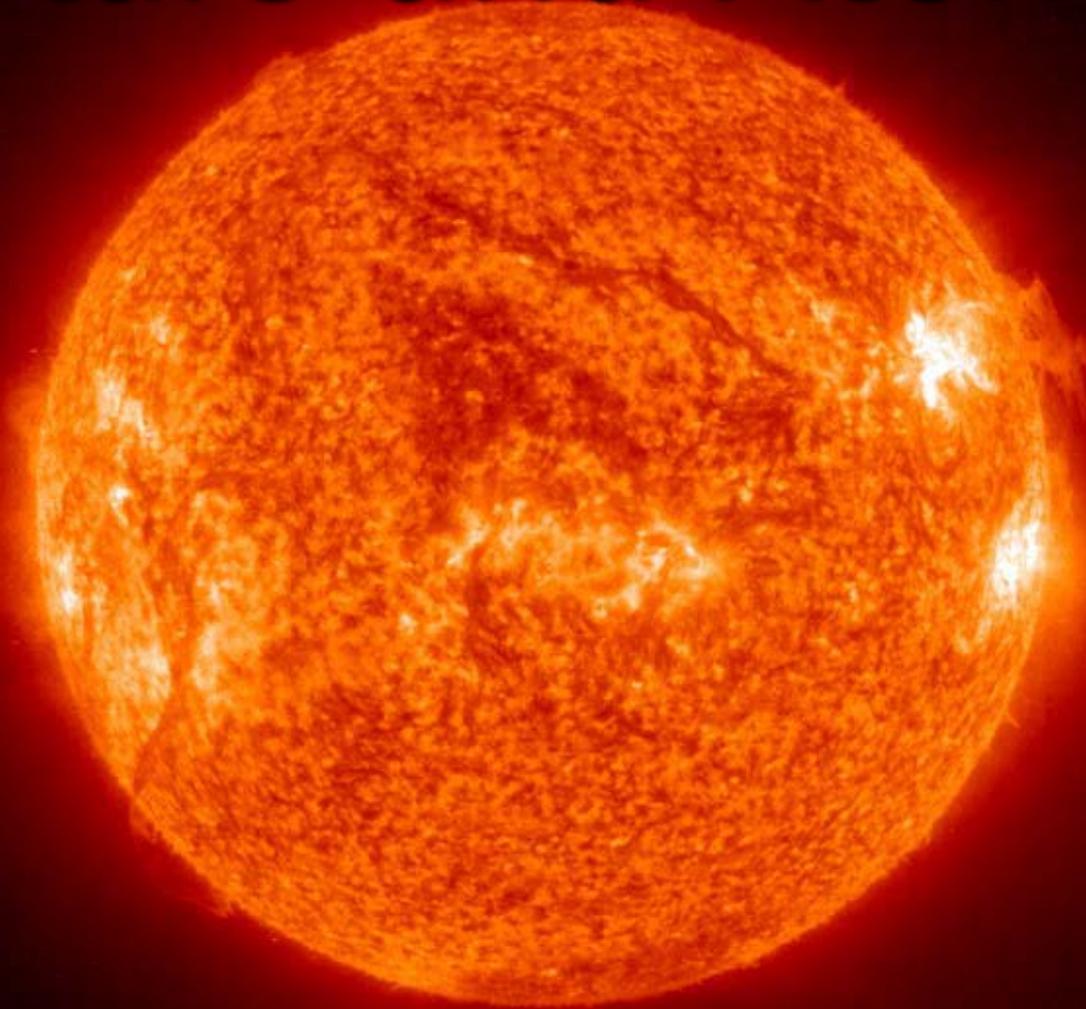


Stars and Atoms



Where did atoms come from?

The first atoms of hydrogen and helium were created during the big bang.

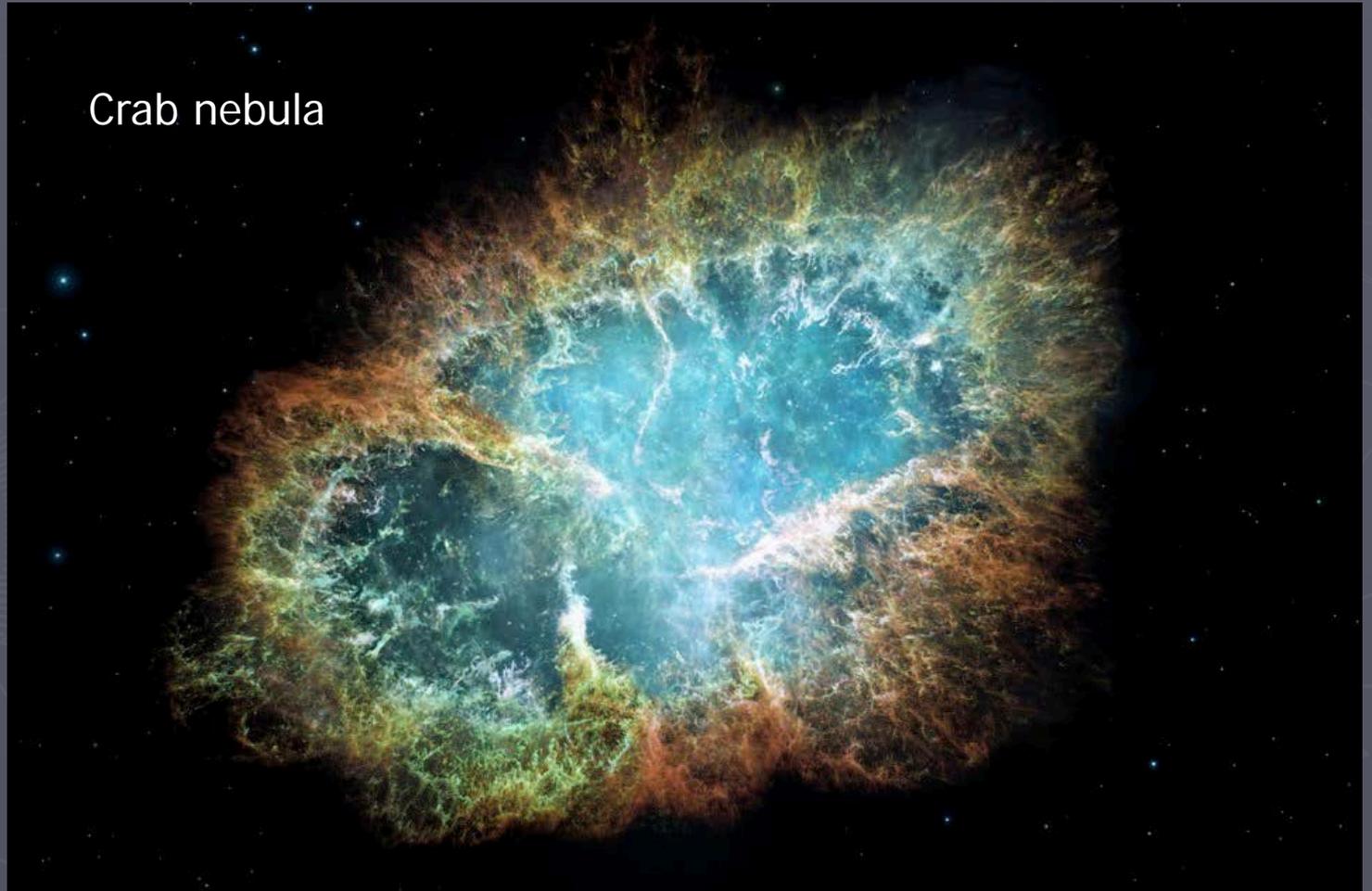


But what about the other atoms?

