

Solar Airship Ltd. - Sunship

Peter Lobner, 12 February 2022

1. Introduction

In a 1983 UNIDO review of LTA technology, Anthony Dolman made the following report on the Sunship:

“Since 1977 parametric studies of a solar powered airship - the Sunship - have been undertaken in England by Solar Airship Ltd. The Sunship's designers believe that improvements in solar cell technologies and their falling costs will bring solar energy, in favorable climates, on economic parity with fossil fuels by the mid-1980s. The Sunship is a conventional non-rigid helium airship equipped with an array of solar cells over the greater part of the envelope.

The cells generate electrical power, which is collected and fed through a grid and control system to DC motors that drive propellers. A part of the energy generated would be stored on board. The energy required for flight services, such as lighting and instrumentation, would be obtained directly from the grid or from the storage unit. A typical prototype for validation and demonstration purposes would be some 80 m (262.5 ft) long and capable of carrying a working load of 3 - 5 (metric) tons with two 100 kW (134 shp) DC engines.

The design problems are formidable. Ways have to be found, for example, of achieving acceptable performance with the weight penalties imposed by the cells and power storage unit, of reducing solar power losses to acceptable levels, of fixing the cell arrays to the flexible envelope, and of protecting the cells from damage caused by ultra-violet rays and general wear and tear. The Sunship's designers are confident that such problems can be overcome, and are now able to point to the successful English Channel crossing made in 1981 by the solar powered balloon, the Solar Challenge.

The Sunship's operational requirement would be for clear skies, low seasonal variations in incident solar energy, relatively low wind velocities, and terrain that permits flying at no more than 1,000 m (3,281 ft) above sea level. When this requirement is met, speeds in excess of 100 kph (62 mph) are considered possible. The required conditions are most likely to be found in the area lying between 15° and 30° north and south of the equator, which includes large parts of Africa, South America and Australia. This suggests that the Sunship would be most suitable for operation in the developing world and an industrialized country with internal transport difficulties.

The cost of solar cells has fallen 100 fold in the past decade and, according to some estimates, could reach the competitive price of less than \$1.00 per peak watt by the mid-1980s. At these prices, the Sunship's designers believe, the prototype solar propulsion system could cost less than \$200,000, with an annual replacement and maintenance cost of about \$4,000. At these costs, the designers maintain, the initial difference in price between gas turbine and solar power airships could be recovered in about 3 years.”

In 2021 (38 years after the UNIDO report), flexible, thin-film solar panels are available on the retail market at prices as low as \$1.40 per watt.

2. The sub-scale demonstrator (1979)

The unmanned, 6.7 m (22 ft) long Sunship demonstrator was constructed in 1979 in Melbourne and became Australia's first solar-powered airship. This non-rigid airship had a pressure-stabilized gas envelope with a mostly transparent skin. Electric power was generated by four solar panel installed inside, along the bottom of the envelope. A Ni-Cd battery was installed in the forward part of the gondola fairing.

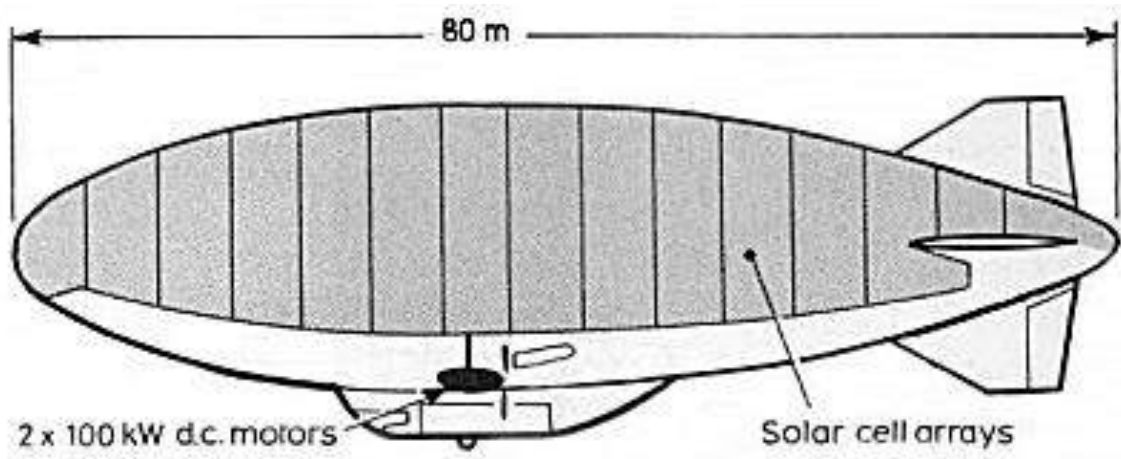
The Gas & Fuel Corporation sponsored public demonstration flights in Melbourne's Fitzroy Gardens, where the small airship was briefly flown by the Premier of Victoria, Rupert Hamer.



