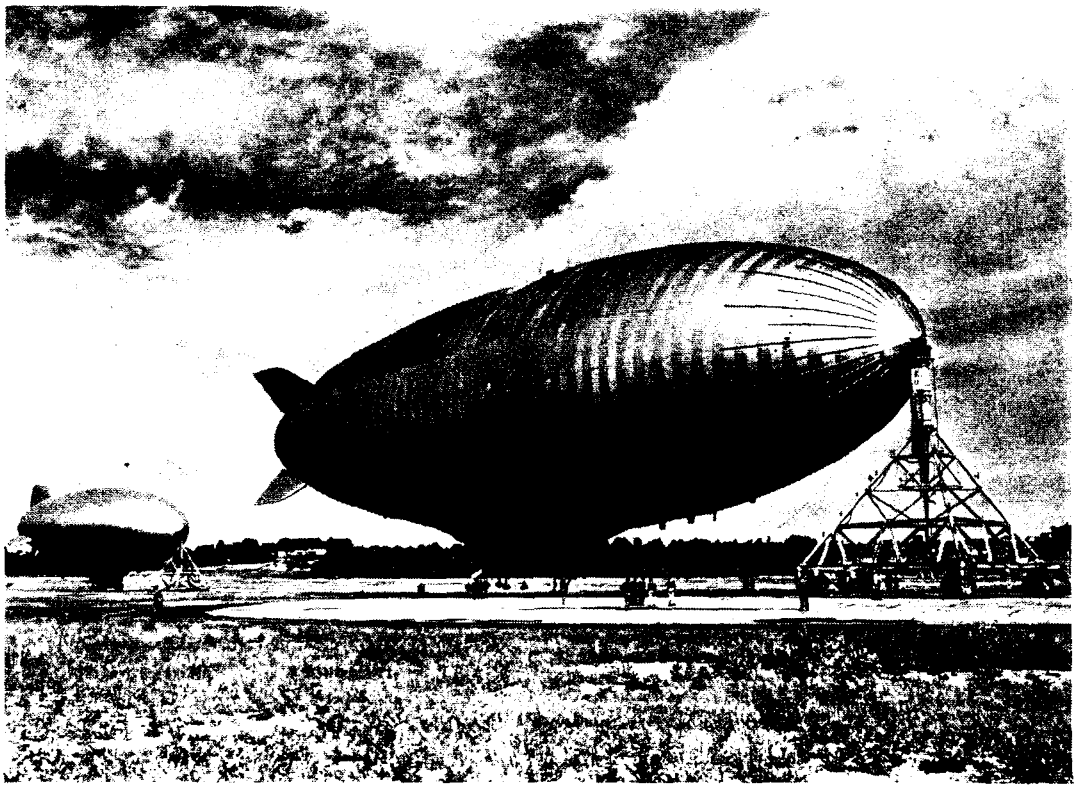

FIG. 1—UNITED STATES NAVY ZPG-3W NON-RIGID AIRSHIP IN THE RADAR PICKET ROLE

Photograph by courtesy of the Royal Aeronautical Society

FLOATING AN IDEA

BY

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Introduction

Airships are history. Maybe, but the United States Navy have been showing increasing interest in them over the past five years. Airships, they think, could do a variety of tasks such as Anti-submarine Warfare, high altitude surveillance and lifting heavy stores from ships where no harbour facilities exist. They have set up an Airship cell in their Naval Air Development Center and have sponsored about half a dozen major studies. None of this is any reason why the Royal Navy should follow suit, of course, but airships do have some unique characteristics which may be useful. Like all craft they have their problems, some real enough and others, perhaps, are more imaginary. This article looks at airships, their characteristics and uses, it also examines some of the apprehensions they excite and finally some of their problems.

Characteristics

Airships get all or most of their lift by displacing air with a lighter gas, usually helium. From this definition most of their characteristics can be derived, which are:

(*a*) *Independence of engines and aerofoils.* They needs neither engine nor aerofoils to stay airborne.

(*b*) *Good range and endurance.* Because they do not use fuel to remain airborne, airships can get more miles per gallon and have better endurance than other aircraft. The record at present is 9400 miles without refuelling and over eleven days endurance.

