

ACCURATE MEASUREMENTS.

In many machine shops and manufactories where $\frac{1}{16}$ inch or $\frac{1}{32}$ inch is considered close enough, it is not realized what degree of accuracy is meant by half or quarter of a thousandth of an inch. There are, however, a great many shops and manufactories, as well as government machine construction shops, in which one-half or one-quarter of a thousandth of an inch is spoken of as a quantity of considerable importance.

In modern machine tool building, graduating of scales, etc., the call is for greater accuracy, and machines have been designed to meet this demand.

Accurate readings from a micrometer caliper can be made to $\frac{1}{100,000}$ of an inch; from this one is able to judge with what care the parts of such an instrument must be made, as a slight inaccuracy in any one of the parts will oftentimes throw the others out of adjustment, and impair the result.

Expensive special machinery of great accuracy is necessarily required for this class of work. These machines have been the outgrowth of long experience and the constant application of some of our best mathematicians. The final testing of a caliper of the kind mentioned above must be made with the most delicate instruments, or with standards made to exact size.

The accompanying cut shows the measuring machine, one of the numerous appliances for securing great accuracy peculiar to the shops of the Brown & Sharpe Manufacturing Company, of Providence, R. I., and used for the measuring of standard gages, and other tools that must be finished to exact size.

One of these machines was exhibited at the World's Fair, at Chicago, where it was shown publicly for the first time. The base of the machine consists of a massive bed 18 inches high. On top of this bed there are two movable heads, fitted to the broad flat surface, and gibbed at the sides. The large head, shown at the left, carries a bar having a finely graduated scale, graduated to fortieths of an inch, fastened to the upper side. The graduations on the inner side of the scale are so fine as to be nearly invisible without the aid of a glass. Above this scale is a microscope, fitted with a micrometer eyepiece, for reading the graduations: the microscope is mounted upon a slide parallel with the scale. By the use of this slide the capacity of the machine is 16 inches in length.

On the smaller head, shown at the right, also movable, is a micrometer screw. The micrometer graduations are read by means of a vernier scale, making the value of the graduations equal 0.00001 of an inch.

The cone shown at the back of the machine is for the purpose of concentrating the light upon the graduations of the scale.

The chief adjustment of the machine is made by the adjustment of the hair line of the microscope coincident with the lines of the finely graduated scale. The other measuring point is placed by means of

the micrometer screw in the head at the right of the machine.

In taking a measurement the machine is first adjusted to a point on the finely graduated scale corresponding to the nearest 40th to the size to be measured. Distances less than $\frac{1}{40}$ of an inch are obtained by means of the micrometer screw.

Measurements may be made on this machine to 0.00001 of an inch, and with ordinary care measurements may be made of variations not exceeding 0.00005

lished the results thereof in the *Elektroteknisk Tidsskrift*, of Christiania.

These experiments show that in such a field the cathodic rays are considerably deflected in the direction of the lines of force and may even be concentrated upon the surface of the glass to such a degree as to cause the fusion of the latter. Much more than this, they clearly prove that the rays that emanate from one and the same cathode fall in groups whose physical constants are connected by some definite law, just as are the frequencies of the different tones emitted by a rod in vibration.

These researches present some importance as concerns the theory of the aurora borealis. As well known, Mr. A. Paulsen, the learned director of the Meteorological Institute of Copenhagen, claims that the aurora borealis owes its origin to the phosphorescence of the air produced in the upper regions of the atmosphere. Mr. Birkeland puts forth the idea that terrestrial magnetism may be the cause of such phosphorescence, which becomes intensified in the vicinity of the terrestrial poles.—*L'Electricien*.

The Quinquennial Census of London.

