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Nobel Prize in Chemistry 1969

Derek H. R. Barton

Odd Hassel

The Nobel Prize in Chemistry 1969 was awarded jointly to Derek H. R. Barton and Odd Hassel *"for their contributions to the development of the concept of conformation and its application in chemistry"*

RESEARCH INFORMATION:

One of the fundamental conditions for life on Earth is the ability of carbon atoms to bind each other to a practically unlimited extent. They form chains, often very branched, but also rings and net-works. The number of carbon compounds is thus very large - some years ago I saw the number two million - and many new ones are discovered or prepared every day. It is obvious that a multitude of different substances are required to build up a living organism and make it function.

The structure of carbon compounds, often called organic compounds, is, however, governed by rather simple principles. To describe an organic molecule, we have first the *constitution*, which can be said to represent the ground-plan. Next we have the *configuration*, which deals with the question of right or left. In the case of unsymmetrical objects like gloves or shoes there must exist a right form and a left form and the same is

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true for unsymmetrical molecules. What is then the *conformation*, which is of interest here to-day?

A molecule is not, in general rigid. There is a certain flexibility, which may, perhaps, be called limpness or floppyness. Certain distances and angles are invariable and the chain must not be broken, but it may bend, turn or twist in different ways. In ring-shaped molecules, the flexibility is more restricted. Small rings of three, four of five atoms are rather rigid and planar. Six carbon atoms permit a certain flexibility and large rings may be rather floppy. Complicated molecules with net-works of several rings are often more rigid. The rings check or lock each other. The conformation is the shape, which the molecule really assumes, utilizing the flexibility. It may be said that conformational analysis deals with the mode of behaviour of floppy molecules.

Metaphorically one could say that the molecule tries to arrange itself in the most comfortable way. It will avoid crowding and strain and must consider that certain groups may attract or repel each other.

Often a great number of conformations are possible, but some are more stable than others. These are statistically favoured. A ring of six carbon atoms can have two conformations, known as the chair and boat forms, which easily interchange. At room temperature, a molecule changes its conformation about a million times in a second. One of the conformations is, however, strongly predominant (about 99%). Professor Hassel has carried out fundamental investigations on this system and shown how heavy or bulky groups, attached to the carbon atoms, take up their positions relative to the ring and to each other.

The conformation is of great importance for the mode of reaction of the molecules. Reactive groups may be easily accessible, or they may also be more or less blocked by other groups. Knowledge of the conformation is therefore of great importance for explaining or predicting the mode of reaction of a certain molecule. It is always a good thing to know if an experiment has any chance of success.

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Geometry in three dimensions is not very popular. I suppose that no one will mind if I refrain from discussing special cases in detail and from describing the physico-chemical methods used in conformational analysis.

In the development of scientific ideas it is generally possible to trace contributions, elements of thought, from many sides. But often the decisive advances, the intellectual syntheses from different thoughts and suggestions can be attributed to one or two scientists, who stand out from the others. Professor Hassel's elegant work on six-membered rings, carried out with ever increasing precision, has laid a solid foundation for a dynamic chemistry in three dimensions. Professor Barton has generalized, opening wider perspectives and deducing the consequences for many complicated ring systems, which play an important role in living nature. Let me only mention the ring system of the steroids, which is found in the bile acids, necessary for digestion, in sex hormones, cortisone, digitalis glycosides and cholesterol but also in the lather-forming saponins and in the special venoms of potato-tops and toads.

Professor Barton. In the classical work "The Conformation of the Steroid Nucleus" you have advanced the leading principles of conformational analysis. In this paper you have also drawn attention to the notable researches of Hassel, which have thrown considerable light on these more subtle aspects of stereochemistry. Your ideas were soon accepted and they play a fundamental role in organic chemistry of today. According to a prominent fellow scientist, your paper represents the first real advance in stereochemistry since the theory of Van 't Hoffand Le Bel, *i.e.* since 1874. I have no objections.

In recognition of your services to Chemical Science, the Royal Academy has decided to confer upon you the Nobel Prize. To me has been granted the privilege of conveying to you the most hearty congratulations of the Academy.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1969/press.html