

its proper position, as far as Great Britain was concerned.

In the past, aluminum had been manufactured in this country by the chemical processes, but those processes had been altogether surpassed by the electrical process. The last he heard of chemical processes was when Mr. Vautin had produced, with very great industry and research, a sulphide of aluminum. He hoped for great things from that, but up to the present, he had not heard that Mr. Vautin had been able to reduce that sulphide. The company he had mentioned would soon be able to manufacture aluminum in Great Britain in the same way as it was produced in Nordhausen, and probably better, because, having the bauxite mines in Ireland and water power in Scotland, they would have every natural facility for success. In fact, they would be giving a new industry to Scotland, and also to Ireland, in the manufacture of aluminum from bauxite. He was glad to hear that Professor Roberts-Austen had a new use for aluminum, and felt that this furnace had a great future before it. Every one who had to do with chemistry knew that there was a very large future in the application of metals which, up to the present, had hardly been used at all. They saw it in the incandescent gas lighting, and in alloys of various metals, and this last use would probably be of very great importance. They knew that one of the great drawbacks to the use of aluminum had been its want of tensile strength, but there was little doubt that the addition of a very small percentage of some of these rarer metals, which had hitherto been beyond practical use, would enormously increase its tensile strength.

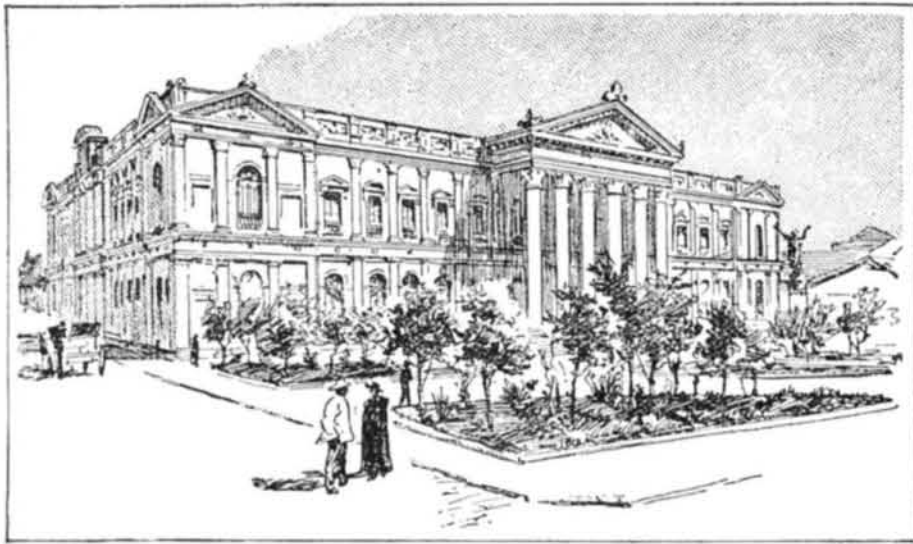
Professor Roberts-Austen said he had not specially dealt with all the beautiful specimens on the table, but had only taken up two at random, the magnificent mass of manganese carbon free and the equally fine fragment of a larger mass of chromium which he handed to the chairman as perhaps the most remarkable metallurgical specimen he had ever seen, both of which were produced by Mr. Vautin. On the table were also carbon-free tungsten, the only mass he had ever seen, uranium and some molybdenum which Mr. Pickard produced at the mint with him. There could be no question that a most important field was opening, and the cheapening of aluminum, to which Mr. Wallace referred, could not fail to play a most important part in metallurgy, by enabling them to get these rarer metals, and to add them to masses of their common associates, the effect of which was, in many cases, most remarkable. For instance, take the case of titanium, that would be most useful.

When the naval architects met in that room very recently, reference was made to the difficulty in the use of aluminum for torpedo boats on account of the boats corroding on the line between wind and water. He knew an instance where a yacht was built for a French proprietor who was very well pleased with it until he moored it, with an iron chain to an iron post, to which post was also moored a boat sheathed with copper. The result was that a gigantic battery was established, and the aluminum yacht was found to be dissolving away.

The addition of 0.2 per cent. of titanium increased the durability of such a metal as aluminum when subject to the solvent action of salt water. It was impossible to say what might happen when they had studied the properties of alloys containing minute quantities of the rarer metals. He hardly dared mention their uses in connection with electricity; "platinoid" and "manganite" had already attracted attention, and it was impossible to say what valuable results might be obtained.

THE CHILEAN HALL OF CONGRESS.

