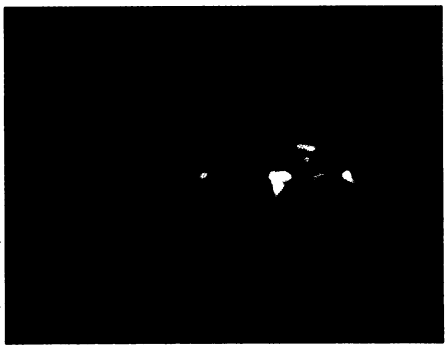
SCIENCE NEWS of the week

Ill-Fated Milky Way Neighbor Found



Ibata, Gilmore, Irwin

False-color image of newly discovered dwarf galaxy. Foreground stars from our galaxy have been removed in this enhanced image. Elongated galaxy appears divided into two main clumps.

Peering through a veil of dust and scattered starlight, English astronomers report finding the closest known galaxy to our own. The faint galaxy, a dwarf resident of the constellation Sagittarius, appears to lie just 50,000 light-years from the Milky Way's center. The Large Magellanic Cloud, until now considered the Milky Way's nearest galactic neighbor, lies more than three times as far.

In addition to its proximity, the Sagittarius dwarf has other intriguing properties, says Michael J. Irwin of the Royal Greenwich Observatory in Cambridge, England. The galaxy's clumpy, elongated shape suggests that the Milky Way's gravity has already stretched it considerably, he notes. Over the next few hundred million years — a blink of an eye, astronomically speaking — our galaxy will most likely devour the dwarf and gravitationally steal its stars, Irwin adds.

Theorists have proposed that the Milky Way and other galaxies evolve through such cannibalism. Observations of the newly discovered galaxy may allow astronomers to see such activity "right in our own backyard," Irwin says. The finding also suggests that the Milky Way has captured other small satellite galaxies in the past and that their remains await detection.

Irwin and colleagues Rodrigo A. Ibata and Gerry Gilmore of the University of Cambridge reported their findings this week at a joint meeting of the Royal Astronomical Society and the European Astronomical Society in Edinburgh.

Early this year, Ibata approached Irwin with a puzzle. A group of stars that Ibata had assumed were part of the Milky Way's bulge — the region surrounding the galaxy's center — were receding from Earth much faster than stars known to reside there. Spectra of this stellar group, taken over several years with the Anglo-Australian Telescope in Coonabarabran, revealed that they all had about the same velocity and weren't moving at the same rate as stars in the bulge.

Irwin suspected that the star group might in fact belong to another galaxy, perhaps a previously unidentified satellite of the Milky Way. To check this, the Cambridge team examined red and blue photographic plates of the Milky Way and its surroundings taken with the U.K. Schmidt Telescope in Coonabarabran.

The team found that the region containing the puzzling star group had several features in common with the eight galaxies known to be tiny, spheroidal satellites of our galaxy. For example, both this patch of sky and the satellites contain a large population of bloated, middle-aged stars and a substantial number of older stars about to end their lives as compact objects called white dwarfs.

Based on this evidence, "I immediately jumped to the conclusion that this was a dwarf spheroidal galaxy," Irwin says.

The Milky Way's dwarf satellites shine about one-hundred-thousandth as brightly as our galaxy. The newly discovered Sagittarius dwarf lies about 75,000 light-years from the sun and radiates about as much light as 20 million to 100 million suns, a luminosity roughly halfway between that of two classic dwarf satellites, Sculptor and Fornax. The Sagittarius dwarf lies on the opposite side of the galactic center from Earth, making observations a challenge.

To determine the dwarf galaxy's shape and extent, the team had to estimate the amount of light from foreground stars in the Milky Way and subtract it. Stretching across a 10° patch of the southern sky like a giant comet tail, the low-density dwarf galaxy currently recedes from us at 153 kilometers per second.

The team suggests that the galaxy is still on its first orbital pass around the Milky Way. The dwarf's low density and elongated appearance indicate that it can't resist the Milky Way's gravitational tug much longer, Irwin says.

"If the team is right, we're seeing the final stages of the demise of an entire galaxy," comments astrophysicist Douglas N.C. Lin of the University of California, Santa Cruz. Lin also notes that this galactic gobble promises to occur far more quickly than the gradual eating away of the Large Magellanic Cloud that he described last year (SN: 6/12/93, p.374).