- Helium through Iron are made by fusion in the core of big stars.
- Fusion?
 - ▶ <https://www.youtube.com/watch?v=w1E15ka8Pm8> (stop at 1:30)
 - ▶ <https://www.youtube.com/watch?v=W1ZQ4JBv3-Y>

- ▶ Atoms larger than Iron are made when large stars die in a huge explosion called a super nova.

Crab nebula



Stars are the beginning of chemistry because they created atoms.

Therefore, we must understand a stars life cycle in order to understand the atom.

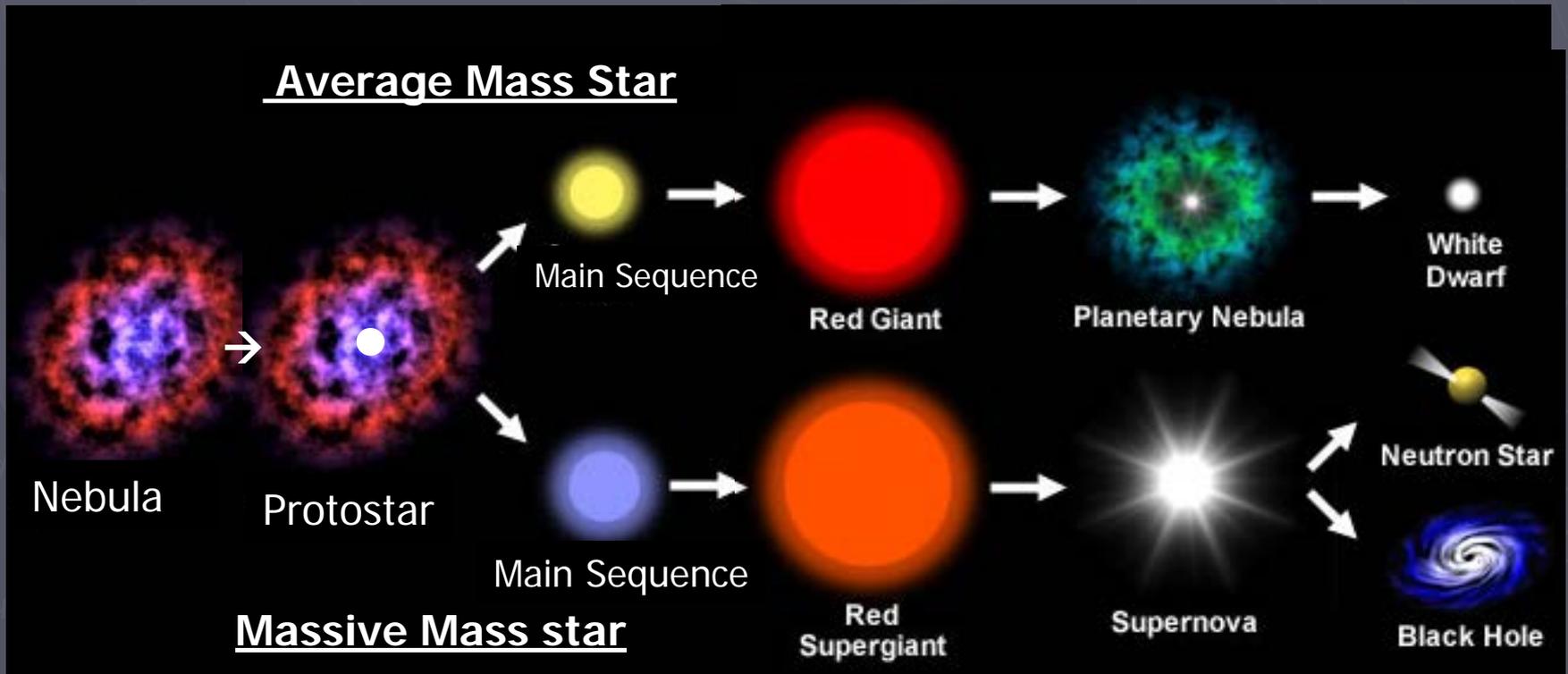
Stellar Evolution

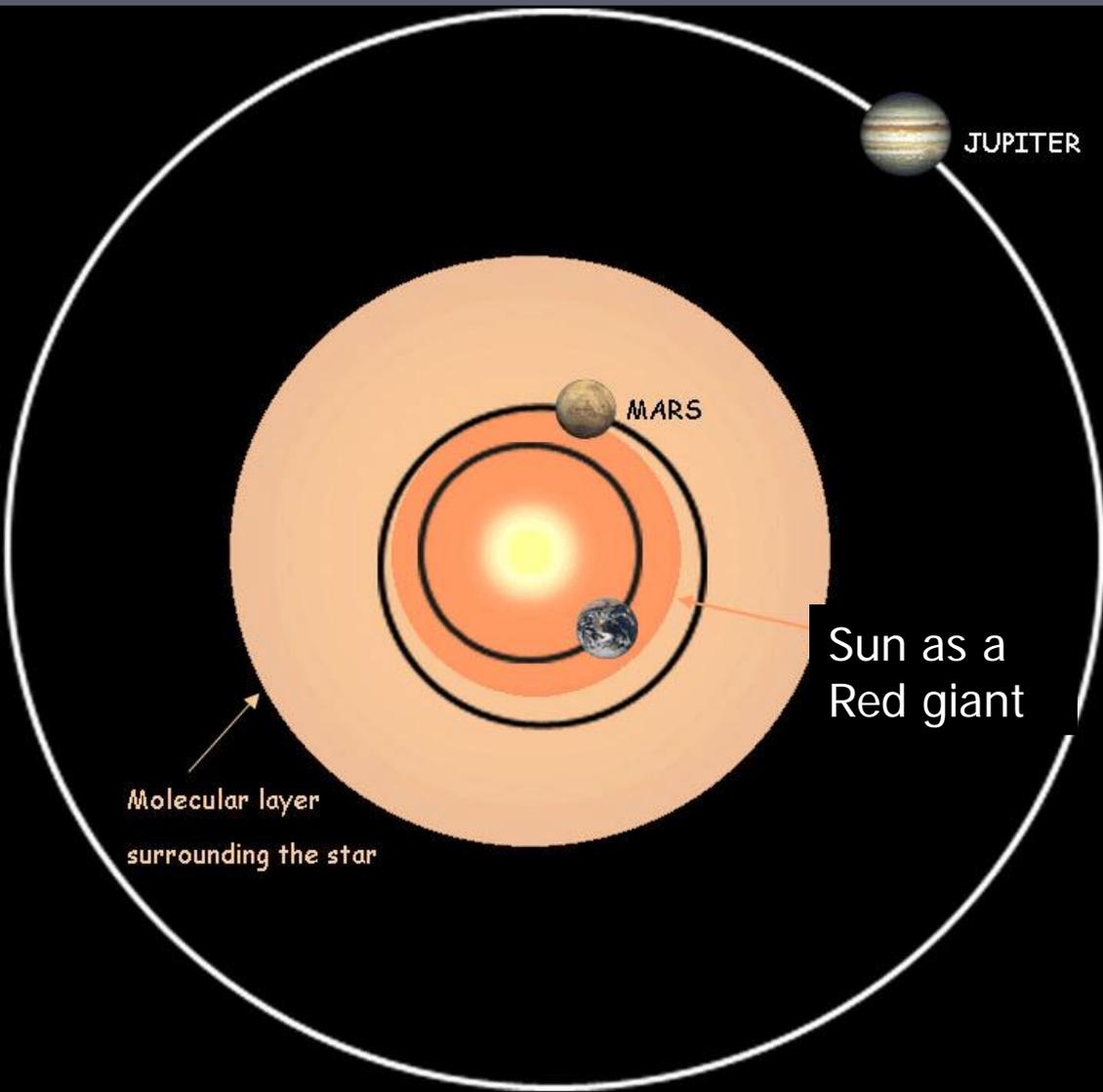
- ▶ Stars evolve over time--Birth to Life to Death
- ▶ The path they take depends on their **MASS!**



