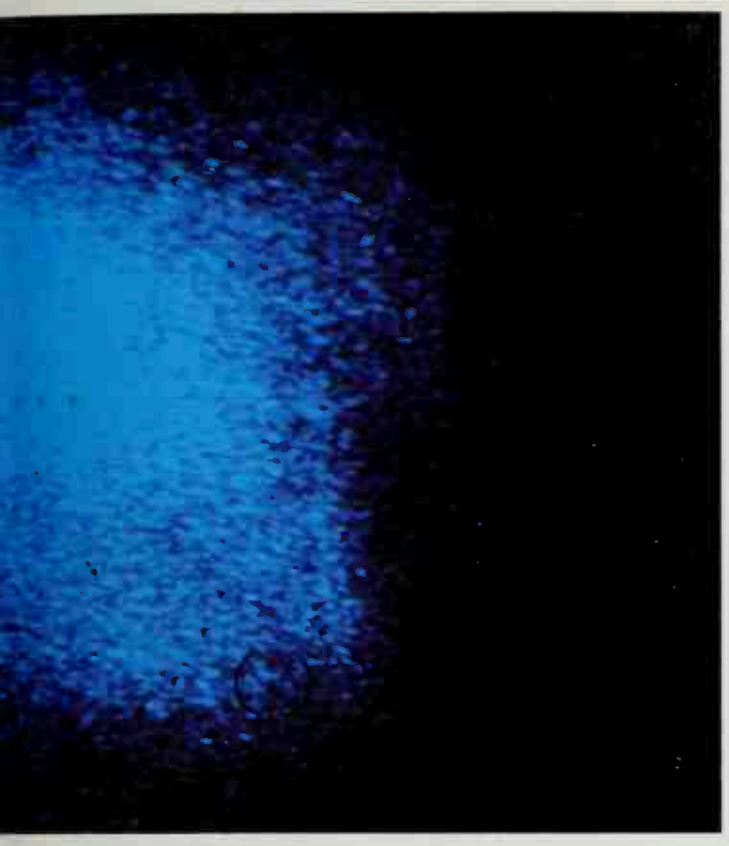

hole. Alternatively, the black hole could have a surrounding accretion disc as it consumes mass from its companion due to its gravitational strength. As the matter spirals towards the black hole, but well outside the event horizon, it will become heated and emit energetic radiation.

Examples of accretion disc processes are believed to account for various X-ray stars. Most have neutron stars as the collapsed component, but one particular source remains a mystery. This is Cygnus X-1, a strong and highly variable X-ray source (Fig. 3·28). The variations are non-periodic and range from flickerings of tenths of a second to flarings on a monthly scale. Optically, the object appears as a spectroscopic binary B star with a period of 5·6 days. When the mass of the unseen companion is calculated the answer turns out to be at least 6 $M_{\odot}$. If this is correct then it seems that the unseen companion must be a black hole. There remain some problems in assigning the mass however, and although Cygnus X-1 remains a good candidate for a black hole, another object known as LMC X-3 seems to be even more definite. Here, determination of the orbital velocity and period, and the perfectly normal appearance of the visible star (a B3 star of about 6 solar masses), suggest that the invisible component must have a mass of between 6 and 14 solar masses, most probably 9–10. A neutron star cannot exceed 4 solar masses, so that a black hole remains the only possibility.

Alternative means of detecting black holes lie in finding systems whose structure indicates the presence of a large amount of mass in a non-luminous region. Globular clusters, galactic nuclei and clusters of galaxies spring to mind as possible occupation regions. Because black holes are so bizarre and there seems every reason, in theory, to suspect that they do exist, it is tantalizing for astronomers to be still thwarted in attempts to observe conclusively even a single such object.

