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Nobel Prize in Chemistry 1930

Hans Fischer

The Nobel Prize in Chemistry 1930 was awarded to Hans Fischer *"for his researches into the constitution of haemin and chlorophyll and especially for his synthesis of haemin"*.

RESEARCH INFORMATION:

"Blood is a very special liquid", this was asserted some 140 years ago by Goethe. When writing these words and ascribing them to Mephistopheles he probably had in mind first and foremost the mystical aura with which popular superstition has been wont to invest since time immemorial the red river of life that flows in our blood vessels, and the magical forces with which it had long been held to be endowed. The methodical scientific research of a later age has however affirmed the phrase to a far greater degree than its author could have surmised. Many and difficult have been the riddles scientists have had to solve in research on blood. The number of those who have applied their ingenuity to the solution of the riddle is large. It is the privilege of this present generation to witness the raising of the veil of Isis which previously concealed the solution from view. The research to which the Academy of Sciences has felt itself constrained to award the Nobel Prize for Chemistry this year is exceptionally successful and significant.

Once the anatomists of the 17th century had demonstrated with the aid of the microscope that blood is a tissue - in the anatomical sense of the word - and that it consists partly of extremely small cells, the so-called blood corpuscles, partly of a liquid substance, the so-called plasma, it became the task of the chemists and physiologists to determine the composition of these constituents and their diverse functions in the vital process. As to the red blood corpuscles in particular it was found that their colour is due to an iron-containing substance, later called haemoglobin, which, by virtue of its strong affinity to oxygen, is of fundamental importance for the familiar changes venous blood undergoes in the lungs during respiration. Haemoglobin can be separated into a protein substance, i.e. globin, and a red substance, still containing iron which, after oxidation, with hydrochloric acid yields a saltlike complex iron compound, called haemin. Considerable uncertainty however prevailed for a long time even regarding the empirical formula of haemin, and the uncertainty as to its internal chemical structure was even greater. Elementary analysis showed that the haemin molecule contains a large number of carbon atoms (the data fluctuated between 32 and 34) and an almost equal number of hydrogen atoms, and also 4 oxygen atoms, 4 nitrogen atoms, 1 iron atom, and 1 chlorine atom. To determine the manner in which all these atoms, numbering more than 70, are linked, or in other words to determine the chemical constitution of haemin, was one of the most difficult and complicated tasks with which any chemist could be faced.

It was discovered that the haemin molecule can be converted by certain chemical procedures into iron-free substances, called porphyrins, and that the porphyrins can be broken down, by other procedures, into pyrrole derivatives, i.e. into compounds containing four carbon atoms and one nitrogen atom in a closed ring. It was clear that the road to an exact knowledge of the structure of the blood pigments would involve detailed examination of these pyrroles and porphyrins.

This is the road which Professor Hans Fischer of Munich travelled, to reach his destination with perseverance and determination; not only did he determine completely the constitution of haemin and all its decomposition products: he also prepared the blood pigments from their simplest constituents by synthesis, a scientific achievement which would scarcely have been considered possible even a generation ago. By this synthesis he

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crowned his researches which both in extent and in the unbelievable difficulties associated with them deserve to be called a gigantic labour.

Moreover, these researches were not wholly restricted to blood pigments. Closely related pigments occur in Nature and not only in the blood. These include the pigments in the bile, of which bilirubin is the best characterized to date. Its constitution, too, has been determined by Fischer who established the connection between this bile pigment and the blood pigment. Further, it was discovered that the pigment in the pinions of certain birds is the copper salt of a porphyrin, whereas the pigment which forms the dark spots on the eggs of a large number of wild birds, the so-called ooporphyrin, has been found to be blood pigment without iron. Even if I add that Fischer has demonstrated the occurrence of haemin in yeast, all this is overshadowed by the fact that, chemically speaking, the pigment of green plants, i.e. chlorophyll, is closely related with the red blood pigment, and even derives, as Fischer has shown, from exactly the same parent substance, as regards the porphyrins.

This shows that Nature in spite of her extravagant diversity was sufficiently economical to use exactly the same building material when constructing these two substances which are so greatly different in appearance and occurrence.

Having completed his work on the blood pigments and their components by the haemin synthesis, Fischer turned with undiminished energy to research into chlorophyll. In this field, where a scientist has previously gained a Nobel Prize, but where much work remained to be done, conditions are even more complicated and the difficulties as a consequence are even greater than in the other field. Nevertheless, Fischer obtained results which are so important that the Academy has considered it fitting to include them in the award.

What has been said, though necessarily brief, could give some idea of the variety and range of Fischer's researches, and has shown at the same time the singlemindedness that prevails in all this variety in that a leading fundamental idea firmly combines the researches in a systematic whole.

These researches have in the main been concerned as we have seen with the two most vital pigments, haemin and chlorophyll. Almost, we are tempted to say that life is pigment, because oxygen transport, by means of blood pigment, to the various tissues of the bodies of animals and humans, and carbon dioxide assimilation in plants, due to chlorophyll, constitute two of the most fundamental processes of organic life. It is therefore hardly possible to overestimate the importance of detailed knowledge of these two vital factors. If we remember moreover that the pyrrole complexes determined by Fischer are contained as basic components partly in the principal catalysts of respiration, partly in an enzyme (catalase) which is indispensable to all living cells, it will be found that the intrinsic value of the researches on it is in full accord with the prize which will now be awarded.

Herr Geheimrat Fischer. The gold medal which you are about to receive shows, on the obverse, the figure of Science, unveiling the goddess Isis. The symbol seems to me particularly appropriate on the present occasion, because you yourself, dear colleague, have solved previously veiled secrets of Nature in exactly the same manner.

By your analytical and synthetic work on the porphyrins, on the blood pigment, on leaf pigments, and other related substances, you have accomplished an achievement which can only be described a great feat in chemistry which will undoubtedly have a beneficial effect on the most diverse branches of natural sciences.

To have mastered a multitude of individual results so successfully testifies not only to untiring, I am tempted to say indefatigable energy, and to superior experimental ability, but also to a rare determination and consistency of scientific thought, which is rivalled by few examples in the history of our science.

In gratitude for your achievement, and with cordial congratulations, I now ask you, in the name of our Academy of Sciences, to receive, from the hands of His Majesty the King, the Nobel Prize in Chemistry for the year 1930.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1930/press.html