a wider shift away from speed and towards sustainability have unleashed a flurry of new airship projects from start-ups, the military and some of the biggest names in aerospace. Along the way, the fears and dreams of yesteryear are being quietly abandoned in favour of more contemporary visions.

For a start, who said airships should float? Traditional LTA airships require large ground crews and awkward ballast transfers when unloading cargo, as well as gargantuan hangars for parking. Cue a slew of heavier-than-air (HTA) airship designs, foremost of which is the JHL-40 from SkyHook, a Canadian company specialising in transport solutions for oil exploration. ▶

pushing the envelope

Seventy years on, the airships are finally emerging from the shadow of the Hindenburg disaster. **Mark Harris** investigates.

'It carries over twice the payload of the largest helicopters, with 10 per cent less fuel consumption. Without the payload you could fly from Calgary to Europe'
Ken Laubsch, Boeing

mhvmhv jbkjbkj kjb .ln :lj;nj;lj :lj;ljw

◀ The JHL-40, which will be developed and built by Boeing, combines a neutrally-buoyant semi-rigid helium envelope with four Chinook helicopter rotors. The inert gas provides enough lift to support the aircraft, leaving the rotors to lift cargo – 40t at a time – and propel it at up to 70 knots (130km/h) over its range of 320km.

"It will be able to stay outside in the snow and hurricane-force (145km/h) winds without the need for a hangar," says Ken Laubsch, Boeing's chief engineer for the project. "It carries over twice the payload of the largest helicopters today, with 10 per cent less fuel consumption. Without the payload you could fly from Calgary to Europe. I can imagine these hybrids succeeding at ship-to-shore transport where there is no deep water port, or placing wind turbines in mountain passes."

In order to hit the project's 2012 deadline for a flying prototype, Laubsch says: "We've actually tried not to develop new technologies. We've been looking at adapting existing technology but there are challenges around flight control. With four lifters and buoyancy to manage, the flight deck will be more complicated than a commercial airliner."

FLYING MONSTERS

If the JHL-40 takes its inspiration from heavy-lifting helicopters, Ohio Airships Inc's Dynalifter is closer to a truly jumbo jumbo. This HTA airship augments helium buoyancy with aerodynamic lift from four wings, is powered by rotating turbo fans and has been designed to take off and land from normal airport runways.

However, the largest planned Dynalifter freighter is 300m long – over four times the length of the Airbus A380 'superjumbo'. It's difficult to imagine how busy airports like Heathrow could accommodate such a monster, let alone manage the chaos that its top speed of 175km/h would unleash.

In reality, the Dynalifter is intended less for intercity passenger transport than as a 'roadless trucking' concept for developing countries or isolated regions, where long distance highways are either in poor condition or don't exist. Barry Prentice, director of University of Manitoba's Transport Institute, says: "Airships represent a breakout technology for reaching remote communities and unlocking their economic potential. The airship industry is re-awakening and a ground swell of manufacturing and customer activity is building. The mood has gone from 'if' this technology will be available to 'when'." Unfortunately, that 'when' doesn't appear to be very soon: a prototype Dynalifter was damaged in a storm and its future is uncertain.

Another HTA airship that has fallen by the wayside is the US military's Walrus project. The Defense Advanced Research Projects Agency (DARPA) floated the idea of a super-massive (365m) airship capable of transporting an entire military unit – comprising 1,800 troops and weighing up to 500t – over 10,000km, dubbing the concept 'fort to fight'.

General William Tuttle was in charge of all logistical support for the US Army. Now retired, he says: "The Department of Defense is embarked upon a new strategy of stability and reconstruction for dealing with the persistent conflict experienced since 9/11. Buoyancy-assisted aircraft can be the key breakthrough to enable agile force repositioning in support of that strategy." DARPA spent millions of dollars on prototype Walrus aircraft from two companies, with Lockheed Martin's P-791 even managing a wobbly test flight in early 2006, before the project was killed by Congress.