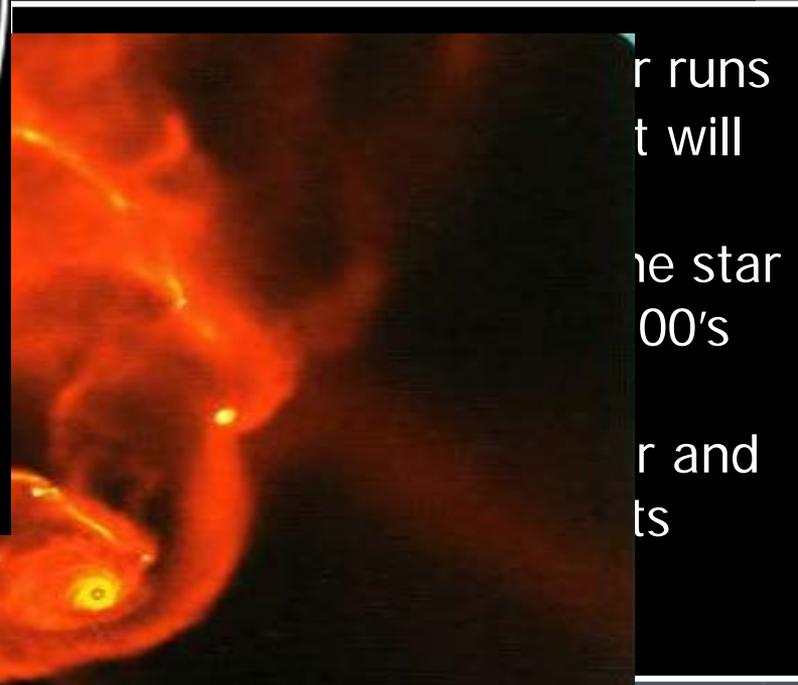
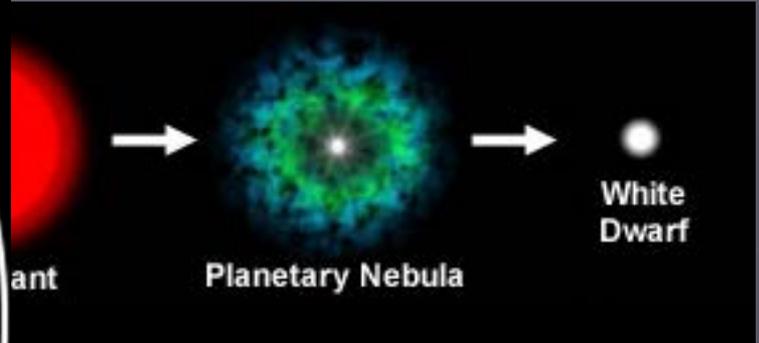
Star Clusters in the Large Magellanic Cloud

There are 2 paths that stars take based on their mass: 1) Average Mass 2) Massive Mass