(*c*) *Large.* Air is light and to get a reasonable lift means displacing a large volume. Displacing one cubic foot of air with helium achieves only 0·062 lbs of lift. Airship volume is usually measured in millions of cubic feet (mcf); the Hindenburg's volume, for example, was 7 mcf.

(*d*) *Slow.* Being large, their drag rises rapidly with speed. There is no theoretical limit but their economical top speed will be about 80 to 100 knots.

(*e*) *Efficient at slow speeds.* Their lift is constant irrespective of speed; this makes them far more efficient at slow speeds and in the hover than other types of aircraft.

(*f*) *Bigger and better.* Lift varies directly with the volume whilst both drag and weight vary with volume$^{\frac{2}{3}}$. The bigger they are, therefore, the more efficient they become.

(*g*) *High inertia.* Because of their size airships have a high inertia. This makes them slow to manoeuvre but it also makes them very stable. Probably they are the most stable of all air-borne platforms.

(*h*) *Low flying.* Air density falls with altitude and so too must the airship lift. Specialized craft have been designed to fly at 70 000 ft but a more practical ceiling is 10 000 ft to 15 000 ft.

(*i*) *Roomy.* Gas occupies about 95 per cent. of the volume and so increasing the size of the working area would not greatly affect the overall drag. This allows working areas and accommodation to be roomy; it also makes in-flight maintenance possible.

The airships' characteristics fall neatly between those of the aircraft and the ship. It will have a better speed and line of sight to the horizon than the ship but will be inferior to the aeroplane. It can carry greater loads than the aeroplane but not of the ship. It will have the same range and endurance as a ship but, being airborne, will not be affected by sea states. It would lack the agility and speed of the aircraft and could not be used, as a rapier, in attack. It cannot carry the load of a ship and so could not be built as a fortress for defence. The airship would be useless in direct conflict but it would make a most valuable mobile watchtower for both aircraft and ship.

Uses

Airborne Early Warning

Backfire bombers and aircraft from KIEV Class carriers will be a constant threat to our ships, and to this is likely to be added soon cruise missiles. According to the 1980 Defence White Paper, these are to be opposed by our land-borne defence flights before they can accurately engage our ships. Those who escape will face Sea Harriers, Type 42 destroyers with Sea Dart and Sea Wolf. All these will need constant AEW to be completely effective. The AEW Shackletons are to be used for home defence. The eleven AEW Nimrods, when built, will be the British contribution to the NATO AEW mixed force. One squadron of radar-reconnaissance Vulcans are nominated for maritime defence but these are also tasked for the Northern Region. (The MR Nimrod is purely for ASW, of course). More AEW Nimrods could be bought but, neglecting the expense for a moment, they would not be best employed by providing a constant AEW cover for units at sea. The advantages of aeroplanes are their speed and ability to cover large areas quickly. They would be far less effective if they had to support convoys and task units whose mean speed was no more than 20 knots.

Airships would be able to give a constant AEW cover and at the same time be efficient at these slow speeds. They have been used for similar tasks before, when in the 1950's they were radar pickets stationed 200 miles off the eastern coast of the United States while the DEW line was being built. It would be better if they could fly higher but at 15 000 ft airships would have a horizon to horizon line of sight of nearly 300 miles.

Logistic Support

Logistics must be close to most engineers' hearts. Ships and aircraft are now so complex that U by E is fast becoming the only practical method of maintenance. Complexity, however, has its penalties. It multiplies the range of stores needed and often seems to increase unit costs. On a limited budget this can only mean fewer of each item. It also means more test equipment and invariably seems to breed more and more experts. Meanwhile ships and aircraft are getting ever more complex.

RFAs will remain the backbone of our logistic support, but it may be that they will not always carry a full range of spares, especially if some of the items are in short supply. It will be very unlikely that they will carry a full range of equipment and the experts needed to test and tune repaired systems. What may be needed in the future is a fast shore-to-ship service whereby stores, equipment and experts can be got to ships in distress quickly. Aeroplanes would be no good, ships might be too slow, and helicopters would not always have the range. Airships would seem to be the only suitable craft available.

