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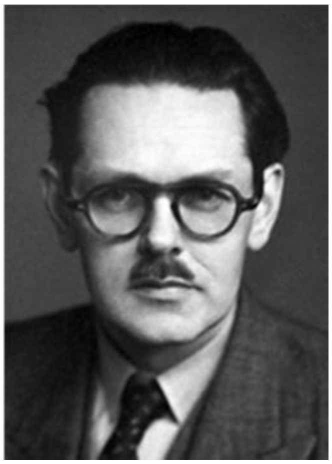
Nobel Prize in Chemistry 1952




Archer John Porter Martin **Richard Laurence Millington Synge**

The Nobel Prize in Chemistry 1952 was awarded jointly to Archer John Porter Martin and Richard Laurence Millington Synge *"for their invention of partition chromatography"*

RESEARCH INFORMATION:

This year's Nobel Prize in Chemistry is awarded for the discovery of a method for the separation of substances from complicated mixtures.

How can it happen, one may ask, that something apparently so commonplace as a separation method should be rewarded by a Nobel Prize? The answer is that from the very beginnings of chemistry until our own time, methods for separating substances have occupied a key position in this science. Even today, in Holland, chemistry is called "Scheikunde", or "the art of separation", and even today some of chemistry's most important advances are linked to the invention of new methods for separating various substances.

Chemistry today is to a large extent concentrated upon the study of natural products, which are obtained from animals, plants, or even bacteria and other microorganisms. A starting material of this type contains a great number of widely varied substances, some simple, others more complicated. The first thing the chemist must do is to

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isolate the substances he is interested in from the material and prepare them in a pure state. The next step is, if possible, to identify these substances and find out what they consist of and how they are built up from simple constituents.

The first problem, the isolation, can indeed be difficult, as it is often a matter of preparing in a pure state substances which constitute only an extremely small fraction of the starting material and which have the disagreeable tendency of, so to speak, disappearing between one's fingers when one tries to get hold of them. It is here that Martin and Synge's method has enjoyed great success, especially in what is perhaps its most important form, and is called filter-paper chromatography. A drop of a liquid containing the substance to be investigated is allowed to fall onto a strip of filter paper, where it forms a little spot. This paper is then caused to draw up some suitable mixture of liquids, for example butyl alcohol-water, by capillary action. The spot begins to move, and one can see how it then gradually segregates into several spots, some of which rapidly follow the liquid which has been drawn up, while others lag behind. Thus there results a resolution of the mixture into its component parts, a resolution which in the last analysis depends on the different *partition* of the substances between the water held by the filter paper and the freely moving butyl alcohol. Hence the name *partition* chromatography. Instead of resorting to a series of intricate chemical operations, one can in this simple way make a complete analysis of even the most extremely complicated mixtures; and a single drop of the starting material is fully sufficient for the purpose.

The method of Martin and Synge, in different forms, has already found extensive application in all branches of chemistry and important discoveries have been made with it. New and interesting substances have been traced and isolated with its help. Metabolic pathways in the organism can be studied and formerly unknown intermediary products identified. This has been done, for example, with studies of the way in which the green leaves of plants build up starch out of the carbon dioxide of the air. With Martin and Synge's method, Calvin and his co-workers in Berkeley have been able to identify some of the most important links in this process, perhaps the most important chemical reaction on our planet.

Partition chromatography has had other extremely important applications when it has been used as a means of studying the structure of giant molecules. It has been possible in this manner to attack problems of the structures of proteins and carbohydrates with considerably greater prospects for success. The intact molecule is too complicated for us to be able to penetrate its structure by chemical methods. If one breaks down these large molecules, a mixture of molecular fragments of different sizes and different chemical natures results. A separation of such extremely complicated mixtures of rather similar substances and an identification of every fragment is a way which allows us to draw conclusions about the structure of the original molecule in the same manner that an archeologist among the ruins of an ancient temple can find archeological details which make it possible for him to some extent to reconstruct the building in its original condition. As a guide in such work, the method of Martin and Synge is of the greatest value. Synge has shown this in some very beautiful investigations on the structure of gramicidin, an antibiotic active against certain bacteria. In work such as this, it is of special importance that the method is suitable for the isolation not only of the smallest building blocks (the amino acids) but also of larger fragments (peptides). It is as if one should have a puzzle to put together: if by chance several pieces happen to hang together, the problem immediately becomes more simple. The young English chemist Sanger has recently succeeded in putting together an unusually difficult puzzle of this sort; from the mixtures which were separated by Martin and Synge's method, among others, he has been able to get an almost complete picture of the structure of the *insulin* molecule - a result which perhaps more than any other shows the method's great scope and principal significance.

For their part, Martin and his co-workers have recently expanded the method's field of usefulness in other directions, of which experiments with gases and vapours on the one hand and experiments concerning the separation of mixtures of very large molecules on the other are attracting special interest.

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Chromatographic analysis has long been known as one of chemistry's most valuable methods. It was discovered in 1906 by the Russian-Polish Michael Tsvett, who succeeded in separating the different pigments in an extract of green leaves using this method. Even earlier than this, several investigators, among them Runge, Schönbein, and Goppelsroeder, had used filter paper for a kind of chromatographic analysis, while Tsvett and many of his successors used mainly tubes packed with various finely powdered, active substances for separations. The novelty in Martin and Synge's method is thus not the "chromatographic column" or "filter paper analysis", but rather concerns the fundamental chromatographic process itself This can now be formulated as the partition of a substance between two liquids, instead of - as previously - entirely as its concentration at the surface of a more or less poorly defined active powder. Thus we have a rational basis for the method and enormously larger possibilities for choosing the experimental conditions which will be most suitable in any particular case. The almost explosive development of chromatography since the discovery of Martin and Synge's principles shows the power and scope of their invention.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1952/press.html