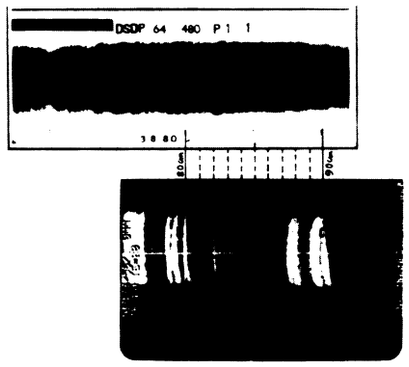
'New window' on earth's climatic record

Nuclear magnetic resonance imaging, the technology that allows physicians to look at cancer cells and brain lesions, has for the first time been used to examine core samples taken from the ocean floor. The images produced so far show new details in the sedimentary record – details that may help scientists assemble a 200,000-year record of changes in the earth's climate, according to Madeleine Briskin, who pioneered the application of the technique.

"This is opening a whole new window for us," says Briskin, a geologist at the University of Cincinnati, who used the technique on sediments from the Gulf of California. Her report is to appear in the August GEOPHYSICAL RESEARCH LETTERS.

The primary advantage of nuclear magnetic resonance imaging, or MRI (until recently called NMR), is that it reveals differences between layers that are rich in organic material and those that contain few organic remains, Briskin says. The richly organic layers show up as light bands, and the layers lacking in organic material appear dark. X-rays, the usual technique for studying core samples, do not make this differentiation.

The ability to distinguish the two kinds of layers makes it possible, for the first time, to tell where one year's worth of sediment ends and the next begins, because each year's deposit contains one richly organic layer (laid down in summer) and one layer with relatively little organic material (deposited in winter), Briskin explains.



Briskin

MRI compared with X-rays of an ocean core sample: MRI (bottom) distinguishes between richly organic layers (light bands) and layers that contain little organic material (dark bands).

Each annual layer, known as a varve, contains organic evidence of the earth's climate and ocean temperatures for the year it was deposited, Briskin says. A long sequence of varves, in turn, records cycles in the earth's climate. "It is a measure of what has gone on at the surface of the planet," Briskin says.

Scientists customarily look at tree rings for evidence of climatic cycles, but the record in ocean sediments stretches back much farther – to about 200,000 years ago, Briskin says.

This sedimentary record, in turn, can be correlated with cycles that are believed to influence climate – such as sunspot activity, changes in the earth's orbit, El Niños and cycles of the moon, Briskin told SCIENCE NEWS. "The implications for this are remarkable," she says.

George Kukla of the Lamont-Doherty Geological Observatory in Palisades, N.Y., says he intends to follow Briskin's example by using MRI on lake sediments. "It's a really great new prospective method," Kukla says. "We are pretty excited by [Briskin's] results."

To make her images, Briskin borrowed MRI equipment used by physicians at the Magnetic Resonance Center of San Diego. It uses both radio waves and magnetic fields to make images. The radio waves excite the hydrogen atoms in the substance to be imaged. When the beam is turned off, the magnetic fields pull the atoms into alignment. The equipment reads the various movement rates of the hydrogen atoms of different materials and, with that information, creates an image of the internal structure.

Because the equipment uses a number of nonuniform magnetic fields superimposed over a background static field, it is able to create a very detailed image. By making a series of such images, MRI also makes it possible to put together a three-dimensional picture of the core sample, Briskin says, which would give researchers more information about the annual constituents of a particular sediment sample. An additional advantage is that researchers can make the images without cutting into the core sample.

X-rays, which are fuzzier, come in only two dimensions and require that the core sample be cut into pieces, Briskin says.

But Briskin does not suggest that MRI should replace X-rays altogether. X-rays can delineate some very fine layers that do not show up as well with MRI. These layers may represent seasonal deposits within varves. By relating the seasonal layers on X-rays to the varves on MRI images, scientists can get a very detailed picture, Briskin says.

One major drawback of MRI is its expense, however. One set of MRI equipment runs about $2 million. Briskin spent $960 an hour, for a total of about 15 hours, to use the equipment in San Diego.

