tion. But this is because we do not take the answer in its literal sense. We do not understand it to mean the structural damage alone. An inflamed lung, an ulcerated stomach, or a cancerous liver may exist in a dead body; may be taken out of the body and preserved in spirits; and it will be acknowledged that it would be erroneous and absurd to call the preserved organ a disease. It is a diseased organ, but it is not a disease; and if it is not a disease when taken out of the body, neither is it a disease when it is in the body. If it is not a disease after death, neither is it a disease during life. Yet we speak of ulcer of the stomach as a disease. But when we speak of ulcer of the stomach or any other structural change as a disease, we do not mean what we say. We express ourselves inaccurately. The expression is approximate only, as so many of our expressions are. We do not regard a patient who suffers from ulcer of the stomach merely as a person in whose stomach there is an ulcer, and there end our contemplation of him. We think of him as a person who not only has an ulcer in his stomach, but also suffers the consequences and presents the symptoms of ulcer of the stomach; and it is these additions to the bare structural change that constitute, with that change, the disease from which the patient suffers. There are, in fact, two very different concepts connoted by the names of most damaging changes of structure. The name may mean the structural damage, the ulcer in the stomach, the lumps of cancer in the liver, the consolidation of the lung, and nothing more; and then it is a term in morbid anatomy. It means disease of an organ, or it means a diseased organ; but it does not mean a disease. The name may, however, be employed with the connotation, not only of the structural damage, but also of the consequences, accompaniments, and symptoms of that damage when it exists in the living body, and, so employed, the name of the structural damage does stand, or may stand, for the name of a disease.

It may stand for the name of a disease, but even when it carries the connotation of its consequences and symptoms, the name of a structural damage does not always stand for a disease, at least for the whole of a disease. In the course of acute rheumatism a valve of the heart may suffer structural damage, and this structural damage has its own group of consequences and symptoms. It allows of regurgitation of the blood into the cavity it has just left, it gives rise to a murmur, it causes shortness of breath, cyanosis, oedema, and so forth, all of which are summed up and included in the term "heart disease"; yet this structural damage to the heart, associated though it is in our minds with its consequences and symptoms under the name of heart disease, does not constitute "the disease" from which the patient suffers. The group of structural damage, consequences, and symptoms is an important part of the disease, no doubt, but a part only; for "the disease" is acute rheumatism. Again, from the valve thus diseased a vegetation may be detached, and may block an artery in the brain, causing structural damage to the brain, with its characteristic train of symptoms. The term "embolism of the brain" has, like other names of structural change, its double meaning. It may mean the presence of the block in the artery, or it may mean this together with the consequent disorganization of the brain, or it may mean these things together with the paralysis and other symptoms that are evidence of them; yet, even if the term is understood in the latter sense, embolism of the brain is not the disease, is not the whole disease, from which the patient suffers. His disease is still acute rheumatism, of which the heart disease and the embolism are consequences and parts. If, however, the rheumatism subsides and disappears, leaving the valve of the heart damaged, then this structural damage, plus its symptoms and consequences, becomes the disease from which the patient suffers. We find, therefore, that structural damage to an organ, together with the consequences and symptoms it produces, may constitute a disease, but does not necessarily constitute a disease.

(To be continued)

Reductions of Nitric Oxide by Contact Action of Metals and Metallic Oxides*

By Birendra Bhusan Adhikary

SABATIER and Senderens have studied the direct hydrogenation of nitric oxide in presence of nickel and copper (*Comptes Rendus*, 1902, cxxxv., 278); Negoï and Adhikary have also shown that nitric oxide is reduced to ammonia in presence of reduced nickel (*Zeit. Anorg. Chem.*, 1910, lxix, 209). As the problem is an interesting one, in this paper has been studied the action of hydrogen on nitric oxide in presence of other metals. Sabatier and Sen-

derens have shown that in presence of palladium sponge, previously saturated with hydrogen, nitric oxide is completely converted into water and ammonia (*Comptes Rendus*, 1892, cxiv., 1429). The same authors have also shown that in presence of nickel and copper (*loc. cit.*) water and ammonia are the main products formed. It has been found that ammonia and water are mainly formed in presence of some other metals, but the temperatures at which the reaction commences are different for different metals; but in all cases it has been found that when the reaction once starts it goes on when the temperature is lowered. The only explanation of this seems to be that the action is exothermic and that the heat evolved maintains the action at a lower temperature.

