A cometary globule shows its true color

Breaking up is *not* hard to do — at least not if you're a tiny interstellar cloud constantly pounded by radiation from hot, nearby stars. For the first time, astronomers have captured a color image of such a faint cloud, caught in the act of coming apart.

This Milky Way resident, called a cometary globule because it sports a comet-like tail of gas and dust dragged out by the bombardment of starlight, lies about 100 light-years from Earth. And in reflecting light from nearby stars, it exhibits a variety of colors that reveal much about its own composition as well as the influence of its surroundings, says David Malin of the Anglo-Australian Observatory in Epping, Australia.

Malin became interested in a cometary globule called CG4 when photographs taken with the United Kingdom Schmidt Telescope in Epping showed that the object appeared dramatically different depending on whether it was viewed through a red or a blue filter. This suggested that CG4 might display an unusual array of colors. Images taken by Malin late last year with color filters at the 3.9-meter Anglo-Australian Telescope in Coonabarabran confirmed that hunch, he says.

Malin reported his results this week at a meeting of the Royal Astronomical Society in Durham, England.

Unlike the majority of interstellar clouds, which serve as nurseries for new stars and measure some 10 to 30 light-years across, most cometary globules span only about one-tenth that distance and lack sufficient gas and dust to form stars. The globules become visible when background stars lie near enough to illuminate them. Each color reflected by the clouds — pale hues of red, blue and green — tells a separate story.

For instance, the blue coloring of CG4's tail indicates the presence of tiny dust particles — less than a millionth of a meter in diameter — that scatter blue light preferentially, Malin says.

The faint red glow near the center of CG4 reveals a violent, two-step process that over millions of years contributes to the total destruction of the cloud, he adds. Radiation from nearby stars heats up molecular bonds in the cloud, breaking them apart and liberating atomic hydrogen. The radiation is so intense, it also ionizes the released hydrogen, producing the red glow. While astronomers had conjectured that light from surrounding stars might release hydrogen, they hadn't expected it to have enough energy to ionize it, Malin says.

He adds that the yellow-green regions of CG4 reveal red-absorbing dust particles that lie between the cloud and Earth.

Malin

First true-color portrait of a cometary globule, a type of interstellar cloud named for its comet-like tail. This faint Milky Way object, dubbed CG4, basks in the light of nearby stars. At left lies a distant spiral galaxy.

Malin constructed the color image from three black-and-white negatives of CG4 taken through different filters. Because the cloud, which lies in the southern constellation Puppis, extends some 20 arc-minutes across the sky, he chose large-format photographic plates — 25 centimeters to a side — to make the images. In contrast, the solid-state light detectors known as charged-coupled devices are about the size of a postage stamp and cannot easily record faint, extended objects, he notes.

Millions of years from now, says Malin, after neighboring stars have died and the contents of CG4 have completely dispersed, some of its molecules may come together again elsewhere in the galaxy, perhaps to start anew as yet another interstellar cloud. — *R. Cowen*

Computer envisions bio-inspired catalysts

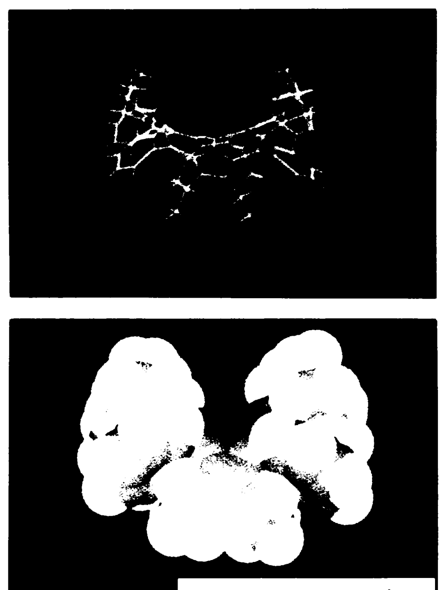
In their search for ever better industrial catalysts, researchers increasingly seek inspiration from Mother Nature. By studying how enzymes selectively foster and control important chemical reactions, catalyst designers hope to one day mimic catalytic function with far simpler and more rugged materials.

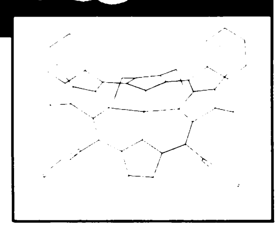
This week, scientists at Sandia National Laboratories in Albuquerque, N.M., reported a major milestone along the road to such materials: the ability to predict reliably the precise, three-dimensional shape of theoretical and potentially desirable biologically inspired catalysts.

Catalysts do not actively participate in chemical reactions; instead they offer a temporary docking site for one or more specific compounds. The more precisely a catalyst's pocket-like docking site matches the shape of a desired guest molecule, the more likely such intended molecules will dock and react.

Pharmaceutical chemists have long designed drugs to fit into specific pocket-like sites on selected proteins. "We turned that idea around," says physicist John A. Shelnutt, who leads Sandia's catalyst-design effort. "As far as I know, we're the only people who are using molecular modeling to design catalysts with pockets that fit given target molecules."

At the American Chemical Society's national meeting in San Francisco, Shelnutt delivered a series of papers on his team's work with metalloporphyrins, a class of compounds that serve as the catalytic centers for cytochrome P-450 proteins. These proteins play an important metabolic role in nearly all cells.





Shelnutt

Top: Bonds defining a novel nickel-containing porphyrin. Middle: Model represents surfaces of the porphyrin's atoms. Bottom: Dark lines depict computer prediction of same porphyrin's copper version superimposed on the actual structure (light lines), determined by X-ray crystallography.

From their study of existing porphyrins, the researchers gleaned a series of rules that characterizes how combinations of atoms in this family of molecules typically bend, stretch or become rigid in