THURSDAY, JUNE 3, 1915.

GERMANY AND THE MUNITIONS OF WAR.

In previous articles we have commented upon the stringency which will undoubtedly be felt in time by our enemies in regard to the provision of certain raw materials which are absolutely essential to the manufacture of munitions of war. All accounts which are allowed to leak through from Germany and Austria clearly indicate that this stringency is now becoming acute, and with the advent of Italy as another of our Allies, it will rapidly become almost insurmountable.

From an article which appears in the last issue of the *Engineering and Mining Journal* of New York, based upon a communication made by the director of a great German metallurgical company to an American correspondent, we gather that the shortage is frankly admitted, and some account is given of the desperate efforts which are being made by our enemies to meet it. Germany has evidently summoned to her assistance all the metallurgical skill and chemical knowledge at her disposal in attempts to improvise substitutes for the materials of which she has been deprived by the effectiveness of our blockade. That she will to some extent succeed may be conceded, for ordinary commercial conditions are no longer applicable to the case of a nation which has "its back to the wall," and is determined to stake everything, regardless of human life and treasure, in the struggle to preserve its existence. But whilst these attempts may do credit to the intelligence and resourcefulness of our enemies, and may serve to illustrate their undoubted organising capacity, they are clear proofs of the straits to which they are reduced.

Such attempts may prolong the duration of the struggle, but it is highly improbable that they will materially affect its ultimate result. It is possible that gun cartridges, rifle cartridges, and the fuse-heads of grenades may be made without the use of copper or brass, or with alloys containing only a minimal proportion of copper, but it is unlikely that such substitutes will prove as efficient as the material hitherto used. It must be remembered that the strongest arm of the enemy's service is its artillery, and anything that militates against the efficiency of that branch *pro tanto* weakens the enemy's power.

Supplies of cotton are almost unavailable to Germany and Austria; the closing of the Italian ports has effectively cut off some lines of importation of this commodity. Other sources of cellulose are, of course, open to them, and other forms of nitro-cellulose than ordinary gun-cotton are being made and are said to be in use with what is stated to be "unobjectionable" results, which rather sounds like damning with faint praise.

It is admitted that we have also cut off all supplies of petrol and petroleum, but as regards the use of the former substance in internal combustion engines, benzene, which is obtained by the destructive distillation of coal, is claimed to be a satisfactory substitute. This may be more or less true of ordinary motor-driven vehicles, especially in summer; but benzene is apt to freeze at low temperatures, and this circumstance has undoubtedly led to trouble in air-craft flying at high elevations in winter. Ordinary gasolene consists largely of pentane and amylene, and no doubt these hydrocarbons can be produced synthetically, if cost is no object. Indeed, it is claimed that German chemists have worked out two synthetic processes which are actually in operation, and are said to be so far successful that Germany is assured of internal supplies, even after the conclusion of the war. Acetylene has largely replaced petroleum as an illuminant, and is in use even in safety-lamps, and it is possible that the substitution may be more or less permanent, unless, which is unlikely, steps are taken on the conclusion of peace to reduce the relatively high price of burning oil consequent on the import duty and the operations of the American, Russian, and Dutch Trusts.

Germany also now claims to be independent of any external supply of nitrates. It is stated that "within a short time enormous works will have been erected, which will convert the nitrogen of the air into ammonia, and thence, by its combustion, into nitric acid"—one works alone turning out about 80,000 tons of nitric acid yearly. It may be confidently asserted that before this consummation is reached the war and all its doings will have been relegated to the domains of history.

Nitric acid can only be made commercially by the use of oil of vitriol, and there is ample evidence that the growing scarcity of the raw materials upon which the manufacture of the latter substance depends is causing great perturbation in chemical circles in Germany. All outside sources of sulphur, whether as such or as pyrites, are excluded. The use of sulphuric acid for the manufacture of fertilisers is practically prohibited. Attempts are being made to convert ammonium carbonate, obtained by the Haber process, into

ammonium sulphate by treatment with gypsum—a process already used in France with only partial success; and various methods of obtaining sulphuric acid from Epsom salts and other alkaline earth sulphates are being tried, with what probable result may be judged of from Lunge's well-known work on sulphuric acid manufacture, in which prior attempts to make use of such processes are described in more or less contemptuous terms. Indeed, the patent literature of every country is evidently being ransacked in the dire necessity which has now overtaken our enemies, and all sorts of suggestions, many of which have been tried and hitherto found wanting, are being exploited with a feverish activity.

