This illustration presents in a forcible manner the importance of giving the closest attention to the protection of the standards, where refined accuracy is sought. The influence of the heat from the observer's body is frequently less than that of other causes against which protection is supposed to have been made. With a micrometer capable of measuring with certainty a hundred-thousandth of an inch, we can repeat observations again and again with a range not exceeding this amount, and yet the result will differ from that obtained on another day by a quantity several times larger than the extreme range during a set taken all at once. Any one who has made careful linear or other comparisons will have noticed this. The fact that the bars, while subjected to apparently the same influences, are yet differently affected, is the principal cause of this trouble; and the only way of eliminating the effects from the final result is to so change and alternate the bars in position as that the disturbing influences may operate in turn on the one or the other of the standards under consideration. H. W. BLAIR.

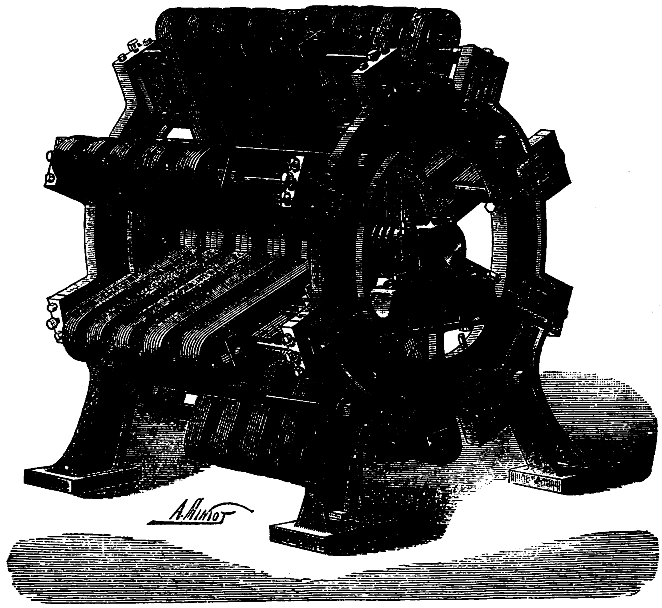

FIG. 16.

HISTORY OF THE APPLICATION OF THE ELECTRIC LIGHT TO LIGHTING THE COASTS OF FRANCE.[1]

V.

IT only remains now to describe the de Meritens machine to complete the description of the electric appliances for light-houses.

M. de Meritens has devised several types of machines. The one adapted for light-house purposes, shown in Fig. 16, has the permanent magnets of horseshoe form arranged radially around the axis in a precisely similar manner to the disposition of the field-magnets of the old Alliance machine, which in general appearance it at first sight much resembles.

Fig. 17 is a transverse section of the machine, and Fig. 18 a longitudinal section taken through the axis, so as to show, in both views, the armature ring, and the position of the field-magnets with respect to it.

Figs. 19, 20, and 21 show the details of the armature bobbins marked H, the iron core-pieces, *h h*, and the projecting pole-pieces, which form enlarged ends to the latter, and are marked *g*. In Fig. 19, which represents a section through half the ring, the method of attachment and of coupling up is clearly shown. On reference to Fig. 17, it will be seen that each armature ring, G, is built up of sixteen flattened oval bobbins, H, separated from one another by the projecting pole-pieces, *g;* and around each ring are fixed, radially to the

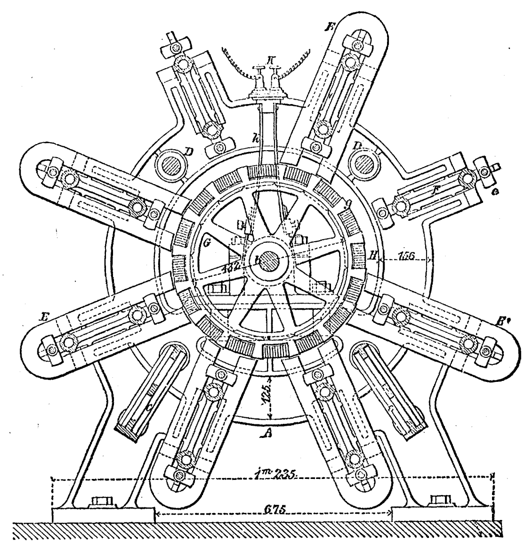

FIG. 17.

