Astronomy

Cosmological paradox in the dark of night

Why is the sky dark at night? At first glance, there seems nothing remarkable about the fact that the night sky appears basically dark, sprinkled with pinpricks of light from a scattering of planets, stars and galaxies. But this simple observation has important cosmological implications.

Early in the 19th century, German physician and amateur astronomer Heinrich Wilhelm Olbers argued that if stars were evenly distributed throughout space in an infinite universe, an observer looking far enough in any direction ought to see a star. Consequently, the entire sky should glow with starlight. The fact that this argument doesn't work and that the night sky is dark became known as Olbers' paradox, although Olbers wasn't the first to ponder the mystery.

Astronomers in the 1950s and 1960s, armed with observations of remote galaxies and intergalactic background radiation, zeroed in on two possible explanations. They argued that the finite age of galaxies, combined with the finite speed of light, limits the amount of light that galaxies have produced and how far out an observer can see. In addition, the expansion of the universe increases the volume of space and shifts to longer wavelengths any light emitted by stars.

Both the age and expansion factors contribute to the darkness of the night sky, but which factor has the greater influence?

In the Feb. 1 Astrophysical Journal, astrophysicist Paul S. Wesson of the University of Waterloo in Ontario presents new calculations demonstrating that the finite age of the galaxies—rather than the expansion of the universe—chiefly accounts for the resolution of Olbers' paradox. Wesson tackled the question after discovering that a number of textbooks still erroneously attribute most or all of the effect to the expansion of the universe. "Unfortunately, this topic has a long history of confusion which still persists," he says.

Using various models of expanding and static universes, Wesson calculated the expected intensity of the extragalactic radiation field at different wavelengths. Those calculations enabled him to separate the influence of the expansion of the universe from that of the age of galaxies. He found that for most reasonable cosmological models, expansion reduces the light intensity by too small a factor to account for the night sky's darkness. His work confirms previous calculations suggesting that the darkness of intergalactic space primarily results from the finite age of galaxies.

Wesson concludes that the intensity of intergalactic radiation would still be low even if the universe were static, and expansion reduces that intensity by only a relatively modest amount. In other words, the universe isn't old enough yet to have permitted light from many of the more distant stars and galaxies to reach Earth. This also implies that there was a time when the early universe lacked galaxies resembling those now observed, and that there has been no opportunity for filling the universe with visible radiation.

Rebirth of a radiotelescope

A 100-meter-diameter dish of a novel design will replace the 91-meter radiotelescope that collapsed suddenly on Nov. 15, 1988 (SN: 11/26/88, p.342; 4/29/89, p.269), say officials at the National Radio Astronomy Observatory at Green Bank, W. Va. The new telescope will feature an instantaneously adjustable surface to compensate for distortions caused by gravity, permitting astronomers to make observations at shorter wavelengths. Moreover, its fully steerable dish will be specially shaped to direct radio waves to the side, where a suspended receiver collects the signals without obstructing the dish. Construction is scheduled to start later this year on the site of the old telescope and should be completed in four years.

Earth Sciences

K-T wallop: Through the looking glass

Scientists who believe a meteorite slammed into Earth 66 million years ago are racking up considerable evidence in their favor, making it increasingly difficult to refute the theory that a catastrophic impact played some role in killing off the dinosaurs and many other forms of life at the end of the Cretaceous period.

This month, geologists report finding telltale evidence of such an impact: rounded pieces of glass in a Haitian rock layer dating to the time of the Cretaceous-Tertiary (K-T) boundary. The glass spherules, which range up to about 6 millimeters in diameter, have almost entirely crystal-free structures — an important feature because it allows scientists to determine how they formed. Glass drops created when meteorites strike Earth typically do not develop crystals, whereas those formed during volcanic eruptions always contain some crystals, note Haraldur Sigurdsson of the University of Rhode Island in Narragansett and his colleagues, who describe their discovery in the Feb. 7 Nature. The Haitian finds therefore support the theory that an impact, rather than intense volcanic eruptions, caused the K-T extinctions.

These specimens are among the oldest known glasses on Earth; such delicate structures usually don't survive for tens of millions of years. In the same issue of Nature, Jan Smit of the Free University in Amsterdam calls the Haitian fragments the "smoking gun" in the K-T drama.

The composition of the new finds reveals clues to where the meteorite or comet actually crashed, suggests that ground zero was a region of continental crust covered by a layer of limestone-like sediments. This kind of geologic fingerprint fits with several structures proposed as the K-T impact site, including a round feature on the northern end of the Yucatán peninsula, identified last year as a leading candidate (SN: 11/17/90, p.319).

Hundreds die in Afghanistan quake

The magnitude 6.8 earthquake that shook northern Afghanistan on Jan. 31 killed 200 to 400 people in that country and at least 300 in nearby sections of Pakistan, according to Waverly Person at the U.S. Geological Survey's National Earthquake Information Center in Golden, Colo. The shock also caused considerable damage and landslides in the bordering Soviet republic of Tadzhikistan, he says.

The quake struck in a mountainous region known as the Hindu Kush, which forms the western extension of the Himalayas. Originating 154 kilometers below the surface, the shock generated seismic waves felt as far away as Delhi, India, about 1,000 km from the epicenter. The Hindu Kush region is one of the few spots around the globe that commonly produce quakes at such depth, says David Simpson, a seismologist at Columbia University's Lamont-Doherty Geological Observatory in Palisades, N.Y. In other seismically active parts of the world, such as California, faulting generally occurs in the crust, the brittle layer forming the upper 30 or 40 km of the Earth. But the Afghanistan quake emanated from a spot in the underlying mantle, where rock is usually too hot and ductile to produce ground-shaking fractures.

What's special about the Hindu Kush? It lies in the middle of a geologic vise created by a collision between the Indian plate to the south and the Asian plate to the north. During an earlier stage of that collision, an ocean separated the two land masses, but the dense oceanic crust has since sunk down into the Earth as the two plates pushed together. Parts of the sunken crust have apparently remained attached to the plates at the surface, and Simpson suggests last month's earthquake occurred within one such section that sticks hundreds of kilometers down into the mantle.