The problem which confronts a Minister of Munitions in Germany is gradually becoming hopeless, unless he is given practically unlimited time in which to solve it. He has the men, who are working with a unanimity and a strenuousness which compels our respect and admiration, and the intelligence, knowledge, and skill of the captains of industry and all their appliances are at his disposal. But he cannot make bricks without straw, and the straw is gradually being denied him, struggle as he may. To us and to our Allies—thanks to our command of the sea—the world is all before us where to choose, and we have access to all the raw material we need. To our Minister of Munitions the problem is not want of material; it is want of men, and the lack of that strenuousness of purpose and of determination, energy, industry, and fixity of effort which have been imbued into the whole German nation. Time is of the essence of the situation, and to waste it in political bickerings, squabbles about profits and war bonuses, labour troubles, strikes, and "slackness" is to play directly into the enemy's hands and to prolong the agony and wretchedness under which the whole civilised world is now suffering.

EXPLOSIVES: ANCIENT AND MODERN.

Explosives: their Manufacture, Properties, Tests and History. By A. Marshall. Pp. xv+624. (London: J. and A. Churchill, 1915.) Price 24s. net.

IT is twenty years since any really important and comprehensive book on the subject of Explosives has been published in England, and the time was therefore ripe for a work that should bring the subject up to date and present it as a whole. In doing this, however, it is obvious that in such a wide and highly specialised field of work it is necessary to exercise the greatest care in selection and arrangement in order to avoid undue bulk of matter and at the same time to present the subject in the clearest possible way. This is the task that Mr. Arthur Marshall has set himself in "Explosives, their Manufacture, Properties, Tests and History," and the author has succeeded in giving us a most valuable book, which will be welcomed by all workers on the subject.

Part i. of the book is historical, and deals with the progress and development of explosives from Greek Fire to picric acid, and considerable space is given to Colonel Hime's translation of Roger Bacon's cipher instructions for the manufacture of gunpowder, and the reasons for supposing that the statements as to the great antiquity of gunpowder were inaccurate and based on erroneous translations. In this part of the book it is pleasant to find an appreciation of the wise and tactful manner in which Sir Vivian Majendie and his successors, Colonel Ford, Captain Thomson, Major Cooper-Key and their subordinates have carried out the working of the "Explosives Act" and have made it a boon to the workpeople without interfering with the development of the industry.

Part ii. is devoted to black powder, and three chapters are given to the preparation of the ingredients and manufacture, but nothing is said as to the reactions taking place on the firing of gunpowder under varying conditions, and although the products of explosion of R.L.G. powder as determined by Nobel and Abel are given, not a word is said of such historical researches as those of Bunsen and Schischkoff Linck, Karolyi and Debus.

Part iii. contains three chapters dealing with the manufacture of sulphuric acid and nitric acid, and the manipulation of waste acids. Although the preparation of nitric acid from Chile saltpetre is very fully described, the production of nitric acid from the air is dismissed in eight lines, which seems strangely inadequate in view of the Germans being at the present time largely dependent upon synthetic nitric acid for the preparation of their high explosives.

Part iv. is on the nitric esters of carbohydrates, and commences with a chapter on the Theory of Nitration of Cellulose, which gives the work done by many observers fairly fully, and then suddenly branches off to the commercial uses of pyroxylin and collodion. Following this come chapters on cellulose, manufacture of nitro-cellulose, stabilisation of nitro-cellulose, and the nitric esters of other carbohydrates.

Part v. deals equally fully with the nitric esters of glycerin, whilst smokeless powders occupy Part vi.

These first six divisions of the book contain