NEWS FROM THE WORLD OF SCIENCE

Part - II

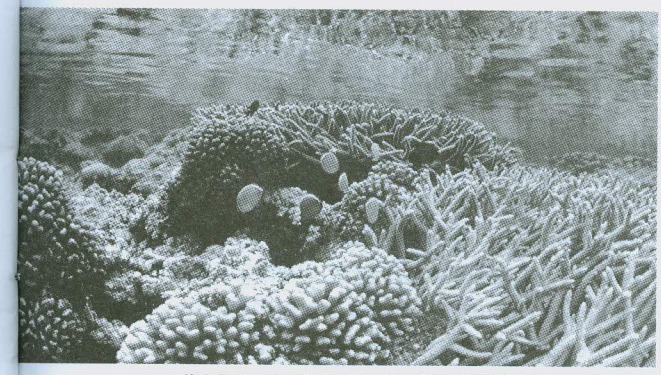
Dr. A.R.S. Menon

Corals dine on microplastics

Scientists discover tiny pieces of plastic deep within the bodies of corals

Plastic trash is washing off of land and into the seas. And that pollution may be harming some of the ocean's most important habitats: coral reefs. That's the conclusion of a new Australian study.

Coral reefs are the most biologically diverse habitats in the ocean. Their nooks and crannies provide shelter for thousands of species of animals, both big and small. That huge variety of reef organisms also provides food for a wide range of other critters. If the corals die, though, lots of those other species will have trouble surviving. The new study raises concerns about the survival of some coral species - and the complex ecosystems that depend on them. The animals that build reefs are called polyps. Coral polyps are small. Their soft bodies also lack a hard outer covering to protect them from potential predators. So the polyps make their own protective home out of calcium carbonate. Coral polyps continually add to these homes. And over time, communities of millions of polyps craft the large, rocky apartment complexes that we know as reefs.



JIM E MARAGOS/U.S. FISH AND WILDLIFE SERVICE

Coral reefs such as this one may be at risk because the young polyps that build reefs ingest super-small bits of plastic. These pollutants may interfere with a coral's ability to obtain real food

Polyps hide in their homes by day. At night, they extend their arm-like appendages out to snatch small snacks, usually *plankton*, from the water. Those snacks are truly tiny - a mere 400 micrometers (0.016 inch) in diameter or less, notes Mia Hoogenboom. She is a marine biologist at James Cook University in Townsville, Australia. Unfortunately, she points out that scientists are finding more and more bits of plastics in the ocean ecosystem. Those microplastic pieces are less than 5 millimeters (0.2 inch) in size. That makes many just the right size for corals to gobble up.

Hoogenboom's team lives and works near the Great Barrier Reef, the world's largest coral system. It stretches across more than 2,000 kilometers (1,240 miles) of Australia's northeast coast. It's also home to the greatest diversity of species

in the world. But that biodiversity could be at risk from plastics. Hoogenboom and her co-workers wanted to find out how plastics might be affecting those reef corals.

Food or plastic?

Corals get some energy from single-celled algae that live amidst the corals' tissues. These algae produce their energy through photosynthesis. But corals also must eat plankton and other foods to obtain certain vital nutrients important for growth and reproduction. So Hoogenboom's team started its investigation by probing whether corals might be mistaking plastics for food. This is a concern because many other marine animals make that error.

The team brought pieces of one type of coral into their lab. The species is known as brain coral because its round shape and fold-like pattern make it resemble the human brain. Then the researchers shredded a blue ice cream tub made of polypropylene. This is one of the plastics most commonly found in the ocean. The scientists added the plastic microbits to the water in which the corals were being kept.Two days later, the researchers examined the polyps' stomachs. One out of every five of the coral animals had eaten plastic. What's more, pieces of the blue plastic had gotten stuck deep in the animals' stomachs. That suggests that the polyps cannot get rid of the plastic once it is swallowed, says Hoogenboom.