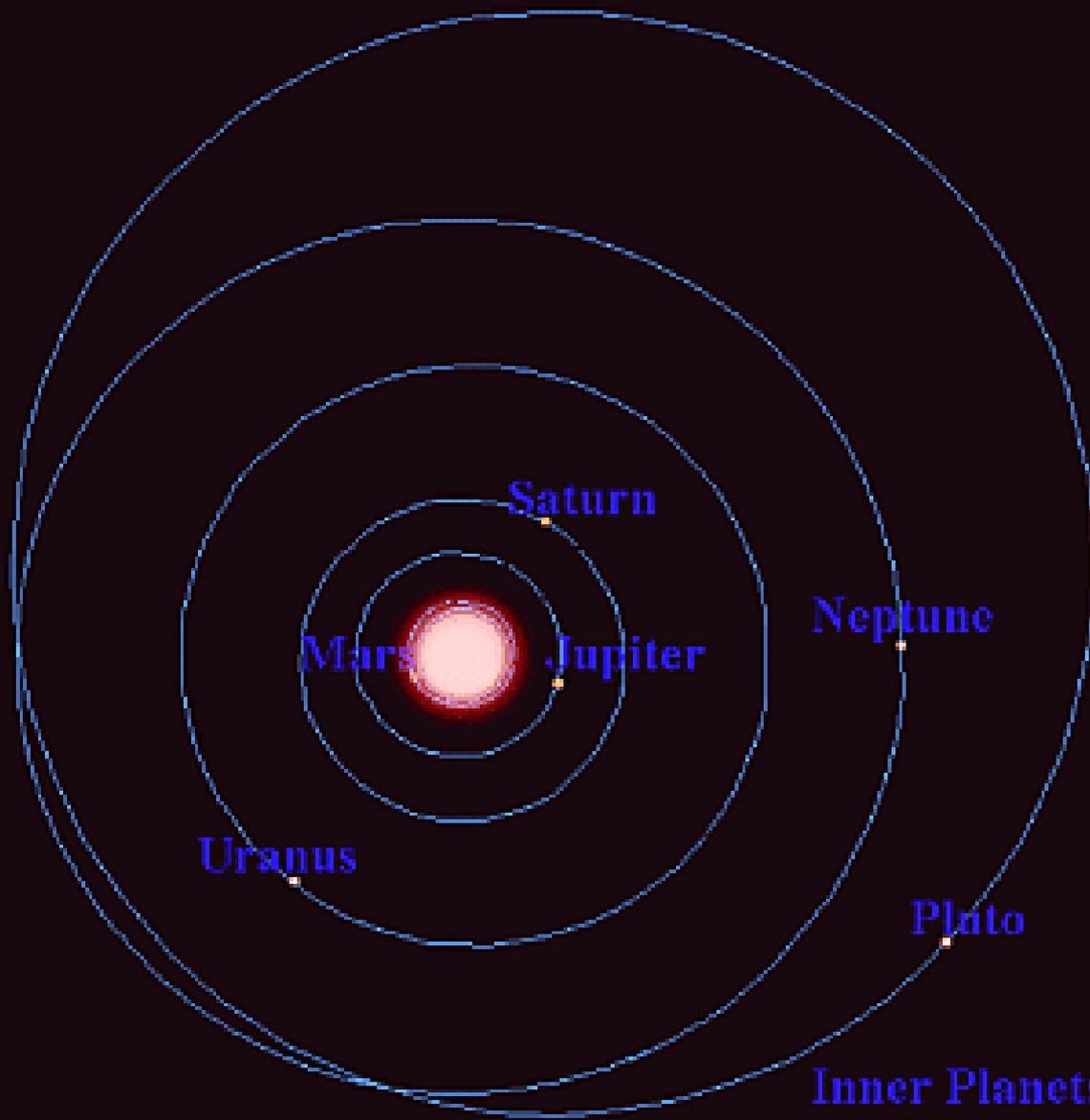


Star- SUN



A protostar 250,000 yrs after it began to form.

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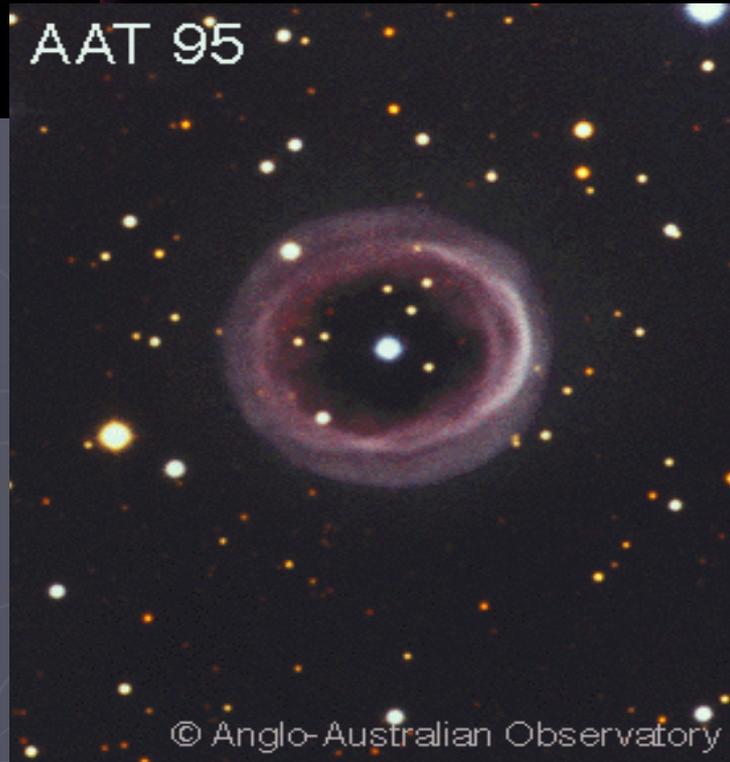
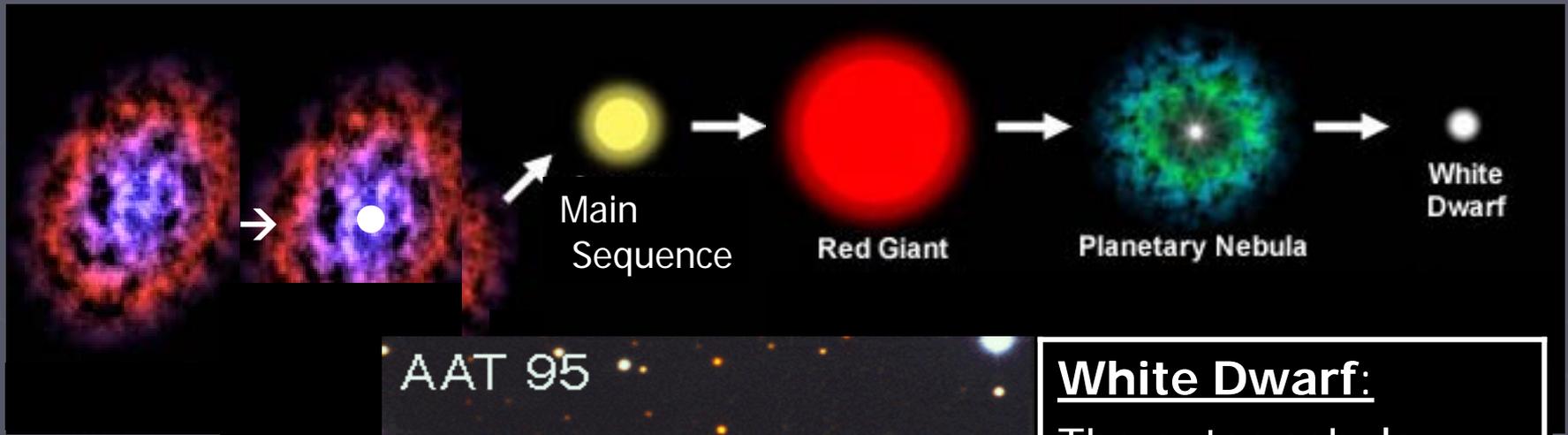
Solar System