The mixture of nitric oxide and hydrogen was passed over gold, silver, magnesium, tin, lead, antimony, bismuth, and iron. It has been found that the yield of ammonia is greater when the metal is in a fine state of division and is freshly reduced. Sabatier and Senderens have found that oxidisable metals, like copper, iron, cadmium, zinc, are superficially oxidized by nitric oxide, and that the same metals obtained in a fine state of division by reduction in hydrogen are more readily oxidized by nitric oxide (*Comptes Rendus*, 1892, cxiv., 1429). It seems that here, in cases of easily oxidizable metals, they are alternately oxidized and reduced by means of nitric oxide and hydrogen respectively, and that nascent nitrogen combines with excess of hydrogen to form ammonia. But exceptions must be made in cases of gold and silver which are not oxidized by nitric oxide (Sabatier and Senderens, *loc. cit.*).

In cases of metallic oxides tried it has been found that oxides are first reduced to lower oxides or to metals, and these then act as catalytic agents.

GOLD AND SILVER AS CATALYTIC AGENTS

Gold was prepared by reduction of auric chloride by ferrous sulphate. A small quantity of it (not more than 0.01 of a grm.) was heated in a tube in a nitre-bath, and the mixture of nitric oxide and hydrogen in the proportion of 1 to 3 was passed over it. Traces of ammonia began to form when the temperature of the bath was 280° C., and the action became quite perceptible at 290° C. As the reaction is exothermic the temperature inside the tube could not be strictly controlled. The action was very rapid when the temperature of the bath was kept between 335°-345° C. It was found that the yield of ammonia was almost quantitative when nitric oxide and hydrogen were mixed in the above proportion. When the same mixture was passed over gold-foil it was found that only traces of ammonia were formed.

Silver was prepared by the reduction of silver oxide. The mixture of nitric oxide and hydrogen in the above proportion was passed over reduced silver heated in a tube in a nitre-bath. Traces of ammonia began to form at 390° C., and the action became quite perceptible when the temperature of the bath was raised above 400° C. Instead of silver, silverized asbestos (*i. e.*, asbestos soaked in a solution of silver nitrate and ignited) may be used. Blank experiments performed with asbestos alone showed that only traces of ammonia form when the mixture is passed over ignited asbestos. It was found that the yield of ammonia is quite large when the mixture of gases is passed over silver in the above proportion, the temperature of the nitre-bath being 430° C.

IRON AS A CATALYST

The mixture of nitric oxide and hydrogen in the proportion of 1 to 3 was passed over iron, prepared by the reduction of iron oxide by means of hydrogen and heated in a nitre-bath. Traces of ammonia began to form at 300° C., and the action was very rapid at 350° C.

MAGNESIUM, ZINC, AND MERCURY AS CATALYSTS

The mixture of nitric oxide and hydrogen in the proportion of 1 to 3 was passed over magnesium powders (Merck), heated in a tube-heater; only traces of ammonia were obtained, and the Nessler's solution became only slightly red.

The same mixture was passed over zinc dust (Merck), heated in a tube-heater; ammonia was obtained in large quantities, and the yield was almost quantitative.

When the same mixture was passed over mercury, heated to about 400° C., no ammonia was obtained. It may be noted here that Sabatier and Senderens (*loc. cit.*) have found that mercury vapor is not oxidized by nitric oxide.

ALUMINIUM, TIN, AND LEAD AS CATALYSTS

The mixture of nitric oxide and hydrogen in the proportion of 1 to 3 was passed over aluminum powders (Merck); only traces of ammonia were obtained. When about two litres of the mixture were passed over aluminium Nessler's solution became only slightly red. Here also it may be noted that aluminium is not oxidized by nitric oxide (Sabatier and Senderens, *loc. cit.*).

