Opposite page, top:
Three of the 27 identical radio telescope dishes which form part of the Very Large Array in New Mexico.

Opposite page, bottom:
Skylab silhouetted against the Earth. Astronomical observations, clear of the Earth's atmosphere, can be made from such a craft, as well as from small unmanned orbiting observatories carrying telescopes and ancillary equipment.

colleagues at Cambridge, England, where the **aperture synthesis** technique has been developed. Basically, this is a method of using an interferometer whose antennae can be spaced out at varying distances from each other so that, by making a set of observations at different spacings, it is possible to build up a radio 'picture' of a source equivalent to that obtained by a radio telescope with a huge aperture, equal in size to the area over which the antennae are spread. Thus, by using a series of small but movable antennae one can get the equivalent resolution of a vast instrument but not, of course, the equivalent sensitivity (the radio equivalent of light-grasp). Such radio telescopes take two forms: one in which there is one fixed antenna array and one moveable one, the other in which the antennae – one fixed and the rest moveable – are laid out in a straight line. In the latter, synthesis is achieved by the rotation of the Earth which sweeps the antenna system round. The 5-km instrument at Cambridge is an example of the second form, the results of this rotational synthesis being fed direct to a computer for analysis.

A recent development has been **long base-line interferometry**, where large dish radio telescopes have been used in pairs. Sometimes the distances have been measured in kilometres, but by recording the observations at each telescope and then analysing both together at a later date, it has been possible even to pair telescopes separated by intercontinental distances. With such extremely long base-lines it has been possible to obtain resolutions down to at least 0·001 arc sec. Using one radio telescope mounted in an orbiting spacecraft, even finer resolution should be possible.

The largest single array of telescopes is the Very Large Array (VLA) located on the Plains of St Augustin, near Socorro, New Mexico. Here 27 dishes, each 25 m in diameter, can be arranged in a vast Y-shaped configuration. With 24 possible positions on each arm and maximum separations of 19 km on the north, and 21 km on the south-west and south-east arms, resolution (which depends upon the observing frequency) can reach down to 0.13 arc sec. Dishes identical to those in the VLA form some of the elements in the British MERLIN (Multi-Element Radio-Linked Interferometer Network) array, which also uses the famous Mark 1A 76 m telescope at Jodrell Bank for some of the time. The maximum separation between MERLIN's telescopes is 135 km, and it can not only achieve a resolution greater than the VLA – down to about 0·1 arc sec. – but also can cover a wider range of frequencies.

Even greater baselines, spanning intercontinental distances, are possible with the technique of **very long base-line interferometry** (VLBI). Thanks to the use of atomic clocks for precise timing, signals may be recorded magnetically at each site and later combined, in just the same way as if the telescopes had been physically connected at the time. This technique has permitted radio astronomers to surpass their optical counterparts in resolution. Only with

Below: *The 300 m spherical reflector radio telescope at Arecibo, Puerto Rico.*