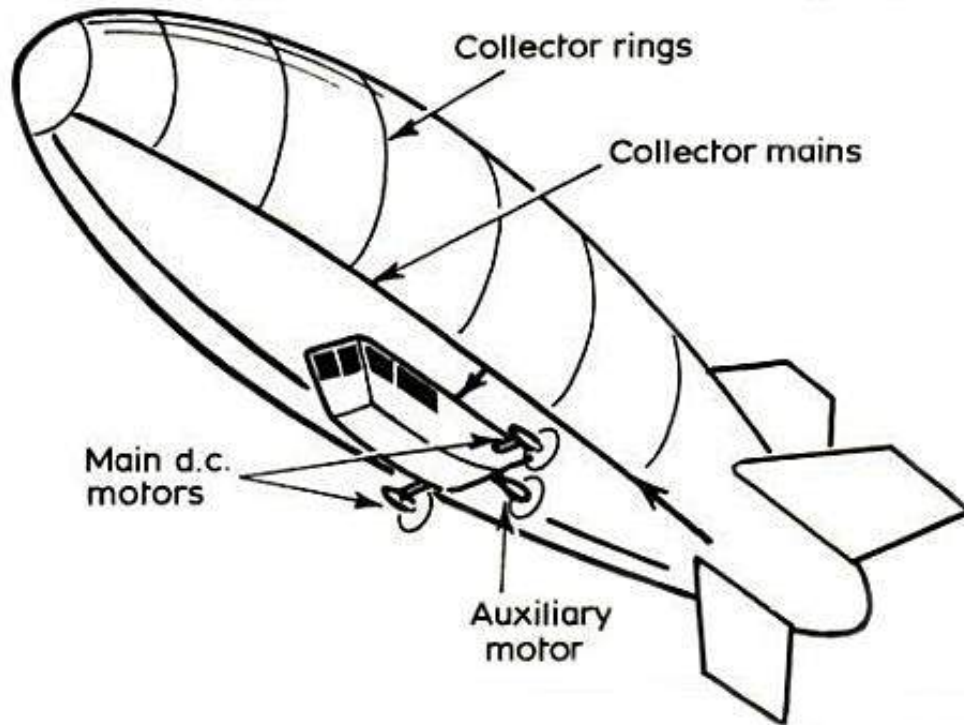
1979 sub-scale demonstrator. Source: Advanced Hybrid Aircraft

3. The full-scale Sunship prototype

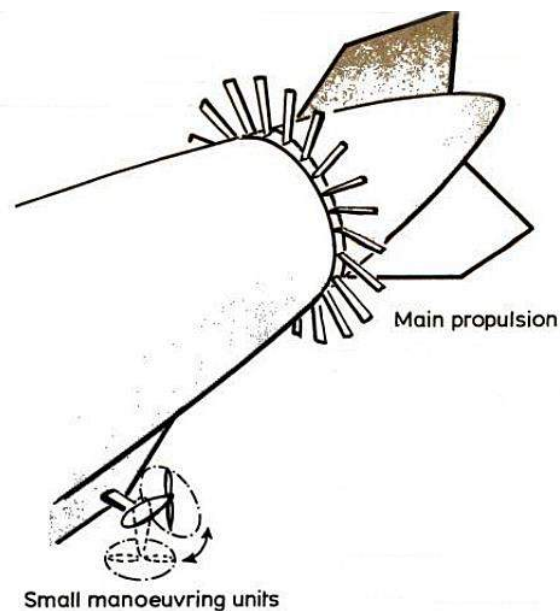
The prototype was expected to be an 80 m (262.5 ft) long non-rigid airship with flexible solar panels covering a large portion of the gas envelope's surface. With two 100 kW (134 shp) DC motors, the airship was expected to have a cruise speed of 100 kph (62 mph), a maximum speed of 120 kph (74.6 mph). It would fly at low altitudes, up to 1,000 m (3,281 ft) above sea level, while carrying a working load of 3 - 5 metric tons (3.3 – 5.5 tons). The prototype was not built.



