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Nobel Prize in Chemistry 1907

Eduard Buchner

The Nobel Prize in Chemistry 1907 was awarded to Eduard Buchner *"for his biochemical researches and his discovery of cell-free fermentation"*.

RESEARCH INFORMATION:

The Nobel Prize in Chemistry for this year (1908) has been awarded by the Royal Academy of Sciences to Ernest This year's Nobel Prize for Chemistry has been awarded to Professor Eduard Buchner for his work on fermentation.
For a very long time both chemists and biologists have always regarded it as a particularly signify

ant achievement when it has been possible to open up for chemical research a new field of the chemical processes which take place in living organisms. Through every step in this direction the puzzling aspect of the life processes diminishes, while on the other hand chemical laws are given a wider application. The farther the field of research in such a direction is extended the narrower becomes the territory at whose limit one must remain, since, as it used to be said, phenomena in such territory were governed by special laws not yet available to us and controlled by a particular kind of so-called "life force".

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For a long time far-seeing research workers in the field of chemistry have opposed the idea that chemical processes in the living being occupy such an exceptional position and have therefore given their full recognition to such works as in their view offered direct support to their views.

In this connection we in Sweden feel bound to draw attention to the statements made by Berzelius. Apart from his creative activity in general chemistry, Berzelius was actively interested in the chemical processes in animal and plant organisms. With regard to these he held the view that they were more complicated and more difficult to learn than chemical reactions which take place independently of the living being. In no way, however, could he associate himself with the view generally held at that time that their nature was different and that they must follow quite different laws from the latter.

Berzelius also had a predilection for taking part in work in this field of chemistry, when he could find time. He set great store by pertinent achievements of others. As an example of this, I recall Berzelius' reply to Wohler when the latter mentioned his discouragement at having missed the discovery of the element vanadium, a discovery he was close to, but did not succeed in making, because he did not complete the work he had started. Berzelius consoled him with friendly words. At the same time he pointed to Wohler's merit on the explanation of the formation of organic substances, which was then just commencing. Referring to a paper by Wohler and Liebig which had just appeared concerning cyanic acid and urea, Berzelius said that anyone who had produced such work could very well forgo discovering an element. One could, writes Berzelius, have discovered ten unknown elements without needing as much genius as for the work just referred to.

Since 1813, when this was written, this field has been extended enormously in many directions; it has been found possible to lift the veil which hitherto covered the phenomena of organic life. Thus a very large number of substances, which at the time in question it was assumed could only be formed by living organisms, can now be prepared synthetically. When, however, it is a matter of the inner course during the formation and conversion of

these substances in living beings, we have to admit that our knowledge is still very far from complete. To be sure, it is no longer said that the living being is governed by a special "life force", but very often we have to make do even today with another expression which, in its actual meaning, does not differ very much from the first. It is frequently said now that this or that process should be regarded as a "life phenomenon" or "life expression" in certain cells. Regrettably we have to recognize that in this we are to a great extent merely providing a word instead of a deeper insight. It is certainly true that the frontier territories in which chemical research is now struggling to penetrate the complicated, mystic phenomena of life have in many respects advanced far beyond where it stood in 1813. Meanwhile, it still remains a fact that we owe considerable unconditional recognition to a work which in this field has taken experimental chemical research a sure step farther.

This is applicable to the work which is now the subject of the Prize award.
In a few words I shall try to explain to you what it is about.

For a long time chemists have been paying great attention to the phenomena which we now call fermentation. Under this name we include a number of chemical processes which occur in living beings and for which they are of the greatest importance. Usually these are decomposition processes in which compound substances are split under the influence of agents which we call ferments. These ferments act, so to speak, by their mere presence. Without being themselves transformed, they cause certain definite changes in other substances, the effect of each ferment being limited to a certain substance or a certain group of substances. It is an important property of ferments that, precisely under such circumstances as obtain in living beings, they exert a powerful action, whilst under others they frequently and easily become ineffective. Since, on the other hand, by means of *other* chemical aids, chemical processes can be brought about which appear similar to the actions of the ferments-several examples of which are available-it often happens that for this purpose agents are necessary whose nature makes them quite foreign to, and often incompatible with, conditions in living beings.

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In very recent times, particularly, the advancement of our knowledge has made it probable that there are processes which are fermentative to a *particularly* high degree, which bring about the conversion of substances in living beings and which thus control this condition of life. Just as chemical science has during the past century acquired an extensive knowledge of the composition and structure of organic substances, so a thorough knowledge of the nature and action of ferments is now essential, in order that this science may be in a position to master the laws of the formation and dissociation of substances within the organism.

Meanwhile, we know these ferments up to now only by the effects they produce. Their inner nature and the constitution of their substance are still unknown to us. It is to be hoped, however, that a solution to this puzzle may be the subject of a future Nobel Prize.

A number of fermentations have been readily observable. This relates, for example, to the ferments which occur in dissolved state in the secretions which are discharged into the digestive system and exert such a great influence there. It has thus been possible to gain very considerable experimental experience concerning these fermentations. Another group of fermentations, however, had been seen to occur *only* in the presence of

cells. To this group belonged, among others, the decomposition of sugar into alcohol and carbon dioxide, under the action of ordinary yeast. The connection between this fermentation and the presence of live yeast cells appeared so irresolvable that this fermentation process was regarded as an "expression of life" by the cells. This process thus appeared to be inaccessible to more detailed research.

Through Pasteur this view was accepted and generally adopted in scientific circles.

The unforgettable service done by Pasteur is that he showed that there are living organisms which are the originators of putrefaction and fermentation and of a number of processes which are of very great significance. Pasteur, who was distinguished not only by the genius of his ideas but also by an eminent talent as an experimenter, also tried - particularly as regards ordinary alcohol fermentation - to investigate the intrinsic interrelationship in this process. In particular he tried to answer the question whether the

fermentation of alcohol was due primarily to a ferment produced by the yeast cells, in which case this ferment must be separated from them and be able to work independently of the presence of live yeast cells. His experiments, however, like those of others, concerning the occurrence of such a soluble ferment gave a negative result. Pasteur's view was thus considered to be confirmed, namely that the chemical process in alcoholic fermentation was a life expression by the yeast cells, and was thus inextricably linked with their life. This view prevailed for several decades.

At the same time as Pasteur earned for himself undying fame by his brilliant exposition of the significance of living beings as the ultimate cause of such processes, he put a brake on the progress of science in this field by the vitalistic concept of the actual course of fermentation. So long as fermentation was regarded as an "expression of life", and hence a phenomenon inseparable from life, there was little hope of being able to penetrate more deeply into the question of its course. It should be noted that this was of all the greater importance as it concerned not only alcoholic fermentation but a large group of important processes.

Under these circumstances it can easily be understood that a great sensation was created when E. Buchner, after many years' work, succeeded in showing that alcoholic fermentation could be produced from the juices expressed from yeast cells, free from live cells. He demonstrated incontrovertibly that this fermentation was due to a ferment produced by the yeast cells, from which it can be separated. Fermentation is not a direct expression of life by yeast cells; the cells can be killed and destroyed, while the ferment remains.

By Buchner's work, the fermentation mentioned and various other processes analogous to it have been freed from the shackles which previously held them and which prevented any progress in research. Now, no special difficulty is encountered in obtaining from yeast cells and various other cells an ample amount of powerfully active cell substance which is free from live cells. Numerous clarifying investigations into its properties have also been made, partly by Buchner himself and partly by others. Hitherto

inaccessible territories have now been brought into the field of chemical research, and vast new prospects have now been opened up to chemical science.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1907/press.html