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Frankfurt am Main, December 12, 2007

### **Ribosomes close up**

*Ada Yonath and Harry Noller receive the Paul Ehrlich and Ludwig Darmstaedter Prize 2007 for the structural analysis of ribosomes, the cellular protein factories*

FRANKFURT. The chemist and bio-chemist **Professor Dr. Ada Yonath** (67), Director of the Helen and Milton A. Kimmelman Center for Biomolecular Structure and Assembly and Holder of the Martin S. and Helen Kimmel Professor of Structural Biology at the Weizmann Institute of Science in Rehovot, Israel, and the bio-chemist **Professor Dr. Harry Noller** (67), Director of the Center for Molecular Biology of RNA and Robert L. Sinsheimer Professor of Molecular Biology, University of California in Santa Cruz, U.S.A., will receive the Paul Ehrlich and Ludwig Darmstaedter Prize 2007, which is endowed with a total of €100,000, for their outstanding contributions to the analysis of the three-dimensional structure of ribosomes – the complex cell organelles where protein bio-synthesis takes place. This has been resolved by the Council of the Paul Ehrlich Foundation. As the statement of the reasons for the decision says: "The research work done by Ada Yonath and Harry Noller has led to important knowledge of the structure and function of ribosomes, thereby facilitating a new understanding of these macro-molecular RNA protein complexes." The Paul Ehrlich and Ludwig Darmstaedter Prize is one of the most internationally reputed awards conferred in the Federal Republic of Germany in the field of medicine. The prize-giving ceremony will take place on March 14, 2007, the date of Paul Ehrlich's birthday, in the Paulskirche in Frankfurt am Main.

For years now, ribosomes have been at the centre of extensive bio-chemical, bio-physical and genetic research activities because they have essential importance for life: they are the cell organelles where protein bio-synthesis takes place. Ribosomes consist of proteins and various RNA components and comprise two sub-units – a large one and a small one. Like a factory, they receive genetically encoded production plans in the form of messenger RNA from the cell nucleus, and then bind amino acid with amino acid according to these plans in such a way that viable proteins are produced. If the work of the ribosomes is impeded, the cell dies. An understanding of protein bio-synthesis therefore has key importance for decoding life and for understanding how sicknesses develop.

Ada Yonath together with Professor Heinz-Günther Wittmann from Max Planck Institute for Molecular Genetics in Berlin pioneered ribosomal crystallography 27 years ago. In cooperation with the Fritz Haber Institute of the Max Planck Society in Berlin they succeeded in characterization of the crystals of the large ribosomal particles by means of

electromicroscopical methods for the first time in 1980. They focused on functional complexes of both the large and the small ribosomal subunits of ribosomes from eubacteria that can serve as pathogen models at various phases of protein bio-synthesis. In 2000-2001 Yonath, in collaboration with the team at the Max Planck Institute for Molecular Genetics in Berlin, determined the exact three-dimensional structure and architecture of the small and the large subunits and their complexes with ribosomal antibiotics and other factors, using X-ray crystallographic methods. This gave new insights into the catalytic process and the protein exit tunnel in the ribosomes leading to the formation of viable proteins. Harry Noller and his team were the first research group worldwide to decode the complete structure of a ribosome of the bacteria *Thermus thermophilus*. Subsequent work revealed details of how a ribosome translocates genetic information in the form of messenger RNA into the synthesis of proteins.

### **Method**

For their research work, Ada Yonath and Harry Noller used X-ray crystallography, where crystals of the material under investigation are exposed to highly intensive X-ray beams. On the basis of the resulting diffraction pattern, the scientists were able to draw conclusions about the exact structure of the crystal. The ribosome is an unstable, gigantic RNA-protein complex which is difficult to crystallize and which typically, in comparison to other biological material, such as viruses, does not have the inner symmetry or repetitions that make it easier to understand a structure. Introducing of innovative crystallographic techniques, Yonath and Wittmann grew the first ribosomal crystals. However, as these crystals proved to be too sensitive for an analysis with the X-ray beam, Ada Yonath introduced and established the cryo-crystallography method, namely measurements at temperatures of minus 185 degrees Centigrade, and consequently succeeded in overcoming this challenge. Yonath and her team used "heavy atom clusters" as markings, which stand out of the ribosomal electron density map owing to their high electron density. These markings allow the exact determination of the positions of certain functional units inside the ribosome. The resulting picture allows a more exact insight into the microscopic world of the ribosome by highlighting particularly conspicuous features. A better understanding of the way in which ribosomal protein bio-synthesis functions could lead to the development of a new generation of antibiotics capable of attacking bacteria at the ribosome level.

