THE LEGAL OHM.

On the 3d of May, 1884, the International Conference for the Determination of Electrical Units decided that the legal ohm should be the resistance represented by a column of mercury of one square millimeter section, and 106 centimeters in height at the temperature of melting ice.

In order to carry out the decisions of the Conference and introduce into practice the standards of resistance, it became necessary to construct fundamental, secondary, and practical standards. The fundamental ones, which are four, so far, were constructed by Mr. Benoit. They consist of straight glass tubes, the dimensions of which have been studied, and which, full of mercury, present a resistance that has been accurately determined by calculation.

This work was performed at the International Bureau of Weights and Measures. The experiments, calculations, corrections, etc., are contained in a quarto volume of more than 500 pages. We shall not even try to give an idea of the nature of this work, which does the greatest honor to the skill and patience of Mr. Rene Benoit. Let us say that the difference between the real and theoretical resistances, deduced from the dimensions, are so small, that the greatest between the four standards established does not exceed two one-hundred thousandths, and the mean result can be regarded as exact at close to one one-hundred thousandth.

These fundamental standards, or prototypes, are very fragile, and are inconvenient for practical use, so Mr. Benoit has got up a certain number of secondary ones of mercury. These (one of which is shown to the left of the engraving) consist of glass tubes bent upon themselves six or eight times, and ending in two cups filled with mercury. These tubes may have any geometrical dimensions whatever. They are adjusted and measured by comparison with the four prototypes, by progressively cutting and polishing the ends until they have a resistance very nearly the same as that of the prototypes. These standards are easily transported, and are easily brought to the temperature of melting ice, but they are still too fragile. They will serve merely as a substitute for the prototypes in important measurements.

For ordinary measurements the standards are made of metal. These instruments, which are constructed by Mr. Carpentier, consist of a bobbin of very coarse wire suspended freely in a metallic box whose sides are lined with a thick layer of paraffine. A thermometer enters through an aperture, and runs to the center of the doubly wound bobbin, and measures the temperature of the air in the interior, which is the same as that of the wire.

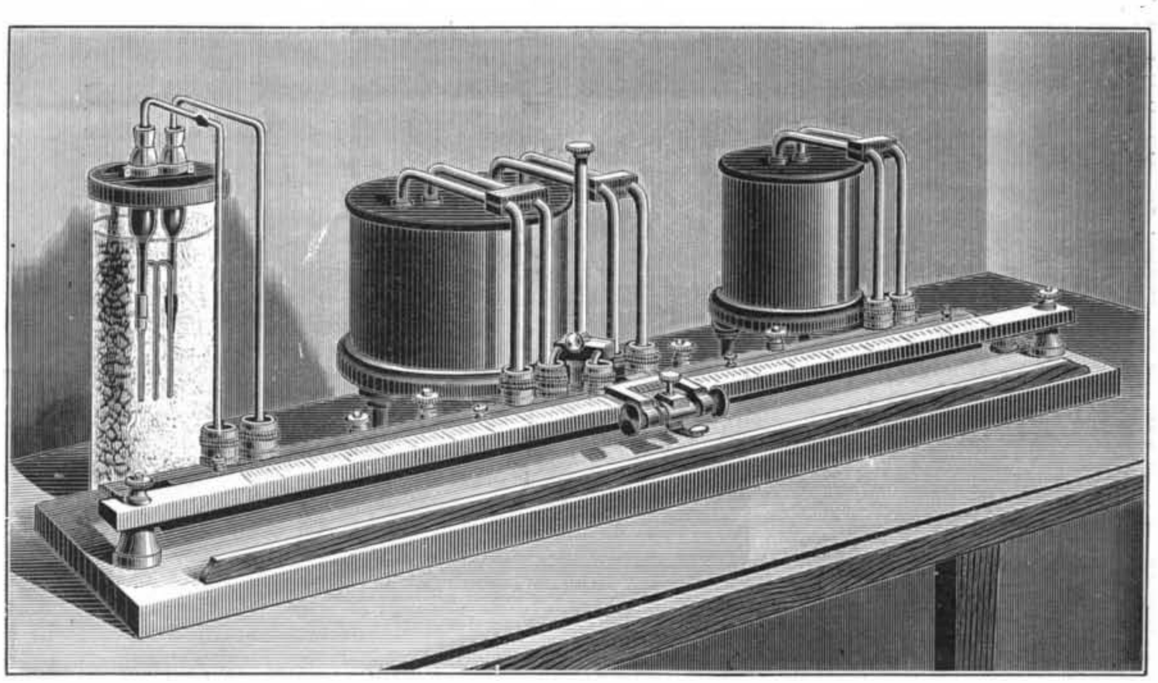
This is an improvement upon the old standards, the wire of which enter a mass of paraffine, and is then so fully protected against the variations of the surrounding atmosphere that its own temperature is not known to within several degrees.