Profile view showing large area covered by solar panels.
Source: New Scientist (13 July 1978)



Isometric view showing locations of the 100 kW main propulsion DC motors and an auxiliary engine to supplement the electric propulsion when needed. Source: New Scientist (13 July 1978)



An alternate propulsion scheme with a variable pitch annular propeller for main propulsion and small thrust vectoring units for maneuvering at low speed. Source: New Scientist (13 July 1978)

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NEXT - THE SUNSHIP

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This Week: NEXT - THE SUNSHIP - Part 1

<p>IN MANY COUNTRIES TODAY THERE IS A REVIVAL OF INTEREST IN THE FIRST POWERED FLYING DEVICE - THE AIRSHIP.</p> 	<p>901-1</p>  <p>WHILE AIRSHIP DEVELOPMENT HALTED ABRUPTLY WHEN THE HINDENBURG BURNED IN 1937, THE VERSATILITY AND LIFTING POWER OF THIS LIGHTER-THAN-AIR DEVICE HAS NOT BEEN FORGOTTEN.</p>	<p>TODAY, ALSO, THERE IS AN EVER-WIDENING SEARCH FOR WAYS OF REPLACING CONVENTIONAL FUELS WITH SOLAR ENERGY - AND INEVITABLY THE TWO CONCEPTS HAVE BEEN LINKED.</p> 	 <p>AERONAUTICAL SCIENTISTS ENVISAGE A SOLAR-POWERED AIRSHIP THAT COULD BE BUILT WITH EXISTING TECHNOLOGY TO OPERATE IN MANY PARTS OF THE WORLD - THE SUNSHIP.</p>
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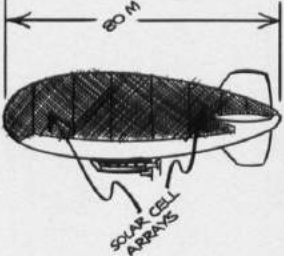
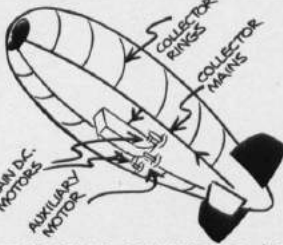


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This Week: NEXT - THE SUNSHIP - Part 2

<p>AN AIRSHIP IS THE ONLY KIND OF VEHICLE WITH A LARGE ENOUGH SURFACE AREA TO GENERATE SIGNIFICANT POWER BY SOLAR ENERGY.</p> 	<p>901-2</p>  <p>WITH ITS ADDITIONAL PROPERTY OF STATIC LIFT (PROVIDED BY GASBAGS) IT REQUIRES ENERGY ONLY FOR DIRECT PROPULSION.</p>	<p>WITH ITS CAPACITY TO CARRY HEAVY LOADS A SUN-POWERED AIRSHIP OR SUNSHIP WOULD HAVE ENORMOUS ECONOMIC VALUE IN MANY UNDEVELOPED COUNTRIES - MANY OF WHICH HAPPEN TO MEET THE SUNSHIP'S REQUIREMENTS: CLEAR SKIES, RELATIVELY LOW WIND VELOCITIES, AND FAIRLY FLAT TERRAIN.</p>  <p>AREAS WHERE CONDITIONS FAVOUR SUNSHIP OPERATIONS</p>
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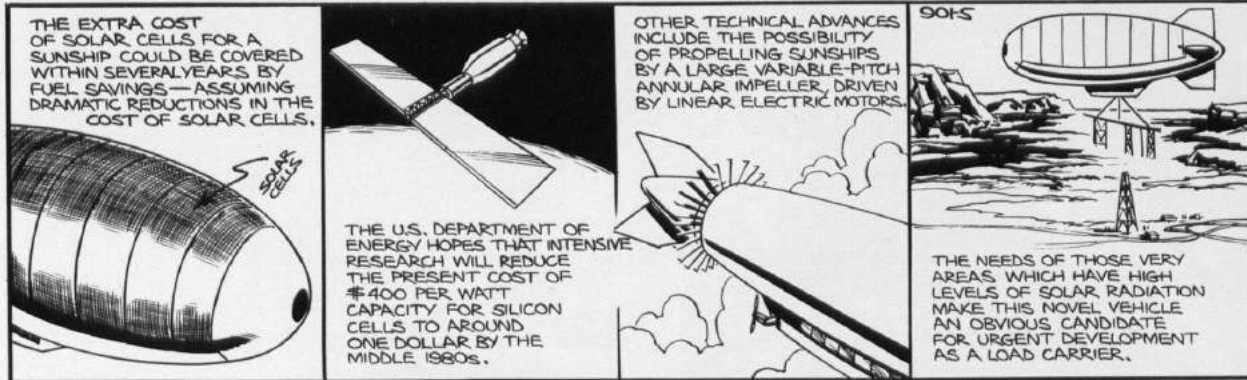
This Week: NEXT – THE SUNSHIP – Part 3