Next, the researchers added a precise amount of microplastics to the corals' water. Twelve hours later, the scientists measured how much had disappeared. This showed that the polyps had eaten microplastic bits at the same rate they normally eat plankton. None of this matters if microplastics are not polluting the waters of the Great Barrier Reef. So the final step by Hoogenboom's group was to sample water at various reef sites. And at each one, they found bits of plastic that had broken off of larger pieces of packaging or items used in fishing. So corals definitely are at risk of eating plastic, the researchers conclude.

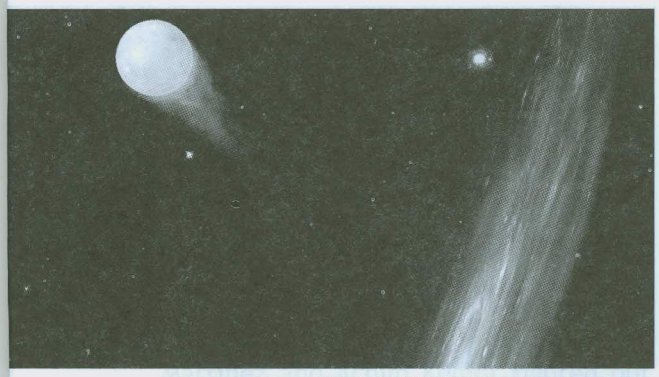
The Australian team published its findings online 2015 February in *Marine Biology*.

It's an interesting study, says Stephanie Wright, a marine biologist at the University of Exeter in England, who was not involved with the study. The new study did not give corals a choice of foods, she points out. They could only eat microplastics. Future steps should look at how easily corals ignore plastic when true food is around. But, she notes, the study does add to a growing body of knowledge about the risks that microplastics in the sea may pose.

Astronomers spy fastest speeding star

A giant explosion hurled the sun out of the Milky Way

Some stars are in an awful rush to get out of our galaxy. Astronomers have clocked one hurtling away from the Milky Way at roughly 4.3 million kilometers (2.7 million miles) per hour. That makes it the fastest moving star to be ejected into the region between galaxies. Scientists refer to this area as intergalactic space.



RUTH BAZINET/CFA

In this artist's illustration, a hypervelocity star is hurtling through space beyond the Milky Way

Located about 28,000 light-years away from Earth, the escapee has been designated US 708. It appears in the constellation Ursa Major (or Big Bear). And it might have been blown out of our galaxy by an exploding star known as a *Type 1a Supernova*. That's the conclusion of Stephan Geier and his co-workers. Geier is an astronomer at the European Southern Observatory in Garching, Germany. This team reported its findings in 2015 March in *Science*. US 708 is one of roughly a couple dozen suns known as *hypervelocity* stars. All travel so fast that they can escape our galaxy, the Milky Way.

Astronomers suspect that most hypervelocity stars leave the Milky Way after a close brush with the supermassive black hole that sits at the center of our galaxy. A black hole is a region of space that is so dense that neither light nor matter can escape the pull of its gravity. That gravity also can slingshot into space any stars that skirt the black hole's edge. Discovered in 2005, US 708 differs from other known hypervelocity stars. Most of them are similar to our sun. But US 708 "has always been an oddball," says Geier. This star has had most of its atmosphere stripped away. He says that it suggests that once it had a very close companion star.

In its new study, Geier's team measured the speed of US 708. The astronomers also calculated its route through space. With this information, they could trace its path back to somewhere in the disk of the Milky Way. That's well away from the galactic center and its supermassive black hole. In fact, US 708 might not have needed the black hole to get it up to speed. Instead, Geier's team suggests, it might once have orbited very close to a white dwarf- the white-hot core of a long-dead star. As US 708 traveled around the white dwarf, the dead star would have stolen its helium (Helium is part of the fuel that keeps a sun burning). The buildup of helium on the white dwarf eventually would have triggered an explosion, called a Supernova. That likely would have destroyed the white dwarf and jet-propelled US 708 right out of the Milky Way.

