Dim Galaxies Shed Light on Early Cosmos

Astronomers who probe the early universe use their telescopes like time machines, peering at galaxies near the edge of the observable cosmos. Since looking into deep space is the same as looking back in time, these distant, luminous galaxies would seem to offer the best opportunity to study the young cosmos.

But new evidence suggests that a group of faint, quiescent galaxies, less than 5 percent as distant, may serve as a Rosetta stone for understanding conditions in the very early universe. After lurking in the dark for billions of years, these massive, gassy structures appear to have only recently begun forming stars. Unlike the typical luminous galaxy, which has evolved dramatically since its birth, they seem to have been frozen in time, preserving several key features—such as low density and low metal abundance—since their creation.

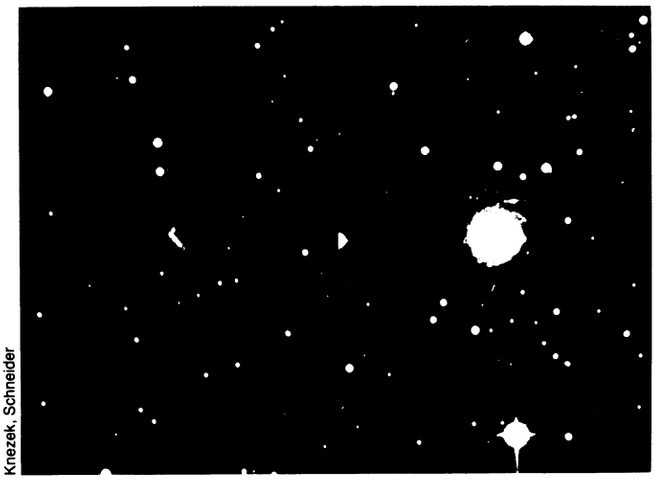
Two independent research teams presented the new evidence in Atlanta this week at a meeting of the American Astronomical Society.

As recently as 1989, astronomers had identified only a few of these "low-surface-brightness galaxies," although some speculated that many more existed (SN: 7/22/89, p.60). That hunch has now proved correct: While scanning photographic plates from a new sky survey conducted at Palomar Observatory, James Schombert of the California Institute of Technology in Pasadena identified about 500 previously unseen low-surface-brightness galaxies. Analyzing visible-light emissions from 24 of these galaxies, Stacy S. McGaugh of the University of Michigan in Ann Arbor and his colleagues found that their oxygen, neon, sulfur and nitrogen concentrations ranged from one-tenth to one-fiftieth of those in the Milky Way.

Since all galaxies start out with hydrogen and helium as their sole chemical constituents, generating heavier elements only through the birth and death of stars, McGaugh says the low concentrations measured by his group indicate that the dim galaxies produced their first glimmers of starlight sometime in the past few hundred thousand years.

The 24 galaxies, whose diameters average about one-tenth that of the Milky Way, represent a crazy quilt of objects lying between 30 million and 500 million light-years from Earth. In contrast, a group of 300 galaxies recently discovered by Patricia M. Knezek and Stephen E. Schneider of the University of Massachusetts at Amherst lie farther from Earth, with diameters ranging from three to 100 times that of the Milky Way.

Since these giant galaxies were too dim to find on visible-light images, Knezek and Schneider used the radio telescope at Arecibo Observatory in Puerto Rico to home in on regions containing ionized hydrogen—an indicator of new starbirth. They then photographed the newly found structures with light detectors known as charge-coupled devices.



Knezek, Schneider

Visible-light images depict newly discovered dim galaxy (far left) and a typical luminous galaxy (near left), about equally distant from Earth.

As researchers continue to find faint galaxies, some astronomers speculate that the universe may harbor billions of them. If so, says McGaugh, these galaxies may account for a significant amount of "dark matter"—the missing mass needed to explain the evolution of large-scale structure in the universe. The cold-dark-matter theory, which holds that some dark matter takes the form of exotic material that interacts only with gravity, predicts that low-surface-brightness galaxies should reside in the empty spaces between clusters of luminous galaxies, McGaugh notes. But so far, the distribution of the dim bodies does not follow that pattern, he says.