These practical standards, as they are called, are made of coarse German silver wire—this metal being selected because it is one of the alloys whose resistance varies the least with the temperature, and *coarse* wire being chosen because slight variations of temperature are less sensible and an exact regulation is more easily obtained.

These secondary and practical types are at the disposal of Mr. de Nerville at the Bureau for the measurement of Electrical Resistance established at the Ministry of Port Officers and Telegraphs, and in the care of Mr. Blavier, director of the Upper School of Telegraphy.

The object of this bureau is to place at the disposal of the public practical means of verifying the accuracy of a standard of resistance. The bobbins confided to the Bureau will go out with an official certificate indicating their true value in legal ohms, as well as the degree of precision to which such value has been determined.

The comparisons of resistance are made with a divided wire Wheatstone bridge. The engraving represents the mounting of the apparatus for the comparison of a German silver standard with a secondary mercurial one. The two proportional arms, which are as nearly equal as possible, are formed of two bobbins placed in the same box in order to be always of the same temperature.



NEW STANDARDS AND MEASURING APPARATUS.

The method employed is that of substitution indicated by Fleeming Jenkin, and comparable to the double weighing one employed for comparing weights.

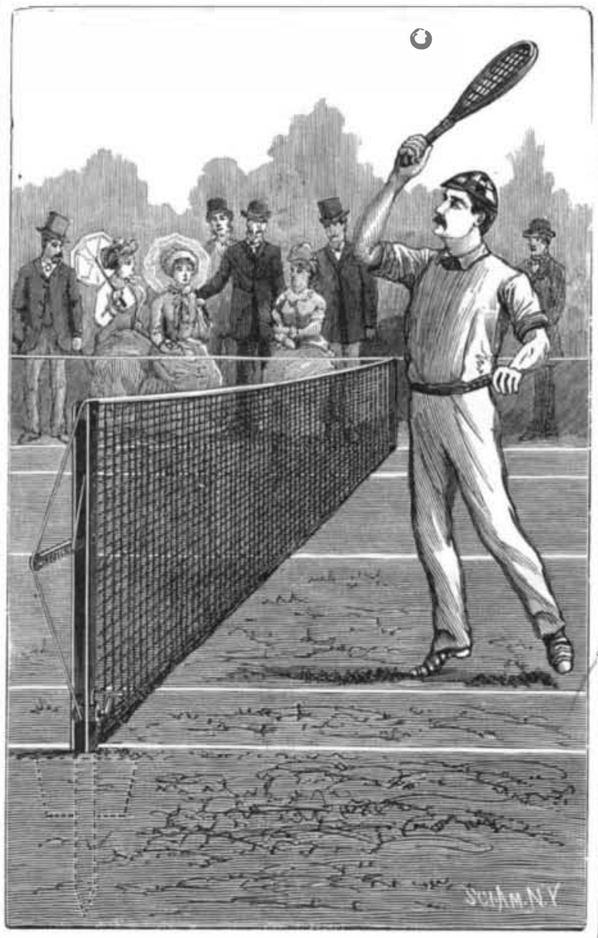
In this style of bridge, which has been studied out and constructed with great care by Mr. Carpentier, all the metallic pieces traversed by the current are of brass. All the contacts are established by means of copper cups screwed on to the bars of the bridge, and filled with mercury. All the metallic pieces are insulated from the base with ebonite. The index moves in front of the scale by sliding; and the equilibrium is perfected by means of a micrometer whose movements are measured by a vernier. The contact of the metallic knife always occurs at a constant pressure, and is regulated by a screw, thus preventing the wire from getting worn. A mercurial commutator permits of quickly charging the proportional arms. The reversal of the pile is effected by means of an ordinary reversing key.

Without entering into the details of the operations, let us say that a complete comparison comprises five series of four readings each, and the precision in the measurement is such that the figures resulting from the comparison may be guaranteed to one one-hundred thousandth, about.