"That's pretty remarkable," says Warren Brown. He's an astronomer at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusets. "You don't normally think of Supernovas popping off their companion stars at over 1,000 kilometers [620 miles] per second." Brown discovered the first hypervelocity star in 2005. His team recently used the Hubble Space Telescope to track the motion of 16 more, including US 708. They reported their findings online 2015 February on *arXiv.org* (Many scientists use this online server to share their recent research). US 708 was probably launched from the outskirts of the Milky Way, Brown's team says. Indeed, they calculate that the star came from much farther

from the center of the galaxy than Geier suggests. Still, the basic conclusion is the same. US 708 "pretty clearly doesn't come from the center of the galaxy," Brown affirms.

Stars like US 708 could give researchers a better handle on what causes Type 1a Supernovas. These are among the most powerful explosions in the universe.The speed at which US 708 is departing the Milky Way would depend on the mass of the white dwarf that exploded. So astronomers might be able to use US 708's speed to determine that white dwarf's mass. This could help them better understand how and why white dwarf stars explode. "If this scenario works," Geier says, "we have a better means to study Type 1a Supernovas than before."

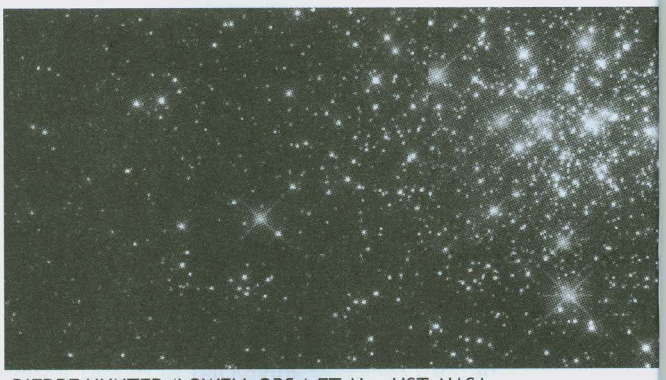
Currently, all astronomers can do is observe a Supernova's stellar fireworks and then try to piece together what happened. "It's like you have a crime scene," Geier says. "Something killed the white dwarf and you want to figure it out."

How to pick up messages after they're gone

Scientists say there's a way to retrieve light-encoded messages even after the light has disappeared

Light may travel at the speed of light. That does not, however, mean that the data it carries has to. Scientists have proposed a way to read light-based messages long after the light itself has flown by.

The new technique relies on measuring electromagnetic "echoes" in space. One



DIEDRE HUNTER (LOWELL OBS.) ET AL., HST, NASA SAN ANTONIO, Texas

Today, astronomers read the history of the universe by looking at the light emitted by hot, distant objects. Sometimes, those light sources give out- and their light disappears.

day, astronomers might use the new process to glean details about distant stars and galaxies without directly measuring their light. Doing that, however, is a ways off. Even so, this new approach to "reading" long-gone messages is piquing the interest of scientists. Physicists study energy and matter. And they had believed that to share information using light, there had to be a source to sent the light and a receiver to absorb it (and its message). The new technique would now prove an exception to that supposed rule.

Scientists described the new technique on 2015 March 2 at a meeting, of the American Physical Society. Additional details appear in *Physical Review Letters*.

How it would work ?

Much communication, today, already depends on messages encoded in electromagnetic radiation - or light. It's what allows Internet users to chat through fiber-optic cables. It also underpins radio broadcasts. A radio antenna, for instance, broadcasts photons. These are particles of electromagnetic energy. Photons travel

at the speed of light. The radio in your home or car absorbs that energy and translates it into sound. If those photons don't strike your radio, it can't play the breaking news bulletin or music you tuned in to hear. Indeed, there should be no way to pick up the information carried by photons once those photons have passed by. But Robert Jonsson, Eduardo Martín-Martínez and Achim Kempf figured out how to do it anyway. These three theoretical physicists work at the University of Waterloo in Canada. And they knew photons always leave some mark on their surroundings. Even in the emptiness of the vacuum of space. And that's because even a vacuum is never truly empty. It is full of fleeting electromagnetic energy (radiation).

The three physicists have now demonstrated - mathematically, anyway - that when a sender generates photons to broadcast a message, those photons produce what might be thought of as an afterglow. And it can be "viewed" by measuring fluctuations - variations - in the radiation present in a vacuum. What this means: Someone could still "tune in" to a light broadcast even if the photon carrying it had whizzed by long ago.

