

During the last week a body calling itself the Réunion International des Electriciens has been holding meetings in a room granted for the purpose in the Exhibition building. It is understood to be mainly composed of persons who felt slighted at not being appointed members of the Congress, and are determined to have a little congress of their own; but their movements have not attracted much public attention.

As this will be our last article, we will endeavour to supplement our previous accounts by some information on what must be regarded as the most important of all the objects in the Exhibition, namely, the machines which generate the electricity. Those which have permanent steel magnets are few in number, and the only large ones are the machines of De Meritens. These usually give alternating currents, but can be made to give direct currents by a change in the connections. The principal type contains five Gramme rings mounted on the same axis, each of them surrounded by eight horseshoe steel magnets with their feet inward. The introduction of the Gramme ring is the chief difference between this machine and the old lighthouse machine of Holmes. The great bulk of the machines in the Exhibition are dynamos, in which the whole current produced passes through the coils of the field magnets, and a large proportion of them are of the Gramme type, generally with one pair of straight massive field magnets arranged in one line above the ring, with a pair of like poles near together close to the ring, and with another similar pair below of opposite polarity to the first pair. The ring thus revolves between two very strong poles outside it, and massive iron pole pieces are usually employed, so shaped as to embrace a considerable arc of the ring. These are the machines for direct current. In the alternating current Grammes, the ring is generally broadened out into a hollow cylinder whose length is as great as its diameter. Sometimes this revolves between four external pole pieces attached to electro-magnets, and sometimes it is fixed, while four broad electro-magnets radiating from the common axis revolve within it. In some examples a separate exciter giving a direct current is mounted on the same stand and on the same axis.

The three firms of Siemens at Berlin, Paris, and London have a very large and diversified collection, partly historical, partly representing the commercial demands of the present day, and partly embodying their latest ideas for future improvement. The prevailing pattern is the well-known Siemens direct acting machine, in which an armature in the form of a cylinder, about three times as long as it is broad, rotates between two sets of pole-pieces, one above and the other below, of opposite polarity produced by the action of four straight flat and massive electro-magnets. The coil of the armature is wound, as nearly as the presence of the axle permits, in planes containing the axis, so that the wires cross one another at all angles at the two ends.

The most remarkable novelty that struck us in going over their collection was a machine in which two armatures consisting of cylindrical iron cores, each inclosed between four longitudinal segments of copper, revolve within two hollow cylinders of iron, which are the poles of a composite magnet, so that each armature is surrounded by a pole of one name, while opposite polarity is induced in the outer part of the iron core. The lines of force thus radiate from the common axis with complete symmetry, and the longitudinal coppers cut these lines at right angles in every position, so that the electromotive force in each copper remains constant as the armature revolves.

A peculiar adaptation of the ordinary Siemens armature has been made by Mr. Edison. The conducting portion of his armature consists of bars and disks. The bars form the outside of the cylinder, and the disks, with mica between for insulation, are built up into two solid masses

which form the ends. The intervening portion is occupied by the core, which consists of a thousand or more very thin disks of iron separated by silk paper. The course of the current is nearly the same as in a Siemens armature, being first along a bar, then across a disk, then back along an opposite bar, then across another disk, and so on. The ends of the bars are disposed along two helical curves at the two ends of the cylinder, each helix having two convolutions. The object of having such excessively thin iron plates is to promote rapid demagnetisation and to avoid the formation of induced currents in the iron. This monster machine has only recently arrived, and is not yet ready for action. Its armature (to which, as well as to that of a smaller machine, the above description applies) is about four feet long by two in diameter. It has two straight and very long field magnets, which are actuated by a branch of the main current of the machine.

A very common pattern of machine for alternating currents, which one sees under various names, has a number of flattish cylindrical coils disposed in circular fashion like the holes of a siren, and revolving in siren fashion between pairs of fixed cylindrical field magnets of more massive appearance, the number of pairs of these fixed magnets being equal to the number of revolving armatures.

