PATHFINDER

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THE RESURGENCE OF THE AIRSHIP

> **The Flight of Zeppelin L.59**
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> In November 1917, the German naval airship L.59 departed from Jamboli, Bulgaria, on a mission to German East Africa (now Tanzania) carrying 50 tons of urgently needed supplies—weapons, ammunition, food and medicine—for the colony's military garrison. Because it would be impossible to resupply the airship with hydrogen gas at its destination, the journey was intended to be one-way only. Events in East Africa caused the voyage to be aborted on 23 November, while the L.59 was 200 kms due west of Khartoum, Sudan. The airship arrived back at base two days later, having covered 6800 kms in 95 hours—a record not surpassed for many years.

The airship or lighter-than-air vehicle (LAV) was used for intelligence, surveillance and reconnaissance (ISR) purposes as far back as 1794 in France's campaign against Austria. In the early 1900s they were used as long-range bombers and cargo carriers, and even undertook trials for use as aircraft carriers. However, technical issues with materials and a number of unfortunate accidents gradually diminished interest in the LAV and relegated them to mere curiosities by the middle of the 20th Century.

In recent times, there has been increasing interest in airships from military forces wanting long endurance ISR platforms and potential large transport capabilities at relatively low cost. Primarily, the need for persistent ISR platforms that can remain airborne for weeks or even months has been identified by military forces as a critical part of response options in irregular conflict. The basic characteristics of LAVs make them ideally suited for this purpose. The United States military is currently exploring the feasibility of fielding airships in Afghanistan to conduct ISR missions.

Airship **Norge**, *the first aircraft to reach the North Pole*

There are three fundamental characteristics of airship, which are viewed as crucial advantages in the modern battlespace. First, their propulsion requirements are modest in comparison to all other airborne platforms. An airship requires independent propulsion only to overcome the initial inertia during take-off, to facilitate staying on station during a mission, and to assist in landing by overcoming the platform's inherent buoyancy. Second, LAVs can stay aloft expending very minimal fuel for long periods of time, and also reach extremely high altitudes. In combination, this offers the potential for these vehicles to operate for extended periods as virtual satellites conducting ISR and being effective communication hubs.

Third, the inherent buoyancy of the platform completely alters the basic power-lift equation of aerodynamics in an airborne vehicle. This allows an airship to lift a given payload to a prescribed altitude in a far more cost-effective manner in comparison to a conventional heavier-than-air aerial vehicle. Further, natural buoyancy also permits LAVs to overcome the limitations of endurance that restrict normal fuel consuming aerial vehicles, thereby increasing persistence. This is a distinct advantage in conflict situations requiring very long-term surveillance of the battlespace.

Developments are also taking place that could further increase the endurance and persistence of airships. The design of airships provides them with large surface areas. These surface areas enable the accommodation of photo-electric cells in sufficient quantity to produce electrical power from sunlight at very high altitudes. This could make the airship almost self-sufficient in meeting its power requirements for station keeping as well as for the functioning of its operational payload.

Early airships developed a reputation for being dangerous fire hazards because of the use of volatile hydrogen to achieve the necessary buoyancy to stay airborne. This had made the survivability of an airship in the battlespace questionable. Modern LAVs use inert helium that almost completely rules out the fire hazard. In fact, trials have shown that they are able to absorb considerable ground fire and yet remain airborne for long periods, making them relatively invulnerable to battle damage. This is predicated not only on helium being an inert gas, but also because it is held at extremely low pressures in the envelope making any leakage and deflation a slow process. Airship trials have repeatedly proven that it is able to absorb damage and fly out of harm's way even as the gas gradually leaks out, reducing its buoyancy.

A modern LAV has another survivability feature that is important in the modern battlespace. Despite having a large visual signature, LAVs are surprisingly stealthy. Their all-composite and advanced fabric hulls and control surfaces are almost invisible to radar and the control cabins have a reduced radar cross section through the use of shaping techniques. Low radar, acoustic and infra-red signatures make airships very survivable even in battlespaces where there is a high density of enemy search and track capabilities.

Although LAVs have advantages when employed in some dedicated roles, they also have certain inherent limitations that could diminish their operational effectiveness. Of necessity, LAVs are large in size. While an advantage in terms of survivability and performance at high operating altitudes, it becomes a liability when they are on or close to the ground. They become vulnerable to weather effects and are also prominent targets for concentrated surface or counter air attacks.

Even though external propulsion requirements are minimal, certain technical challenges and issues regarding the engines have still not been fully mitigated. The engines of an airship have to be able to operate at unusually high altitudes for extended periods of time. Further, they also have to be able to run efficiently for long periods of low-power operations—typical of optimum LAV employment. Conventional engines face challenges in ensuring adequacy of lubrication over extended operations. Electrical motors are increasingly viewed as becoming vital features of airship propulsion.

An older application of airships, the Tethered Aerostat Radar System (TARS), has been in operation with the United States Air Force for more than two decades. The data available from these operations provide an indication of the potential of LAVs. The operating cost of TARS in comparison to the same surveillance being provided by a US Customs P-3 airborne early warning and control aircraft has been estimated as less than 10 per cent (approximately US$300 as against US$3,500 per hour of operation). Further, this does not take into account the disparity in acquisition costs—around US$22 million for an aerostat based system and US$37 million for a P-3 in the 1992 timeframe.

Tethered Aerostat for ISR

In 2011, the United States will evaluate the High-Altitude Long-Endurance Demonstrator (HALE-D) that promises to be the first high-altitude airship that will fill the role of a virtual satellite. This LAV will be able to lift a 23 kg payload to 60 000 feet and stay on station for at least 15 days.

While it is still early days in the operational deployment of free moving LAVs, it is not difficult to envisage the advantages that will come with the maturation of these concepts and supporting designs. In the long duration irregular conflicts that seem to be the contemporary norm, ISR is critical to success. The LAVs will be able to provide a cost-effective and affordable solution to the challenge of providing actionable intelligence derived through their capacity for persistent surveillance.

- *Tethered aerostats have proven to be a cost-effective ISR option.*
- *Lighter-than-air vehicles have the potential to become virtual satellites providing ISR and communications.*
- *High-Altitude Long-Endurance airships are likely to become operational in the near future.*

From the time of the Crimean War a century and a half ago until recently, platforms were militarily crucial: the newest ship, plane or tank. Now what the platform carries—sensors, munitions, and electronics—matters more than the platform itself.

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