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Lewis (Lew) Snyder (1939–2021)

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Lewis (Lew) Emil Snyder died on Wednesday the 3rd of February, 2021.

Photo courtesy of the Department of Astronomy at the University of Illinois.

Lew Snyder will be most remembered for leading the detection of the formaldehyde molecule (H_2CO) in the interstellar medium using the Green Bank 140 Foot Radio Telescope in 1969 [1]. This was the first polyatomic molecule detected in space that contained more than a single heavy atom, and demonstrated that complex molecules (including organic molecules) could form and persist in space. The widespread abundance of formaldehyde suggested that interstellar organic chemistry would be a rich field of research. Snyder was a pioneer in the field of molecular astrochemistry and provided scientific motivation for the modern generation radio observatories such as the Atacama Large Millimeter/submillimeter Array (ALMA).

Snyder was born on November 26, 1939, in Fort Wayne, Indiana, the eldest son of Herman L. and Bernice McKee Snyder. In 1962, he married Doris Lautner, who became his wife for over 58 years until his passing. Snyder graduated from Cannelton High School in Cannelton, Indiana, and then attended Indiana State Teachers College and Southern Illinois University. In 1967 he earned a Ph.D. in Physics from Michigan State University. Snyder then took a postdoctoral position with the National Radio Astronomy Observatory (NRAO) between 1967 and 1969. Snyder's first astrochemistry publication was on the possible detectability of water vapor (H_2O) in the interstellar medium [2]; the discovery of which was contemporaneous by A. Cheung and collaborators. Shortly after, Snyder published the aforementioned seminal work on the detection of interstellar formaldehyde that pioneered the modern science of astrochemistry. That paper is still frequently cited and read more than 50 years after publication. The current ADS count of just under 250 citations to this paper far underestimates the total, since ADS does not include numerous other journal citations (e.g., Chemistry). Foreseeing what has become the rich field of astrochemistry, Snyder and collaborators stated in their formaldehyde detection paper:

> *"The detection of interstellar formaldehyde provides important information about the chemical physics of our galaxy. We now know that polyatomic molecules containing at least two atoms other than*

> *hydrogen can form in the interstellar medium. Their formation apparently does not require extremely unusual interstellar conditions since we detected H_2CO in clouds at various distances between earth and the background radio sources... Hence large regions of the galaxy may be filled with clouds containing formaldehyde... This evidence coupled with the recent discovery of ammonia in the galactic center and water in several sources indicates that processes of interstellar chemical evolution may be much more complex than previously assumed."*

Since this discovery and as predicted by Snyder, well over 200 distinct molecules have been detected in a variety of astronomical environments, ranging from the first molecular gas produced in the most distant galaxies, to molecular clouds and star formation regions in our own Galaxy, to the atmospheres of moons and even exoplanets. Over the past 50 years, the rate of new molecules discovered in astronomical environments has stayed nearly constant at about four new molecule detections per year. These successes are largely attributable to Snyder's pioneering work. Snyder and his frequent collaborators (e.g., Dave Buhl, Jan Hollis, Frank Lovas, Phil Jewell, Pat Palmer, and Anthony Remijan) were responsible for about 20 astronomical detections of new molecules. These included the first discoveries of polyatomic molecules in space that had not previously been seen on Earth, neither naturally occurring nor in the lab. Two examples are HCO^+ [3] and HNC [4]; the former was the first polyatomic molecular ion detected in space. Today, these molecules are significant diagnostic molecules in astronomy.

In addition to his work on detecting new astronomical molecules, Snyder characterized the range of molecules in the interstellar medium. He was on the team that first discovered absorption by H_2CO of the cosmic background radiation in 1969. The fact that anything could be cooled to below 2.7 K was a remarkable finding that stunned the community, but it is possible to anti-invert energy levels, just as it is possible to invert them to produce a maser. Snyder was one of the first researchers to recognize the possibility of biologically-significant molecular species in interstellar space and revolutionized our understanding of the chemical complexity of cometary comae. He was also an expert in the application of interstellar maser emission as an astrophysical diagnostic and was responsible for the discovery of maser emission from interstellar silicon monoxide (SiO) [5]. Overall, Snyder had over 150 publications during the course of his career.

In 1983, Snyder was one of the five members of the NSF committee chaired by Professor Alan Barrett that recommended the construction of a US national millimeter / submillimeter array. This recommendation was adopted as the MMA project, which became a forebearer of the current ALMA Observatory. Snyder also played a large role in establishing the Berkeley-Illinois-Maryland Association (BIMA) Array, another precursor of ALMA, jointly operated by the University of California Berkeley, University of Illinois, and the University of Maryland, which became part of the Combined Array for Research in Millimeter-wave Astronomy (CARMA). He was on the BIMA/CARMA board of directors

from 1985–2005, being the Illinois Director of the Laboratory of Astronomical Imaging from 1992–2005. During his tenure at BIMA/CARMA, Snyder and his team detected the largest interstellar acid, acetic acid (CH_3COOH) [6] and through a multi-telescope campaign, suggested the presence of interstellar urea ($(NH_2)_2CO$) [7] — his final refereed publication.

Over the course of his career, Snyder mentored dozens of students, postdocs, and early-career faculty and scientists, many of whom are still actively working in the field of astrochemistry. Snyder's pioneering contributions to astronomy, his commitment to expanding our knowledge of the chemical understanding of the universe, and his contributions to the next generation of scientists form a lasting legacy. He had a singular feisty/spirited Midwest personality that made him a fun collaborator and colleague.

Snyder held faculty appointments at the University of Virginia (1969–1975) and for over 30 years was a Professor at the University of Illinois (1975–2005), where he was named a Professor Emeritus in 2005. He also held appointments at the University of Colorado (1973–1974) and at the Max-Planck-Institut für Radioastronomie in Bonn, Germany (1983–1984).

Lew is survived by his wife, Doris, two brothers, a son, a daughter and four grandchildren. The Lewis E. Snyder Astrochemistry Award is presented yearly at the International Symposium on Molecular Spectroscopy in recognition of his commitment to expanding our knowledge of the chemical understanding of the universe and to developing the next generation of scientists dedicated to building a scientific literate community.

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