[1] Concluded from No. 8.

frame of the machine, eight very powerful compound permanent magnets, each composed

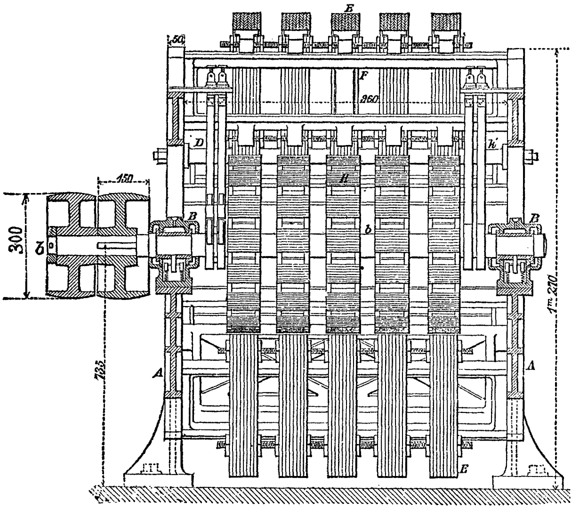

Fig. 18.

of eight laminae of steel. The distance apart of the two limbs of each magnet, as well as the distance between the north pole of one magnet and the south pole of the next, is precisely equal to the distance apart, or pitch around the armature, of the pole-pieces and the coils. The details of the magnets, and their method of adjustment and attachment, are shown in Figs. 22 and 23. Each magnet is built up of eight laminae of steel, each ten mm. in thickness, and are held together tightly by the bolts and nuts, *c d*, the whole being attached to the brass frames, F, which are fixed to the framing of the machine in radial slides, by which the distance from the armature ring can be adjusted with

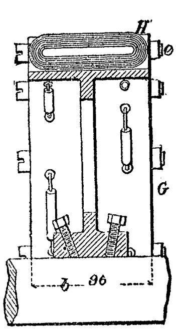

Fig. 19.

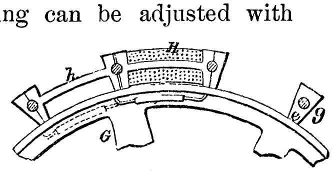

Fig. 20.

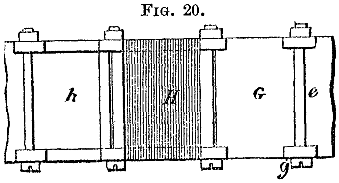

Fig. 21.

great accuracy. The total weight of the forty magnets (see Fig. 16) is about one ton.

The currents from the five armatures are brought together, in two groups, to the four brass collecting-disks, *i*, which are mounted in pairs on an insulated bush, *j*, fixed to the principal shaft of the machine. The details of the collecting-apparatus are shown in Figs. 24, 25, and 26. Against the disks, *i*, are pressed, by means of springs, the four collecting plates or brushes, K′ K′, which are in metallio connection with the attachment screws, K K, of which there are two pairs, — one at each end of the machine (as shown in Fig. 18).

The construction of the armature is very interesting and ingenious. Each of the induction coils shown at H (Figs. 19, 20, and 21) is composed, first, of a flat spool or bobbin of the form marked *h*, and then is wound in a lathe with insulated copper wire 1.9 mm. in diameter, and of which the total weight in the whole machine is from 120 to 130 pounds. The iron cores of these coils are built up of eighty thicknesses of soft sheet-iron one milli-

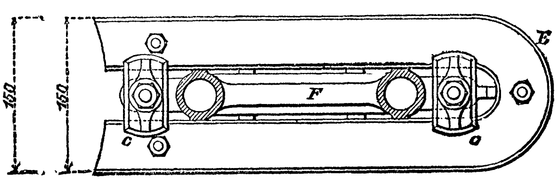

Fig. 22.

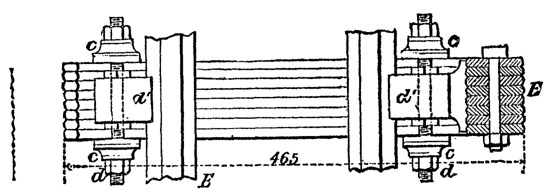

Fig. 23.

metre in thickness, and stamped out by a machine. The coils are wound, and attached to the armature wheel by a set of bolts marked *e*, which pass through the projecting lugs, *g*, of the wheel, and through the cylindrical hole formed by the semi-cylindrical grooves in the ends of the iron core-pieces when abutting the one against the other.