There are also some direct current machines of this construction. They can be distinguished by having a commutator of many segments on which the brushes rub to collect the currents, while the alternating machines give off their currents from two insulated rings which are not divided in any way.

Last Saturday evening there was a special gala at the Opera House in honour of the Electrical Congress, admission being by presentation ticket. In addition to the ordinary operatic performances there was a somewhat stilted poem in celebration of the achievements of electricity, which was read between two of the pieces by an eminent comedian; and the whole performance wound up with a grand chorus calling on the earth to light itself up. Preparations had been made for illuminating the house by electricity, but they were far from complete, and gas was decidedly in the ascendant. The place where the telephonic transmitters are bestowed was easily recognised, there being a wooden screen about ten inches high and six feet long on each side of the prompter's box.

We stated in a previous letter that a committee of jurors had undertaken some quantitative experiments on the machines and lamps. These are still going on, and will probably be continued till the Exhibition closes.

The chief practical result of the Congress has been the agreement to adopt the British Association system of units, and we understand that Prof. Everett's book, which is the recognised exposition of this system, will be immediately translated into French, German, and Italian.

THE IRON AND STEEL INSTITUTE

ONE of the most interesting features connected with the recent meeting of the Iron and Steel Institute was the fact that the Arsenal authorities abandoned at last the official reserve which has so long been complained of, and descended into the arena of professional discussion by reading papers on the manufacture of ordnance, projectiles, small arms, and gun-carriages, and submitting them to public criticism. We must specially congratulate Col. Maitland, the present distinguished head of Woolwich Arsenal, on having had the courage to take this step. His paper on the Metallurgy and Manufacture of Modern British Ordnance was extremely interesting. Its production also was well timed, coming at a period when the confidence of the public was consider-

ably shaken in the management of the Royal Arsenal, by the bursting of the *Thunderer's* 38-ton gun. Col. Maitland reviews in succession the early history of Steel *versus* Iron, the successive improvements in the manufacture of gunpowder, the processes of the manufacture of the iron and steel, the building up of the gun, and the boring and rifling of the barrel. The paper concludes with a description of some of the special tools and furnaces in use at the Arsenal. As regards the question of powder, it is satisfactory to find from an official utterance that the problem of the proper action of gunpowder is at last thoroughly understood. On this point the author states, "With the large slow-burning powders now used, long heavy shells move quietly off under the impulse of a gradual evolution of gas, the pressure of which continues to increase till the projectile has moved a foot or more; then ensues a contest between the increasing volume of gas, tending to raise the pressure, and the growing space behind the advancing shot tending to relieve it. As artillery science progresses, so does the duration of this contest extend further along the bore of the gun towards the great desideratum, a low maximum pressure long sustained." To this last sentence we call particular attention, for in the attainment of this object by our powder manufacturers lies the whole possible development of the power of artillery. When the author uses the words *low* maximum pressure, we take it that the expression must be understood in a relative sense only, and that the maximum pressure should not be high as compared with the mean; what is in reality the great desideratum is as high a maximum pressure as is consistent with the strength of the gun, sustained throughout the entire length of the bore. How far this object is from being attained at present can be seen at a glance from the shape of even the most modern heavy gun, which is very thick at the breech and dwindles down to almost nothing at the muzzle, showing that the pressures at the breech are still far from being sufficiently sustained. The problem here is more one for powder-makers than artillerymen. The latter can but indicate what is wanted. It seems from *à priori* grounds impossible to expect that the solid pebble powder now in use, burning as it does from the surface to the centre, can ever give off the increasing volumes of gas wanted in order to fill up the spaces behind the advancing projectile, and thus maintain the pressure. It is, we believe, no secret that the results attained with our home-made powders are inferior to those furnished by the perforated prismatic powders made in Germany and Russia.

