broidery, needlework, laces, trimming, wall-paper, etc., which was acquired by the State and presented to the school. The original school only had 21 students, while the new establishment has 140 in the weaving branch, and 30 in that devoted to dyeing and finishing.

The following summary indicates the principal features of the course of study at the new school: 1. The instruction of foremen, designers, and manufacturers for all branches of the weaving industry, and for mechanical engineering in connection with it. 2. The instruction of students who wish to learn chemistry, by as thorough a training as possible in all branches of this science, and in its practical application. 3. The instruction of those students who wish to follow the dyeing, bleaching, printing, and finishing trades, in the manufacture of dyes and mordants, and in the methods of testing and valuing natural and artificial dyestuffs and chemicals. 4. The carrying out of practical operations in dyeing, bleaching, printing, and finishing in such a manner as to facilitate students carrying into practical effect the theoretical instruction they have received.

THE PRODUCTION OF AMMONIA BY THE ACTION OF FREE HYDROGEN ON NITROGENOUS COMPOUNDS

By R. TERVET.

PRELIMINARY to a more extended treatment of this subject, I beg to contribute to the *Journal* the subjoined brief notice thereon.

In following up the experiments previously detailed, upon the production of ammonia by passing hydrogen over coke resulting from the destructive distillation of coal,* I find that the reaction is one common to nearly all nitrogenous bodies, and that the majority of compounds yield up their total nitrogen in the form of ammonia so easily and so completely, that it may be adopted as an analytical method for the estimation of nitrogen.

The compounds experimented upon were the following: Ferrocyanide of potassium, ferricyanide of potassium, cyanide, sulphocyanide, cyanogen, paracyanogen, nitrate of soda,

endless a variety of compounds as nitrogen. Many of these compounds contain only a very limited number of the different elements in their composition, and yet may contain as much as 20 atoms of nitrogen. Nitrogen compounds also exhibit the most wonderful changes under the phenomena of polymerism, metamerism, and isomerism. Again, the affinity of nitrogen is so weak as to be incapable of application; but when in combination, in the form of cyanogen, paracyanogen, potassic cyanide, titanite nitride, etc., it may withstand the temperature of a blast furnace without decomposition; while these very same compounds, if subjected to a moderate temperature in an atmosphere of hydrogen, are immediately decomposed, with the production of ammonia.

In order not to be misled in such experiments, it was necessary to avoid the employment of salts containing water, or such as might give rise to the formation of water by the hydrogen. The presence of water would undoubtedly propagate reactions which would make them no longer fit for such an investigation. My earlier experiments were confined to the cyanides and ferrocyanides. The examination of the substances mentioned above does not call for any special remark, with the exception of the last three.

Experiments with the solid substances were, as far as possible, conducted on one uniform method. A quantity of the salt is taken and reduced to the finest state of subdivision. A portion (dependent upon the percentage of nitrogen which it may contain) is then weighed off, and is incorporated with a given weight of finely elutriated pumice-stone. The mixture being placed in a metallic boat, the latter is then pushed into a malleable iron tube, heated to redness, and through which a current of hydrogen is passing. The ammonia is produced at once, and admits of easy collection and estimation. The last traces are, however, somewhat slow in coming off.

Pyrrol and alkaloids do not seem to be so susceptible of decomposition as the other substances. Perhaps this arises from the fact that they are already *ammonias*, and, as such, conform, within certain limits, to the conditions under which ammonia is produced. For the oxides of nitrogen and cyanogen, a special adaptation is required to conduct the gas into the combustion-tube. With the nitrogen oxides the reaction takes place with explosive violence, which varies according to their degree of oxidation. With nitrous oxides, and when carefully regulated, the minute explosions occur with such rapidity as to produce a musical sound. With nitrous acid and nitric peroxide, the experiment becomes decidedly dangerous.

Dr. Mills, of the Andersonian College, Glasgow, to whose courtesy I have been indebted, during the course of these experiments, for several valuable hints, suggested to me paracyanogen mixed with clay as a substance likely to yield ammonia on treatment with hydrogen, by means of the apparatus shown in my paper on the production of ammonia from coke (see *ante*, p. 21). A single experiment sufficed to prove that his prediction was well founded; and, further, that it is a substance containing only carbon and nitrogen in its composition, so that the production of ammonia at once shows that combination does take place.