A TELEGRAM from Santiago announces that the Chilean Hall of Congress in the capital was totally destroyed by fire on May 18, the disaster being attributed to incendiarism. Santiago, the "city of rich people," as it is called on the west coast of South America, is famous for its fine streets and handsome public buildings. A third of a century ago (writes a correspondent) the church of the "Compania de Jesus," situated at the back of the cathedral, caught fire while mass was



THE CHILEAN CONGRESS HALL AT SANTIAGO, WHICH HAS BEEN TOTALLY DESTROYED BY FIRE.

being celebrated, and about 2,000 ladies lost their lives. The behavior of the priests on this occasion is said to have given the death blow to priestcraft in Chile. The church was not allowed to be rebuilt, but on its site was erected a hall for the Chilean Legislative Assembly, a building some 60 ft. in height and 300 ft. in length. It was profusely adorned with marble in its three large halls, one of which was used as the Chamber of Deputies, another as the Chamber of Senators, and the third for swearing in the president of the republic. One portion of the building was used as

offices for the engineers of the Public Works Department.—London Daily Graphic.

A NEW METHOD OF COMPUTING.

By E. W. SCRIPTURE, Yale University.

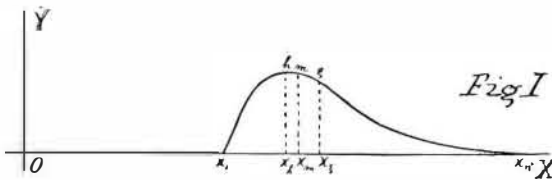
SUPPOSE that you have measured the heights of a group of twenty-five men, what do you do with the results, which vary, more or less, from one another? Let us take a case that occurs all over the country every year. Each graduating class of every college and school has the heights of its members measured. For the sake of comparison with preceding and succeeding classes, the individual heights are generally "averaged." Thus the "average" height of the class of '93 is said to have been, say, 66 inches, that of '94, 67 inches, etc.

But a great deal of dissatisfaction arises with this "average" height. The presence of a single very tall or very short man upsets the whole result.

Let us take a class of ten men, of the heights 65, 64, 65, 66, 66, 67, 65, 66, 76, 66, the average height is 67 inches.

Now let us take another class, with the heights 66, 65, 68, 67, 69, 68, 66, 67, 66, 67. Every man is taller by an inch than the corresponding man in the previous class, but there is no extraordinarily tall man there. Yet the average is 66.9, or a little less than that of the other class.

Now it is evident that the one very tall man ought



not to outweigh the influence of the other nine men. It is apparent that the average is a very unsatisfactory representative value in such a case.

What is especially striking is that every man influences the result in direct proportion to his deviation from the average. For example, in the first class the man of 65 inches influences the average by the amount

$\frac{67-65}{10} = 0.2$ of an inch, while the tall man influences it by $\frac{76-67}{10} = 0.9$ of an inch. This does not seem quite fair.

This difficulty and unfairness can be removed by treating every man alike, by allowing all measurements to affect the result to the same degree. This is done by the use of the median instead of the average.

The median was first considered as a representative value by Laplace, who treated some of its properties from a theoretical point of view. Fechner believed that it could be used for statistical purposes. He explained a crude method of computing it. But aside from a few isolated attempts, mainly as curiosities, the median was never practically used in computation until I introduced it into my laboratory in the year 1893. During the year 1894 fully 100,000 measurements of the most varied kinds were adjusted on the basis of the median in place of or in addition to the average.

On the strength of this experience I have published (Studies from the Yale Psychological Laboratory, Vol. II) an analytical and practical consideration of the median and its properties.

What is the median? It is the middle value in a set of numbers. Suppose the numbers to be arranged in order of size; then, beginning at the smallest or at the largest, count them off until you come to the middle one. For example, the first class mentioned above would run 64, 65, 65, 66, 66, 66, 67, 67, 68, 76. The middle value for ten measurements would be between the fifth and the sixth. In this case, both are the same and the median is 66.

How much influence does the tall man have? Merely that of one man; as long as he is above 66 inches, it makes no difference how tall he is. In like manner every value influences the median merely as one value above or below. As tall men or short men are added, the median goes up or down according to the number of men added, not according to the number of inches added.

For the second class we had 65, 66, 66, 66, 67, 67, 67, 68, 68, 69. The median is 67.