The same mixture was passed over tin metal powders (Merck) heated in a tube heater; ammonia was obtained in large quantities and the yield was almost quantitative.

The same mixture was passed over lead-foil. Lead melted and ammonia was obtained only in small quantities. It was found that lead powders obtained by the reduction of lead oxide gave better yield of ammonia. In this case it was found that lead, though melted, remained in the form of a number of separate globules. It has generally been found that if the metal be in the liquid state better results are obtained when it is in the form of minute globules; in the latter case it may be noted that the metal presents a larger surface.

ANTIMONY AND BISMUTH AS CATALYSTS

When the mixture of gases was passed over antimony powders (Merck) ammonia was obtained, but larger quantities were obtained when antimony powders were freshly prepared by the reduction of the oxides of antimony by means of hydrogen.

When the same mixture was passed over bismuth metal powdered, bismuth melted and no ammonia was obtained, but when bismuth powders were prepared by the reduction of bismuth oxide and the mixture passed over it large quantities of ammonia were obtained. In this case the metal, though in a liquid state, remained in the form of a number of separate globules.

METALLIC OXIDES AS CATALYSTS

The mixture of nitric oxide and hydrogen in the proportion of 1 to 3 was passed over oxides of metals belonging to Group II of Mendeleeff's Table. When zinc oxide or cadmium oxide were taken large quantities of ammonia were evolved, but in the case of other oxides—*e. g.*, BaO, MgO, etc.—no trace of ammonia was obtained. When mercuric oxide was used it volatilized, and no ammonia was evolved.

When the same mixture was passed over oxides of aluminium, boron, and silicon ammonia was not obtained, but when it passed over oxides of lead, tin, bismuth, and antimony ammonia evolved copiously. In the case of arsenious oxide it volatilized and no ammonia was obtained. When the mixture was passed over oxide of chromium ammonia was produced. When the same mixture passed over oxides of manganese (MnO or MnO₂) ammonia was produced in large quantities. In the case of MnO₂ it was found that the dioxide was converted into yellowish green monoxide during the reaction.

An Improvement in the Open-Hearth Steel Making

MANY modifications in the the original basic open-hearth process of steel making have attained important results, but in each process the elimination of the impurities in the molten metal has been effected by the refining action of a basic slag floating upon the surface of the metallic bath. The resulting action has of necessity been comparatively slow, as such a limited quantity of the metal to be refined is in contact at any one moment with the basic slag.

With the object of overcoming this difficulty, and thereby shortening the time taken in steel making, a British inventor proposes in patents which he has recently taken out in this country and in the United States, for the refining slag not merely to rest upon the surface of the molten metal, but also to be below the metal. This may be accomplished, it is proposed, by coating the basic bath lining with a layer of highly-heated slag of a rich calcareous and oxidizing nature, which would slowly liquefy when the charge of molten pig was poured upon it. Consequently it would work up through the metallic bath, afterwards continuing its oxidizing and refining action while floating upon the surface.

If it could be carried out practically there certainly would seem to be something in the idea. The great advantage of innumerable small streams of globules of molten slag rising up through the metal will be at once apparent when it is realized what an immense area of rich oxidizing slag would be exposed with an ever-changing surface to the action of the metal, causing an intensely rapid and searching reaction in a manner somewhat analogous to the action of the air in the Bessemer process.

Though the first charge of molten metal in the suggested process is worked in the usual manner, subsequent charges are worked on new lines, the object being to secure a slag coating on the bottom and sides of the furnace, the latter being preferably of the tilting type, to enable the metal to be poured off and the slag left behind. Thus, after the first charge, on pouring into the steel furnace the usual charge of molten pig-iron from the blast furnace or mixer, a vigorous refining action at once ensues.

Whether all the many claims set out in the patent would be verified as a result of an actual trial remains to be seen. Certainly it would appear that the question, bearing as it does so closely upon the vital subject of speeding up our steel output, deserves more than passing notice.—*The London Daily Telegraph*.

*Chemical News.