only combine with one substrate molecule, the results can be explained by assuming a powerful hæmin-hæmin interaction which causes the affinity and catalytic reactivity of the remaining free hæmin groups to decrease when one group is held in combination.

The formation of a hæmin-peroxide complex is implicit in both mechanisms, and a possible explanation for the transition from the initial rapid rate to the steady rate lies in the setting up of an equilibrium between the hæmin peroxide complex and its decomposition product. The equilibrium in both cases is one between opposing first-order reactions with respect to the hæmin group. The amount of oxygen evolved while such an equilibrium is being reached should decrease exponentially, which is in agreement with experiment; and furthermore, it can be shown that the first-order constant k_1 should be made up of the constants for the forward and back reactions. The forward reaction can be identified with the term $aP/(b + P)$, and the back reaction with cP. The forward reaction thus corresponds to the decomposition of the hæmin-peroxide complex, and the back reaction to a regeneration of the hæmin group by reaction with another peroxide molecule.

Forward reaction: $E + P \rightleftharpoons EP$ (rapid equilibrium)
$EP \rightarrow E' +$ products (rate-determining step).
Back reaction: $E' + P \rightarrow E +$ products (rate-determining step).

The familiar valency change of a ferric iron atom provides the simplest chemical picture for these general reactions. The labile more active form of the catalase may thus be identified with an equilibrium mixture of the ferric enzyme and its peroxide complex, and the less active form of the catalase with an equilibrium mixture of ferric enzyme, peroxide complex and ferrous enzyme.

If the total amount of oxygen evolved while the equilibrium is being set up (ΔO_2 above) comes entirely from the forward and back reactions, then the ratio $\Delta O_2/E$, where E is the enzyme concentration, should be less than one. The experimental values for this ratio lie between $5 \cdot 8 \times 10^5$ and $4 \cdot 0 \times 10^6$. These high values could arise from a chain decomposition of the peroxide: however, it has as yet been impossible to set up any chain mechanism which would account for the observed kinetics, and an explanation in terms of the alternative mechanisms proposed above may be considered. First, if each hæmin group can combine with two peroxide molecules, then the high values of $\Delta O_2/E$ can be explained by the rapid reaction of one combined peroxide molecule while equilibrium conditions are being reached in the reactions of the other. Secondly, if each hæmin group can react only with one peroxide molecule, the high values of $\Delta O_2/E$ can be explained by the rapid reaction of the three remaining hæmin groups with peroxide while equilibrium conditions are reached in the reactions of the first hæmin group. This second explanation seems more likely, because it is easier to understand the great catalytic power of catalase if its hæmin iron atoms are directly joined to the protein during all phases of the reaction. The assumption of differing reactivities of the four hæmin groups of catalase would bring the enzyme into line with hæmoglobin, where it is necessary to assume that the four hæm groups have differing affinities for oxygen to explain the sigmoid shape of the dissociation curve[2].

A full account of the kinetics of the uninhibited reaction is in the process of publication, and further experiments are being carried out on the reaction inhibited by cyanide and azide to determine whether any differences exist in their kinetic effects. The resemblance between the action of the two inhibitors reported above is very remarkable in view of the contrasting spectroscopic and chemical properties of azide-catalase and cyan-catalase shown in the experiments of Keilin and Hartree[3].

[1] Yamasaki, E., *Tôhoku Imperial Univ., Sci. Rep.*, **8**, No. 13 (1920). Morgulis, S., *J. Biol. Chem.*, **47**, 341 (1921). Northrop, J. H., *J. Gen. Physiol.*, **7**, 373 (1924–25). Williams, J., *J. Gen. Physiol.*, **11**, 309 (1927–28).
[2] Adair, G., *Proc. Roy. Soc.*, A, **108**, 627 (1925). Adair, G., *Proc. Roy. Soc.*, A, **109**, 292 (1925). Ferry, R. M., and Green, A. A., *J. Biol. Chem.*, **81**, 175 (1929).
[3] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **121**, 173 (1936).