The coupling-up of the armature coils is one of the most ingenious features of the machine; for, as the magnets are arranged around the armature in such a way that, in the rotation of the coils, alternate poles are presented to any one bobbin, it follows, that if the bobbins were numbered 1, 2, 3, 4, etc., up to 16, the currents induced in all the even-numbered bobbins would be in one direction, and in all the odd numbers in the opposite; and it would appear at first sight that these coils could not be connected together in series without the one set of currents neutralizing the other.

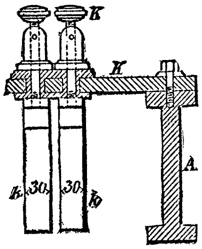

Fig. 24.

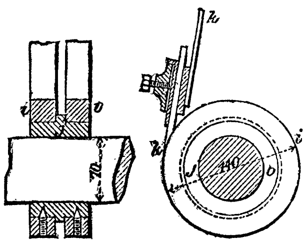

Fig. 25.

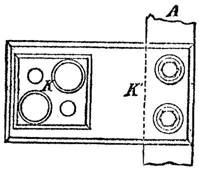

Fig. 26.

But, by connecting the armature coils together in the manner shown in Fig. 27 it will be seen, that although the currents generated in consecutive coils are opposite in direction to one another, yet their combined current transmitted to the collecting-apparatus is in the same direction.

In the early part of this article, attention was drawn to the distinction between the luminous and geographical range; and, in all the installations described, regard has only been paid to the increase of the former, the latter being neglected. This is readily explained by the necessity there was of giving a unit to the new system of lighting the French coasts. There is, however, a point which it will be important to consider, and which may serve to augment the efficiency of the system. In days of heavy fog, when the luminous range is considerably diminished, this diminution would be much less if the geographical range could be increased.

A rather important step has been made in this direction by the use of specially constructed optical apparatus. This apparatus is furnished on the upper part with a series of annular lenses, whose effect is to project above the light a beam of vertical rays extending to a great height. This beam illumines either the clouds, or the vapor which fills the atmosphere, and is even visible in clear weather, because the air contains enough particles, both solid and vaporous, to allow the phenomenon of diffusion to be produced. These luminous rays thus projected are visible to quite a distance even in foggy nights, and the geographical range is notably increased.

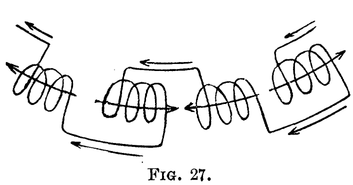

Fig. 27.

The first application of this system, which has not yet been adopted in France, is about to be made in the Sea of Azof. The ships which cross this sea in the direction of Berdiansk are guided to their point of arrival by a light, which, in the actual state of its installation, could not be seen sufficiently far; and it was decided to apply the system mentioned above. The apparatus recently constructed by Messrs. Sautter and Lemonnier will shortly be installed, and then the efficacy of the system can be judged.

The example thus given by the French lighthouse board has already been followed by other nations. The Ottoman government has studied a plan of electric lighting for the coasts of Turkey. In England an appropriation has been asked to establish, in 1881, about sixty electric lights; and a similar request will be made for the establishment of a hundred lights in 1882.

On account of the time which the complete execution of the project for lighting the French coasts will take, it may be that the experience obtained with the first lights will show some modifications to be made to the adopted plan, and that the lights last made may not have entirely the same dimensions and characteristics as those first built.

In fact, some criticisms have been made by foreign engineers, especially on the diameter of 0.6 met. of the optical apparatus, — a diameter which these engineers consider relatively too small. The faults ascribed to optical apparatus of small diameter are those of heating too readily on account of the proximity of the luminous *foyer*, and also that of being more quickly covered with carbon-dust. We do not, however, believe that there is much to fear from this with apparatus 0.6 met. in diameter; since, for the last twenty years, the lights of la Hève have worked well with apparatus 0.3 met. in diameter. The probabilities are, that future modifications will only be changes in detail, which will not affect the general project.

The above shows the means France has taken to light her coasts, and is a most emphatic recognition of the value of the electric light for that purpose.