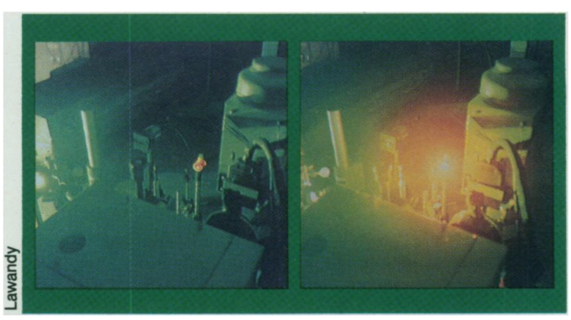
Lin calls evidence for the Sagittarius dwarf compelling but not definitive. However, he notes that its apparent location coincides roughly with that of a puzzling group of globular clusters, densely packed collections of stars. Such clusters rank among the oldest groupings of stars in our galaxy, but these particular ones appear slightly younger. If these globulars actually belong to the Sagittarius dwarf rather than the Milky Way, it could account for the age discrepancy, Lin says.

In that case, the Milky Way should soon claim the clusters for its own.

— R. Cowen

Boosted light: Laser action in white paint

There's nothing like a coat of fresh paint to brighten up a room. But you wouldn't expect an intense, room-filling glow to emanate from the paint.



Lawandy

A green laser pulse excites a pure dye dissolved in a liquid to make the solution light up (left). A laser pulse of equal intensity sent into the same dye mixed with tiny particles of titanium dioxide suspended in a liquid produces a much stronger, room-filling glow (right).

Now, researchers have discovered that certain dyes, when dissolved in a liquid also containing tiny particles of titanium dioxide (a key ingredient of white paint), generate light similar to that produced by a laser. In essence, the randomly distributed titanium dioxide particles act together to amplify light emitted by dye molecules that are excited by a laser or some other external energy source.

"It was quite startling to see this," says physicist Nabil M. Lawandy of Brown University in Providence, R.I. Lawandy and his coworkers report their discovery in the March 31 NATURE.

The researchers already have a number of applications in mind for their "paint-on laser," ranging from display screens to the removal of discolored skin resulting from tattoos or birthmarks.

Normally, lasers require a source of energy, a material — such as a ruby rod or a liquid dye — that can be induced to emit light, and a resonator. In its simplest form, a resonator may consist of nothing more than a pair of mirrors at either end of the lasing medium. Light bounces back and forth between the mirrors to stimulate the emission of additional radiation, building up the emitted light into a strong beam.

Lawandy and his colleagues dispense with the mirrors. They use green laser light having a wavelength of 532 nanometers to excite molecules of a rhodamine dye dissolved in methanol. The dye in turn emits orange light with a wavelength of 617 nanometers. Adding titanium dioxide particles, averaging 250 nanometers in diameter, to the dye solution greatly amplifies the emitted light.

The surprise is that a medium containing particles that reflect light in all directions can somehow amplify the emitted radiation. Generally, fabricators of lasers go to a lot of trouble to make the lasing medium as uniform as possible, eliminating any impurities or inhomogeneities that might scatter light and degrade the laser's performance.

"As lasing and disorder appear to be incompatible, it would seem to be folly to attempt to promote lasing by deliberately introducing scatterers into a medium," Azriel Z. Genack of Queens College of the City University of New York in Flushing and J.M. Drake of Exxon Research and Engineering Co. in Annandale, N.J., comment in the same NATURE. But that's precisely what Lawandy and his colleagues accomplished.

It isn't clear yet why a suspension of titanium dioxide particles in a liquid works effectively as a resonator and amplifier. Lawandy and his collaborators are now conducting several experiments that may lead them to a theory of how this effect occurs.

Although the light that emerges from dye-laced white paint appears as a general glow rather than a definite beam, it still retains several characteristics of laser light, including intense emission over a narrow range of wavelengths. This laserlike behavior could lead to advances in such areas as laser medicine and display technology, Lawandy says.

For example, dermatologists use an array of lasers operating at different wavelengths to treat and remove various types of skin discolorations. Lawandy envisions the development of a cream or gel containing an appropriate dye that could be applied to the affected area and then excited to generate an intense burst of light of just the right wavelength to erase the mark.