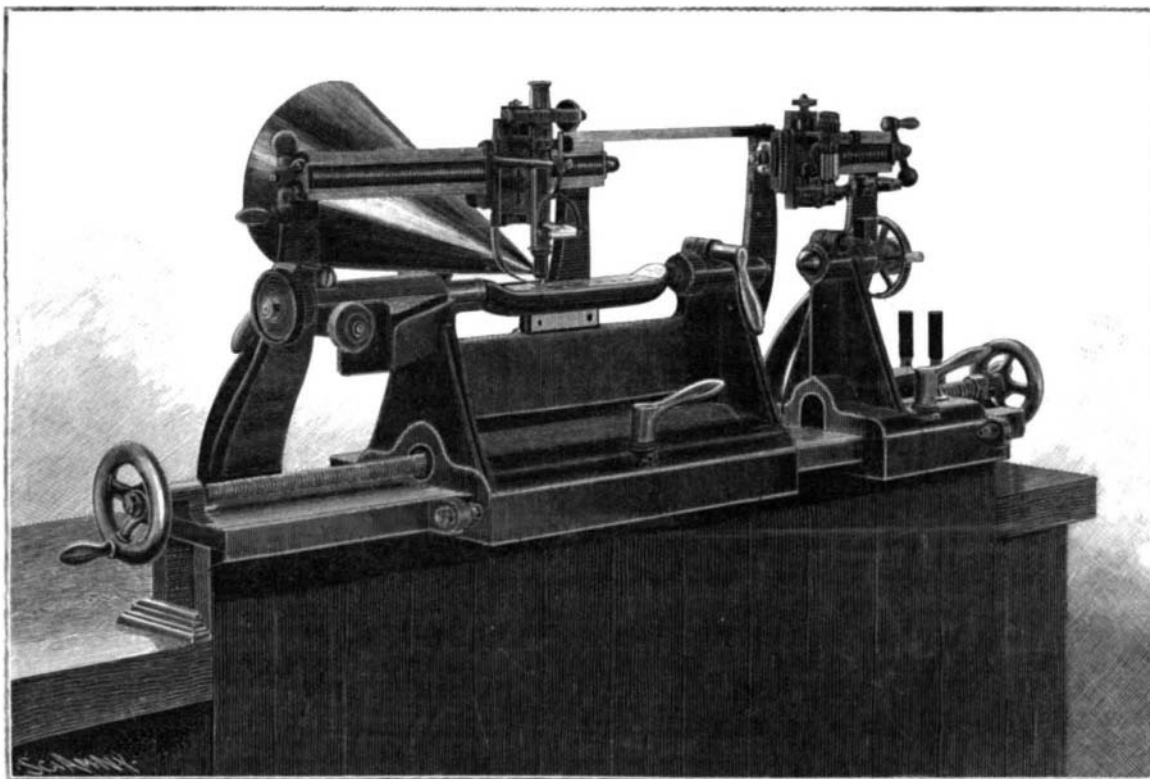
The result of the census, taken for the purpose of ascertaining the number of persons present within each parish in the administrative county of London, on the night of Sun-

day, March 29, has not yet been officially declared, but we believe the return will show an increase of 221,000 in the population of the prescribed area since the census of 1891. At that date the population of the administrative county, which includes the hamlet of Penge, was 4,232,118. We may, therefore, reckon that the total was raised at the close of March last to something like 4,453,000. When the census of 1891 was taken, the population of Penge was found to be 20,375. In 1894 it was estimated by the registrar-general at 20,589, showing, therefore, a small rate of increase. If we add the whole of the quinquennial increase of the administrative county to the population of London, as shown

in 1891, we get a total of 4,432,743.

The registrar-general has estimated that the population of London, by the middle of the present year, would be 4,435,955. But there is a gain of three months in this reckoning, owing to the circumstance that the national census is taken at the commencement of April, or three months earlier than the midsummer epoch. As there is an increase of more than 43,000 in the population of London in a year, the three months' deduction will bring down the estimate to 4,425,000 for March last, or a quinquennial increase of a little over 213,000. It happens that, if we take the increase estimated by the registrar-general for each year from 1891 to 1895, both inclusive, thereby constituting a quinquennial period, the increase becomes 212,593.

The recent census seems to show a more rapid growth.—*London Standard*.



MACHINE FOR MEASUREMENTS OF GREAT PRECISION.

of an inch. In the same class of appliances is the Odontom engine for milling templets and for making cutters for the teeth of epicycloidal gears with the curves theoretically correct. The variations left by the milling cutters made from these templets do not exceed 0.001 of an inch. A standard yard, used for reference, may also be considered one of these appliances.

X Rays and the Aurora Borealis.

A series of experiments of the greatest interest, relative to the action of a powerful magnetic field upon the cathodic rays in Crookes or Hittorf tubes, has been undertaken by Mr. Birkeland, who has pub-



BROWN & SHARPE MEASURING MACHINE IN USE.

Dark Light.

