Western Science

**Western University**
**DEPARTMENT OF PHYSICS AND ASTRONOMY**

# ELIZABETH LAIRD MEMORIAL LECTURE

## Wednesday, 16th March 2016
## 7:00 p.m.

**Paul Davenport Theatre, Talbot College**
***Reception to follow in the Talbot Atrium***

CANCELLED

# Dr. Ada E. Yonath

**Nobel Prize in Chemistry, 2009**
**Martin and Helen Kimmel Professor of Structural Biology**
**The Weizmann Institute, Israel**

## *"The Origin of Life"*


**Abstract:**

Just as carpenters and bricklayers are needed to convert the blueprint of a house to a physical structure, so it is that within living organisms, special entities are needed to translate the blueprint of life held within the DNA to functional molecular units. In living species, ribosomes play this role, taking amino acids and merging them into functional proteins. Ribosomes possess spectacular architecture accompanied by inherent mobility, allowing for their smooth performance in translating the genetic code into proteins.

Ribosomes from bacteria, archaea and eukaryotes (the 3 domains of life on earth) are remarkably similar, and some aspects of their character appear to have been largely unchanged over eons of time. Such a time-independent character is especially true for the cores of ribosomes, where the formation of proteins takes place. This high degree of conservation implies that their existence is, in part, independent of environmental conditions, and indicates that these cores might represent a prebiotic RNA entity with catalytic capabilities. These observations, in turn, lend themselves to the idea that these regions could be the kernel around which ALL life originated and evolved. The mechanistic and genetic applications of this finding will be discussed.

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**Ada E. Yonath** has had a wide and varied career, culminating in joint receipt of the 2009 Nobel Prize in Chemistry for her studies on the structure and function of the ribosome. She is currently Director of the Helen and Milton A. Kimmelman Center for Biomolecular Structure and Assembly of the Weizmann Institute of Science in Israel.

Yonath was born in Jerusalem on June 22, 1939 to a Zionist Rabi and his wife. Relatively poor, she turned to books to keep herself occupied. She moved to Tel Aviv after the death of her father, and paid her way through high-school by giving math lessons. Inspired (but not necessarily guided) by the Polish and naturalized-French scientist Marie Curie, she took an interest in the Sciences. She graduated from the Hebrew University of Jerusalem with a bachelor's degree in chemistry in 1962, and a master's degree in biochemistry in 1964. In 1968, she obtained her PhD from the Weizmann Institute of Science for X-ray crystallographic studies on the structure of collagen, with Wolfie Traub as her PhD advisor.

Following postdoctoral positions at Carnegie Mellon University (1969) and MIT (1970), (including some time with 1976 chemistry Nobel Prize winner William N. Lipscomb, Jr. of Harvard University, where she was inspired to pursue very large structures), she established what was for nearly a decade the only protein crystallography laboratory in Israel. From 1979 to 1984 she was a visiting scientist at the Max Planck Institute for Molecular Genetics in Berlin, and visiting professor at the University of Chicago in 1977-78. She was also a visiting scientist at the Max-Planck Institute Research Unit at DESY in Hamburg, Germany (1986–2004) in parallel to her research activities at the Weizmann Institute.

Yonath uses ribosomal crystallography to focus on the mechanisms underlying protein biosynthesis, a research technique she pioneered over twenty years ago. More specifically, she developed cryo bio-crystallography, which has become routine in structural biology and allows intricate projects otherwise considered formidable.

Ribosomes translate RNA into protein and, because they have slightly different structures in microbes when compared to eukaryotes (such as human cells), they are often targets for antibiotics. In 2000–2001, she determined the complete high-resolution structures of both ribosomal subunits and discovered within the otherwise asymmetric ribosome, the universal symmetrical region that provides the framework and navigates the process of polypeptide polymerization. Consequently, she showed that the ribosome is a ribozyme that places its substrates in stereochemistry suitable for peptide bond formation and for substrate-mediated catalysis. In 1986, she visualized the path taken by the nascent proteins, namely the ribosomal tunnel, and recently revealed the dynamic elements enabling its involvement in elongation arrest, gating, intra-cellular regulation, and nascent chain trafficking into their folding space.

Additionally, Yonath elucidated the modes of action of over twenty different antibiotics targeting the ribosome, illuminated mechanisms of drug resistance and synergism, deciphered the structural basis for antibiotic selectivity and showed how it plays a key role in clinical usefulness and therapeutic effectiveness, thus paving the way for structure-based drug design.