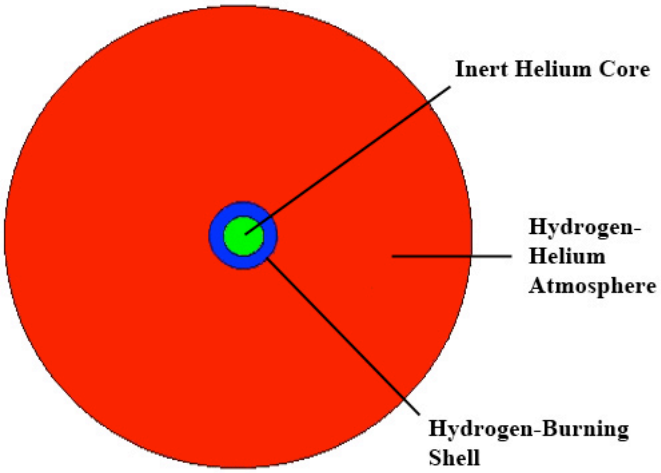
The illustration shows the Sun just after it has made the transition to shell burning. It has a very hot but inert helium core, surrounded by a very hot shell which is expanding as it burns the hydrogen around it ever faster. This version of the Sun will be very bright, anywhere from three to three thousand times as bright as the current Sun.



It is tricky to explain the reason why the atmospheres of stars "boil" outwards – and cool off in the process to a "red" or at least "orange" color – as the star gets brighter.

Let me put it this way. If the atmosphere of the star was *perfectly* transparent, then it would not boil outwards. The extra heat being produced by the star would just pass through it like light through a pane of glass, and that would be that.

But because the atmosphere does adsorb some of the radiation coursing through it, it begins to heat up as the star produces more energy. Now, your first instinct is probably to wonder why the gas doesn't getter hotter if that is the case, rather than cooler – and that instinct would be sound ***if*** the gas could be held in place somehow, perhaps by an imaginary glass globe surrounding the star. If it weren't allowed to expand, then heating the gas would make it hotter.

But, the gas *can* expand. So, it does. Heated gasses always expand if they can, which is why hot air rises. And as it rises, it must *lose* some of its energy, precisely because it is rising.

Let me explain that last statement.

If you throw a rock into the air, it will slow down (lose kinetic energy) as it rises because gravity is acting on it. A rising gas is no different, except that it is losing *microscopic* kinetic energy (the energy of each atom) as it expands. This means that it is losing heat, because the microscopic kinetic energy of atoms and heat are the same thing. Thus, the gas must cool as it expands and rises.

The bottom line, then, is that the atmosphere of a star which is getting brighter absorbs more heat, but it doesn't keep the heat. Instead it rises and "puts the heat into the bank", so to speak, by transforming the heat energy into gravitational energy. Thus the atmosphere simultaneously boils outwards but gets cooler, as counter-intuitive as that may seem.