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Nobel Prize in Physics 1929

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The Nobel Prize in Physics 1929 was awarded to Louis de Broglie *"for his discovery of the wave nature of electrons"*.

RESEARCH INFORMATION:

The question as to the nature of light rays is one of the oldest problems in physics. In the works of the ancient philosophers are to be found an indication and a rough outline of two radically different concepts of this phenomenon. However, in a clear and definite form they appear at the time when the foundations of physics were laid, a time that bears the stamp of Newton's genius. One of these theories asserts that a light ray is composed of small particles, which we may term corpuscles, which are projected into space by light-emitting substances. The other states that light is a wave motion of one type or another. The fact that these two theories, at this elementary stage, are equally possible, is attributable to their explaining equally well the simplest law governing a light ray, viz. conditions being undisturbed it propagates in a straight line.

The 19th century sealed the victory of the wave theory. Those of us whose studies coincide with that period have certainly all learned that light is a wave motion. This conviction was based on the study of a series of phenomena which are readily accounted

for by the wave theory but which, on the other hand, cannot be explained by the corpuscular theory. One of these phenomena is the diffraction undergone by a light beam when it passes through a small hole in an opaque screen. Alongside the diffracted ray there are alternate light and dark bands. This phenomenon has long been considered a decisive proof of the wave theory. Furthermore, in the course of the 19th century a very large number of other, more complex, light phenomena had been learnt of which all, without exception, were completely explainable by the wave theory, while it appeared to be impossible to account for them on the basis of the corpuscular theory. The correctness of the wave theory seemed definitely established.

The 19th century was also the period when atomic concepts have taken root into physics. One of the greatest discoveries of the final decades of that century was the discovery of the electron, the smallest negative charge of electricity occurring in the free state

Under the influence of these two currents of ideas the concept which 19th century physics had of the universe was the following. The universe was divided into two smaller worlds. One was the world of light, of waves; the other was the world of matter, of atoms and electrons. The perceptible appearance of the universe was conditioned by the interaction of these two worlds.

Our century taught us that besides the innumerable light phenomena which testify to the truth of the wave theory, there are others which testify no less decisively to the correctness of the corpuscular theory. A light ray has the property of liberating a stream of electrons from a substance. The number of electrons liberated depends on the intensity of the ray. But the velocity with which the electrons leave the substance is the same whether the light ray originates from the most powerful light source that can be made, or whether it originates from the most distant fixed stars which are invisible to the naked eye. In this case everything occurs as if the light ray were composed of corpuscles which traversed the spaces of the universe unmodified. It thus seems that light is at once a wave motion and a

stream of corpuscles. Some of its properties are explained by the former supposition, others by the second. Both must be true.

Louis de Broglie had the boldness to maintain that not all the properties of matter can be explained by the theory that it consists of corpuscles. Apart from the numberless phenomena which can be accounted for by this theory, there are others, according to him, which can be explained only by assuming that matter is, by its nature, a wave motion. At a time when no single known fact supported this theory, Louis de Broglie asserted that a stream of electrons which passed through a very small hole in an opaque screen must exhibit the same phenomena as a light ray under the same conditions. It was not quite in this way that Louis de Broglie's experimental investigation concerning his theory took place. Instead, the phenomena arising when beams of electrons are reflected by crystalline surfaces, or when they penetrate thin sheets, etc. were turned to account. The experimental results obtained by these various methods have fully substantiated Louis de Broglie's theory. It is thus a fact that matter has properties which can be interpreted only by assuming that matter is of a wave nature. An aspect of the nature of matter which is completely new and previously quite unsuspected has thus been revealed to us.

Hence there are not two worlds, one of light and waves, one of matter and corpuscles. There is only a single universe. Some of its properties can be accounted for by the wave theory, others by the corpuscular theory.

In conclusion I would like to point out that what applies to matter applies also to ourselves since, from a certain point of view, we are part of matter.

A well-known Swedish poem has as its opening words "My life is a wave". The poet could also have expressed his thought by the words: "I am a wave". Had he done so, his words would have contained a premonition of man's present deepest understanding of the nature of matter.

Monsieur Louis de Broglie. When quite young you threw yourself into the controversy raging round the most profound problem in physics. You had the boldness to assert, without the support of any known fact, that matter had not only a corpuscular

nature, but also a wave nature. Experiment came later and established the correctness of your view. You have covered in fresh glory a name already crowned for centuries with honour. The Royal Academy of Sciences has sought to reward your discovery with the highest recompense of which it is capable. I would ask you to receive from the hands of our King the Nobel Physics Prize for 1929.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/physics/laureates/1929/press.html