bog ore appears to be of better quality than much of that used at the St. Maurice Forges, and yields in the furnace an average of 44 45 per cent. of iron. Some of it is rich in manganese, and is only employed when it is desired to produce white iron. The limestone used as flux is a slaty argillaceous variety, apparently derived from the Levis formation. Analyses of samples made in the laboratory of McGill College, by Messrs. W. H. Howard (I), and E. H. Hamilton (II), gave:

	I	II
Calcium carbonate	49.25	52.12
Magnesium "	1.36	3.86
Ferrous "	5.03	4.82
Alumina	6.91	2.93
Insoluble matter	35.55	35.50
Copper	traces	traces
	98.10	99.23

The charcoal is chiefly obtained from soft wood and weighs about thirteen pounds to the bushel (the *minot*.) It is made entirely in brick kilns or charring ovens, of which there are fourteen, the internal dimensions being.

Length	50 feet
Width.....	16 "
Height	17 "

From thirty-five to fifty bushels of charcoal are obtained from a cord of wood, soft wood giving a larger yield by measurement than hard wood. From seventy to eighty men are constantly employed at the works, while, at certain seasons of the year, in addition to these, from 200 to 300 men are engaged in cutting wood and obtaining ore.

ELECTRICITY APPLIED TO EXPLOSIVE PURPOSES

BY PROF. F. A. ABEL., C B, F.R.S. ETC

(Concluded from Page 151.)

The conductivity of very fine wires could therefore be but slightly affected by physical differences in the metal, and the considerable difference in conductivity observed in different samples of platinum were therefore chiefly ascribable to variations in the degree of its purity. It appeared likely that definite alloys might furnish more uniform results than commercial platinum; experiments were therefore made with fine wires of German-silver, and of the alloy of 66 of silver with 33 of platinum employed by Matthiessen for the reproduction of B. A. Standards of electrical resistance. Both were greatly superior to ordinary platinum in regard to the resistance opposed to the passage of a current; German silver was in its turn superior to the platinum-silver alloy, although the difference was only trifling in the small length of the fine wire used in a fuse (0 25 inch), while the comparatively ready fusibility of the platinum-silver wire contributed, with other physical peculiarities of the two alloys, to reduce the fine German-silver wire to about a level with it. Moreover, the latter did not resist *the tendency to corrosive action, exhibited by gunpowder*, and other more readily explosive agents, which had to be placed in close contact with the wire-bridge in the construction of a fuze, while the platinum-silver was found to remain unaltered under corresponding conditions. Experiments having also been made with alloys of platinum with definite proportions of iridium, the metal with which it is chiefly associated, very fine wires of the alloy containing 10 per cent. of iridium were eventually selected as decidedly the best materials for the production of wire-fuzes of comparatively high resistance and uniformity, this alloy being found decidedly superior in the latter respect, as well as in point of strength (and therefore of manageableness in the state of a very fine wire, 0 001 in. in diameter), to the platinum-silver wire. The fuzes now used in *military and submarine services were made with bridges of* iridio-platinum wire, containing 10 per cent. of the first-named metal.

The electrical gun-tubes in the navy were fired by means of a specially arranged Leclanché battery, and branch circuits worked to the different guns, in broadside firing, it was important that the wire-bridge of any one of the gun-tubes which was first fired should be instantaneously fused on the passage of the current, so as to cut this branch out of the circuit; in this respect the comparatively fusible platinum-silver alloy appeared to present an advantage, hence the naval electrical fuses were made with bridges of that alloy. Uniformity of electrical resistance had become a matter of such high importance in the delicate arrangements connected with the system of submarine mines, as now perfected, that the very greatest care was bestowed upon the manufacture of service electric fuzes and detonators, which were in fact made, in all their details, with almost the precision bestowed upon delicate scientific instruments, and the successful production of which involved an attention to minutæ which would surprise a superficial observer.

One of the earliest applications of electricity to the explosion of gunpowder was the firing of guns upon proof at Woolwich by means of a Grove battery and a gun-tube, which was fired by a platinum wire bridge, a shunt arrangement being used for directing the current successively into the distinct circuits connected with the guns to be proved When the high-tension fuze had been devised, gun-tubes were made to which it was applied, and an exploder was arranged by Wheatstone, having a large number of shunts, so that as many as twenty-four guns might be brought into connection with the instrument, and successively fired by the depression of separate keys connected with each.

The firing of cannon, as time-signals, was an ancient practice in garrison-towns, but the regulation of the time of firing the gun, by electrical agency from a distance, appears first to have been accomplished in Edinburgh, where, since 1861, the time-gun had been fired by a mechanical arrangement, actuated by a clock, the time of which is controlled electrically by the mean time clock, at the Royal Observatory on Calton Hill.

Shortly alter the establishment of the Edinburgh time-gun, others were introduced at Newcastle, Sunderland, Shields, Glasgow, and Greenock. The firing of the gun was arranged for in various ways; in some instances it was effected either direct from the Observatory at Edinburgh, or from shorter distances, by means of Wheatstone's magneto-electric exploders. At present there were time-guns at West Hartlepool, Swansea, Tynemouth, Kendal, and Aldershot, which were fired electrically, either by currents direct from London, or by local batteries, which were thrown into circuit at the right moment by means of relays, controlled from St. Martin's-le-Grand.

About thirteen years ago the electrical firing of guns, especially for broadsides, was first introduced into the Navy, with the employment of the Abel high-tension gun-tube and voltaic piles. The gun-tubes then used were manufactured simply for the proof of cannon and for experimental artillery operations, and were of very simple and cheap construction. Experience proved them to be unfitted to withstand exposure to the very various climatic influences which they had to encounter in Her Majesty's ships, and in store in different parts of the world. The low-tension gun tubes, having a bridge of very fine platinum-silver wire, surrounded by readily ignitable priming composition, was therefore adopted as much more suitable for our naval requirements.

The arrangements for broadsides or independent firing, and also for the firing of guns in turret-ships, had been very carefully and successfully elaborated in every detail, including the *provision of a so-called drill or dummy electrical gun-tube*, which was used for practice, and refitted by well-instructed sailors. The firing-keys, and all other arrangements connected with electrical gun-firing, were specially designed to ensure safety and efficiency at the right moment.

The electric detonators for firing out-rigged torpedoes, or for other operations to be performed from open boats, corresponded, so far as the bridge was concerned, with the naval electric gun tubes, and were fired with a specially-fitted Leclanché battery. These electric appliances were now distributed throughout the navy, and the men were kept, by instruction and periodical practice, well versed in their use.

The application of electricity to the explosion of submarine mines, for purposes of defence and attack, received some *attention from the Russians during the Crimean War* under the direction of Jacobi; thus a torpedo, arranged to be exploded electrically when coming into collision with a vessel,