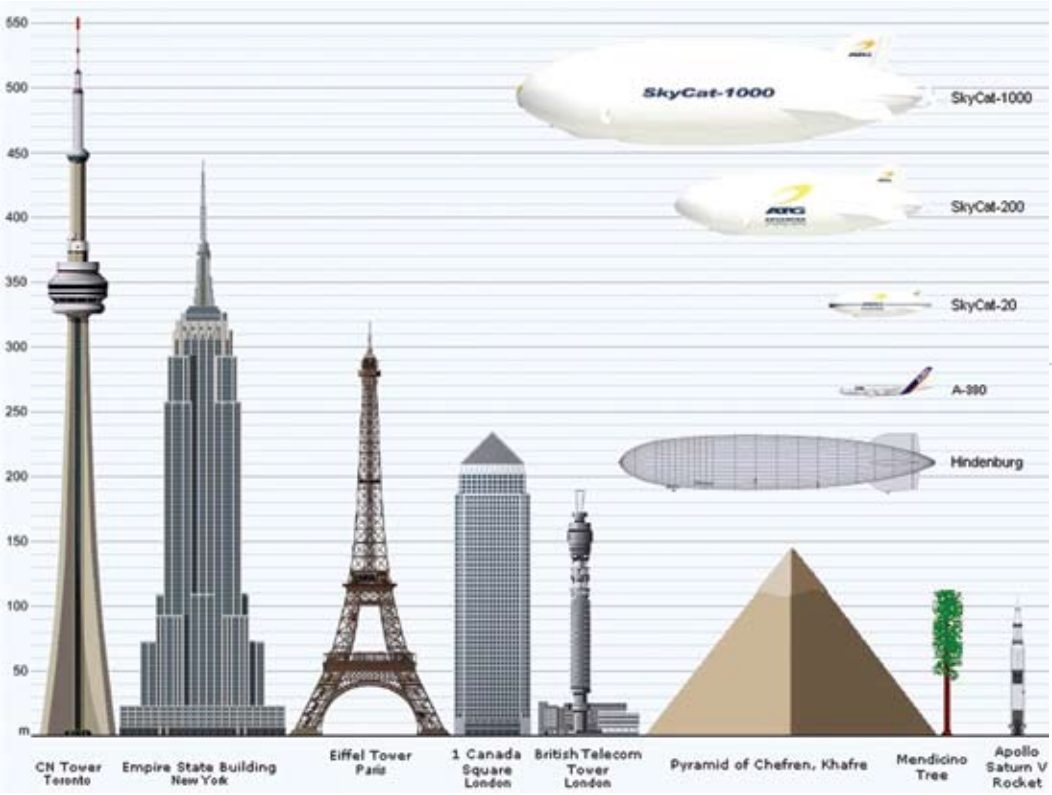
Not to be dissuaded, the other Walrus contractor, Aeros, scaled down its HTA design (it's now just 64m long) and took it public. At first glance, the ML866 looks like a streamlined airship with modified Pratt and Whitney PT6 turbo-props for vertical take-off. But appearances can be deceptive, says Edward Pevzner, business development manager at Aeros: "The ML866 is not exactly an airship. It has a rigid shell and technology that allows control of buoyancy at all stages. On the ground, it's heavier than air without needing ballast. To take off, our buoyancy management system allows us to make it neutrally buoyant. Then once we're in aerodynamic flight, it becomes heavier than air again. We call it an 'aeroscraft'."

THE SKY DRAGON

The new buoyancy management system, codenamed COSH (control of static heaviness), compresses, stores and decompresses helium as required, adjusting the ML866's buoyancy like a fish's swim bladder. The COSH unit is currently undergoing tests in a smaller, FAA-approved airship called the 40D Sky Dragon. Construction of key components for the ML866 has already started and Aeros hopes to have it flying within 24 to 30 months.

Aeros envisages the ML866 as a luxurious sky-yacht catering to well-heeled individuals or companies seeking the ultimate board room. "It's the perfect business tool for executives," says Pevzner. "It's more economical than a jet and allows passengers to be more productive. And if you need to travel to places

mhvmhv jbkjbkj kjb .ln
;lj;nj;lj ;lj;ljw



with limited infrastructure, an aeroscraft lets you land almost anywhere."

While the ML866's planned range of 5000km raises possibilities of transatlantic travel, its flight ceiling of 3,650m would leave it vulnerable to storms similar to those that wrecked large airships in the 1930s.

Aircraft can avoid most bad weather by ascending to 10,000m, although that places them smack in the fast-moving jet stream among commercial planes – no place for a cumbersome airship. By 20,000m, though, both traffic and winds are light. At that height, an airship could fulfil many of the tasks of a satellite, and at a fraction of the cost.