The claims of M. Gustave Le Bon, a French physicist, to have discovered what he terms "dark light"—an invisible form of radiation arising from the passage of ordinary light through apparently opaque metal plates, and capable of producing shadowgraphs like those of the X rays—have already been noticed in these columns. M. Le Bon's experiments have been described before the French Academy of Sciences, a sufficient proof that they have been performed in good faith; but his conclusions have been usually looked upon with suspicion, men of science having generally thought that he has been deceived by the filtration of light through chinks in his plate holder, or by some similar action. Nevertheless, his experiments and papers continue, and in his last paper, read on May 11, he asserts that many forms of invisible radiation, including Roentgen's X rays, rays from fluorescent bodies, the rays discovered by himself as noted above, and others, are all merely forms of "dark light," which term he thus widens in application to cover all kinds of radiation capable of affecting a photographic plate, but not the retina of the eye. Le Bon's experiments have been unaccountably neglected in this country. They are so simple that it should be easy for almost any one to prove the truth or falsity of his claims, yet no one apparently has thought it worth while to take the trouble, One American scientific magazine of high repute

even refers to his experiments as experiments on X rays, says the Literary Digest. It is quite certain, however, that there are forms of invisible radiation capable of taking a photograph, besides the famous X rays. Some of the methods of photographing "in the dark" were known, in fact, long before Roentgen's discovery. It may be that Le Bon has really discovered a new and related form of radiation, and in any case his recent classification of all such forms under one comprehensive head is a step in the right direction. We translate below an extract from the paper alluded to above, together with an abstract of other portions of it, from Cosmos (Paris, May 23):

"To place his previous experiments definitely beyond all the objections brought against 'dark light,' notably that which suggests the filtering of ordinary light through the cracks of the plate holder, M. Le Bon has undertaken new experiments with the object of condensing it on the surface of metal plates, and then obliging it to pass through these and act on photographic plates in darkness. We quote from his communication the description of his experiments:

"Take a sheet of copper and one of lead, about one millimeter in thickness; place each of these two sheets in a photographic printing frame instead of the sheet of glass and expose one of the faces—one only—at a distance of 20 centimeters [8 inches] to the light of an electric arc, for one hour. Remove the two frames to darkness and allow them to cool for two hours. Remove the sheets from their frames; then, between the two faces that haven't been exposed to the light, place a sensitized glass plate, and the object that we wish to reproduce, a photographic negative for instance, taking care that the object shall be between the copper and the sensitized plate. To avoid all contact action, be careful to separate the sensitized glass from the object to be reproduced, by a sheet of glass or celluloid. It will be sufficient to leave the whole in darkness for five or six hours, to obtain on development a perfect image of the object placed between the metal sheet and the

photographic plate. It is then evident that the light condensed on one of the faces of the sheet of copper has traversed the metal and made an impression on the photographic plate."

"Adopting the term 'dark light' for all forms of invisible radiation hitherto discovered, M. Le Bon believes that he has been able to establish the following classification:

"X Rays.—These traverse black paper and organic substances, do not pass through most metals, and are neither reflected nor refracted.



A HUT IN PROCESS OF CONSTRUCTION.

"Invisible Rays from Fluorescent Bodies.—These pass through metals, as Messrs. D'Arsonval and Becquerel have shown, are refracted and reflected, and present, consequently, no peculiarity permitting us to identify them with the X rays.

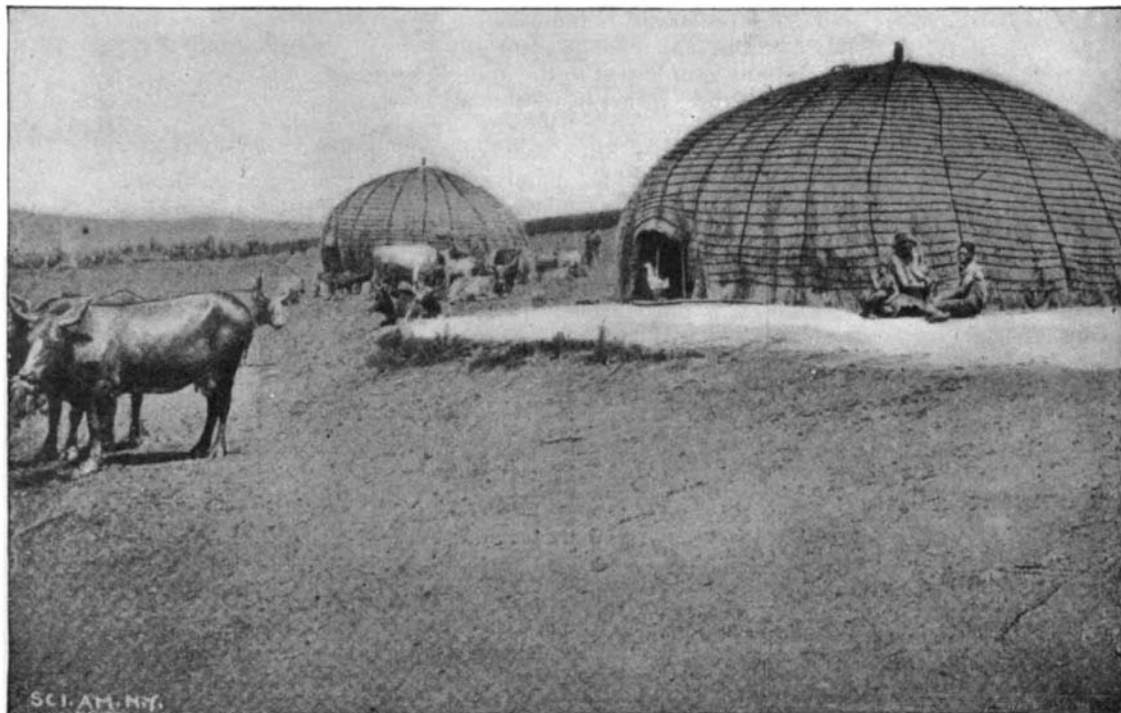
"Rays that are Formed when Visible Light Falls on Metallic Surfaces.—The researches of M. Le Bon show that these rays do not pass through black paper, nor through the greater part of organic substances, but that they pass through a large number of metals. They also possess the property of being condensed and diffused, like electricity, on the surface of metals.