<p>IN ESSENCE, A SUNSHIP IS A CONVENTIONAL AIRSHIP, LIFTED BY HELIUM, FITTED WITH SOLAR CELLS OVER ITS LARGE UPPER SURFACE.</p> 	 <p>THE CELLS CONVERT SOLAR RADIATION INTO ELECTRIC CURRENT, WHICH IS COLLECTED BY A NETWORK OF WIRES AND FED DIRECTLY TO D.C. MOTORS DRIVING PROPELLERS.</p>	<p>IN SUITABLE CLIMATIC ZONES A SUNSHIP COULD FLY FROM DAWN TO DUSK, ALTHOUGH IT WOULD ACHIEVE ITS BEST PERFORMANCE—UP TO 120 KPH—TOWARDS NOON.</p> 	<p>901-3</p>  <p>IT COULD ALSO HAVE A BATTERY-DRIVEN AUXILIARY MOTOR FOR MANOEUVRING, AND AS A POWER RESERVE IN CASE OF TOTAL OVERCAST.</p>
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This Week: NEXT – THE SUNSHIP – Part 4

<p>THE CHIEF APPEAL OF THE SOLAR-POWERED AIRSHIP WOULD BE TO COUNTRIES WITH LITTLE OR NO ALTERNATIVE TRANSPORT NETWORKS, AND MANY OF THESE LIE WITHIN THE MOST SUITABLE CLIMATIC ZONES.</p> 	<p>901-4</p>  <p>A TYPICAL SUNSHIP 80 M LONG COULD CARRY A WORKING LOAD OF UP TO 5 TONNES, AND OPERATE AS LONG AS THE SUN SHONE—UP TO 10 HOURS PER DAY.</p>	<p>THE NEED FOR SOME FORM OF ON-BOARD ENERGY STORAGE COULD BE MET BY USING PART OF THE ELECTRICITY TO PRODUCE HYDROGEN FROM WATER BY HYDROLYSIS, THIS GAS COULD DRIVE AN AUXILIARY GAS TURBINE IN CLOUDY WEATHER.</p> 	 <p>A SUNSHIP COULD OPERATE FOR LONG PERIODS IN REMOTE AREAS WITHOUT NEEDING FUEL OR REFUELLING FACILITIES.</p>
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Frontiers of Science five-panel graphic description to the Sunship.

Source: The University of Sydney digital library, Frontiers of Science collection, Issue 901, Parts 1 to 5

4. For more information

- Gabriel Khoury & Edwin Mowforth, “A solar airship – more than just a flight of fancy?” *New Scientist*, pp. 100 – 102, 13 July 1978:
https://books.google.com/books?id=PhxDVgkDfuwC&pg=PA100&lpg=PA100&dq=a+solar+airship+-+more+than+just+a+flight+of+fancy&source=bl&ots=AdQ1gaELQo&sig=ACfU3U0QjDtjtDYAq115_agJETxOv0hyDQ&hl=en&sa=X&ved=2ahUKEwjVj-WS37L0AhWWFjQIHU6IAIkQ6AF6BAgaEAM#v=onepage&q=a%20solar%20airship%20-%20more%20than%20just%20a%20flight%20of%20fancy&f=false
- “Next – The Sunship,” The University of Sydney digital library, *Frontiers of Science* collection, creators Stuart Butler & Bob Raymond, illustrator David Emerson, originally published in issue 901, 11 December 1978:
<https://digital.library.sydney.edu.au/nodes/view/2670>
- Anthony J. Dolman, “Current and Possible Future Developments in Lighter-Than-Air (LTA) System Technology,” Section 4.3, United Kingdom, pp. 81-86, United Nations Industrial Development Organization (UNIDO), 1983:
<https://open.unido.org/api/documents/4793600/download/CURRENT%20AND%20POSSIBLE%20FUTURE%20DEVELOPMENTS%20IN%20LIGHTER-THAN-AIR%20>

Other *Modern Airships* articles

- *Modern Airships - Part 1*: <https://lynceans.org/all-posts/modern-airships-part-1/>
- *Modern Airships - Part 2*: <https://lynceans.org/all-posts/modern-airships-part-2/>
- *Modern Airships - Part 3*: <https://lynceans.org/all-posts/modern-airships-part-3/>