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IB Physics 2 HL

Nobel Prize Winner – Johannes Diderik van der Waals

Introduction

In 1910 The Nobel Prize and Laureates Committee poured over thousands of possible recipients and in the end they chose to award the Nobel Prize in Physics to Johannes Diderik van der Waals. The Nobel Prize in 1910 was awarded to Johannes Diderik van der Waals "for his work on the equation of state for gases and liquids"[1]. He was the only one of his partners to earn the award so he was able to retain the entire grant to maximize his usage of the money to further his experiments. At the time of receiving this award Johannes Diderik van der Waals was affiliated with Amsterdam University, Amsterdam, Netherlands. The specific field that this prize was awarded under was gas physics and molecular physics.

Who

Johannes Diderik van der Waals was born on November 23, 1837 in the Netherlands. His rise to science was quite un-orthodox. He became a schoolteacher after primary school and began studying on the side at Leyden University. Eventually Johannes obtained his teaching certificates in mathematics and physics this way. In the town of Deventer he was appointed as a teacher at the secondary school in 1864. Later on in 1866 he moved to the town of Hague and worked his way up to the director of secondary schools in that town.

1873 was when he broke onto the true science scene. He was awarded his doctorate for

[1] http://www.nobelprize.org/nobel_prizes/physics/laureates/1910/

his thesis on the continuity of the gas and liquid state. This moved him to the foremost rank of physicists.[2] In this equation he discussed the fact that both gas and liquids is in fact the same thing. His findings were quickly translated into other languages and were published in the *Proceedings of the Royal Netherlands Academy of Sciences* and in the *Archives Néerlandaises.* In the Netherlands a new law was passed in 1876. The Law on Higher Education moved the Athenaeum Illustre of Amsterdam to University classification. It was here where Van der Waals became a professor of physics. During his tenure at the University he made many other important discoveries that thrust the school into the international scene.

He had a relatively quiet personal life. He married Anna Magdalena Smit in 1864 but sadly she died early and he never remarried. They had three daughters and one son, all of whom went on and became successful professors except Anne Madeleine who stayed to run the house and look after her father. Eventually his son became so successful in following his father's footsteps that he succeeded his father as the Chair of Physics at the University of Amsterdam. Van der Waals enjoyed walking the countryside and reading. He participated in these hobbies up until his death in Amsterdam on March 8, 1923. He was 85 at the time of his death.

What

The direct reason Johannes Diderik van der Waals was awarded the Nobel Prize in Physics was for "his work on the equation of state for gases and liquids".[3] This work was in van der Waals primary field of thermodynamics. This new equation directly addresses the

[2] http://www.nobelprize.org/nobel_prizes/physics/laureates/1910/waals-bio.html
[3] http://www.nobelprize.org/nobel_prizes/physics/laureates/1910/

continuity of the gas and liquid state. In this thesis he put forward an "Equation of State" embracing both the gaseous and the liquid state; he could demonstrate that these two states of aggregation not only merge into each other in a continuous manner, but that they are in fact of the same nature.

The sheer importance of his newfound conclusion can be summed up quite nicely by the remarks made by James Clerk Maxwell, "that there can be no doubt that the name of Van der Waals will soon be among the foremost in molecular science".[4] The Prize was awarded for this work because it is highly important. When deriving his work he not only assumed the existence of molecules but that they are of finite size and that the attract each other.[5] He was the first to explain intermolecular force and that force is now known as a van der Waals force.

Where

The majority of his work on this thesis was done during his time at the University of Amsterdam during his sitting for university examinations. He was working towards getting his doctorate when he uncovered these new facts to support his thesis. He work wasn't influenced by any geopolitical forces as it was done in 1873 which was a year in which there was no war or extreme nationalism for war such as in Germany in the late 1930's. During this time period the Netherlands was not at war and was not going to go to war anytime soon. Also they weren't under a harsh oppressive dictatorship so none of his work was suppressed or censored. This allowed Johannes Diderik van der Waals to use his full effort to obtain his results that he felt fit his thesis the best.

[4] http://www.nobelprize.org/nobel_prizes/physics/laureates/1910/waals-bio.html
[5] http://en.wikipedia.org/wiki/Johannes_Diderik_van_der_Waals#cite_note-8

When

As stated previously the main uncovering of his findings was during 1873 which was during a period of peace in the Netherlands. There is nothing reported or known of that could have influenced his reports or skewed his results, politically and situational based at least.

Why

Johannes Diderik van der Waals was a highly intriguing man and the main reason he was interested in the subject of his thesis was R. Clausius' treatise considering heat as a phenomenon of motion. This sparked van der Waals's interest into the field of thermodynamics. This caused Johannes Diderik van der Waals to investigate T. Andrews's experiments during the attempt at obtaining his doctorate. T. Andrews's experiments revealed the existence of critical temperatures in gases but van der Waals was able to identify the missing component in his study. Johannes Diderik van der Waals saw that one must take into account the volumes of molecules and the appearance of intermolecular forces. So thus incidentally Johannes Diderik van der Waals established the relationship between the pressure, volume and the temperature of gases and liquids.[6] He later investigated many aspects that branched off of this originally ground breaking founding but they weren't awarded the Nobel Prize or as much recognition as his original experiment.

How

[6] http://www.nobelprize.org/nobel_prizes/physics/laureates/1910/waals-bio.html

Unless one reads his experiment journals it is hard to decipher his actual procedure in developing his thesis. His data is unavailable online, and due to the lack of time one cannot fly to the Netherlands to obtain copies of his work from their archives. Though it would be quite interesting I am unable to do so at this time. It can be inferred though that little was actually done to test his thesis at the time. In 1873 much scientific equipment that we take for granted nowadays was not in existence or highly crude. It can be inferred that he studied his predecessor's mistakes and looked for a possible reason to why his project was inconclusive. Only through his genius was Johannes Diderik van der Waals able to identify the lack of intermolecular forces and volume being accounted for in the experiments.

References

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