### **Short biography of Ada Yonath**

Prof. Dr. Ada Yonath was born in Jerusalem on June 22, 1939, studied chemistry and bio-chemistry at the Hebrew University in that city, and received her doctorate in 1968 at the Weizmann Institute of Science in Rehovot, Israel. After spells in the U.S.A., she returned to the Weizmann Institute of Science in 1970, where she built Israel's first laboratory for protein crystallography, which became world-famous through the X-ray crystal structure investigations of ribosomes. At the end of 1979 she established a collaboration with the Max Planck Institute for Molecular Genetics in Berlin, which lasted until 2004, and from 1986 until 2004, she was also, in addition to her activity at the Weizmann Institute of Science, head of the research unit for molecular biology at the Max Planck Institute on the DESY (German electron synchrotron) in Hamburg. She has received numerous awards for her work, among them the first European Crystallography Prize in 2000, the Israel Prize (in 2002), the Harvey Prize (in 2002), the Massry Foundation International Award and Medal for Ribosome Research (in 2004, jointly with Harry Noller), the Luiza Horwitz Prize (in 2005), the EMET Prize (in 2006), the Rothschild Prize for Life Sciences (in 2006), and the Wolf Award in Chemistry (in 2007). She is a member of the National Academy of Sciences in the U.S.A., the

Israeli Academy of Sciences and Humanities, the European Academy of Sciences and member of the European Molecular Biology Organization (EMBO). She is also joint editor of various scientific journals, including the EMBO Journal.

### **Short biography of Harry Noller**

Prof. Dr. Harry Noller was born on June 10, 1939 in Oakland, California. He studied biochemistry at the University of California in Berkeley, U.S.A, taking his doctorate in chemistry at the University of Oregon, U.S.A. After research spells in England and Switzerland, he returned to the U.S.A., where he has worked since 1968 at the University of California in Santa Cruz. There, Noller heads the Center for Molecular Biology of RNA. Noller has already received several awards for his work in the field of RNA and ribosome research, including the Massry Foundation International Award and Medal for Ribosome Research in 2004 (jointly with Ada Yonath), the Lifetime Achievement Award of the RNA Society in 2003 and the Newcomb Cleveland Prize of the American Association for the Advancement of Science in 2002. He is a member of various scientific bodies, including the National Academy of Sciences since 1992.

### **The Paul Ehrlich and Ludwig Darmstaedter Prize**

The Paul Ehrlich and Ludwig Darmstaedter Prize is traditionally presented on Paul Ehrlich's birthday, March 14, in the Frankfurt Paulskirche. It is awarded to scientists in recognition of their special achievements in Paul Ehrlich's field of research, especially immunology, cancer research, hæmatology, microbiology and chemotherapy. This year, the laudatio will be held by Professor Dr. Ruth Arnon, Weizmann Institute of Science, Rehovot, Israel, and Member of the Council of the Paul Ehrlich Foundation. The Chairman of the Council, Hilmar Kopper, will present the award jointly with a representative of the Federal Ministry of Health.

### **The Paul Ehrlich Foundation**

The Paul Ehrlich Foundation is a legally dependent foundation of the Association of Friends and Patrons of the Johann Wolfgang Goethe University Frankfurt am Main e. V. The Honorary President of the Foundation, which was set up in 1929 by Hedwig Ehrlich, is the President of the Federal Republic of Germany, who also appoints the elected members of the Council and the Board of Trustees. The Chairman of the Association of Friends and Patrons is at the same time the Chairman of the Council of the Paul Ehrlich Foundation. This committee, comprised of 12 nationally and internationally reputed scientists from four countries, selects the prizewinners. The President of the Johann Wolfgang Goethe University is ex officio member of the Board of Trustees of the Paul Ehrlich Foundation. The prize, which has been awarded since 1952, is financed by tied donations from the Federal Ministry of Health, companies and the German Association of Research-Based Pharmaceutical Companies.

### **Further information**

Personal biographies, selected publications, lists of publications and photos of the prize winners can be obtained from the Press Office of the Paul Ehrlich Foundation (c/o Dr. Monika Mölders, phone: 0049-6238-982783, fax: 0049-6238-982784, e-mail: [Paul-Ehrlich-Stiftung@pvw.uni-frankfurt.de](mailto:Paul-Ehrlich-Stiftung@pvw.uni-frankfurt.de)). Photos of the prize winners can be downloaded from the web page of the **Paul Ehrlich-foundation**: <http://www.paul-ehrlich-stiftung.de>

**Scientific pictures:** [http://rna.ucsc.edu/rnacenter/ribosome\\_images.html](http://rna.ucsc.edu/rnacenter/ribosome_images.html)

**Professor Dr. Ada Yonath:** [http://www.weizmann.ac.il/sb/faculty\\_pages/Yonath/home.html](http://www.weizmann.ac.il/sb/faculty_pages/Yonath/home.html)

**Professor Dr. Harry Noller:** <http://www.biology.ucsc.edu/faculty/noller.html>