Listening would take very sensitive "ears"

This technique is truly new. In fact, the sender never directly transmits energy to the receiver, explains Jorma Louko. He is a theoretical physicist at the University of Nottingham in England. For the Waterloo technique to work, he says, the receiver has to use energy. That energy measures disturbances to the background radiation by the long-gone photon broadcast.

"The receiver has to actively do something to see something," he explains.

Detecting the changes in the background energy would require both the sender and receiver to use special antennas. These would consist of atoms that appear to have multiple amounts of energy at the same time - a state known as quantum superposition, Martín-Martínez says. Such technology is not yet available for consumers. But it is available in some physics labs.

Martín-Martínez is talking to other physicists who might be interested in trying to demonstrate his team's new technique. Those scientists would use chilled superconducting circuits for their system's antennas.

Eventually, Martín-Martínez hopes this research will lead to grander uses. His team outlines one in a paper posted online 2015 January at *arXiv.org*. In it, the group argues that light emitted during the dawn of the universe should have left an afterglow. And it may be "visible" to a new breed of telescopes. If successful, these telescopes might detect objects billions of light-years away - even if the photons those objects emitted passed by Earth long ago.

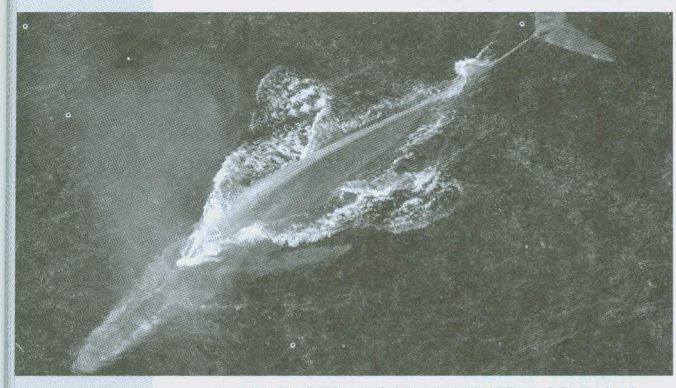
Ocean animals have mushroomed in size

Many have bulked up dramatically since ancient eras

Ocean animals have been getting bigger over the last half-billion years. Not

a little bigger. Not even a lot bigger. They have mushroomed gigantically, scientists now conclude.

Their new finding lends support for something known as "Cope's rule." It holds that animals tend to evolve into species that are much larger than their distant ancestors. This hypothesis takes its name from the 19th century paleontologist Edward Drinker Cope.



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This blue whale is the biggest animal ever to live. Today's sea creatures tend to be larger - many are more than 100 times larger - than their ancient relatives

While studying fossils, he was the first to notice this trend. Noel Heim is a paleontologist at Stanford University in Palo Alto, California. He is also a co-author of the new study. His team compared the body size of animals between the Cambrian Period and modern times. This was a span of 542 million years. The animals studied included species from more than 17,000 genera. They ranged from ancient trilobites, plesiosaurs (extinct reptiles with a long neck and flippers) and many less familiar creatures to today's whales and clams.

Marine animals today are an average of 150 times larger than they were during the Cambrian period, Heim's group reports. The smallest animals alive today - tiny crustaceans called *ostracods* - are only about one-tenth the size of the Cambrian's tiniest animals. But today's largest marine animals - whales - are more than 100,000 times bigger than the biggest in the Cambrian. "Classes of animals that were already big ... tended to persist longer," Heim says. They also tended to change more than did classes of creatures that started out, on average, far smaller. The size gains in marine animals are much larger than would be expected by chance, says Jonathan Payne. He is a coauthor who also works at Stanford.

Findings from the new analysis appear in the 2015 February issue of *Science*. The scientists don't know what drives the trend. One possibility is an arms race between predators and prey. The idea here is that larger animals are less likely to become some other critter's snack. Another possibility has to do with oxygen. Land animals evolved from species that started in the ocean. Some of these land mammals and reptiles eventually returned to the ocean. And they kept the ability to breathe oxygen-rich air. That may have made it easier for them to outgrow animals that had to filter their oxygen out of the water.

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