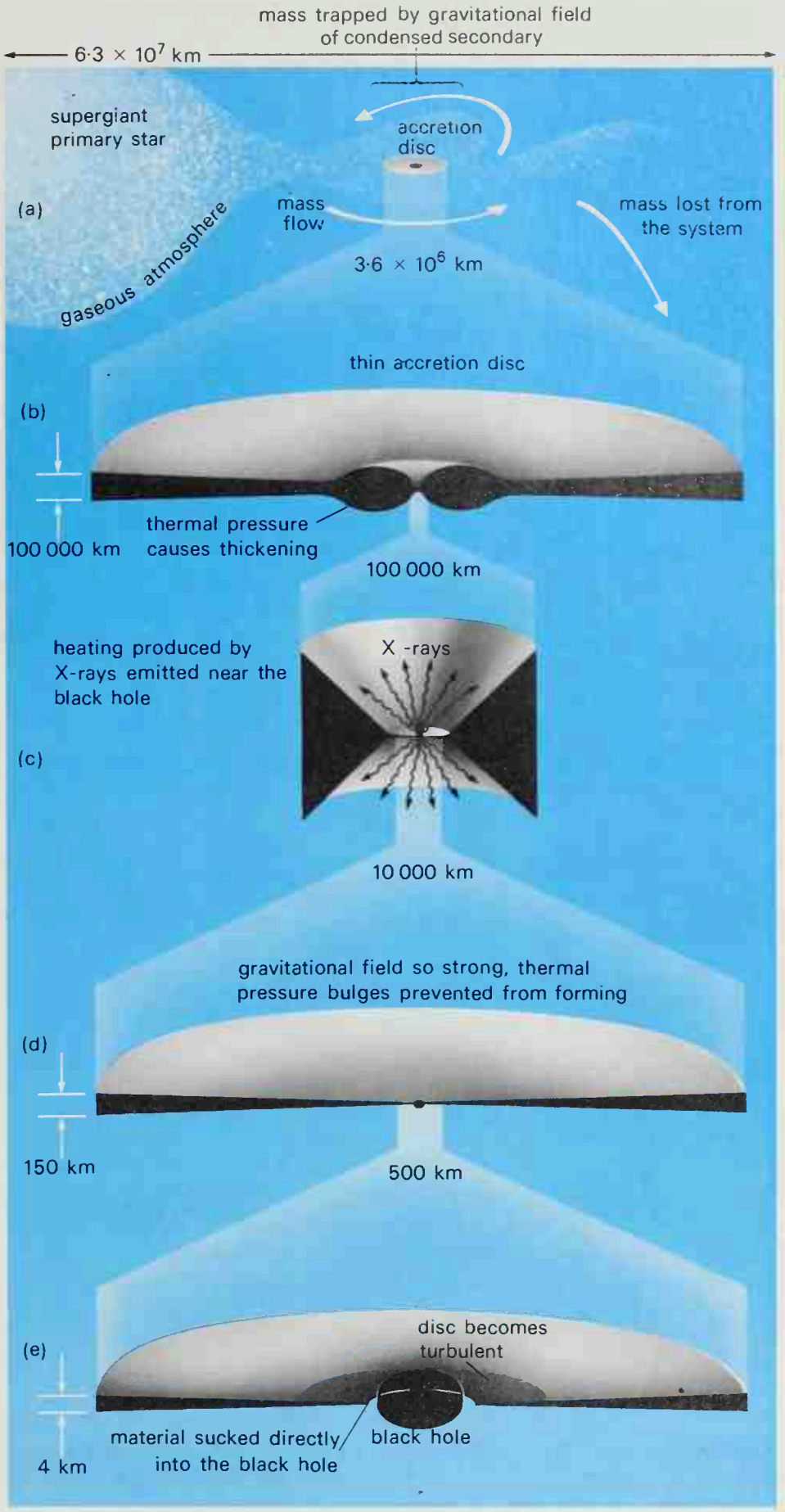

Fig. 3·28 A model of an accretion disc surrounding a black hole in Cygnus X-1. The gas pulled off the primary does not fall directly into the black hole but, instead, forms a circling accretion disc around it. This very flat disc is large in extent compared with the Schwarzschild radius of the black hole. The X-rays we observe probably emanate from only the innermost part (e) of the disc, where temperatures rapidly increase as material is eventually sucked into the black hole itself.