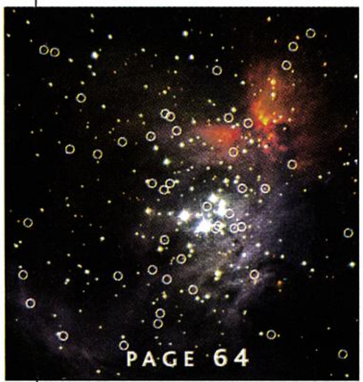
Great Balls of Fire

Eons before Jerry Lee Lewis recorded his ground-shaking 1957 tune "Great Balls of Fire," human beings were pondering the stars. Lewis's single (released, aptly enough, by Sun Records) revolutionized popular music and set three generations jumping and gyrating. Astrophysicists and astronomers have had their share of hits, too. Yet they are still learning the dance by which the real balls of fire in the night sky came into being. Did luminous matter in the universe start with a single star or with a cluster of stars? Did later stars come into being through variants on a common theme (such as the collapse of molecular clouds) or in a seething mosh pit of disparate forces and mechanisms? No one knows.

Still, progress is being made. In the past few years, advances in computing power and numerical techniques, as well as millions of stellar observations have improved our understanding of the mechanisms needed to initiate star formation, the physical and chemical environment in which stars form, and the evolution and clustering of stars in space and time over the history of the universe. This special section synthesizes and reviews what scientists have recently learned about star formation and what this knowledge can teach us about our solar system, other planetary systems, galaxies, clusters of galaxies, and large-scale luminous structure in the universe.



In perhaps the simplest scenario, a star of a few solar masses forms in isolation from other stars. Ward-Thompson (p. 76) reviews the first two stages of such stellar development, from the formation of a gravitationally bound core in a cloud dominated by molecular hydrogen to the collapse of this core under self-gravity. The trickiest part is getting the core to collapse to form a protostar despite interference from turbulence and magnetic fields. Recent simulations by Abel *et al*. (p. 93 and the accompanying Perspective by Rees, p. 51) and others suggest that a much more massive single star may have been the first luminous object in the universe to form by the collapse of a molecular cloud.

Pudritz (p. 68) reviews the formation of clusters of stars. Many experts think most stars form in clusters rather than singly, so that effects such as stellar winds and shock waves from nearby supernovae need to be considered in star-formation scenarios. Pudritz argues that the first stars formed in such turbulent cluster environments. The argument for simplicity gained force recently when astronomers synthesized data on the initial mass function; the spatial distribution of stars of a specific mass range in a given volume of space. Kroupa (p. 82) reviews the initial mass function for stars in a wide range of masses. He shows that all of them, regardless of their age or environment, have similar initial mass functions. This unexpected uniformity suggests that all stars form by some common mechanism.

To round out the section, News writer Robert Irion describes how two very different residents of the cosmic menagerie may shed light on broader processes of star formation. Brown dwarfs and other very-low-mass dim objects of uncertain origin are showing unexpected similarities to their more conspicuous stellar cousins. At the other end of the size and age scales lurk the ancient Population III stars; huge masses of pristine hydrogen and helium whose sheer simplicity may help astrophysicists unscramble their secrets.

There's more. An online supplement to this issue (www.sciencemag.org/feature/data/starformation/index.shtml) includes links to previous *Science* reviews, articles, and special issues related to star formation, as well as to a wide variety of other Web resources.

Star-formation researchers may still be waiting for the great hit single that will set their field ablaze, but *Science* readers don't have to wait. Ladies and gentlemen, let's rock and roll.

–LINDA ROWAN AND ROBERT COONTZ

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