@~scale

Inner Planets

- Mars
- Earth
- ~~Venus~~
- ~~Mercury~~

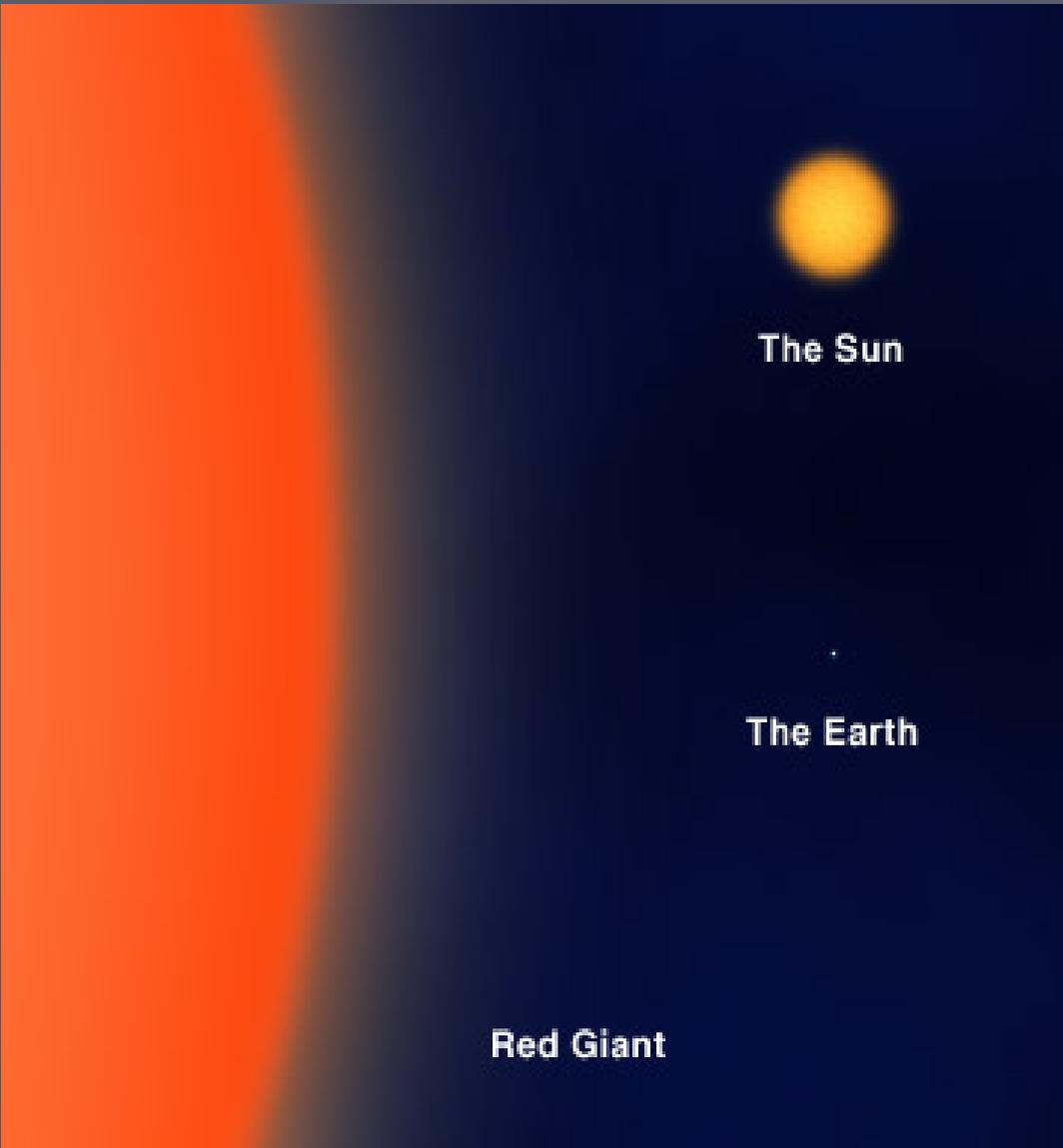
Average Mass Star- continued



White Dwarf:

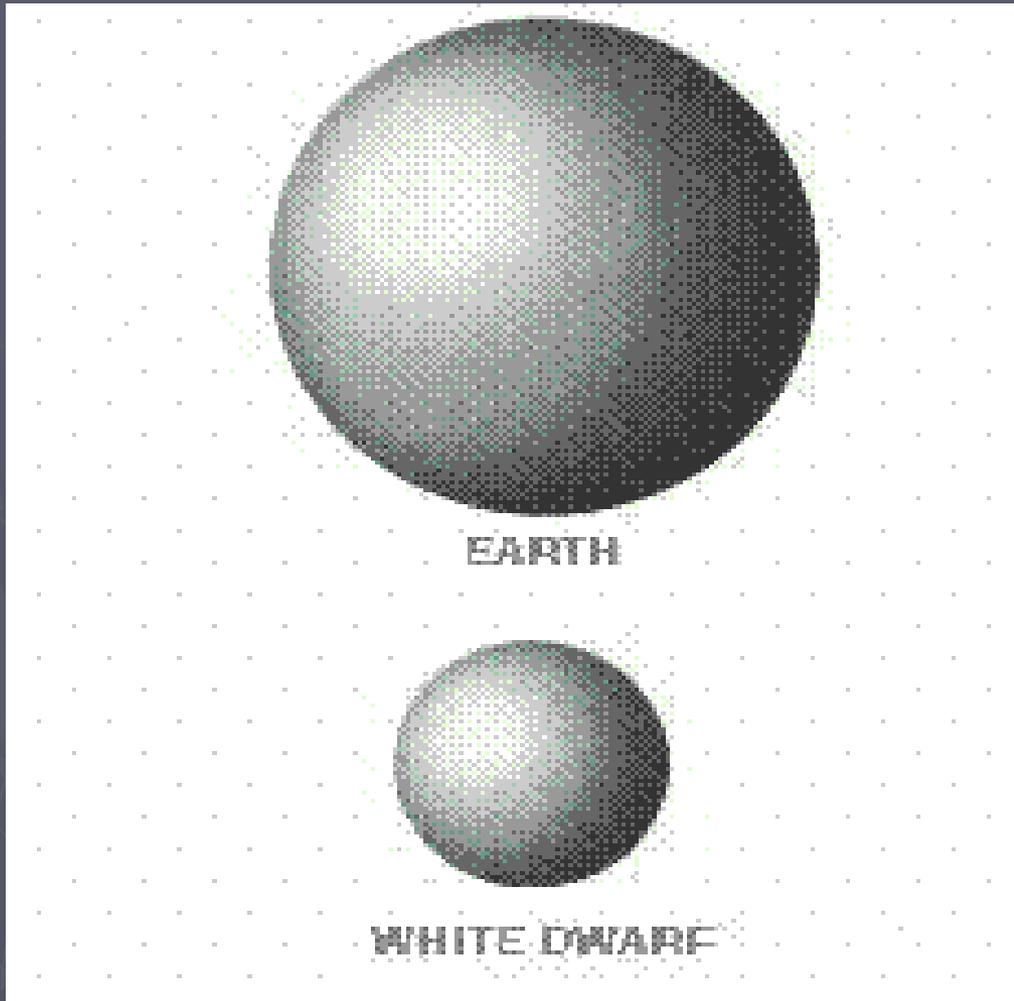
The outer nebula expands away & a small dense core remains. 300,000 times the mass of earth. It is very hot but very dim. Will eventually burn out and become a Black Dwarf.

The Sun –A Red Giant



- ▶ In 5 billion years the sun will be:
100 times bigger
& 2000 times brighter.
- ▶ The sun will engulf Mercury, Venus, & Earth.

How small is a white dwarf?

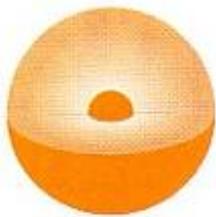


Smaller than earth!

Massive Star



Metallic core



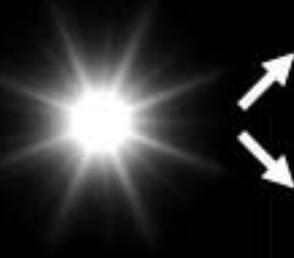
Core



Outer layers



Star explodes.