"Rays Belonging to Organic Beings.—Rays are emitted by organized beings in darkness, which allow

offer so little that is attractive in the eyes of white men, and for this authority there is fierce contention among the descendants of a deceased chief.

Like the ancient feudal lords, African princes usually obtain supremacy over their people only at the price of the blood of their opponents. The reign of the last monarch of the Matabeles, Lo Benguela, was inaugurated by the massacre of all of his brothers. It is true that he was encouraged in this particularly by his sister Njina, who hoped also to gain power, but having, in her turn, been accused of casting a spell over the queen, rendering her barren, the tender sister was condemned to death and hung from a tree on April 2, 1880. It is thus seen that the

women of these countries play a certain part, in spite of the state of servitude endured by the "weaker" sex among all primitive races. The distribution of work is often quite the reverse of that which we are accustomed to see among civilized people. On the shores of the Zambezi, especially where the breeding and raising of cattle is impossible on account of the ravages of the fly tze-tze, agriculture constitutes the only occupation of the inhabitants. The work of the fields falls entirely upon the women, who start off early in the mornings to cultivate the ground and raise the grain and corn. Millet or sorghum, called mabele by the Matabeles and imphi by the other tribes, constitutes their principal food. The cooking is carefully attended to by the men who remain in



MATABELE HAMLET.

From photographs supplied by the Société de Géographie.

us to photograph them, as M. Le Bon has shown by operating on ferns, fishes and various animals. These rays appear to be related to the invisible rays of phosphorescence, but they differ nevertheless in that they do not pass through metallic bodies, at least those experimented upon—notably aluminum."

Como, in Italy, is the birthplace of Alessandro Volta, and will celebrate, in 1899, the hundredth anniversary of his invention of the voltaic battery by an electrical exhibition and congress.

the village, and they also take care of the household arrangements. After the return home the members of the family assemble around the pot, into which each one dips his five fingers and makes a ball, which quickly disappears down his throat. This is the one meal of the day. They talk often until very late at night, all smoking the daga, a kind of native tobacco, after which all go to bed, either inside of the huts or in the open air, rolled in a sheepskin.

Contrary to the practice among other African races, the Matabele women are subjected to a most austere

THE MATABELES AND MASHONAS.

BY F. LEMOSOF, IN MAGASIN PITTORESQUE.

Matabeleland and Mashonaland form part of British Zambezi or Rhodesia, as it has been named from Cecil Rhodes. Various conventions with the neighboring powers have assured to England the possession of this vast country extending northward from Cape Colony, and which a privileged company—the Chartered Company—has tried to render valuable. The results thus far obtained by no means correspond to the amount of money and labor expended in the exploitation of the country; for, although some parts of the territory, in the neighborhood of the rivers—like that in the neighborhood of Senna shown in our engraving—present a real tropical beauty, the greater part of Zambezi is arid and barren, its only riches being a few auriferous veins which scarcely repay the cost of the first installation; and furthermore, it is very difficult to establish trade with the natives, especially with the Matabeles, who are supposed to belong to the most refined tribe of the Kafir races. Imperious, warlike, accustomed to maintain themselves by their raids on neighboring tribes, Matabeleland was, until a few years ago, a very powerful realm. The chiefs of all of these South African tribes, the Mashonas, the Matabeles and the Zulus, enjoy a real authority in spite of their air of indifference and physiognomies which