It may also be possible to get similar laserlike behavior out of a porous solid lasing medium, Lawandy says. Applied as tiny dots on the inside surface of a television tube, such materials, when excited, could generate intense light of precisely defined colors to create bright, vivid displays. *— I. Peterson*

Reservoir linked to deadly quake in India

The earthquake that killed 10,000 people in India last September struck within 15 kilometers of a reservoir filled just 2 years earlier. That proximity in time and space seems more than coincidental to two U.S. seismologists who propose that filling the reservoir may have set off the quake.

Scientists had previously documented cases in which reservoirs induced sizable quakes in India, China, Africa, and the United States. Four of these matched or exceeded the strength of last year's tremor, which measured magnitude 6.1. But none of the previous shocks linked to reservoirs killed as many people as the September tremor, which leveled more than 20 villages near the city of Latur.

Leonardo Seeber and John G. Armbruster of the Lamont-Doherty Earth Observatory in Palisades, N.Y., presented their controversial theory in Pasadena, Calif., this week at a meeting of the Seismological Society of America. In support of the hypothesis, they note that Earth's crust in this part of India is extremely old and normally stable. Local records show no sign of earthquake activity until a year after the Killari reservoir was filled, when residents began noticing small tremors. The main quake followed these preshocks a year later.

"That doesn't prove [the connection]. But the timing favors this hypothesis, as does the location," says Seeber, who visited the region of the epicenter in the weeks following the quake.

Filling a reservoir can trigger a tremor in two ways. The weight of the water can stress the crust underneath, causing it to crack. Or water can seep down into old faults near the reservoir, lubricating rock on either side of the fault and enabling these crustal blocks to slip.

Seeber and Armbruster's arguments have not convinced other seismologists who have studied the Latur earthquake. Pradeep Talwani, an Indian-born seismologist at the University of South Carolina in Columbia, has investigated numerous reservoir-induced quakes. After visiting the epicentral region last year, he concluded that the Latur shock does not fit the pattern observed in other examples of reservoir triggering.

Talwani and others point out that the Killari reservoir was only 10 meters deep at the time of the quake, whereas most reservoirs that spark large quakes measure 100 meters or more in depth. "This was essentially a puddle compared with most cases of reservoir-induced seismicity," Talwani says.

He also focuses on the unusual pattern of foreshocks and aftershocks. When reservoirs set off large quakes, they usually trigger a "swarm" of many small tremors that begin before the main jolt and continue long after. Although the Latur quake did have preshocks, they did not occur as part of a swarm that rattled up until the disaster. Furthermore, the aftershocks died off extremely quickly.

"None of the features that we usually associate with reservoir-induced seismicity was present," Talwani says.

Archibald C. Johnston of Memphis State University visited the Latur area in February as part of a United Nations group studying the earthquake. "Our team favored the conclusion that it was not induced by the reservoir, although we acknowledged that it could have been triggered. The difference being that when we say triggered, we mean the earthquake would have happened anyway, but its timing might have been altered by the reservoir. Induced means that the reservoir actually created an earthquake that wouldn't have happened otherwise."

Regardless of what caused the Latur quake, Seeber notes that many earthquakes are set off by reservoirs, quarries, geothermal power stations, and other artificial structures. Because tremors often precede these quakes, Seeber and Armbruster urge colleagues to consider the seismic potential of such structures when small shocks occur in normally stable continental crust. *— R. Monastersky*

Nursing mother rats show brain changes

You might call it sleeping on the job, since a female rat naps as she nurses her young, but she's certainly paying attention. In fact, a recent study shows that nursing dramatically increases the size of the area in the brain that picks up sensations from a mother rat's nipple-bearing underbelly.

Two major changes occur as a mother nurses, report Judith M. Stern and her coauthors in the March JOURNAL OF NEUROSCIENCE. The area of the somatosensory cortex — the part of the brain that registers touch, pain, and temperature — devoted to sensations from a rat's underbelly almost doubles. And the mother's perceptions of feelings from her underbelly sharpen as the surface area of skin that excites a particular nerve cell shrinks. This sharpens the brain's perceptions, just as smaller dots, or pixels, in a television picture make it clearer.

Stern's team compared nursing mothers with virgin rats and with rats whose babies had been removed soon after birth. After anesthetizing the rats, the researchers recorded in detail the activity in nerve cells, or neurons, when they touched different areas of the animals' trunks with microelectrodes.

Normally, there isn't much direct stimulation of a rat's stomach, says Stern, a