Supernova



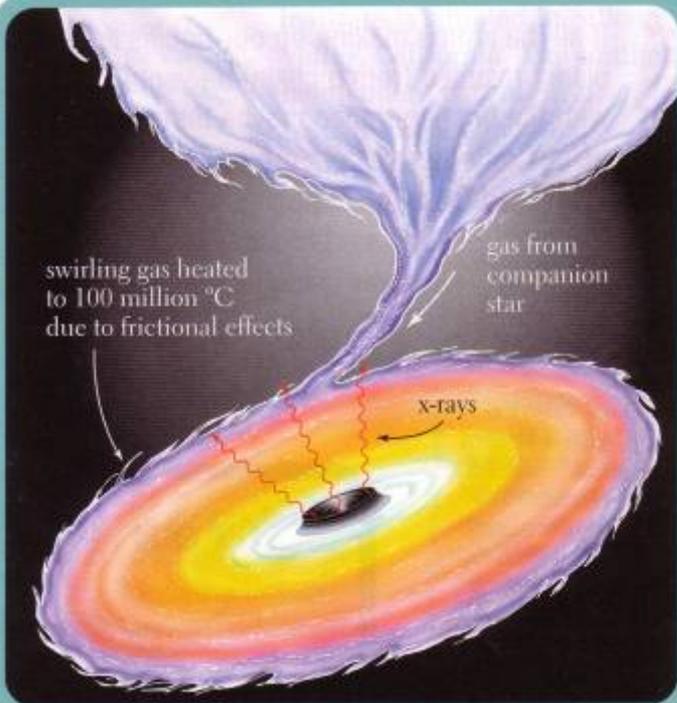
Neutron Star



Black Hole

A black hole near a companion star

Fig 3.3.6



Neutron Black Hole (forms is a star is times greater than 30 times the size of our sun)

If a star is massive enough, it collapses even more than a neutron star to form a black hole –

an object so dense that not even light can escape..(more later)

All stars take the same 1st 3 steps:

