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Nobel Prize in Chemistry 1904

Sir William Ramsay

The Nobel Prize in Chemistry 1904 was awarded to Sir William Ramsay *"in recognition of his services in the discovery of the inert gaseous elements in air, and his determination of their place in the periodic system"*.

RESEARCH INFORMATION:

One of the most prominent features of natural science research in our day is the reciprocal action characterizing physics and chemistry, causing an important discovery in one of these sciences almost invariably to affect the sister science. Thus Lord Rayleigh's investigations concerning the physical properties of certain gases that have just received award gave rise to a whole series of surprising and important discoveries in the department of pure chemistry.

Lord Rayleigh having proved the remarkable difference in density existing between atmospheric nitrogen and chemically prepared nitrogen, another British scientist, already well-known as an eminent chemist, received permission to co-operate in the continued investigations with the intention of discovering, if possible, the cause of the peculiar state of things previously mentioned. The result of this co-operation was the discovery

(published in 1894) that the air contains a gaseous component, previously unknown, of nearly one-and-a-half the density of nitrogen, which explains the higher specific weight of the atmospheric nitrogen. A careful study of the properties of the new gas soon proved beyond all doubt that a new chemical element had been discovered, which owing to its disinclination to enter into chemical association with other elements was called *argon* ("the inactive one").

Not content with having proved the presence of argon in the gaseous envelope of the globe, Lord Rayleigh's chemical co-operator, on his own initiative, devoted himself to searching for the occurrence of argon in the solid crust of the earth. This led him to a new discovery, scarcely less surprising than the preceding. He succeeded in isolating from certain uranium minerals a gas, which in the spectroscope proved identical, not to argon, but to the long sought-for solar element *helium* hitherto undiscovered on earth, the existence of which had first been demonstrated by Janssen, the French astronomer, during a spectroscopic examination of the solar chromosphere in 1868, while making observations on an eclipse of the sun in India. It has subsequently been found that helium is also present in the water of some mineral springs, in certain meteorites, and that like argon, only in a far less degree, it forms a component of the atmosphere of the earth.

As soon as the atomic weight of the two new gases had been approximately determined - as 4 for helium and 40 for argon- the energetic scientist was led, by theoretical reasoning, to search for yet another elementary gas, the atomic weight of which should lie between the two preceding gases and should probably be about 20. Having made a great number of fruitless attempts in various directions, he at last obtained an active agent when the problem of making liquid air on a large scale was practically solved. With the assistance of the low temperature which occurs when liquid air evaporates (-200°C and lower) he was able to obtain considerable quantities of liquid argon without any great difficulty, and both by fractional distillation thereof and by direct fractionation of liquid air, he succeeded in demonstrating in the more freely volatile fractions the sought-for element which was called by him neon ("the new one"). Not was this all: in the less freely diffused

fractions of the air he almost simultaneously discovered two new elements, both gaseous at ordinary temperature, of greater density than argon, the existence of which he had predicted - though with rather less certainty - and for which he proposed the denominations krypton ("the hidden one") and xenon ("the strange one").

These gases occur in the air but sparingly as a rule, for while argon forms nearly 1 hundredth of the volume of the air, neon occurs only as 1 to 2 hundred-thousandth, helium as 1 to 2 millionth, krypton as 1 millionth and xenon only as about 1 twenty-millionth part per volume. This more than anything else will enable us to form an idea of the vast difficulties which attend these investigations. In spite of all obstacles, however, it has not only been found possible to isolate the new elements but also to study their peculiarities with an accuracy which enabled their place to be determined in the periodic system of the elements. It has been demonstrated that the five new gases, or "noble gases" as they are often called, form a natural family of elements which by the absence of electric polarity is strictly differentiated from all elements previously known, filling a void in the periodic system hitherto existing between the highly negative halogens and the highly positive alkali metals.

The discovery of an entirely new group of elements, of which no single representative had been known with any certainty, is something utterly unique in the history of chemistry, being intrinsically an advance in science of peculiar significance. The more remarkable is this advance when we recollect that all these elements are components of the atmosphere of the earth, and that, though apparently so accessible for scientific research, they have for so long a time baffled the acumen of eminent scientists, who from the time of Scheele, Priestley, and Lavoisier to our own day have been occupied in determining the chemical and physical properties of the air. The discovery, however, signifies far more than the simple addition of five new elements to the seventy odd that are already known. This to no slight degree owing to the inert character of the new gases, which certainly renders their study very difficult, but at the same time places them in a very peculiar position among the other elements. In spite of repeated and indefatigable

endeavours it has been found impossible in any authenticated case to induce chemical combination either with each other or with other known elements. Such a total inertness among elements was previously unknown; indeed it was almost generally believed that the power of entering into chemical reaction was a fundamental attribute which- though in a higher or lower degree - characterized all the elements. The discovery of the noble gases has removed this impediment to our knowledge, widened our far too narrow view of the nature of the elements, and for this reason, from a theoretical aspect, is of special interest.

This interest has of late been still further heightened by the observation that the spectral lines of helium appear in the emanations from radium, that very puzzling element, an observation which may bear fruit in results for science, the full extent of which it is now impossible to foresee.

The scientific triumphs gained by the discovery of the noble gases are easily described, though they have not been acquired without great toil, being not merely a combination of fortunate circumstances but the result of a well-planned, persevering, and tiresome work. The man who has opened these new realms of nature to science, and to whom the Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry for the present year is Sir William Ramsay, Professor at University College, London.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1904/press.html