The low gas density of the faint galaxies — about one-twentieth that of the Milky Way — may shed light on other cosmic mysteries, he adds. For instance, McGaugh speculates, this density may represent the smallest primeval "lumps" in the smooth broth of the early universe. Such lumps may have helped trigger the expansion of the cosmos. S. George Djorgovski of Caltech disagrees, arguing that the dim galaxies actually evolved over billions of years, and thus would not constitute ancient, pristine galaxies.

McGaugh suggests that all galaxies went through an early phase characterized by diffuse gas and low abundances of elements heavier than helium. But what prompted the faint galaxies to remain dormant for so long? The low gas density may have been too tenuous to coalesce into stars, he postulates. And unlike most luminous galaxies, these dim galaxies reside in isolation, lacking neighbors that could provide the extra gravitational tug needed to convert gas into stars, Knezek says.

The intense blue of the faint galaxies poses another puzzle, Knezek notes. Blue light typically connotes a lack of metals, which absorb those wavelengths, and the presence of young, massive stars, which radiate at those wavelengths. But the radiation emitted by such stars readily ionizes hydrogen gas, and researchers have found few ionized regions in these galaxies, Knezek observes. One possibility: The galaxies may undergo a unique kind of star formation that has gone undetected in other galaxies. —*R. Cowen*

Dyslexia: New twist on 'word blindness'

A new scientific study challenges the traditional view of dyslexia as an all-or-nothing phenomenon. Instead, the new data suggest that this reading disorder occurs in a spectrum of cases ranging from mild to severe.

"Dyslexia is currently envisioned as a discrete entity—either you have it or you don't," says Sally E. Shaywitz, a pediatrician with the Yale University School of Medicine in New Haven, Conn. But data collected by Shaywitz and her colleagues indicate that "dyslexia is much more like hypertension, occurring along a continuum with gradations or degrees," she told SCIENCE NEWS.

Dyslexia, also known as "word blindness," is broadly defined as the failure to read at expected levels. Dyslexic children exhibit normal intelligence and often perform well in other academic areas such as mathematics. Yet these children have difficulty translating strings of letters into verbal utterances. Thus, a dys-

lexic child will repeatedly stumble over common words in a frustrating attempt to read a simple passage.

To find out more about how children learn to read, Shaywitz and her colleagues designed a project called the Connecticut Longitudinal Study. The researchers randomly selected 24 kindergarten classes during the 1983-1984 school year and then kept track of these youngsters from first through sixth grade. Kids took intelligence tests in grades 1, 3 and 5 and reading achievement tests yearly. The diagnosis of dyslexia was reserved for children whose reading ability fell far below the level predicted from their intelligence test scores.

Using statistical techniques, the researchers found that variations in discrepancy scores — a measure that takes into account reading achievement and intelligence — followed a bell-shaped curve. Scores for dyslexic children tended to appear toward the end of the curve, but there was no natural cutoff point separating dyslexic children from those with normal reading skills, Shaywitz says.

A well-known study reported in 1970 had suggested that discrepancy scores for dyslexic children appeared as a hump at the end of the curve — quite separate from the rest of the data points, Shaywitz notes.

Instead of depicting dyslexia as a fixed condition that doesn't change over time, the new data indicate that a child's reading ability can vary widely, especially during the early school years. For example, only seven of the 25 children classified as dyslexic in first grade got the same label again in the third grade. And fewer than half of the third graders diagnosed as dyslexic kept that label when retested in the fifth grade. Of the first graders diagnosed with dyslexia, only one in six still had that label by the time they reached the sixth grade.

Children who test adequately one year but fall behind the next may escape the notice of educators, Shaywitz says, noting that many schools offer special reading classes only to children who test poorly at one specific point in time.

Shaywitz believes that system is flawed. "It may be that because of administrative and budgetary constraints, school administrators need to establish a cutoff point for determining who is eligible for special help," she says. "But people will have to realize that such a cutpoint is arbitrary and that children who fall on the other side of it may still require and benefit from special help."

The current system may not flag children with very mild learning disabilities, adds Peter B. Rosenberger, a pediatric neurologist with Massachusetts General Hospital in Boston.

"If you have a bright kid who is only reading at grade level and his teacher says there's nothing wrong with him, this study offers evidence that you should be concerned," Rosenberger contends. Very intelligent children often read well above their grade level, he notes.

