

INTRODUCTION

OTTO MEYERHOF

A TRIBUTE ON HIS 65TH BIRTHDAY (APRIL 12, 1949)

by

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The scientific work of OTTO MEYERHOF has profoundly influenced the development of Physiology and Biochemistry of the last three decades. By the originality of his approach, the elegance of his methods, and the wide range of his knowledge and his interests he became a pioneer in many fields.

OTTO MEYERHOF received his degree of Doctor of Medicine from the University of Heidelberg in 1909. Under the influence of OTTO WARBURG his interest turned to cellular physiology, especially to aspects concerning energy transformations. The association of these two great scientific figures was extremely fruitful and important for the development of this field.

In 1913 OTTO MEYERHOF became Privatdozent in Kiel and in 1918 Professor extraordinarius. It was there that MEYERHOF started the brilliant work on muscular contraction with which his name will always remain connected and for which he received the Nobel prize in 1923, jointly with A. V. HILL. In 1924 he moved to the Kaiser Wilhelm Institute for Biology in Berlin Dahlem, and in 1929 he became head of the Department of Physiology in the Kaiser Wilhelm Institute for medical research in Heidelberg.

The outstanding feature of OTTO MEYERHOF's work on muscle is the first really successful attempt to correlate chemical and physical processes of cellular function. He was able to establish such correlations in a great variety of ways and with amazing ingenuity. During these investigations he maintained a continuous exchange of views and information with A. V. HILL. The collaboration between these two men who have maintained a close personal friendship over decades was most fortunate and essential for the development of muscle physiology. These two names will continue to be linked in the History of Science.

In the course of his research on intermediary metabolism in active and resting muscle, OTTO MEYERHOF discovered many fundamental laws which greatly stimulated the whole of Biochemistry in general. Among his many achievements may be reckoned the clarification of the PASTEUR reaction. He showed that oxygen consumption prevented 3 to 6 times the equivalent amount of lactic acid formation in muscle. OTTO WARBURG later found the same principle to be true in the glycolysis of tumor cells and MEYERHOF in yeast fermentation. MEYERHOF's discovery thus proved and extended PASTEUR's hypothesis that fermentation is "*la vie sans air*", i.e., to a certain extent substituted respiration, whereas in the absence of respiration fermentation increases. PASTEUR has proposed this assumption but was unable to verify it, because he used cultivated yeast in which respiration is negligible compared with fermentation. This reaction in the

carbohydrate cycle has been called the PASTEUR-MEYERHOF reaction. The carbohydrate cycle was the first one to be demonstrated but the idea of cyclic processes in cellular mechanisms has since become more and more generalized. Today it is familiar to every biochemist and an integral part of our thinking.

The discovery of OTTO MEYERHOF and his students that some phosphorylated compounds are rich in energy led to a revolution, not only of our concepts of muscular contraction, but of the entire significance of cellular metabolism. A continuously increasing number of enzymatic reactions are becoming known in which the energy of adenosine triphosphate, the compound isolated by his associate LOHMANN, provides the energy for endergonic synthesis reactions. The importance of this discovery for the understanding of cellular mechanisms is generally recognized and can hardly be overestimated.

In 1925 MEYERHOF succeeded in extracting the glycolytic enzyme system from muscle, retracing a pathway which BUCHNER and HARDEN AND YOUNG had explored in yeast. This proved to be a decisive step for the analysis of glycolysis. MEYERHOF and his associates were able to reconstruct *in vitro* the main steps of the complicated chain of reactions leading from glycogen to lactic acid. They verified some and extended other parts of the scheme proposed by GUSTAV EMBDEN in 1932, shortly before his death.

The few examples given may suffice to indicate not only the brilliance but also the wide scope of his achievements. A real appreciation of his work is impossible within a few introductory remarks. MEYERHOF has always been driven by the true pioneer spirit. His open and critical mind quickly grasped new developments. When, in 1929, EINAR LUNDSGAARD found that contraction in a monoiodoacetate poisoned muscle occurs without lactic acid formation, MEYERHOF rapidly accepted the evidence which was built essentially on his own line of approach. This rapid change of his views shows the strength of his scientific personality and was all the more remarkable since for many years he had vigorously supported the idea that lactic acid formation was the primary step.

After the rise to power of the Nazis, MEYERHOF, like other Jewish scientists, had to leave Germany. In 1938 he went to Paris where he was warmly welcomed and well received. By the combined efforts of the late JEAN PERRIN, Professor RENÉ WURMSER and Professor HENRI LAUGIER, he was appointed Director of Research at the University of Paris and was able to continue his research in the Institut de Biologie Physico-Chimique. When the Nazi hordes invaded France, he had to flee again under most difficult circumstances, and came to the United States at the end of 1940. Here he was appointed Research Professor of Physiological Chemistry in the School of Medicine of the University of Pennsylvania, a position he holds at present. In spite of all difficulties his creative spirit is unbroken, as shown by the great number of his publications during the past few years, concerning especially intermediary metabolism, the purification and properties of adenosine triphosphate, the free energy of phosphorylated compounds, and various other subjects.

In spite of his intense scientific activity, MEYERHOF's interests have never been limited to science. The extraordinarily wide scope of his nonscientific activities shows best his rich personality. From his student years on he had been not only interested but actively engaged in philosophy. He was closely associated with the NELSON group in Göttingen. He devoted much time to a critical analysis of GOETHE's scientific work and presented recently at the GOETHE Bicentennial Celebration of the Rudolph Virchow

Society in New York a profound and most lucid and critical evaluation of GOETHE's scientific ideas and concepts, especially the Farbenlehre. He always had and still has a passionate love of art, literature and poetry. His interest in painting has been greatly stimulated by his wife HEDWIG who is a painter and actively engaged in teaching the art of painting. No matter which field MEYERHOF discusses, it is always a great stimulus and his views show the originality of his ways of thinking and his remarkable gift of integrating a great variety of phenomena.

OTTO MEYERHOF's 65 birthday offers a happy occasion for his former associates to express their gratitude and for his friends their esteem. The contributions of this anniversary volume are only a very incomplete indication of the influence of his work in so many fields. They are offered as a small tribute to his creative genius.