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Nobel Prize in Physics 1920

Charles Edouard Guillaume

The Nobel Prize in Physics 1920 was awarded to Charles Edouard Guillaume *"in recognition of the service he has rendered to precision measurements in Physics by his discovery of anomalies in nickel steel alloys"*.

RESEARCH INFORMATION:

The Swedish Academy of Sciences has decided to award the Nobel Prize for Physics 1920 to Ch.E. Guillaume, Director of the International Bureau of Weights and Measures, for the services he has rendered to the physical precision technique by his discovery of the properties of nickel steel.

One of Greece's greatest thinkers said that "things are numbers" and attempted to explain the origin of everything by numbers. The scientists of today do not take the cult of numbers to quite that extent; yet they recognize nevertheless that every exact knowledge of Nature begins only when we succeed in expressing the phenomena in measures and weights. The development of science has always been in step with the progress in measuring precision. This applies to astronomy, geodesy, chemistry and above all to physics, the special growth of which dates from the time when modern precision began to be applied in observations.

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This was the point which had been grasped by the French National Assembly when, in 1790, it instructed the Academy of Sciences of Paris to lay down an invariable base for weights and measures. A committee was set up for that purpose, consisting of Borda, Lagrange, Laplace, Monge and Condorcet, and on their suggestion the National Assembly adopted a decimal system based on a certain part of a quadrant of the Earth's meridian. Thus the principle of the metric system was introduced into France which was then established by a law passed by the Convention held on August 1, 1793.

In the other countries progress was slower. It was not until after a few decades that people in Europe began to realize the advantages of the metric system and that mainly because of the large international exhibitions. During the 1867 international exhibition in Paris a committee was formed by most of the countries represented at the exhibition with a view to preparing the adoption of a single international system for weights and measures. The proposal to that effect, approved by the emperor on September 1, 1869, was submitted to all the states and thus was subsequently founded the International Bureau of Weights and Measures at Breteuil, near Paris.

It was the French nation which not only conceived the idea of this great reform, but which, by its diplomatic skill, was also able to bring about its adoption in the whole civilized world; on this account, therefore, mankind owes France a great debt of gratitude.

All the copies of the standard metre and the standard kilogramme intended for the various countries are meticulously examined and compared in this International Bureau, the head of which, Charles-Edouard Guillaume, is undeniably the foremost metrologist of today. By devoting his entire life to the service of science, this scientist has made a powerful contribution to the progress of the metric system; during his long and painstaking studies he discovered a metal with the most excellent metrological properties. That is the discovery which the Swedish Academy of Sciences has sought to reward by conferring this year's Nobel Prize for Physics, since the discovery is of great significance for the precision of scientific measurements and thereby even for the development of science in general.

Actually the mere fact of possessing an international system for weights and measures and an International Bureau for the application of that system had not done away with the difficulties entailed in each measuring or weighing operation unless it is possible to achieve here the maximum precision. With measurements of length in particular the chief source of errors was dependent on temperature as a result of the well-known property of materials to change their volume with variations in temperature.

It was thus basic to examine with the greatest precision the expansibility of all metals and alloys under the action of heat. During these delicate examinations, and particularly while studying the properties of certain types of steel, Guillaume hit on the apparently paradoxical idea that it should be possible to produce an alloy free from this universal property of materials to change their volume at various temperatures. The long and difficult experiments performed by Guillaume year after year on numerous alloys and above all on nickel steel to determine their expansibility, elasticity, hardness, changeability with age, and stability ultimately led him to the important discovery of the nickel steel alloy known as invar, the temperature coefficient of which is practically zero.

These studies and discoveries by Guillaume have continued to give rise to new and significant practical applications. Instances are the use of invar in the design of physical instruments, and especially in geodesy where Guillaume's discovery has completely transformed the methods of measuring base lines; nickel steel has also supplanted platinum in the manufacture of incandescent lamps and on the basis of the current price of platinum this represents an annual saving of twenty million francs; lastly chronometry is indebted to Guillaume's discoveries and investigations for a new refinement - the use of the new alloys enables watches to be adjusted more accurately and at less cost than formerly.

From the theoretical standpoint, too, Guillaume's penetrating and systematic studies on the properties of nickel steel have had the greatest significance because they have confirmed Le Chatelier's allotropic theory for binary and ternary alloys. He has thus made an important contribution to our knowledge of the composition of solid matter.

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In consideration of the great importance of Mr. Guillaume's work for precision metrology and thus for the development of all modern science and engineering, the Swedish Academy of Sciences has awarded this year's Nobel Prize for Physics to Charles-Edouard Guillaume in recognition of the services which he has rendered to the physical precision technique by his discovery of the properties of nickel steel.

Monsieur Guillaume. By your persevering studies in thermometry you have deserved well of physics and chemistry; but you have gained your scientific laurels mainly in a different sector. By your studies of metal alloys and their sensitivity to temperature influences, you established that a few of those alloys possess remarkable properties; some scarcely expand on heating which suggested to you the idea of making them into measuring standards. One of the nickel steel alloys in particular, the one containing thirty-six per cent nickel, you considered to fulfil the necessary conditions. Since it is almost invariable under the action of heat and under other influences, you have called it invar. Its potential benefit to science for the construction of standards and of various instruments can readily be appreciated. In geodesy, invar wires give much more accurate base-line values than those formerly obtained.

On behalf of the Royal Swedish Academy of Sciences, I congratulate you on your studies and on your discoveries which have been of the greatest utility and for that very reason deemed worthy of the Nobel Prize. I would now ask you to receive the prize from the hands of His Majesty the King who has been pleased to make the presentation to you.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/physics/laureates/1920/press.html