- 1) Nebula
- 2) Protostar
- 3) Main Sequence

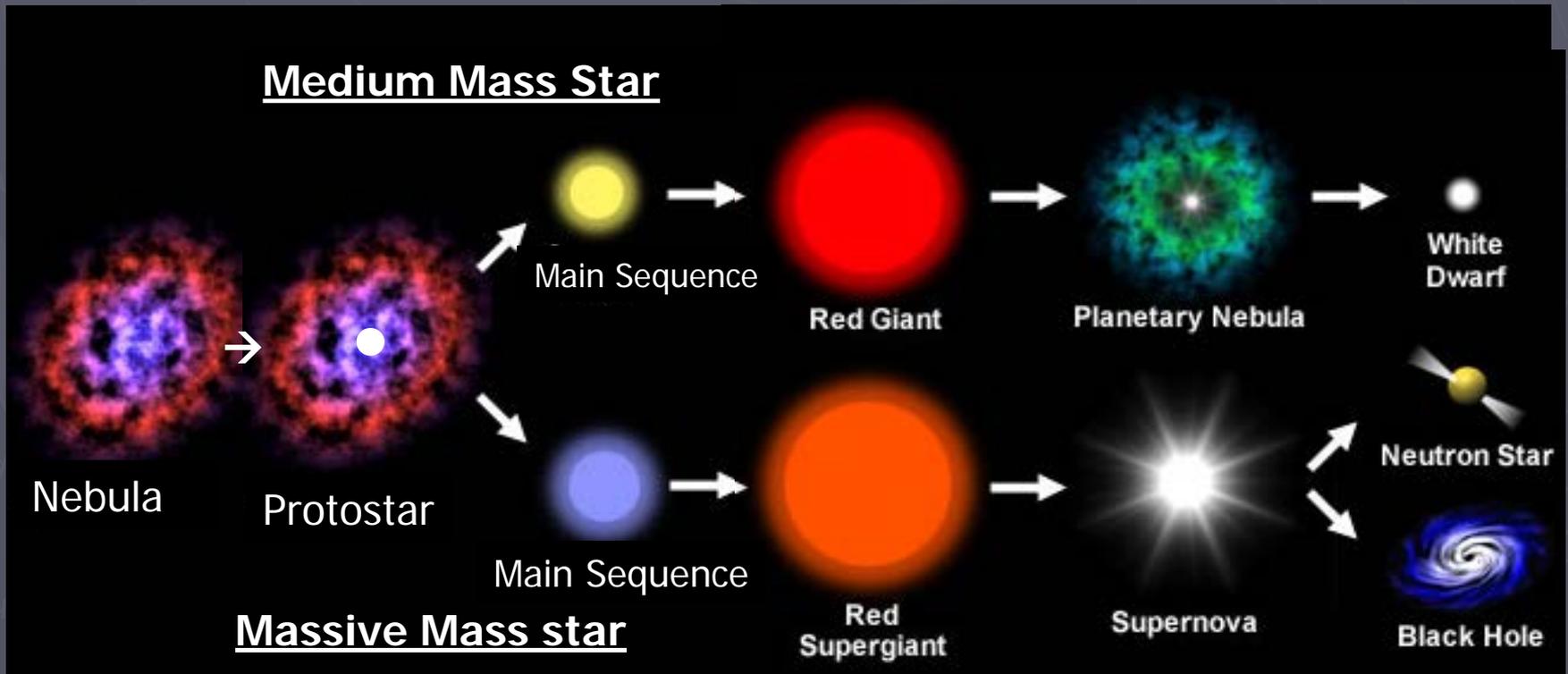


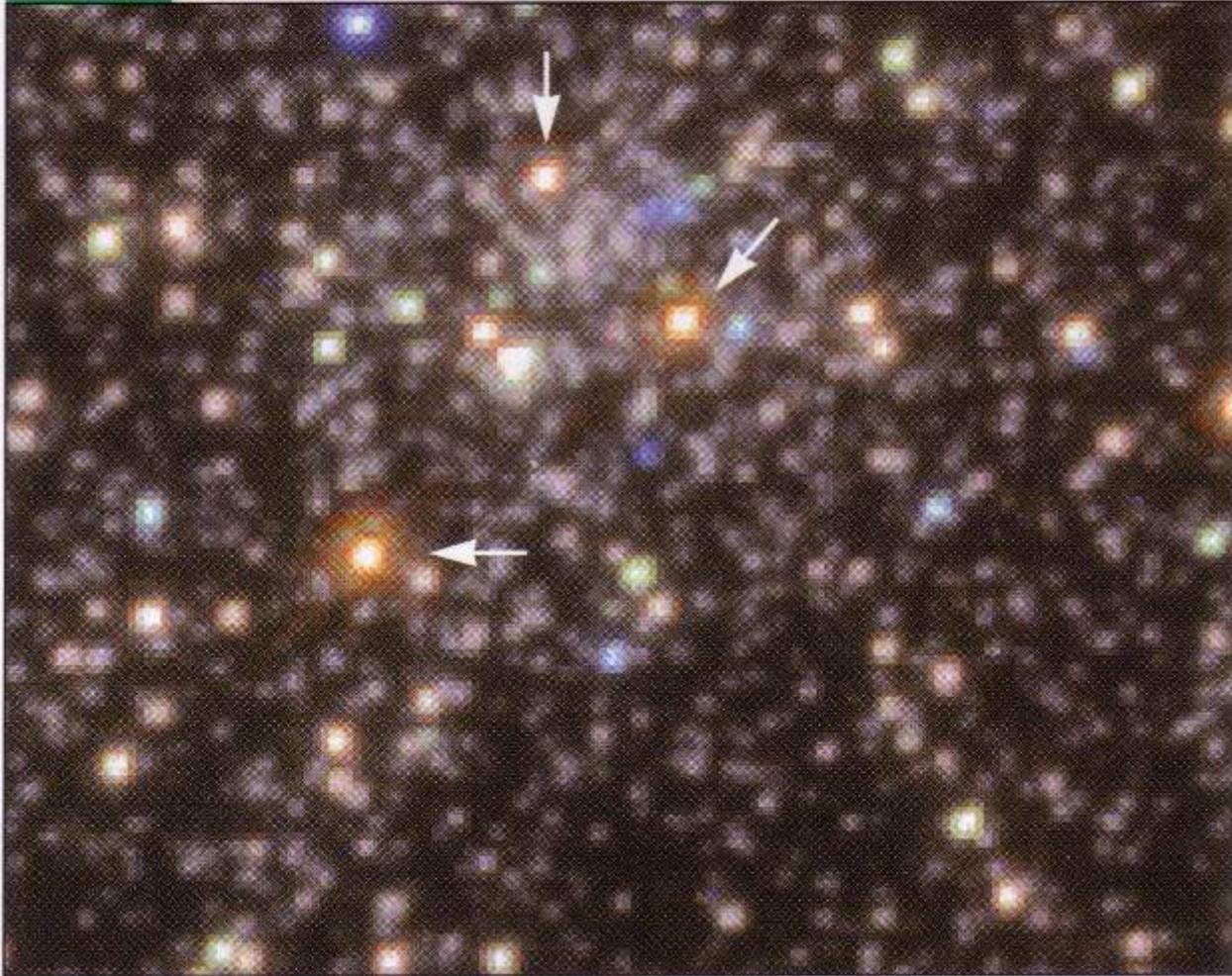


Fig 3.3.3

Optical image of stars in interstellar gas and dust. The star Antares (bottom left) is a red supergiant. It is several hundred times the diameter of the Sun and several thousand times the Sun's brightness.

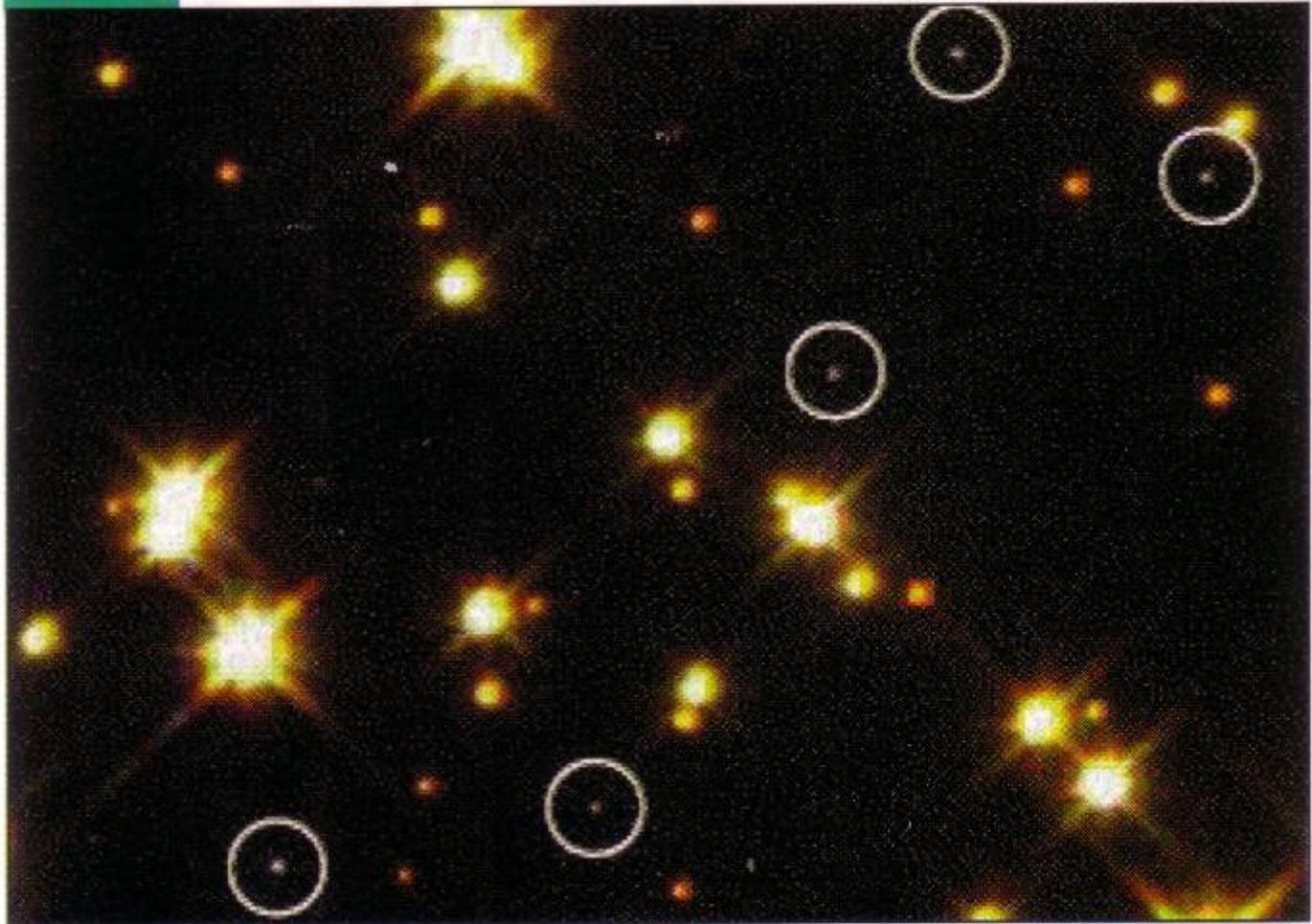
Red giants in M15. The photo is fuzzy because of high magnitude.

8.4B



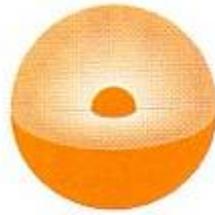
8.4D

White dwarfs in M13 have been circled.





Metallic core accumulates.



Core heats up.



Outer layers collapse on core.