The median for n values is that one which is the

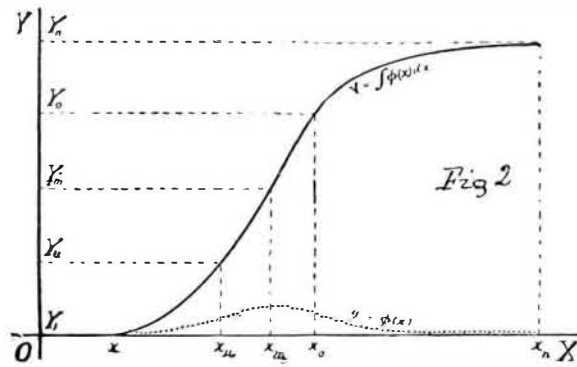
$n+1$

th in order of size from either extreme. For five

values it will be the third, for thirty the 15½th, etc. It is not necessary to write the values in order of size; they can generally be selected by the eye. For short sets of values the whole process can be done mentally.

Persons familiar with the science of measurement will realize the theoretical advantage of the value of middle probability, the median X_m , over the value of mean area, the average X_e , for all unsymmetrical curves of error (Fig. 1). When the curve is symmetrical, the median and the average are the same. The case is very striking when the integral curve of probability (Fig. 2) is considered. The values X_o and X_a are the over and under quartiles proposed by Galton for use instead of the mean variation in statistical measurements. Of the use of these values I do not approve.

Experience has shown that the median is a far better value than the average in all statistical and psychological measurements and in all measurements where psy-



chological factors come into play, e. g., in the so-called errors of observation of astronomical and physical measurements. Strangely enough such phenomena as the fluctuating price of corn or the varying records of the barometer are better represented by the median than by the average. Of course, in cases where the results are reckoned by the number of units and not by the number of things, e. g., meat by the pound, debts by the dollar, etc., the average is the proper value.

ELECTRIC CURRENTS.

PROF. GEORGE FORBES, F.R.S., delivered recently lectures at the Royal Institution on "Alternating and Interrupted Electric Currents." He said that in the course of the work in which he had been engaged during the past few years, he had had occasion to find some simple means of expression to convey to his own mind, as well as to the minds of others, clear ideas about more or less obscure electrical phenomena, and the analogies thus wrought out he intended to set forth in these lectures. Professor Dewar had told him that his listeners expected him to talk much of what he had been doing at Niagara. He was not responsible for that anticipation, and was sorry to disappoint them to a great extent, for he was going to speak more about the problems of submarine telegraphy, and in the experiments he intended to show had been assisted by several friends, more especially Mr. Swinton and Dr. Muirhead. Submarine telegraphy has hitherto been much wrapped up, he said, in the obscurity of mathematical symbols, and he hoped to make some of its more recondite phenomena intelligible to every one.

Professor Forbes then explained how a submarine cable has to be charged and discharged like a Leyden jar, the conducting wire forming the inner coating and the sea the outer coating. In early times electricity was spoken of as analogous to the flow of water through pipes, and in some respects an exceedingly good analogy it is. The pressure of the water symbolizes the electromotive force, and the friction of the pipe the resistance. The pressure may be supposed to be furnished by a centrifugal pump at the central station. Instead of using up the whole of the energy of the centrifugal pump in the pipe, we might have a very large pipe, with a little one at its farther end in which there is great friction, and that is analogous to the principle of electric lighting; or instead of a little pipe at the far end we may place a turbine there, and that would be analogous to an electro-motor to drive machinery.

There are, however, more obscure electrical phenomena to which the analogy of water flowing through pipes does not apply, and especially is this the case when alternating currents are used. In mechanics likewise we have obscure phenomena not easily explicable, as in those presented by the action of the gyrostaf, the principles of which it takes a considerable amount of thought to make clear. Again, suppose a revolving wheel, A, Fig. 1, to have an endless chain,



B, hanging on a groove in the circumference of the wheel, and turning with it, then let the loop of the chain be pressed at K out of the perpendicular and made to assume the form shown in the cut, it behaves like a rigid body, and when left to itself does not rapidly fall back into a perpendicular loop. No intelligent mechanic would have expected such a result beforehand, and still less would he have expected the following: A, Fig. 2, is a wheel of cardboard with a number of little weights fixed round it near its circumference. The wheel is made to revolve round its central axis, W. If now the top of the revolving wheel be bent over as at K, in the side view shown at B, Fig. 2, it will remain bent over so long as the wheel is driven at a particular rapidity, and a much greater speed has to be applied before it shows a tendency to assume the vertical.