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Nobel Prize in Physics 1968

Luis Walter Alvarez

The Nobel Prize in Physics 1968 was awarded to Luis Alvarez *"for his decisive contributions to elementary particle physics, in particular the discovery of a large number of resonance states, made possible through his development of the technique of using hydrogen bubble chamber and data analysis"*.

RESEARCH INFORMATION:

The science of physics has as its function the study of energy in all its forms. Einstein observed that matter, or mass, is one of the forms in which energy manifests itself. This fact was established experimentally 35 years ago, when it was discovered that high-energy electromagnetic radiation was capable of producing pairs of electrons, one with positive, the other with negative charges. It has since been possible to produce other similar pairs, for example protons and antiprotons. These newly-created particles are stable and, if left undisturbed, can exist indefinitely. Unstable particles can also be produced, however. These disintegrate rapidly into other particles and, passing through one or several stages, revert to stable forms or develop into other forms of energy. Many such new particles have been discovered and studied during the last two decades. They are so minute that it is impossible to see them; they can only be identified by the tracks they leave behind them as

they move. The scientist must behave like the hunter, who determines the identity and behaviour of his quarry by studying tracks left in the snow.

The new particles are normally produced with the help of the great, new accelerators which cause the particles to move at very great speed. This has the advantage that, although the life-span of the particle might be as little as a ten-thousandth part of a millionth of a second, the track acquires a length of several centimetres.

One could, however, suspect the existence of particles with considerably shorter life-spans and with such small track-lengths that they are impossible to measure. In this case one is obliged, instead, to study the tracks of their disintegration products and the tracks of the reactions they produce in collision with other particles. The pattern of tracks thus becomes very complicated; the correct interpretation of what actually occurs requires acute powers of discernment and a particularly advanced experimental technique. It is in this field that Professor Luis Alvarez has made the contributions for which he is today being rewarded.

He has with insight and determination developed the bubble-chamber, invented by the Nobel Prize winner in Physics, Donald Glaser, into an invaluable instrument for this type of investigation. Alvarez' bubble-chamber contains many hundreds of litres of hydrogen, reduced to a temperature of minus 250°C, which thus becomes fluid. When the particle passes through the liquid, it is warmed to boiling point along the track it leaves. In the wake are a trail of bubbles that can be photographed whilst still very small. The photographs are able, in this way, to reproduce accurately the path of the particle. Because the chamber contains only hydrogen, it is evident that all reactions must occur with hydrogen nuclei, protons. This considerably simplifies the interpretation of the phenomenon. The cost of this instrument, capable of producing about a million photographs annually, was two million dollars.

The photographs must be studied and measured with great accuracy. In order to carry out this enormous task, Alvarez and his assistants have constructed a series of more and more delicate automatic scanning and measuring instruments capable of transferring

the information from the photographic film into a state suitable for treatment by computer. In this field, too, Alvarez has made contributions of a pioneering nature.

With the establishment of the hydrogen bubble-chamber, entirely new possibilities for research into high-energy physics present themselves. Results have already been apparent in the form of newly-discovered elementary particles. The first, very short-lived, so called, "resonance particle" was found in 1960. Since then there have been a whole series of discoveries made by Alvarez' group in Berkeley, California and in other laboratories where Alvarez' material is being used or where his methods and programs are adopted. Practically all the discoveries that have been made in this important field of high-energy physics have been possible only through the use of methods originated by Professor Alvarez.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/physics/laureates/1968/press.html