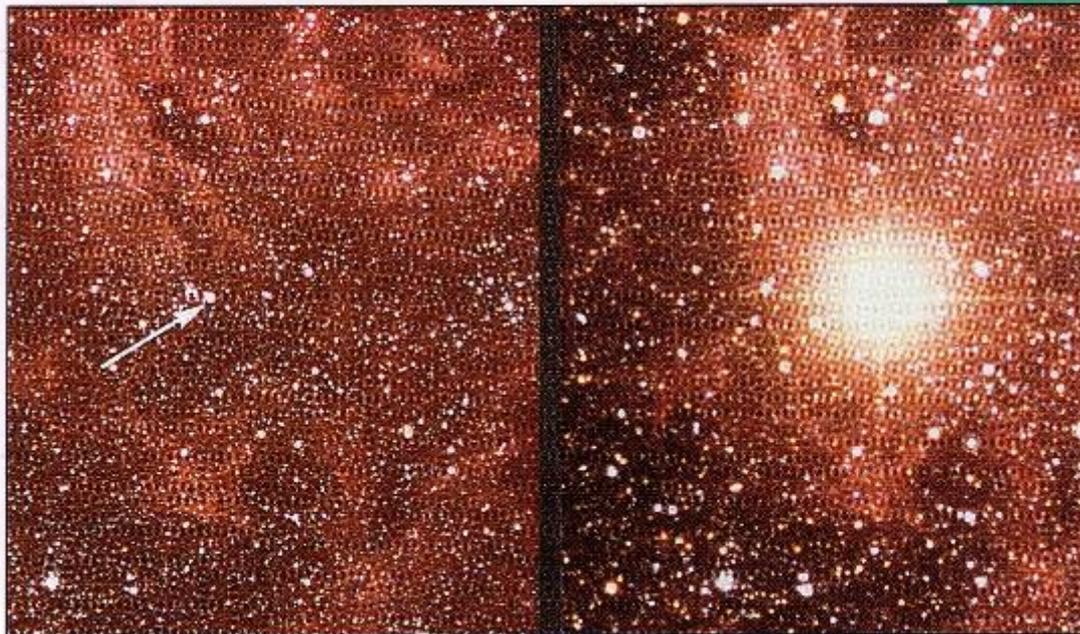


Star explodes.

FIGURE 10.9
A supernova explosion.

Supernova 1987A before and after it exploded.

8.3J



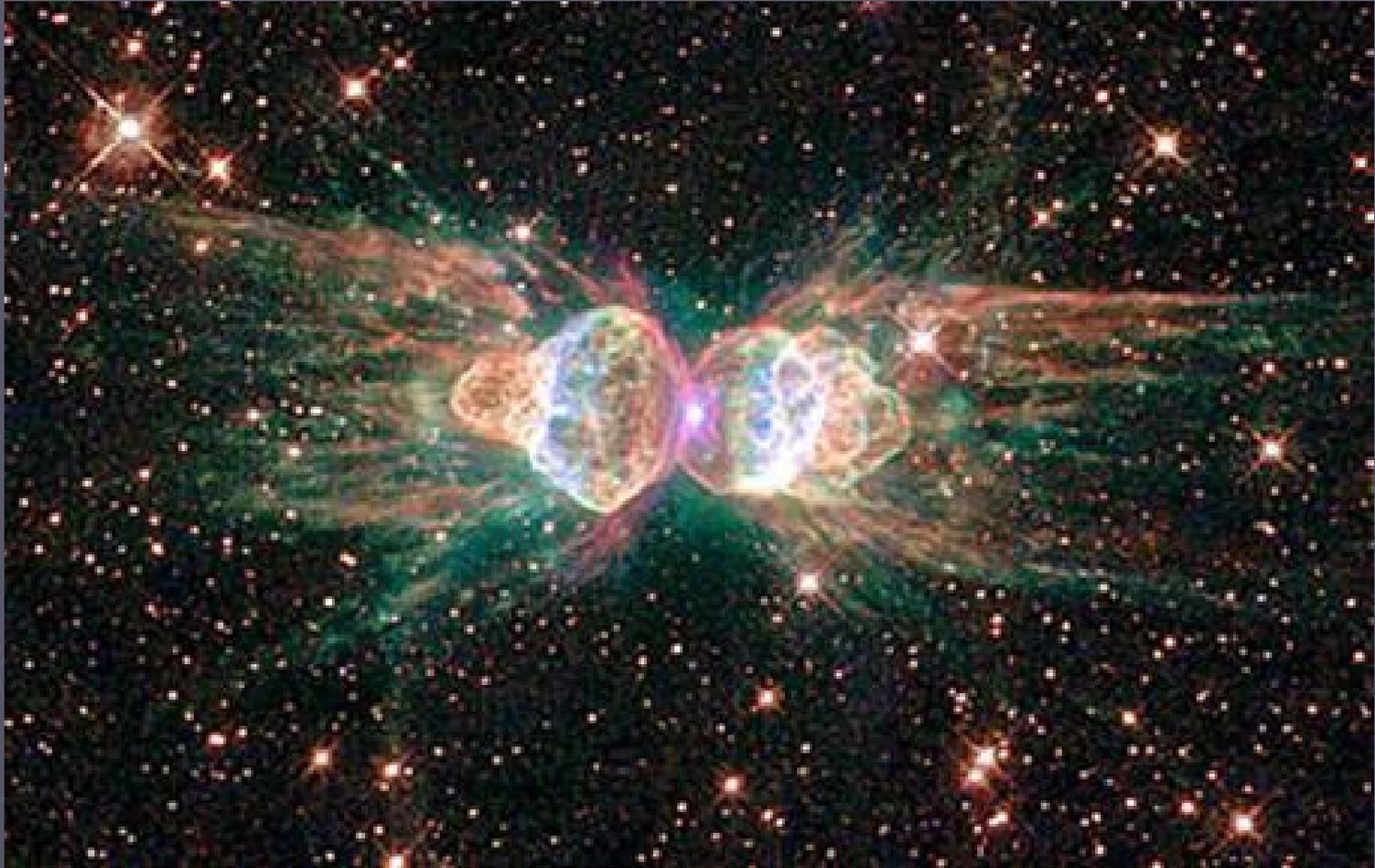
The following remaining slides
contain some images of nebulas
taken by the Hubble space
telescope



- ▶ THE TRIFID NEBULA. A 'STELLAR NURSERY', 9,000 LIGHT YEARS FROM HERE, IT IS WHERE NEW STARS ARE BEING BORN.



- ▶ THE PERFECT STORM, A SMALL REGION IN THE SWAN NEBULA, 5,500 LIGHT YEARS AWAY, DESCRIBED AS 'A BUBBLY OCEAN OF HYDROGEN AND SMALL AMOUNTS OF OXYGEN, SULPHUR AND OTHER ELEMENTS'.



- ▶ THE ANT NEBULA, A CLOUD OF DUST AND GAS WHOSE TECHNICAL NAME IS MZ3, RESEMBLES AN ANT WHEN OBSERVED USING GROUND-BASED TELESCOPES. THE NEBULA LIES WITHIN OUR GALAXY BETWEEN 3,000 AND 6,000 LIGHT YEARS FROM EARTH.



- ▶ NEBULA NGC 2392, CALLED ESKIMO BECAUSE IT LOOKS LIKE A FACE SURROUNDED BY A FURRY HOOD. THE HOOD IS, IN FACT, A RING OF COMET-SHAPED OBJECTS FLYING AWAY FROM A DYING STAR. ESKIMO IS 5,000 LIGHT YEARS FROM EARTH.