Other Supporting Roles

Ships, aeroplanes, and helicopters all have more than one role. Airships, if they are to be a useful part of the Fleet, must be equally versatile. Some suggested roles are:

Anti-submarine Warfare (ASW)
Off-Shore Tapestry
Fishery Protection
Mine Warfare
Electronic Warfare (EW)
Command Control and Communications (C3)
Remotely Piloted Vehicle (RPV) Carrier
Search and Rescue (SAR)
Missile Guidance
Hydrographical Survey

ASW is the airships' traditional role. This was their role during the two World Wars. Modern sensing equipment, such as towed array, MAD, and thermal detectors, would give them a new potency. They could stream decoys long enough to make them a convincing spoof. They would be suitable for those phases of searching, identifying, and tracking submarines where endurance would be necessary and leave more helicopters to deal with the prosecution phase where their agility and quick response would be most valuable. They would enjoy a further advantage over helicopters for they could remain airborne in wind conditions and sea states that could be hazardous to helicopter operation.

Off-shore tapestry, fishery protection, mine warfare, SAR, and hydrographic survey are all roles that airships have previously performed. So too is RPV carrier, albeit in disguise. U.S.N. *Akron* and U.S.N. *Macon* operated small manned aircraft in the 1930s. Today the role would be similar only the pilot would be absent. The three remaining roles EW, C3, and missile guidance would be new but only because they did not exist in 1961 when airships were last in service.

Technological Improvements

If new sensors would improve airships' potency then new technology would increase their effectiveness. Except when Dacron replaced rubberized-cotton as the balloon fabric, there has been no major technological improvement for forty years. Some of the innovations and advances during this period would be very useful to the airship engineer. He will be looking for ways of saving weight and these savings he can trade off for better speed, altitude, endurance, payload, or a combination of all four. His interests are likely to concentrate on:

Light-weight strong fabrics.
Light-weight engines, such as turbo props.
High strength-to-weight construction materials.
Improved radars.
Fly-by-wire systems.
Computers.
Micro-electronics.

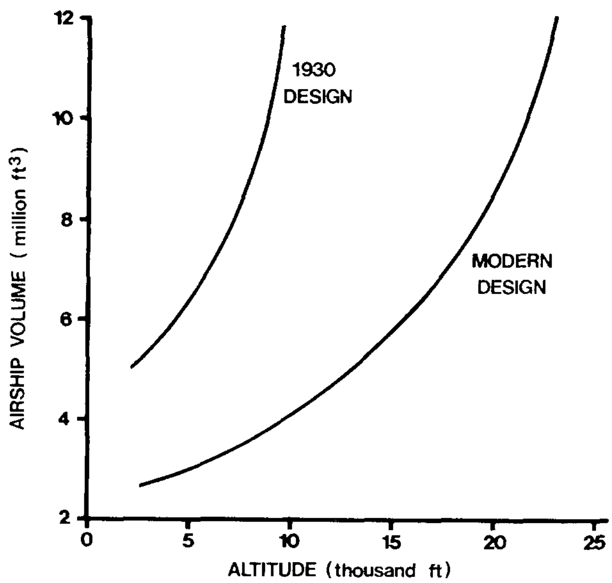

FIG. 2—AIRSHIP SIZE VERSUS OPERATING ALTITUDE

He is also likely to study closely:

Aerodynamics of large bodies.
Theory of minimum weight structures.
Improved weather forecasting techniques.

Some innovations would lead to savings of structural weights. Others would reduce crew size for fuel usage. Yet others would make it easier to predict accurately maximum structural loads and safety margins. Modern airship structures could be up to 40 per cent. lighter than those of equivalent volume in the 1930s. (FIG. 2). The airship, using modern technology, would be as different from its 1940 counterpart as a Boeing 747 is from a Wellington bomber.

Apprehensions

Nothing so far written would remove any of the apprehensions people feel about airships. These could probably be listed under four headings: Safety, Operating Capability, Vulnerability and Survivability.

(*a*) *Safety*. In the past the airship scene was dominated by two types. One was the rigid, as exemplified by the Zeppelins: R38, R101, U.S.N. *Akron* and *Hindenburg*. This type had a disastrous safety record. The other was the non-rigid or blimp, the most well-known example today being the Goodyear *Europa*. This type was used during two world wars and since 1915 probably no more than fifty people have lost their lives in or because of it. It is likely that blimp would be the airship that would next see service in the Fleet.