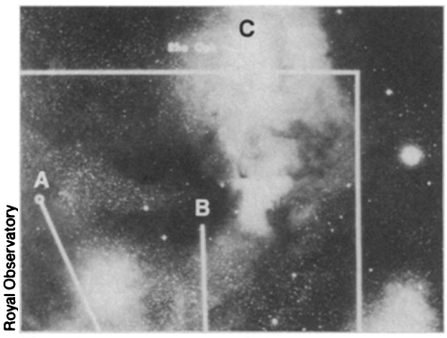
– M. Murray

A star is born in the Milky Way

Birth is an exciting process, especially when no one has ever seen it happen before.

The developing embryo lies wrapped in clouds of gas and dust 500 light-years away, near the bright star Antares. The mother, the constellation Ophiuchus in the Milky Way galaxy, will endure birth pangs for another 100,000 years before delivering a star about the size of our sun. Anxiously observing the event – the first one ever seen by humans – are astronomers from the University of Arizona at Tucson and the University of Missouri at St. Louis, assisted by the 12-meter radiotelescope of the National Radio Astronomy Observatory near Tucson.

First detected in the galactic womb by the Infrared Astronomical Satellite in 1983, the embryo contains about one-fourth the mass of our sun but lies at the center of a cloud of gas and dust 10 times the size of our solar system. For the first time, astronomers can see that the inner cloud is falling into the star, adding to the embryonic star's size and mass and making it glow 20 times brighter than the sun. Erick Young, a researcher at the University of Arizona, explains: "When [cloud] material falls in, it eventually crashes onto a surface, releasing gravitational energy in the form of photons," the subatomic particles that make up light. The surrounding outer cloud, however, absorbs the light and reemits the energy as infrared and radio radiation.



Royal Observatory

The developing star (A) and interstellar clouds of gas and dust (B) lie in the star-forming region near the star Rho Ophiuchi (C).

Astronomers discovered the developing star while looking at radio waves emanating from the cloud in Ophiuchus. Radio waves detected from the inner cloud were slightly shifted away from their expected values, indicating the cloud is collapsing.

Astronomers don't know what mechanisms trigger the collapse of galactic clouds to form stars (SN:8/25/84,p.125), but they know that this collapse will end in about 100,000 years, when the embryo will have collected most of the matter in the immediate area. The infant star will then emerge from its surrounding clouds, and future astronomers can pass around cigars.

According to astronomer Charles Lada

of the University of Arizona, the large, hot infant will begin to cool and contract for 1 million to 2 million years, until its density causes nuclear fusion to replace gravitational pull as the main source of luminous energy. By then a juvenile, the star can look forward to an adult life of about 10 billion years. — *T. Kleist*

Plugging up leukemia cells

As scientists learn more about the immune system, they are developing sharper tools for manipulating it. At the Sixth International Congress of Immunology in Toronto earlier this month, Thomas A. Waldmann of the National Cancer Institute (NCI) in Bethesda, Md., described the use of an antibody that specifically targets only active forms of T cells, one of the two types of lymphocytes that make up the immune system. In experimental use against adult T cell leukemia, the agent caused temporary remission; Waldmann hopes it will eventually be useful in other T-cell-related conditions as well.

Each T cell is sensitive to a specific foreign antigen. To generate enough T cells to mount a defense, a T cell that has "seen" its target antigen initiates the cloning process in two ways — by producing interleukin-2, which stimulates T cell division, and by manufacturing specific cell-surface receptors for interleukin-2, making the T cell more sensitive to its presence.

Interleukin-2 can be helpful therapeutically. Steven A. Rosenberg and his colleagues at NCI have had initial success in using it to stimulate immune cells to fight cancer (SN:12/7/85,p.359). But in adult T cell leukemia, naturally produced interleukin-2 promotes an eventually fatal proliferation of T cells.

Waldmann and his colleagues injected five patients with an antibody to the interleukin-2 receptor in order to block its cell-stimulating effect. Since the interleukin-2 receptor appears only on activated T cells, including the leukemic cells, the antibody leaves the rest of the immune system alone. The treatment initially worked in two patients but, for undetermined reasons, eventually wore off. None of the patients had any side effects. As a next step, the researchers have just begun animal trials with a toxin-armed antibody aimed at killing the leukemic cells rather than just blocking their division.

