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Nobel Prize in Chemistry 1980


Paul Berg


Walter Gilbert


Frederick Sanger

The Nobel Prize in Chemistry 1980 was divided, one half awarded to Paul Berg *"for his fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant-DNA"*, the other half jointly to Walter Gilbert and Frederick Sanger *"for their contributions concerning the determination of base sequences in nucleic acids"*.

Information about winners:

Paul Berg,

Stanford University, USA,

Walter Gilbert,

Harvard University, USA,

Frederick Sanger,

Cambridge University, Great Britain,

RESEARCH INFORMATION:

NOBEL PRIZE IN CHEMISTRY TO NUCLEIC-ACID INVESTIGATORS

The attributes of life and living organisms, such as reproductive ability, growth, motility and response to external stimuli, are outward manifestations of a very complicated network of coupled chemical reactions. The chemical machinery of a living cell is governed

by DNA (deoxyribonucleic acid) in its chromosomes. DNA carries out its task by determining which enzymes a cell shall manufacture. The enzymes impart to the cell its characteristic chemical pattern by their ability to speed up (catalyze) given chemical reactions in a specific manner. The scientists who have been awarded this year's Nobel Prize in Chemistry have developed methods making it possible to map in considerable detail the structure and function of DNA.

Nucleic acids (e.g. DNA) and proteins (e.g. enzymes) consist of giant molecules (macromolecules), which are built up by smaller molecules, functioning as building blocks, linked together into long chains. The building blocks of DNA are called nucleotides, and in enzymes they are named amino acids. We know through investigations which have led to earlier Nobel Prize Awards, that DNA expresses its genetic message by the sequence of its building blocks determining the sequence of amino acids in an enzyme. But different cells differ in their chemical machinery, and there are consequently parts of the DNA molecule which control how much of its message which shall be copied. In higher organisms the chromosomes have in addition DNA with an hitherto unknown function.

The scientific contributions which are now awarded with Nobel Prizes have to a considerable degree increased our knowledge of the way in which DNA as carrier of the genetic traits govern the chemical machinery of the cell. Berg was the first investigator to construct a recombinant-DNA molecule, i.e. a molecule containing parts of DNA from different species, e.g. a chromosome from a virus combined which genes from a bacterial chromosome. His pioneering experiment has resulted in the development of a new technology, often called genetic engineering or gene manipulation, which has already had important practical applications, e.g. the manufacture of human hormone with the aid of bacteria. Berg performed his experiment, however, as part of an incisive analysis of the chromosome of an ape virus (called SV 40) Viruses contain DNA (or sometimes RNA, another nucleic acid). They cause disease by introducing foreign genetic information in a cell and in this way disturbing its chemical machinery. As DNA molecules from viruses are

relatively small, they are excellent objects of investigation for the study of the relationship between the chemical structure and biological function of DNA.

Gilbert and Sanger have independently developed different methods to determine the exact sequence of the nucleotide building blocks in DNA. Among applications of sequence methods may be mentioned that Gilbert has investigated the structure of those parts of a bacterial chromosome which control the reading (transcription) of the genetic message. Sanger is responsible for the first complete determination of the sequence of a DNA molecule. He has established the sequence of the 5375 building blocks in DNA from a bacterial virus called phi-X174. Sanger's method has also been used to determine the sequence of DNA from humans, which led to the surprising discovery that the genetic code is not universal, i.e. it is not the same in all living organisms, from viruses and bacteria to man.

Sequence investigations with the methods of Gilbert and Sanger together with the recombinant-DNA technique make excellent tools for continued investigations of the structure and function of the genetic material. Sequence determinations are also important for the planning of a rational and efficient recombinant-DNA technology. Consequently there is a close relation between the contributions of the three scientists, the reason for having them share a Nobel Prize.

The investigations of Berg, Gilbert and Sanger have given us a detailed insight into the chemical basis of the genetic machinery in living organisms. They have already formed the foundation for important technical applications. In an extended perspective they will certainly play a decisive role in our efforts to understand the nature of cancer, as in this disease there is a malfunction in the control, by the genetic material, of the growth and division of cells.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1980/press.html