If it be recalled that the decisions of the International Conference date back scarcely a year, that it has been necessary to establish prototypes, secondary standards, and measuring apparatus, and to organize a service, and that we have already standards, resistance boxes, and *legal ohms* in the market, it will be seen that, in this circumstance at least, France has not been the last to quickly utilize the practical results of a scientific progress in which she took the initiative in 1881 in the convocation of the first International Association of Electricians.—*E. Hospitalier, in La Nature.*

EXPERIMENTS made with gases upon insects proved the Colorado beetle hardest of all. It took prussic acid vapor to kill it, and it was paralyzed in illuminating gas.

IMPROVED LAWN TENNIS POST.



JEFFERSON'S IMPROVED LAWN TENNIS POST.

Every lover of lawn tennis appreciates the advantage of having a post that facilitates the ready adjustment of the net to the required height. Mr. Chas. W. Jefferson, of Rugby, Tenn., is the patentee of the post and net tightener which is illustrated in the accompanying cut. This post is quite novel in form, and enables the net to be very quickly raised and lowered, while in construction it is strong and durable.

The post is preferably U shaped, may be made of channel iron, which may be painted or nickel plated as desired. It is secured firmly in an iron socket that is driven permanently into the ground. The rope for raising and lowering the net passes over a roller on the top of the post and thence over a pulley on the end of the horizontal arm, as shown in the engraving. The rope is secured to a reel near the bottom of the post, enabling the net to be raised and secured at the required height. The horizontal arm is pivoted at its inner end, and may be raised and lowered at will. It is held in its horizontal position by the brace rod shown. When the court is not in use it is desirable, as all acquainted with the game are aware, to slacken the net to prevent dampness from tightening it and doing harm to the net and injury to the post. All that is necessary, therefore, is to raise or lower the pivoted arm, and the net will hang loosely in the posts. It is only necessary that one of the posts should be constructed as shown, as the net may be secured permanently in any suitable manner to the other post.

The Great Pyramid.

Mr. J. B. Bailey writes to the *St. James Gazette* as follows, with reference to the desirability of exploring the great pyramid: Now that Great Britain is dominant at Cairo, would it not be a good plan to clear away the sand and rubbish from the base of the great pyramid right down to its rocky foundation, and try to discover those vast corridors, halls, and temples containing priceless curiosities and treasures with which tradition in all ages has credited the great pyramid? The wonderful building, of such exquisite workmanship, was erected many years before any of the other pyramids, which are only humble imitations, built by another nation, and also for other purposes; for neither King Cheops nor anybody else was ever interred beneath this mighty mass of stone. The smaller pyramids also exhibit neither the nicety of proportion nor the exactness of measurement, both of which characterize the first pyramid. From internal evidence it seems to have been built about the year 2170 B. C.; a short time before the birth of Abraham, more than four thousand years ago.

This—one of the seven wonders of the world in the days of ancient Greece—is the only one of them all still in existence. The base of this building covers more than thirteen square acres of ground. Its four sides face exactly north, south, east, and west. It is situated in the geographical center of the land surface of the globe. It was originally 485 feet high, and each of its sides measures 762 feet. It is computed to contain 5,000,000 tons of hewn stone, beautifully fitted together with a mere film of cement. And these immense blocks of stone must have been brought from quarries five hundred miles distant from the site of the building. The present well known king and queen chambers, with the various passages, might also be thoroughly examined by means of the electric or lime lights. The astronomer royal of Scotland some years since closely and laboriously examined all that is at present known of the interior of this enormous building. He states that measurements in the chambers, etc., show the exact length of the cubit of the Bible—namely, 25 inches. This cubit was used in the building of Noah's ark, Solomon's Temple, etc. He also maintains that the pyramid shows the distance of the sun from the earth to be 91,840,000 miles.

A Canadian Ship Railway.

It is said that the construction of a ship railway to connect the Bay of Fundy with the Gulf of St. Lawrence has been finally decided on. Ships of 1,000 tons and under will thus be able to reach St. John from Montreal, Quebec, and other parts of the St. Lawrence, without having to encircle the dangerous Nova Scotian coast, a saving of 600 miles. The ship railway, which is to be seventeen miles long, will, it is expected, be supported by a subsidy of £60,000 per year for twenty years from the Canadian Government.