The arc-light, however, has two defects which have not been mentioned, — one, a lack of fixity; the other, a deficiency in the red and yellow rays of the spectrum. This lack of fixity is partly due to the carbons not being homogeneous, and partly to faults in the regulators. Improved processes of manufacture have in a great measure removed these defects, but even the best lights will still occasionally flicker.

The red and yellow rays have the greatest penetrating power; and for this reason an oil-light, which is rich in these rays, can be seen farther in foggy weather than an electric light of *equal candle-power*. But the electric light can be made so much more powerful than the best oil-light, that this deficiency can be more than made up; still, it must be borne in mind when the candle-powers of the two lights are compared.

When the French system was adopted, the incandescent electric light had not left the domain of experiment; and even now its luminous intensity is very much less than that which can readily be obtained from an arc-light of moderate dimensions. It possesses, however, the element of remarkable fixity, and is rich in red and yellow rays. No light could be better for a light-house, if it can be produced cheaply, have sufficient luminous intensity, and be made reliable. It will, moreover, dispense with the somewhat complicated and expensive regulators.

It is in this line that the Light-house board of the United States is about to make experiments, and the results obtained will have great interest for the whole world.

David Porter Heap.

GEOLOGICAL NOMENCLATURE AND COLORING.

The following stratigraphical divisions have been provisionally adopted by the international commission of the geological map of Europe. The colors placed against them are those proposed by the directors.

1. Gneiss and protogine. Bright rose-red.
2. Crystalline schists (mica schists, talc and chlorite schists, amphibole schists, and foliated gneiss). Medium rose-red.
3. Phyllites (argillaceous schists, urthonschiefer). Pale rose-red.
4. Cambrian (all fossiliferous beds below the Llandeilo flags; primordial fauna, Taconic). Reddish gray.
5. Silurian, lower fauna (second of Barrande). Dark silk-green.
6. Silurian, upper fauna (third of Barrande). Light silk-green.
7. Devonian, lower. Dark green-brown.
8. Devonian, middle (limestone of the Eifel). Medium green-brown.
9. Devonian, upper. Light green-brown.
10. Carboniferous, lower (culm, mountain limestone, etc.). Blue-gray.
11. Carboniferous, upper (houillier, millstone-grit, etc.). Gray.
12. Permian (dyas), lower (rothliegendes, etc.). Burnt sienna.
13. Permian (dyas), upper (zechstein and equivalents). Sepia.
14. Trias, lower (grès bigarré). Dark violet.
15. Trias, middle (muschelkalk). Medium violet.
16. Trias, upper (keuper and equivalents). Light violet.

16′. *Rhetic*, provisionally (haupdolomit excluded).

17. Jurassic, lower (lias). Dark blue.
18. Jurassic, middle (dogger, kellovien included). Medium blue.
19. Jurassic, upper (malm with tithonic and Purbeck). Light blue.
20. Cretaceous, lower (Neocomien and Wealdian). Dark green.

20′. *Gault*, provisionally.

21. Cretaceous, upper (from the cenomanien). Light green.
22. Eocene (nummulitic, etc.). Orange-yellow.

22′. *Flysch*, provisionally.

23. Oligocene (with the aquitanien). Dark yellow.
24. Miocene (mollasse). Medium yellow.
25. Pliocene. Light yellow.
26. Diluvium. Naples yellow.
27. Alluvium. White.

The subdivisions, 'Rhetic,' 'Gault,' and 'Flysch,' whose affinities are doubtful, will be figured separately in the preparatory work; so that they can finally be joined either to the upper or lower formation, according to the decision reached by the commission of nomenclature.

INDIAN RELICS FROM NEW BRUNSWICK.

Though Indian relics of the ordinary type, such as arrow-heads, axes, gouges, celts, etc., are of common occurrence in this region, as elsewhere, it is extremely rare to find any articles showing other features than those of mere utility; while remains of pottery, so far as I am aware, have, until recently, been entirely unknown. During the last summer, however, my attention was directed to a locality which is one of some interest, not only as containing undoubted relics of this character, but also as illustrating a somewhat unusual mode of occurrence.

The locality in question is that of a small stream or 'thoroughfare' connecting two sheets of water known as Grand and Maquapit Lakes, being the two principal members of a series of lakes and streams covering a considerable area in the central coal-basin of New Brunswick, and tributary to the river St. John. Both