VLADIMIR N. IPATIEFF

THE memoirs of Prof. Vladimir Ipatieff are written in the grand manner*. They cover a period of sixty years, during which the author not only achieved distinction in the field of chemical research but also, at the same time, played an important part in the great revolution and renaissance of his country. On all the stirring events in which he was a prominent actor, he throws an illuminating and revealing light.

Born in 1867, Ipatieff had grown to manhood and had acquired a European reputation at the time the Tsar signed the famous Manifesto of October 17, 1905, and when the first Duma met in the spring of the following year. For a short space, there seemed a fair prospect of Russia becoming a constitutional monarchy. "My eyes filled with tears," says Ipatieff, "when I read the Manifesto. I could hardly believe that I was witnessing my country's entrance into the path of political development long since entered by other Western Countries." But the dawn of this hopeful era was soon overcast. A powerful aristocracy and a corrupt court were not prepared to lose their inherited privileges without a struggle. Political, religious and domestic pressure was brought to bear upon the Emperor, and he failed to withstand the combination. An internecine struggle between the old order and the growing revolutionary movement followed. A Soviet of Workers' Deputies was organised by Trotsky and Khrustalev; open revolt occurred in many districts, and massacres and deportations followed. A semblance of order was restored, and it took another decade of misrule and the impact of a world war to precipitate that final explosion of popular resentment, which has since had such world-wide consequences.

During that uneasy interval which preceded the First World War, Ipatieff pursued his scientific research with great concentration and with outstanding success. His investigations of catalytic reactions and his discovery of the precipitation of metals from their salt solutions by the action of hydrogen at high pressure date from this period. But as the great crisis of his country approached, he became increasingly involved in its industrial affairs. His administrative and technical abilities were soon recognized and, by 1914, we find him, as a prominent member of the Artillery Committee of the Chief Artillery Administration, largely responsible for the planning of industry throughout the Russian Empire.

* The Life of a Chemist: Memoirs of Vladimir N. Ipatieff. Edited by Xenia Joukoff Eudin, Helen Dwight Fisher and Harold H. Fisher. Translated by Vladimir Haensel and Mrs. Ralph H. Lusher. (Hoover Library on War, Revolution and Peace, Publication No. 21.) Pp. xv+658+8 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1946.) 33*s*. 6*d*. net.

The energy, enterprise and judgment he displayed during the difficult war years would be considered exceptional, even in one trained to important administrative tasks. That they should be found in a man of science brought up in academic seclusion and long confined to the narrow paths of fundamental scientific research may be thought a portent.

On this subject, the memoirs are singularly revealing and present an interesting psychological study. Perhaps the main characteristics of the author may be summarized as an abiding enthusiasm for scientific studies, a deep sincerity of purpose and abounding self-confidence. From that day in early youth when, with some trepidation, he waited upon the great chemist Mendeléeff and received from the lips of the sage an opinion that his knowledge was too meagre for experimental work, until the occasion some thirty five years later when he celebrated his scientific jubilee amid congratulations from the whole scientific world, no misgivings ever entered his mind as to his high destiny. Indeed we may attribute to this trait an impatience with mediocrity and a highly critical attitude towards his colleagues and associates, which form one of the less pleasing aspects of his character.