Boron nitride is the most stable compound with which I have met; only a very small proportion of the total nitrogen can be obtained under conditions identical with those in which the whole could be obtained from ferrocyanide of potassium. An additional quantity of its nitrogen can be obtained as ammonia by fusing it with metallic sodium in an atmosphere of hydrogen; and a still larger quantity by fusing with oxide of lead. The total can be eliminated by oxidizing with caustic potash in an atmosphere of hydrogen. The cause of the difficulty of decomposing boron nitride hardly requires explanation, as it differs so much from the other nitrides—such as carbon nitride, magnesium nitride, iron nitride, copper nitride, etc.—that, with the exception of composition, it does not admit of any comparison with them. It, however, illustrates a physical property entirely dependent on the nature of the element boron.

All nitrides do not act alike in respect to the influence of hydrogen. Their power of being decomposed by hydrogen would appear to be directly proportionate to their affinity, and, consequently, the temperature to which they are exposed; or, in other words, in direct relation to their power of forming oxides. Thus, besides their unequal affinities for nitrogen, they have unequal powers of forming oxides, by which their action in yielding to decomposition is regulated. We find that carbon, iron, and copper admit of easy oxidation, and that their respective nitrides are easily decomposed. But, on the other hand, we find that boron is difficult to oxidize, requiring to be raised to an exceedingly high temperature, in an atmosphere of oxygen; and likewise that the nitride is difficult to decompose.

I have already pointed out that the chemical nature and the mechanical character of the mineral matter (such as ash) associated with nitrogenous bodies exert a great influence upon the production of ammonia. I find that in mixing some of the substances mentioned above with a very large excess of the finely elutriated pumice, the rapidity of evolution is greatly retarded; and with some of them diminished in quantity. This can be accounted for by the amount of contact surface being greatly diminished, and hampered by the presence of so much inert substance. It therefore follows that, exclusive of all other effects, longer time will be required for the liberation of the ammonia. This may, in some measure, account for the difficulty of liberating the nitrogen from shales by hydrogen, as compared with steam. Shales, as a rule, contain a very large proportion of ash, so that the steam, on burning away the carbon, makes pores and inroad passages through the body of the ash; thus exposing new surfaces to the action of the hydrogen. The penetration of the hydrogen into the pores of the ash is due to diffusion, and the expulsion of the ammonia may be the result of diffusion. The condition, therefore, most favorable for the production and preservation of the ammonia, when formed, is when the respective molecules have ample space to glide over one another, so that the ammonia may be brought as little as possible into contact with the surface of the ash by being surrounded with hydrogen, which prevents decomposition.

Silvestri* has pointed out that ammonia, on being made to pass through ignited lava, is decomposed into its elements; the whole of the nitrogen being absorbed by the lava. We thus see that these inert bodies play a far more important part than we are likely to ascribe to them; and that, besides their physical properties, they possess certain chemical properties by which they are enabled to produce decomposition, and even recombination.

The results of these experiments, in so far as they permit conclusions to be drawn as to the cause of the formation of ammonia, agree in all respects with the observations made on coal.—*Journal of Gas Lighting*.

* *Gazzetta Chimica Italiana*, anno v, (1879), fasc. vi.

THE BOAR HUNTER.—BY OTTO LANG.

Herr Lembecke, the director of the school, had previously occupied an important position of a similar nature at Chemnitz. The head of the finishing and dyeing branch is Dr. Lange, from Stuttgart.

THE BOAR HUNTER.

OUR engraving, from the *Illustrirte Zeitung*, represents Otto Lang's statue of the Boar Hunter. The man stands with one foot resting on his booty, and in his right hand he holds the spear with which he has killed the animal, while in his left hand he holds the horn with which he has signaled his victory. It is a spirited and striking work.

Land and Water says that Lord Tennyson has written a \$750 poem on blackbirds, and blackbirds are only quoted at 7 cents apiece. This shows how much raw material it takes to make a poem.

nitrate of potash, nitrate of ammonia, nitrous oxide, nitric oxide, nitric peroxide, nitrate of urea, urea, quinine, tobacco, melon, nitroprusside of soda, nitrobenzol, dinitrobenzol, nitronaphthalene, pyrrol, alkaloids from crude shale oil, boron nitride.

In choosing such widely different bodies for experiment, an effort was made to ascertain experimentally the exact conditions under which the nitrogen acquires the property of combining with free hydrogen; but in the course of the investigation the more intimate study of the phenomena impressed me with the conviction that this is another of those unique characteristics which enable nitrogen to hold so distinct a position among the elements. Indeed, with the exception of carbon, there is no element which gives rise to so

* See *Journal* for January 1, p. 20.

† I consider it of sufficient importance to state here that quinine and tobacco do not yield all their nitrogen as ammonia; the greater portion being liberated as bases.