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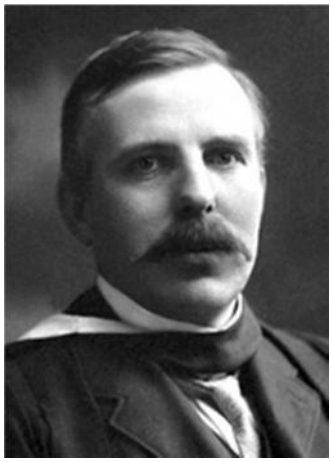
Nobel Prize in Chemistry 1908



Ernest Rutherford

The Nobel Prize in Chemistry 1908 was awarded to Ernest Rutherford *"for his investigations into the disintegration of the elements, and the chemistry of radioactive substances"*.

RESEARCH INFORMATION:

The Nobel Prize in Chemistry for this year (1908) has been awarded by the Royal Academy of Sciences to Ernest Rutherford, Professor of Physics at the Victoria University, Manchester (England), for his researches concerning the disintegration of elements and the chemistry of radioactive substances.

Those researches are closely allied to, and form a worthy continuation of, work which has already met with recognition from the Academy in the shape of Nobel Prizes on former occasions, viz. J.J. Thomson's theoretical and experimental researches regarding the passage of electricity through gases, Becquerel's discovery of spontaneous radioactivity, and M. and Mme. Curie's investigation of those elements that emit uranium rays, or, as they are also called in honour of the French scientist, Becquerel-rays.

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Shortly after Becquerel's discovery of these rays, which - as has since been shown - are not emitted solely by uranium, but also by several other elements, such as thorium, discovered by Berzelius 80 years ago, radium and polonium discovered by Mme. Curie, etc., Rutherford chose them as a subject of very thorough investigation, evolving exceedingly exact methods for measuring their intensity, proving the existence of absolutely distinct types of rays (the so-called -rays and -rays), establishing the more important characteristics of the two types, and bringing forward, more especially as regards the -rays, unimpeachable proof of their material nature.

His investigation of the radiating phenomena that characterize the element thorium led Rutherford to make the remarkable discovery that that element emanates a gaseous substance, the so-called thorium emanation, which has since been shown to be of elemental nature, and with the agency of liquid air has proved capable of being condensed into fluid form.

In the progress of the work it became clear that the emanation does not arise directly from thorium, but from the so-called thorium-X, an intermediate product, that may be separated off from thorium and which is continuously formed from it, and is itself in due course continuously disintegrated while the gaseous emanation is produced. The emanation itself, however, is not permanent either, for after a short time it is transmuted into other radioactive substances, which - if the emanation comes into contact with solid bodies - become deposited on them in the form of an exceedingly delicate integument, or a so-called active precipitation.

The same conditions as those now described as arising with thorium, have also shown themselves to exist with radium, uranium, actinium, polonium, in short, with all the radioactive elements, and it has been possible to prove, especially with respect to radium and actinium, the formation of a gaseous emanation in just the same way as with thorium.

All these changes accompanying the phenomenon of radiation are indeed of an entirely different order of dimension than those occurring during the ordinary chemical reactions, and cannot as a rule be shown by the balance or even by the spectroscope. On

the other hand they can be traced and measured by the far more sensitive electroscope with a distinctness and accuracy that does not leave room for any doubt whatever as to their reality.

As will be seen, Rutherford's discoveries led to the highly surprising conclusion, that a chemical element, in conflict with every theory hitherto advanced, is capable of being transformed into other elements, and thus in a certain way it may be said that the progress of investigation is bringing us back once more to the transmutation theory propounded and upheld by the alchemists of old.

As an explanation of these remarkable phenomena, Rutherford, in conjunction with Dr. F. Soddy, one of his numerous co-investigators, brought forward in 1902 the so-called disintegration theory, which is closely allied in several aspects to the opinions earlier enunciated by J.J. Thomson and other physicists with regard to the nature of matter.

According to this theory the origin and the loss of radioactivity are to be regarded as due to changes - not in the molecule - but in the atom itself. The radioactive elements are consequently subject to actual disintegration, in such a way that in the space of every unit of time a definite percentage of their atoms are broken up into one or more particles of radiation on the one hand, and a new atom on the other, which consequently represents a new element that is different from the original one owing to the difference it manifests in both its physical and its chemical properties. That new element may in its turn be disintegrated in a similar manner, and so on step by step, until finally an atom is evolved, possessed of more stability and permanence. For it must be remembered that the transmutation of the radioactive elements always takes place gradually and gives rise to the production of a quantity of more or less unstable transitional forms (metaboles). In radium, for instance, as many as seven at least have been thought to be observable. These ephemeral elements are characterized in the first place by the different rate with which they are transmuted or, as it is often expressed, by the variation in their average length of existence, a constant which is of the same importance in determining the identity of a radioactive element as its atomic weight is for an ordinary stable element. The

measurements carried out show that the average length of existence may vary from a few seconds to thousands of millions of years.

The disintregation theory was strikingly confirmed almost directly after it was first published to the world, by Sir William Ramsay and Dr. Soddy successively showing in a most convincing manner how helium originated from radium; this discovery cannot be considered any less interesting or momentous than the circumstance that Rutherford and Soddy had previously expressed the supposition that helium was probably to be regarded as a product of the disintegration of the radioactive elements. Finally, the disintegration theory, in spite of the audacity with which it assailed and brought to nought the theory accepted of the stability of the elements among all chemists, met with approval and general recognition remarkably quickly, a fact probably to be ascribed principally to the perspicuity and systematic orderliness that it introduced into the department of radiology.

Though Rutherford's work has been carried out by a physicist and with the aid of physical methods, its importance for chemical investigation is so far-reaching and self-evident, that the Royal Academy of Sciences has not hesitated to award to its progenitor the Nobel Prize designed for original work in the domain of chemistry - thus affording a new proof to be added to the numerous existing ones, of the intimate interplay one upon another of the various branches of natural science in modern times.

The above-mentioned disintegration theory and the experimental results upon which it is based, are synonymous with a new departure in chemistry, involving a fresh and decidedly extended comprehension of the very basis of that science. To the chemists of the 19th century the atom and the element represented each in its sphere the uttermost limit of chemical subdivision or disintegration, and at the same time the point beyond which it was impossible for experimental investigation to proceed. If it were queried what there was beyond, nothing but more or less vague and fruitless speculations were forthcoming. This line of demarcation, for so long regarded as insurmountable, has now been swept away, at all events in principle. Nowadays the inner structure of atoms and the laws regulating that structure belong to the problems that can be made the subject of discussion

in a thoroughly practical and at the same time fully scientific manner, thanks to the exactness of the measurements which have been taken. The results already arrived at are not only of the utmost importance in themselves, but derive perhaps a still greater significance from the numerous possibilities, wholly unsuspected ten or twelve years ago, which have been thrown open for the continuance of the work of investigation in this department of science.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1908/press.html