This computer-processed optical picture is of the Homunculus nebula and Eta Carinae, a massive star which may soon (astronomically speaking) become a supernova.

The Cepheids we have discussed are massive young stars (of Population I) and are referred to as **classical Cepheids**. Another type, **W-Virginis stars** (of Population II) are old, low mass stars and are intrinsically two magnitudes fainter than classical Cepheids with the same periods. They are in the helium-burning phase of their evolution and are found particularly in globular clusters.

RR-Lyrae type variables are conspicuous and very numerous members of globular clusters. These are also helium burning stars and their absolute magnitudes are all around +0·6 irrespective of their periods which range from 0·4 to 1·0 days. This is because they are all in the same phase of evolution with very similar age, mass and chemical composition. This constancy of absolute magnitude makes them ideal distance indicators for the older (Population II) regions of the Galaxy.

Ultra-dense cosmic bodies

Stars have a wide range of densities. The mean density of the Sun is $1{\cdot}4 \times 10^3$ kg per m^3 (1·4 times the density of water) and it is known that the density at the centre is over a hundred times greater. However, this is trivial in comparison with those we shall now explore. We saw that the end product of stellar evolution may be the formation of a condensed stellar remnant; perhaps a white dwarf following a planetary nebula phase of a red giant, or a neutron star via a supernova explosion. Both of these stellar bodies have incredibly high densiti , among the highest known.

There is a maximum density to which matter can be packed if it is to remain as atoms with nuclei surrounded by their electron clouds. Normal matter is mostly empty space, because, although the electron cloud occupies the volume of the atom, its mass is negligible compared with the protons and neutrons of the nucleus, each weighing roughly 2 000 times more than an electron. If the electron cloud was removed and the nuclei were squeezed together, they would repel one another because of their positive charges, and in doing so settle down to a new and stable configuration. They would then be at the density of nuclear material, about 10^{17} kg per m^3! This phenomenal density turns out to be that of a neutron star, the material of which, if packed into a match box, would weigh 2×10^{13} kg (the same as 2 000 million double decker buses). One could also achieve this density by compressing the entire Earth into a sphere of radius 200 m! Yet there is one further régime more extreme than white dwarfs and even neutron stars, and this is the realm of the black hole. We will now survey all these regions of ultra-high density in turn.