amounted to 750,000 tons of Chilean nitrate, 35,000 tons of Norwegian nitrate, 46,000 tons of ammonium sulphate, and 30,000 tons of cyanamide. In 1913 great efforts were devoted in Germany to the preparation of materials necessary for war, and no attempt was made to conceal them. The German Ammonium Sulphate Syndicate had a reserve of 43,000 tons, and on the declaration of war there was probably a stock of 100,000 tons of Chilean nitrate. Immediately after the battle of the Marne, when a long war was evidently certain, the production of artificial nitrates and of ammonium sulphate was stimulated, the Badische Aniline Company and Bayer and Co. being subsidized to the extent of 30,000,000 marks for the installation of factories to convert ammonia into nitric acid. In peace time 550,000 tons of ammonium sulphate were produced annually in Germany, but this output was reduced once war was declared. As this substance is a by-product in the manufacture of gas and cast-iron, people in Germany were instigated to use gas and coke instead of coal, and by such means an annual output of 250,000 tons of ammonium sulphate was attained.

The problem of converting the ammonia into nitric acid was solved by the Frank and Caro and the Kayser processes. A French chemist, Kuhlmann, had discovered that ammonia is oxidized to nitrogen peroxide when mixed with air and passed over warm, finely divided platinum. The reaction was employed on a commercial scale by Ostwald, and improved both by Kayser and by Frank and Caro. By the end of 1915 the Anhaltische Maschinenbau Society of Berlin had established thirty installations for the conversion by Frank and Caro's process, and these had a capacity of more than 100,000 tons of nitric acid per month. But this was only one of the methods adopted. Given a cheap source of electrical energy, it was known to be commercially practicable to prepare nitric acid by the direct oxidation of nitrogen in the electric flame, and this process had been established in Norway by Birkeland and Eyde, who used the waterfalls as a source of energy. The Germans have established a factory employing Pauling's process (a modification of that of Birkeland and Eyde) at Muhlenstein, in Saxony, in the neighborhood of the lignite beds, which form the source of energy, and this has an annual output of 6,000 tons of nitric acid.

The third principal method adopted for the preparation of combined nitrogen was the direct synthesis of ammonia. Bosch and Mittasch, two chemical engineers of the Badische Company, had adapted Haber's synthesis to industrial conditions, and the company had established a factory with an annual output of 30,000 tons of synthetic ammonium sulphate. In April, 1914, the company increased its capital in order to raise the output to 130,000 tons, and after the battle of the Marne it was subsidized by the German government to increase the production to 300,000 tons.

Before the war the production of cyanamide in Germany was comparatively small, but it has increased largely under government stimulus. In the direction of the manufacture of manures, it was necessary to economize sulphuric acid, so ammonia was neutralized with nitre cake, and the resulting mixture of sodium and ammonium sulphates was mixed with superphosphate. Moreover, it was found that superphosphate will absorb gaseous ammonia, and although the calcium acid phosphate is thereby converted into the insoluble tricalcic phosphate, it is formed in an easily assimilable condition, and the product is found by experience to act both as a nitrogen and phosphorus manure.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND INDUSTRIAL RESEARCH

While offering every facility of the laboratories of the Massachusetts Institute of Technology to the United States government for any research in which it with its staff of trained professors can be of service, the institute holds that in addition to the education of its students it has an important function in being helpful to the industrial world. An agreement with Technology by the U. S. Smelting, Refining and Mining Co., to be in force in April, whereby the latter is to avail itself of the

laboratory facilities offered by the institute, is the latest step in forming closer relationships with the industrial world. This Boston-controlled corporation is one of the two large companies of the kind in this country. With the ability of Technology to undertake the work, it has expressed itself, through its president, William G. Sharp, as desirous of availing itself of the advantages offered by the institute. Instead of establishing a private research laboratory of its own it will bring its problems to Technology.

The advantages which accrue to a corporation which makes such an agreement include the economy afforded by not being obliged to establish a laboratory parallelling that of the institute. Such laboratories are very costly, construction and equipment running into the scores of thousands. The institute presents a further advantage that no private laboratory can afford, in that it maintains a great group of allied laboratories. There are unlimited quantities of water, steam, electricity and anything else that is needed, a great library, a large active force for investigation in the student body and unequalled facilities for quick and satisfactory conferences with the instructing staff. Then there is the ease with which other laboratories may be called to help in the solution of any problem. So related are the different industries that hardly any problem lies entirely within the sphere of only one of them. Chemistry turns to electricity, metallurgy to both of these, while mechanical engineering is fundamental.

On the other hand there are advantages to the institute. It has a very costly equipment which it really holds in trust for the community. It is the duty of its officers to make the fullest returns possible. Every use of its facilities by the industrial world is a step towards the realization of its ideals. Cooperation like that with the United States Smelting Co., in the solution of industrial problems makes it the more valuable to the people and the more valuable it becomes the better the chance of greater importance in the future, with the better outlook for the carrying forward of research work that may be of general benefit. That the latter may truly be assured the institute has in its agreement the provision that publication of results be not unduly delayed.

To carry on the special work which this cooperation necessitates, the corporation of Technology has named Henry M. Schleicher, B.S., a graduate of 1910, to be research associate in charge of the work, the general direction resting on Professor H. O. Hoffman, professor of metallurgy. Mr. Schleicher since his graduation has been engaged in research work with two Boston firms, with especial attention to electrolytic separation and flotation.

CHEMISTRY AND THE WAR

THE registrar of the Institute of Chemistry of Great Britain and Ireland, according to *The British Medical Journal,* prefaces an account he has written of the work done by chemists in the war by observing that the government has secured the guidance of chemists and other men of science to assist in the investigation of suggestions and inventions and to bring their knowledge and experience to bear on measures and devices of offense and defense. The country had come to rely so much on foreign sources of supply that means had to be found for dealing promptly and efficiently with the difficulties which arose so soon as importation was stopped by the war. The laboratories of universities and colleges quickly became small factories for the preparation of drugs and medicaments, and many were entrusted with the examination of materials used in the manufacture of explosives. Uniformity in method and the standardization of processes was secured, and students unfit for service with the colors were set to work under the supervision of their professors. Several hundred chemists were engaged to assist in the laboratories and in government and controlled establishments supplying armaments, munitions and other materials of war, and in some branches arrangements were made for probationary training. The staffs of the chemical department of Woolwich arsenal, and of the government laboratory responsible for the examination of foodstuffs and many other requirements of the expeditionary force, were