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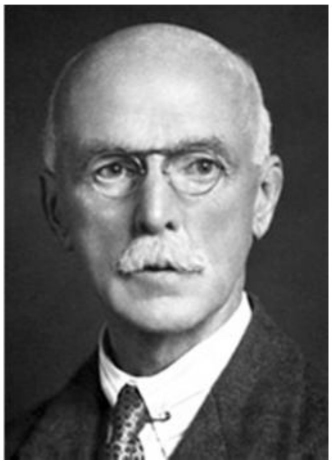
Nobel Prize in Chemistry 1929



Arthur Harden

Hans Karl August Simon von Euler-Chelpin

The Nobel Prize in Chemistry 1929 was awarded jointly to Arthur Harden and Hans Karl August Simon von Euler-Chelpin *"for their investigations on the fermentation of sugar and fermentative enzymes"*

RESEARCH INFORMATION:

The fermentation of liquids containing sugar - there we have a chemical reaction older than all chemical science. The point of time when men first began to take this reaction into their service is really lost in the mists of antiquity, before the beginning of history. The peculiar and apparently self-caused process by which an innocent fruit juice is transformed with the active formation of scum, into a drink which is either stimulating or intoxicating according to the quantity partaken, attracted attention in the very earliest times; and to many peoples it appeared so wonderful that nothing less than the cooperation of a divinity seemed to them possible as an explanation.

Our enlightened time has scarcely the right to marvel at this, when we take into consideration how long a time science has since required to obtain an acceptable conception of the nature of fermentation. Here we stand face to face with one of the most complicated and difficult problems of chemical research. Little more than a couple of centuries separate us from the time when men first began to perceive that the fermenting substance was sugar, which under the influence of a certain *something* was decomposed, with carbonic acid and ethyl alcohol as the final products of the decomposition.

But what this "something" was, and how it worked, still remained unsolved questions, long defying the most penetrating attempts at interpretation. It was not until our own days that it has been vouchsafed to us to have a fairly satisfactory answer to these questions, but even here the process of development has been slow, toilsome, and it took place, so to speak, in several instalments.

In carrying out the provisions of Alfred Nobel's Will, the Swedish Academy of Sciences has already once before had its attention directed to this sphere of research. That was in 1907, when Eduard Buchner was awarded the Nobel Prize in Chemistry for his discovery of non-cellular fermentation. At the time complaints were raised in certain quarters against this award as being insufficiently justified. Seen in the perspective of distance in time, however, Buchner's discovery has more and more stood out as a line of demarcation between two different epochs, pointing the way to a new phase in the history of the chemistry of fermentation.

Buchner's discovery marked the final decision in a long struggle between two distinct schools - one, the older one, represented by Justus von Liebig the other, the younger one, represented by Louis Pasteur. According to the former school, fermentation was a purely chemical process, evoked by an unorganized ferment with unstable properties, which were imparted to the fermenting substance and thereby brought about its decomposition. According to the latter school, it was rather a physiological process, inseparably connected with the vital act of a microorganism known as the "fungus of fermentation". Buchner's discovery made it evident that to some extent both were right, but also to some extent both were wrong, and, consequently, that the truth lay between the two.

But the value of the discovery makes itself known in a still more definite way through the impulse it has given to later research. In fact, during the last three decades that research has made such great advances, has given such an enlarged insight into the mechanism of the process of fermentation, that the Academy of Sciences has found the time ripe once again to award a Nobel Prize in this department. In so doing the Academy has deemed it right to divide equally the Nobel Prize in Chemistry for the present year between Professor Arthur Harden and Professor Hans von Euler.

Buchner assumed in the yeast juice the presence of a uniform ferment or enzyme, known as "zymase".

When, however, Harden and his fellow-workers filtered a quantity of Buchner's yeast-juice through a gelatine filter, known as an "ultrafilter", and thereby split it up into two fractions (a filtrate and a sediment that did not pass through the filter), the curious state of things occurred that neither of these fractions was any longer able to bring about fermentation, but that after being mixed with one another they recovered that capacity.

Harden explained this by saying that a high-molecular enzyme, the zymase proper, was left on the filter, which let through a low-molecular complementary enzyme, which for the sake of brevity was called co-enzyme or co-zymase.

Another no less important advance is made in Harden's demonstration of the hitherto neglected part played by phosphoric acid in the process of fermentation. It has been found that a certain addition of phosphate gives rise to an equivalent amount of carbonic acid and ethyl alcohol. This effect is associated with the formation of one or more definite compounds between sugar and phosphoric acid - known as the "zymo-phosphates", amongst which a glucose monophosphate and a glucose diphosphate are to be regarded as the most important.

In the same measure as research in this department has made new conquests, a clearer and clearer insight has been gained into the importance of this discovery. In particular the work of von Euler and his pupils during the last few years greatly contributed to the unravelling of the mechanism of phosphorization.

The primary function of phosphoric acid in fermentation consists, according to von Euler, in the fact that in cooperation with an enzyme it gives rise to glucose monophosphate, identical with the monophosphate discovered by Harden and Robison. This phosphate afterwards undergoes a mutation in the presence of co-zymase, inasmuch as a glucose diphosphate and an active glucose are formed, after which the latter yields the necessary material for the subsequent stages of the fermentation.

This demonstration of the part of mutase played by the co-zymase, or in other words of the identity of co-zymase and co-mutase, is of fundamental importance, for it has fully revealed the central position in the process of fermentation of the complementary enzyme in question.

The researches of von Euler and his pupils have further led to the concentration of the co-zymase and to a far more exact study of its properties than had been previously possible. They have been able to determine approximately its molecular weight, which has been found to be about 490; and they have also been able to draw certain definite conclusions concerning its chemical nature, which make it highly probable that we have here what the chemists call a pentosenucleoside. The production of a co-zymase with a high activity has also shown in a brilliant manner the character of that enzyme as a specific activator.

Finally, what gives special interest to the study to the complicated reaction mechanism of the fermentation of sugar is that it has been possible to draw from it important conclusions concerning carbohydrate metabolism in general in both the vegetable and the animal organism.

The brief summary which has now been given, and which, in view of the scanty time allowed, has necessarily been extremely fragmentary, will in any case probably have shown that there is an extremely intimate connection between the researches of Harden and von Euler in this field. On the one hand, the fundamental discoveries of Harden have formed the

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precondition and point of departure for the various work of von Euler; and on the other hand, it is only the work of the latter that has made fully evident the importance of Harden's discovery.

Under such circumstances the Academy of Sciences has not hesitated this time to avail itself of the expedient that is offered by the Statutes of the Nobel Foundation of dividing the prize between two equally meritorious scientists.

Professor Harden. When the Royal Swedish Academy of Sciences resolved to adjudge to you, together with Professor von Euler, this year's Nobel Prize in Chemistry on account of your important contributions to our knowledge of alcoholic fermentation, the Academy had let herself guided by a firm conviction that these contributions had opened indeed a new chapter in the investigation of that very complicated matter.

It is with the most sincere gratification that I have the honour of conveying to you the congratulations of the Academy on this distinction, the outward signs of which you are now about to receive

Professor von Euler. It is a great pleasure to the Swedish Academy of Sciences to be able to award this time the Alfred Nobel's Prize also to one of her members, and so much more since during a long series of years we have been in the position to follow from nearby your energetic, persevering, and systematic investigations. The Academy is also firmly convinced that the distinction which has fallen upon you today, will not contain for you the temptation to rest on laurels already obtained, but that on the contrary it will mean a stimulus to continued and, as we all hope, successful work in the service of biochemistry.

For more details please visit:

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