As airships climb, the helium in their envelopes expands, requiring internal ballonets (flexible air-filled chambers) to be deflated and thus maintain a constant internal pressure. Once the ballonets are empty, the airship has reached its maximum altitude or 'pressure height'. In order to reach extreme altitudes, you either need a very large envelope – which makes the airship difficult to control – or to keep the total weight very low.

For the US Air Force and DARPA, again, the benefits of altitude outweigh the risks. Their planned ISIS (integrated sensor is the structure) airship will operate at 20,000m as part of the military's missile defence, surveillance and communications infrastructure. A single ISIS airship could provide high-resolution radar cover for the whole of Afghanistan, for instance, replacing dozens of drones or satellites.

The ISIS super-pressure envelope will be metallic and reflective to withstand helium leakage and damage from intense ultraviolet light. Its biggest innovation, though, will be to incorporate photovoltaic cells into the upper surface of the envelope itself, and efficient sensors into the lower surface, giving the military a solar-powered spy in the sky that can remain on station for months. The US Air Force has authorised a $400m (£275m) prototype, and hopes to take ownership of a full-size ISIS airship by 2013.

NO FLYING BACK

For civilian manufacturers, though, officials remain sceptical about airships, according to Pevzner: "The FAA knows us and our engineering very well, which will help in the certification process. However, it will still be difficult, as this is a new craft with a certification basis being written from scratch. It's difficult to predict how long approval will take."

Perhaps Canadian company 21st Century Airships can enlighten him. Its 19-seater Voyager dirigible began the process in 2006 and is unlikely to fly until next year. 21st Century's Christina Muir says: "The only remaining challenge is type certification. The authorities are less familiar with airships than with traditional aircraft. Consequently, they have to become educated and that makes the certification process more time consuming."

The LTA Voyager uses four turbo-diesel engines mounted in ducts on the envelope, meaning a quieter ride in the gondola for its sightseeing passengers and better control at low speeds than older designs. It's also fairly fuel efficient, managing a thrifty ten miles per gallon and speeds of up to 100km/h.

Boeing's Laubsch believes that once the benefits of such next-generation aircraft are demonstrated, there will be no holding them back: "Once you show you can do things – once you can lift 40t – you let the market and entrepreneurs figure out ways of using them."

However, there is little sign of a concerted movement back to the massive passenger airships of yesteryear. "I think that if there was a large ship that could cruise around the world, like the Graf Zeppelin used to, the market would be there," says Alex Hall of Airship Ventures. "But it's a big leap for someone to go ahead and raise hundreds of millions of dollars to fund the R&D and certification."

Even the biggest name in airships, Zeppelin, has no plans to develop a vessel larger than the 12-seater NT 'flightseeing' airship. Dietmar Blasius, head of special projects at Zeppelin Luftschifftechnik, says: "We are convinced that for the time being you will not find any demand for large passenger airships comparable with the old ones. We only build airships on demand, and have recently started the manufacturing of airship number five."

I'm slightly disappointed to report that not a single one has a smoking room. ■

orbital airships

UP, UP AND AWAY

Ballooning to space? The very idea smacks of Jules Verne, but that hasn't stopped airship enthusiasts in California from testing airships that they hope will one day reach orbit the slow way. JP Aerospace's ATO (airship to orbit) programme consists of three separate stages. The first is a 55m-long, V-shaped Ascender airship using propellers and aerodynamic lift to reach a suborbital 'Dark Sky' space station floating at 43,000m. There, it hands over to a mile-long airship with an electric ion engine to ease itself gradually into orbit.

JP Aerospace has managed to secure some funding from the US Department of Defense and raises additional money by flying adverts to the edge of the stratosphere. The team hopes that future flights will be subsidised by telecommunications companies and, eventually, space tourists.

There are even plans to launch airships on other planets. Ralph Lorenz, a scientist with the Lunar and Planetary Laboratory at the University of Arizona, believes that autonomous airships are the best way to explore hostile environments such as Titan, Saturn's largest moon and the only place apart from Earth known to have a thick atmosphere and liquid oceans.

The Southwest Research Institute in Texas is also considering robotic airships, to map and survey the surface of Mars. The solar-electric airship would be deployed directly from space, inflating as it descended through Mars's thin atmosphere and powering itself using photovoltaic cells on its upper surface.