Molecular clouds: Diamonds in the heavens

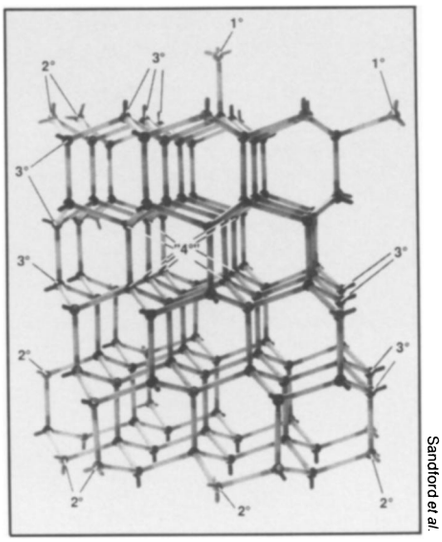
The heavens' twinkling denizens have oft been compared to glittering jewels. Now astronomers report evidence that the cosmos may literally harbor countless tiny diamonds.

Analyzing infrared light from molecular clouds — blobs of gas and dust that give birth to stars — researchers conclude that as much as 10 percent of the carbon in these clouds takes the form of diamonds. Though scientists had suspected that the heavens might hold such gems ever since the discovery of diamonds in meteorites that had fallen to Earth (SN: 3/14/87, p.166), the new finding marks the first time astronomers have located a celestial storehouse for the material.

When Scott A. Sandford and Louis J. Allamandola at NASA's Ames Research Center in Mountain View, Calif., and their colleagues began studying four dense molecular clouds in the Milky Way several years ago, they weren't searching for diamonds. Using the NASA Infrared Telescope Facility atop Mauna Kea in Hawaii, they sought to determine the methanol concentration of the clouds. And, as Sandford reported this week at the annual Lunar and Planetary Science Conference in Houston, methanol proved the second most abundant component of ice in these clouds.

That result is intriguing, notes Sandford, because ultraviolet light can transform methanol into a variety of organic compounds that might be associated with life. But a second finding really captured the imagination of scientists.

In analyzing the absorption spectra of infrared light from the clouds, Sandford and his co-workers found a pronounced dip that is different from that caused by methanol. Comparing the celestial spectra with those from laboratory samples, the researchers attributed the dip to a mystery molecule containing a carbon atom bonded to a hydrogen atom and three other carbon atoms. In addition, relatively few of the unknown molecule's carbon atoms bonded to two or three hydrogen atoms — features that excluded such carbon-based compounds as benzene or methane as sources for the dip.



Sandford et al.

Cosmic jewel: Model of microdiamond believed to reside in molecular clouds.

After months of constructing Tinker-Toy models and analyzing the spectra of additional laboratory compounds, the team concluded that "microdiamonds" were responsible for the absorption spectra. Either free-floating or stuck to dust grains in the clouds, these diamonds apparently consist of the familiar, repeating pattern of four carbons in a tetrahedral arrangement. But on their surface these diamonds also have carbon-hydrogen bonds, accounting for their unique fingerprint in the infrared spectra.

Sandford says it's likely that diamonds in the clouds explain the diamonds first found in meteorites by Edward Anders, now retired from the University of Chicago, and his co-workers. Because the meteoritic diamonds contain traces of xenon gas in an isotopic proportion uncommon in the solar system, researchers believe they predate the sun.

"It's certainly very desirable that one should find some actual astronomical sites where the diamonds [in meteorites] occur," Anders says. He cautions, however, that interpreting infrared spectra can pose difficulties because of their intrinsically lower resolution than spectra at many other wavelengths.

Sandford says it remains unclear whether the celestial diamonds represent relics of stars that died long ago and spilled their contents into space, or whether they formed within the clouds. His team has now found preliminary evidence of diamonds in three other Milky Way clouds, suggesting, he says, that the carbon compound may represent a common feature of the interstellar medium. In other words, every molecular cloud may have a diamond lining.

— R. Cowen

Schizophrenia: A 'negative' challenge

A new study provides support for an emerging — or, more precisely, a re-emerging — view of schizophrenia as a mental disorder comprising two distinct clusters of symptoms that combine differently in each sufferer.

One set of symptoms involves psychotic features, such as hallucinations and delusions; the other consists of signs of pervasive problems in dealing with others and holding down a job. The latter category, referred to as "negative" or "deficit" symptoms, has attracted much research in the past decade. But rating scales for negative symptoms vary substantially and hinder efforts to understand the nature and frequency of schizophrenia's "deficit syndrome," say psychiatrists Wayne S. Fenton of Chestnut Lodge Research Institute in Rockville, Md., and Thomas H. McGlashan of Yale University.

Still, the presence or absence of deficit symptoms, based on broad definitions now in use, proves a better long-term predictor of how a schizophrenic individual will function than do the signs of psychosis, Fenton and McGlashan report in the March Archives of General Psychiatry.

Negative symptoms include emotional unresponsiveness, lack of communication with others, few movements or gestures and absence of interest in social activities.

The researchers applied eight rating scales for negative symptoms to clinical assessments of 187 schizophrenic patients made upon admission to Chestnut Lodge, a private psychiatric hospital. Clinicians conducted follow-up evaluations of each patient an average of 19 years later.

The broadest rating scale diagnosed 75 patients as having serious deficit symptoms; the narrowest scale yielded 11 patients with a cluster of negative symptoms.

A promising rating device, developed by psychiatrist William T. Carpenter Jr. of the University of Maryland in Baltimore and his colleagues, separates primary from secondary negative symptoms, according to Fenton and McGlashan. Unlike secondary symptoms, primary symptoms last for at least one year and do not stem from anxiety, depression, antipsychotic medication or social isolation experienced as a result of psychotic symptoms. Based on Carpenter's scale, 46 Chestnut Lodge patients exhibited primary deficit symptoms, the researchers maintain. These people generally fared poorly.

More than 70 years ago, German psychiatrist Emil Kraepelin separated schizophrenia (which he called dementia praecox) into two maladies roughly comparable to psychosis and primary deficit symptoms, notes Carpenter in a commentary accompanying the Chestnut Lodge study. That distinction faded as researchers promoted theories of schizophrenia as either a single disease or a group of related diseases.

The new study may help prod schizophrenia researchers to consider the "vitally important" distinction between primary and secondary deficit symptoms, Carpenter contends.

— B. Bower

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