30 October 1968

THE UPPER ATMOSPHERE RESEARCH PROGRAMME OF FLIGHT PROJECTS GROUP, WEAPONS RESEARCH ESTABLISMENT

By B. Rofe

Mr. Rofe, Principal Officer of Flight Projects Group, Weapons Research Establishment, S.A. spoke of the work that had been carried out by the group over the past few years, illustrating his talk with slides.

Initially, a sounding rocket named "Long Tom" made of surplus boosts had been used to carry a variety of payloads up to about 100 miles. A later development was the HAD (High Altitude Density) rocket which carried a 2-metre metallised plastic sphere to over 400,000 ft. Upon ejection, the sphere was inflated and tracked by radar. By noting the change in the rate of descent and knowing the drag on the sphere, it was possible to determine the density and, by use of the hydrostatic equation, temperature and pressure. As the sphere weighed about 1 lb, it was possible to determine horizontal components of the wind.

The rocket at present being used is the KOOKABURRA, a two-stage vehicle with first and second stages of 5 and $3\frac{1}{2}$ inch diameters respectively. Heights of 260,000 ft are usually reached and with minor fin modifications 300,000 ft is possible. Although the present payload is a WRE designed dropsonde, other suitable payloads could be used.

Presenting slides of temperature-time sections derived from 'falling sphere' data for Woomera, the speaker said that all firings had been carried out 30 minutes after sunset to facilitate optical acquisition and to minimize diurnal variation effects. A climatological point of interest was the annual variation in the mesopause temperatures, these being warmer in winter by about 60°C as compared with summer. The reverse was the case at the stratopause where the variation was about 10° to 20°C. The variation of stratospheric temperatures had been found to be greater than in equivalent Northern Hemisphere latitudes. This could be due both to greater incoming solar radiation in the Southern Hemisphere and to geographical differences between the hemispheres.

A time section of zonal wind for Woomera showed the downward movement of summer easterlies. Also there was evidence of the quasi-biennial oscillation, with the stratospheric easterlies in 1962 being stronger than in 1963. This was consistent with ozone data from C.S.I.R.O.'s Aspendale station. A relationship between stratospheric wind and ozone had been established for the years 1957-1963.

Presenting a slide of four zonal wind profiles indicating interdiurnal variation in winter, the speaker pointed out the apparent negative correlation between the tropospheric and the stratopause westerly maxima. Results from a set of ten firings over a day at Carnarvon (W.A.) were presented and showed clearly the diurnal pressure and density variations. At 80 to 90 km, density changes of over 10 percent of ambient were recorded.

Some work has been carried out on the determination of molecular oxygen concentrations using ionisation chambers. Three ionisation chambers used in WRESAT were the lithium fluoride-nitric oxide gauge with a window in the 1050 to 1350 Å range, the sapphire-xylene gauge with its window in the 1400 Å band, and the quartz-triethylamine gauge in the 1600 Å band. Measurements of absorption in each particular band permit the determination of molecular oxygen concentration. Some results were presented from experiments involving rocket-borne gauges.

About two years ago an American Redstone rocket became available suitable for putting into orbit a small satellite and WRE was involved for almost a year in planning, designing and building the satellite which was named WRESAT. Exhaustive acceleration, shock, torsional and impact tests were carried out prior to the launch. The firing itself was an

achievement in many respects, notably:

(a) it was the first time that a satellite had been placed in orbit from Australia,

(b) success was achieved at the first attempt - a performance not elsewhere equalled,

(c) useful telemetered data were received until the batteries were exhausted, which occurred in accordance with the maker's specifications,

(d) the satellite was tracked worldwide by all the NASA stations, French stations in Africa and France, British stations in UK and the Falkland Islands, German university stations and posts in Brazil.

Reduction of the large amount of data is continuing at present. A film covering the more important phases of the WRESAT project completed the talk.

In subsequent discussion, the speaker was asked about the accuracy of the temperatures measured at 85 km. In reply Mr. Rofe said that the limiting factors were primarily the accuracies of the sphere drag coefficient and of the radar tracking system. About 5 to 10 percent was a realistic figure.

A member of the audience mentioned the apparent large diurnal temperature changes noted by W.L. Webb (U.S.A.). The speaker commented that the heat bulge of about 10-15°C at 2 p.m. local time near the stratopause was not confirmed by the Carnarvon measurements which indicated a diurnal variation of about 5°C.

Dr. Bourne said that echo sounder results indicated that there appeared to be a heat pool at about 73 km in the Southern Hemisphere. Mr. Rofe said that the explanation for the echoes probably lies in the existence of a temperature inversion at this height.

F.C.

13 November 1968

ACOUSTIC SOUNDING OF THE LOWER TROPOSPHERE

By L.G. McAllister

Mr. McAllister, Principal Officer of the Telecommunications Group, Weapons Research Establishment, Salisbury, S.A., stated that one of the problems in radiometeorology is to explain the anomalous radio propagation which occurs in a stable atmosphere, and the first difficulty encountered is in observing the profiles of temperature and humidity along the path. Acoustic sounding was expected to show low level inversion structures, with the advantage over other available techniques that it is adaptable to continuous display.

The first results at Salisbury were obtained with a centre-fed parabolic concrete dish 50 feet in diameter acting as transmitting and receiving antenna for 10 ms acoustic pulses at 950 Hz directed vertically once every two seconds, the echoes returned by the atmosphere being displayed against height and time through a facsimile recorder. The strength of the echo returned from any level is related to the turbulence and temperature gradients in the atmosphere. Mr. McAllister showed slides of sounder records which illustrated various atmospheric structures, including subsidence inversions at heights up to 5000 feet, surface inversions, and the Adelaide "gully wind" inversion with an apparent hydraulic jump.