The Revolution of 1917 found Ipatieff a lieutenant-general in the Imperial Russian Army, chairman of the important Chemical Committee and one of the key men responsible for the organisation and conduct of the industrial war effort. From the first, he refused to interest himself in political affairs, but was prepared to work loyally with any party in power. There were moments in those turbulent days which ushered in the spring of 1917 when it seemed probable that he would share the fate of his distinguished predecessor, Lavoisier. The revolutionaries of the Kremlin had no greater respect for savants than had those of the Luxembourg; many of his colleagues perished in the first explosion of popular wrath. But Ipatieff had powerful friends and loyal subordinates. "During the first days of the Revolution," he says, "the soldiers of the Chemical Battalion were worried about me and repeatedly offered their protection in case of danger." He continued to be employed by the Provisional Government, and later by the Bolsheviks, under Lenin. Although an uncompromising individualist, he contrived to work with the People's Commissars and with the Party representatives on his various committees. But his opinion of his colleagues is outspoken and critical. Of Kuibyshev, chairman of the Supreme Council of National Economy, he says: "I knew no more narrow-minded, stupid man than he. His knowledge of industry was nil, and, since he had no opinions of his own, his superiors could easily persuade him to accept theirs. I did not like him, nor he me." Of another eminent colleague, Lobov, he states: "His stupid, unattractive face classified him at once as one fitted for only the most menial work".

Holding these views, which he was not always successful in concealing, it is not surprising that he encountered increasing political obstruction in his efforts to organise and develop the Russian chemical industry in the post-war years. While Lenin and Trotsky were in power his position was assured; but Lenin was a sick man, and after his death Trotsky's influence declined, and he was finally expelled from the Party and exiled in 1927. Of all the revolutionary leaders with whom Ipatieff came in contact, Lenin impressed him as being the only one with the high ideals and vision necessary to build up the new Russia on sound and progressive lines.

Stalin succeeded Lenin and, under his leadership, the Soviet Government gradually assumed its present form. The State Political Administration, afterwards the G.P.U., was created in 1922, and rapidly grew to be a powerful instrument of Government policy. Ipatieff's position became increasingly dangerous. His refusal to join the Party, his outspoken criticism of his political colleagues and his frequent visits abroad served to arouse the suspicion of the G.P.U. Many of his contemporaries were arrested and imprisoned or executed. "I reckoned," he says, "that up to 1930, of all the military engineer-technologists who had completed their training at the Artillery Academy, only two or three were left in Soviet territory. The remainder had been arrested and their fate was unknown. Day by day, these facts confirmed my suspicions that I could not long escape the fate of most of my dear students and comrades of the Artillery Academy."

He resolved to quit Russia for ever. Fortunately, he had duties which necessitated frequent visits to Germany; and, in June 1930, he was able to obtain permission again to proceed there on Government business. It was with a feeling of relief and gratitude that, in company with his wife, he passed the frontier for the last time; and on this happy note the memoirs end. It is gratifying to know, however, that after so many years of trouble and danger, Ipatieff spent his declining years a distinguished and honoured guest of the United States. D. M. NEWITT

OBITUARIES

Sir F. Gowland Hopkins, O.M., F.R.S.

FREDERICK GOWLAND HOPKINS, the father of British biochemistry, and perhaps the last of our great pioneers of science, died on May 16, at the age of eighty-five. His death will be felt with a keen sense of loss by all those who have come under his inspiring influence.

Hopkins was born at Eastbourne on June 20, 1861, in a house now destroyed by enemy action. While still an infant he lost his father, who had been an enthusiastic amateur in science. This loss greatly affected his subsequent career. He was educated at private schools. He published his first scientific contribution—a brief note—at the age of seventeen. Shortly afterwards he was articled to a public analyst, from whom he received his first technical training, and in 1883 he was appointed assistant to Sir Thomas Stevenson, the eminent Home Office analyst, whose evidence played an important part in many sensational trials. His real scientific education, however, began five years later, when at the late age of twenty-seven he became a medical student at Guy's Hospital. The ordinary medical curriculum constituted his only academic training. During his medical course he did important research and was the first holder of the Gull Research Studentship. He graduated in science and medicine at the University of London in 1894, and was a member of the staff of Guy's Hospital Medical School.

In 1898 Hopkins married Jessie Stevens, daughter of Edward Stevens, of St. Lawrence, Kent, and was expecting to follow a clinical career. In the same year, however, Sir Michael Foster invited him to join the staff of the physiological department at Cam-