While a mild difficulty with words may pose no particular difficulties in the third grade, sluggish reading can trip up students later, especially if they are college-bound, says Rosenberger, whose editorial on the Shaywitz study appears along with the research report in the Jan. 16 New England Journal of Medicine. Many dyslexic children who receive coaching overcome their difficulties, he adds.

At the same time, the disorder can be tricky to diagnose — or even define. Although educators look for a gap between reading ability and IQ score, such a gap may not always indicate dyslexia, says Reid Lyon of the National Institute of Child Health and Human Development in Bethesda, Md., which funded the Shaywitz study. In some cases, intelligent youngsters may not excel in reading — just as some bright people can't sing or hit a tennis ball well, Lyon notes.

— *K.A. Fackelmann*

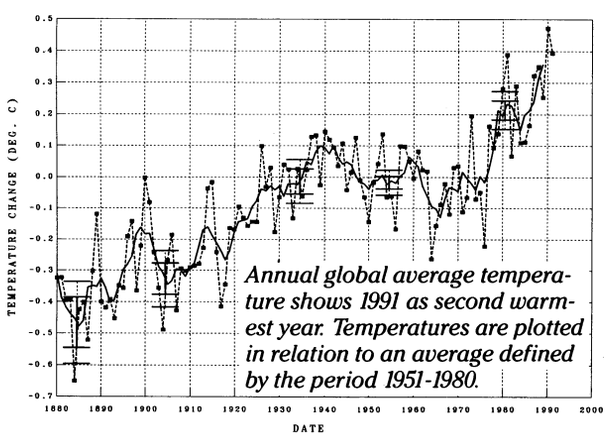
Pinatubo and El Niño fight tug of war

January is a month made for breaking New Year's vows and for assessing how the climate behaved over the previous year. According to analyses presented last week by two research teams, Earth's average temperature in 1991 ranks as the second highest on record, continuing a pattern of global warming that emerged during the 1980s.

"Although it is still too early to link the recent concentration of warm years with the influence of increasing greenhouse gases, international scientific opinion strongly supports the reality of the greenhouse effect, and it is likely that this has played some role in contributing to the recent warmth," concludes a group of climate researchers from the United Kingdom Meteorological Office in Bracknell and the University of East Anglia in Norwich.

The U.K. group analyzed both land and sea-surface temperatures measured around the globe, while a separate team from NASA's Goddard Institute for Space Studies in New York City focused on measurements from land stations.

The British researchers' analysis shows 1991 finishing 0.05°C cooler than 1990, which was the warmest year in their 140-year-long record. The NASA investigators found last year 0.08°C below 1990, which holds top position in their 111-year-long record.



Annual global average temperature shows 1991 as second warmest year. Temperatures are plotted in relation to an average defined by the period 1951-1980.

NASA

Balloon measurements taken in the lower atmosphere at 63 sites around the world also show 1991 as a warm year. In this 33-year-long record, 1991 qualifies as the fourth warmest, coming in close to 1988 and 1983, the second and third top years, says James K. Angell of the National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Md.

In all three data sets, 1991 started off very warm in comparison to other years, and then cooled in the second half of the year, in part, perhaps, because of the eruption of Mt. Pinatubo in the Philippines last May. After the eruption, researchers predicted that sulfur gases from the volcano would block out sunlight, cooling the climate for a few years (SN: 8/31/91, p.132). James Hansen of the Goddard Institute says the volcanic cooling should reach its maximum strength later this year and next year.

Global temperatures may not drop excessively in 1992, however, because an El Niño warming in the Pacific Ocean will mitigate the cooling, says Hansen. The El Niño has been growing in the equatorial Pacific since last summer (SN: 12/14/91, p.389), and NOAA scientists formally announced its existence this week.

Caused by oscillations in the ocean and atmosphere, El Niño events push warm water from the West Pacific toward the East Pacific, raising temperatures across the ocean. In December, the patch of abnormally warm water had spread along the equator one-quarter of the way around the globe. The El Niño may intensify over the next few months, but should run its course by the end of the year, says Vernon E. Kousky of NOAA in Camp Springs, Md.

— *R. Monastersky*