"I think [the antibody] treatment has much broader ramifications," Waldmann says. T cells are also at fault in other conditions, such as transplant rejection and diseases marked by the immune system mistaking normal tissue as foreign; the antibody, he suggests, might prove useful in these cases. — *J. Silberner*

Signs of how lead toxicity begins

Researchers at the University of California at Los Angeles believe they've uncovered evidence of how lead, at least initially, damages the brain. Their tissue culture studies, involving mouse cells, suggest that this heavy metal not only inhibits the growth of cells making up the blood-brain barrier but also may damage the barrier's membrane so that it no longer prevents entry of substances that could disrupt normal brain function. Lead's apparent ability to make this membrane leaky could explain the brain hemorrhages, tissue swelling and nerve dysfunction seen in people suffering from acute lead toxicity, according to an account of the research in the most recent (June 30) TOXICOLOGY AND APPLIED PHARMACOLOGY.

The researchers studied the endothelial cells that make up those capillaries in the brain that serve as the blood-brain barrier. Ordinarily, explains Karen Maxwell, one of the researchers, these cells prevent transfer of all but a few essential nutrients — like glucose — into the brain from the blood.

In their studies, the researchers incubated endothelial cells in a normal cell-growth medium to which they had added fetal-calf blood serum containing inorganic lead. At those lead concentrations normally regarded as acutely toxic — for example, 60 to 80 micrograms of lead per deciliter (μg/dl) of serum — the researchers witnessed a number of adverse cell-function changes, all of which grew more pronounced as lead concentrations increased. Among these changes were an inhibition of cell growth; a reduction in the transport of blood glucose, the brain's energy source; and a reduction in "cell drinking" — the capture of substances from the fluid outside the cell by the cell's membrane. At lower concentrations of lead, such as 40 μg/dl, they saw no cell changes. Taken together, the researchers say, these findings suggest that the membrane of these cells may be lead's initial target.

Lead toxicologist Bruce Fowler of the National Institute of Environmental Health Sciences in Research Triangle Park, N.C., characterized the work as "potentially a very significant finding." However, adds Fowler, still to be resolved is whether this membrane effect is the sole early mechanism of lead toxicity or one of several. — *J. Raloff*

Concern over Chernobyl-tainted birds

After the meltdown and the fallout, the effects of the Chernobyl nuclear accident continue to ripple outward. A meeting between European and U.S. scientists at an ornithological convention last month has raised concerns that migratory birds may be carrying radiation throughout Europe. And the National Wildlife Federation (NWF) has requested that the United States become "more actively involved" in determining Chernobyl's effects on birds.

According to I. Lehr Brisbin Jr. of the University of Georgia at Athens, who led the roundtable discussion at the Nineteenth International Ornithological Congress in Ottawa, Chernobyl sits in a major migratory flyway. "The birds funnel north from Africa . . . and come up through the Ukraine," he says. The accident occurred during the northward spring migration.

Monitoring of radiation levels since the April 28 disaster has concentrated on immediate dangers to human health, such as those posed by livestock due to be slaughtered for food. But wildlife may be more heavily contaminated than livestock, which have been given relatively "clean" feed, says Brisbin — and because many Europeans hunt, and eat what they catch, the contamination may threaten more than long-term ecological stability. In addition, he says, "many Third World countries depend on fish and wild game for food."

Scientists at the meeting pointed out that radiation has been measured in wild reindeer, according to Douglas Inkley of the Washington, D.C.-based NWF, and the government of Sweden has reportedly recommended that citizens limit their consumption of wild game. But migratory birds would be a more efficient vector for radioactive isotopes, Inkley says. Italy, "downstream" from the Ukraine during the fall migration, is considering a ban on bird hunting this year; more than 20 million birds are hunted and eaten each year in that country.

Prompted by concerns raised at the ornithological convention, the NWF in June asked the Environmental Protection Agency (EPA) to study the problem, citing a 1978 U.S./USSR convention to protect migratory birds and their habitats. The letter was forwarded to the Department of Interior, an EPA spokesperson told SCIENCE NEWS, adding, "We agree that something ought to be done."

At this point, nobody knows whether there is a serious problem, according to Brisbin. "What we need are good [bird] population studies," he says. "It may be smoke and no fire. [But] it would be a shame to spend all the time and energy we're spending on [monitoring] livestock and vegetables, and ignore an important source of [potential] contamination." — *L. Davis*