Opposite page, top: *A composite of three single-colour photographs of Mars made by Viking Orbiter 1, with south at top to assist recognition of surface relief. Part of the south polar cap can be seen, while frost covers the area between it and Argyre basin, which is itself beneath frost or haze. Vallis Marineris is recognizable towards the bottom, but water ice clouds cover the Tharsis volcanic region.*

Left: *Viking Orbiter 1 photomosaic of Vallis Marineris, the area covered being about 1 800 km by 2 000 km. The canyon system is 4 000 km long and up to 120 km wide and 6 km deep. Note how the depressions are extending along lines of structural weakness (bottom centre). General levels trend downwards towards the Chryse Trough which is out of the picture to the upper right.*

Due to the lesser density of the atmosphere, higher wind speeds are needed on Mars to transport particles (30–60 m per s) than on Earth (less than 10 m per s). The Viking Landers actually recorded speeds of only 10–20 m per s on the surface, but found much higher velocities higher in the atmosphere (100 m per s at about 10 km).

The major planet-wide dust storms all seem to originate in the southern hemisphere, but there is a strong tendency for the fine particles to be removed from the high cratered terrain and to be deposited on the lowlands, particularly on the northern plains. The erosive action of wind-borne particles can be seen in large areas of grooved and fluted surfaces all over the planet.

Winds have transported material towards the poles and formed two major sedimentary deposits, probably composed of mixed ice and dust, which cover older pitted terrain. One deposit is smooth and unlayered, but the other, on which the polar ice caps themselves are resting, is composed of numerous layers about 30 m thick, giving it a highly distinctive appearance (page 131, top left), and is known as **laminated terrain**.

Both types of deposit are apparently being eroded at the present time.

## Atmosphere

The Viking Landers have shown that the average surface pressure is $7{\cdot}4 \times 10^{-3}$ atmospheres and that the mean temperature is 230 K, with a summer maximum of about 265 K and a winter minimum close to 150 K.

Details of the atmospheric composition are given in Table 5·10, where it will be seen that the main constituent is carbon dioxide amounting to about 96 per cent. It is difficult to establish the amount of carbon dioxide and water which have been produced by loss of trapped gas on Mars, but the quantities seem to have been many, possibly hundreds of times less than on Earth.

Water ice forms the permanent polar ice caps and the majority of the clouds and fogs which are observed.

There has long been a debate concerning whether temperatures are low enough for carbon dioxide to freeze, but spacecraft measurements indicate temperatures as low as 125 K, so that the seasonal caps are probably formed of both water and carbon dioxide ices. Carbon dioxide ice is also present in some clouds at high altitudes and in the winter polar regions.

Opposite page, bottom: *Photomosaic of the channelled terrain west of the Viking Lander 1 site in Chryse Planitia. The slope is from west to east (left to right). Note that the channels cut some craters, but also have other, later craters superimposed upon them.*