In dealing with pure metallurgical processes Col. Maitland made a great mistake in not making himself acquainted beforehand with the name of the inventor of the process of making steel adopted at the Royal Arsenal. Nearly two pages of the paper are taken up with a description of the process invented by Dr. Siemens, which is described in detail without any reference to that distinguished engineer, so much so that any uninitiated person reading the paper would have inferred that the process was peculiar to the Royal Arsenal. It is true that in the discussion which followed Col. Maitland disclaimed any originality for the Royal Arsenal, but it seems, to say the least of it, curious that he should have occupied so much space in describing a process which was perfectly familiar to everybody in the audience, had he been aware that it was in use in every civilised steel-producing country in the world. Of course this line of conduct compelled Dr. Siemens to speak in his own defence, and the stories which he told of the conduct of the Royal Arsenal authorities towards himself ought to have been sufficient to make Col. Maitland ashamed of some of his own predecessors in office, or of their immediate superiors in Pall Mall. Not only has the Siemens open hearth process of steel manufacture been appropriated without thanks or even acknowledgment, but on

a former occasion they endeavoured to imitate his regenerative furnace without his cognisance, by employing a former draughtsman in his office. The furnace failed, having cost the country some thousands of pounds, and then, and not till then, was Dr. Siemens' help called in. It is really time that the Government claim to appropriate all patents without consulting or rewarding the owners should be inquired into, for the present policy cannot even be commended on the score of economy, for in the case in point the blundering of inexperienced engineers cost the country far more than the few hundred pounds of royalty which would have been due to Dr. Siemens.

We are glad to infer from this paper that there is some hope that wrought iron will shortly be entirely superseded by steel in the manufacture of ordnance. Really the caution in this matter which has been hitherto observed at Woolwich exceeds the bounds of prudence and sense. For years past the most eminent metallurgists and users of steel in every branch of manufacture have over and over again declared publicly that steel is in every respect, including ductility and toughness, vastly superior to iron, but we still find at Woolwich Arsenal that wrought iron is used for all the coils of a gun. All that Col. Maitland can bring himself to say on this point is, "but now that the pressures" (of the powder) "are longer sustained, it becomes advantageous to thicken the inner tube of steel, and it will most likely be found beneficial to support it with steel in place of wrought iron." We welcome the conclusion, though we fail altogether to appreciate the soundness of the reasoning which has led up to it; for if it is advantageous now when pressures are weak to use the stronger and tougher material, it must have been doubly so when the internal strains generated by the powder were greater than at present. The remainder of this paper calls for no special comment. It is undoubtedly interesting as an official statement, but in style it seems to us to betray the fact that the author is dealing with information which he has only recently acquired; otherwise how does he betray himself when addressing an audience composed exclusively of technical men into dwelling with minuteness on such trivial details as, for instance, the use of soap and water as a lubricant for cutting tools, in place of oil? Surely he ought to be aware that the same practice obtains in nearly every workshop in the country.

Of the remaining papers read before the Institute, one by the Assistant-Superintendent of the Enfield Small Arms Factory was a mere chronicle of the various details of the manufacture and inspection of Martini-Henry rifles and bayonets. Another, by Mr. Butter of the Royal Arsenal, was a short account of the application of steel and iron to the manufacture of gun carriages and slides. The last paper which we shall notice was by M. Ferdinand Gautier of Paris, on the Application of Solid Steel to the Manufacture of Ordnance and Small Arms. M. Gautier had already communicated two papers to the Institute on the remarkable Steel Castings of the Terre Noire Company. The peculiarity of the castings of this Company is their freedom from blow-holes, which is attributed to the rather considerable percentage of silicate of manganese used in the manufacture.

At Bofors, in Sweden, the same process is used with perfect success in the production of steel barrels for artillery.

The following analysis is given of the material produced:—

Carbon	Silicon	Manganese	Sulphur	Phosph.
0·45	0·351	0·540	Traces	0·042
0·40	0·322	0·612	0·02	0·045
0·50	0·183	0·360	0·02	0·040

The tests of this steel, both ordinary tensile tests and in guns, when fired with heavy proof charges, are stated to have given most satisfactory results.