(*b*) *Operating Capability*. This is made up of a number of factors including endurance, serviceability, and all-weather capability. Endurance is a characteristic of airships that can be improved, as has been done in the past, by in-flight refuelling at sea. This would make them virtually 'organic' with surface units with the ability to remain at sea for as long as the ships they support. Airship availability was nearly 70 per cent.

when they went out of service in 1961 and in-flight maintenance would be as feasible in the future as it was in the past. (History abounds with stories of engine strips and reassemblies whilst airborne). In addition they would provide a stable platform for the most delicate equipment. Finally, their all-weather capability has been demonstrated when, in 1957, in the worst blizzard along the east coast of the United States for over 75 years, they remained on station and operated in weather which grounded all other aircraft for three days.

(*c*) *Vulnerability*. Undeniably airships are big and slow. They are, however, mainly fabric and gas, neither of which shows up well on radar. For their size they have a very low infra-red radiation which can be easily hidden, so they would make a poor target for IR seeking missiles. They are not vulnerable to torpedoes and mines, as are ships, and they could carry sufficient air-to-air missiles to deter would-be aggressors. Notwithstanding, airships should not be used in hot conflict. But neither should RFAs, transport and maritime reconnaissance aircraft, nor many types of helicopters, yet all these have important military tasks.

(*d*) *Survivability*. If hit, an airship would need to have a reasonable chance of staying airborne, be able to be controlled, and unlikely to explode or catch fire. The gas in balloons is at a very low overpressure and so holes, even as large as several square feet, would result in a very slow loss of lift. Total loss of lift would be avoided if the gas was divided into cells. There should be a reasonable chance, if its excess stores and fuel were jettisoned, of an airship making base. Many important items and systems, such as engines and flying controls, will be duplicated. In airships there is enough room to place these far enough apart to avoid being crippled by one hit. Finally fuel, which is the most likely source of explosions and fire, will be in tanks surrounded by inert helium.

No airship will ever be 100 per cent. safe and inevitably it will go unserviceable from time to time. It is vulnerable and, if damaged enough, it will crash. It would be stupid to pretend otherwise. But in all these respects, the airship is unlikely to be any worse than many a ship or aircraft now usefully employed in the Fleet.

Problems

It is now time to consider airship problems. There will be technical problems and construction problems, operating problems, training and safety problems, and many more besides. The greatest by far, however, will be difficulty of balancing the risk of success against the cost of development. This is a fundamental problem which bedevils all innovations.

Probably airships will be very useful and will successfully carry out many tasks. But this is mere conjecture, there is no proof. What is needed is a craft large enough to demonstrate the major roles but none is available. An airship should be available soon but, at 181 000 cubic feet, this would do no more than show the need for something bigger and to build it would be costly.

The cost of a new vehicle would inevitably be high. Construction would cost about the same as commercial airliners pound for pound of structural weight. In addition, there will be the expense of airfields, gas storage and transport, hangarage for new build and major maintenance (although the RAE Bedford hangars might be used), ground equipment, and training. There is no large indigenous airship industry and neither is there any commercial inducement to build one. The Ministry of Defence would probably have to do its own research (which should be small), development (albeit low risk), design, contracting, overseeing, and testing if it is to get a demonstration craft.

There is a need for an act of faith. Entrepreneurs are wanted. The financial climate, however, is hardly conducive to growing such luxuriant plants.

Conclusions

The airship is a unique form of transport, having characteristics which, as its name implies, lie between the aeroplane and the ship. It would be no good in hot combat but would be useful in both attack and defence as a mobile, long endurance, airborne watchtower. AEW, logistic support, and ASW would be some of the more important roles it could perform. Present-day sensors and modern technology would transform the airship of forty years ago as much as it has changed the airplane and ship over the same period. Non-rigids (blimps) are safe and would be used for the foreseeable future; these should be able to stay continually with units at sea and are as likely to survive an attack as many ships and aircraft already in Fleet service. This is all conjecture, however, and a demonstration craft is needed. None is available and to build one will be costly. The difficulty is in estimating the airship's potential success against its development costs. There is a need for an act of faith but this is difficult to make in the present financial climate. A partner would be useful because then the costs would be shared and both could enjoy the fruits of success that airships should bring. But then the United States Navy have been showing increasing interest in them over the last five years.