of them happening by $\frac{n}{n} = 1$, these quantities have to one another the ratios required. We then arrive at the true meaning of the fraction which is said in mathematics to be the "probability" of a contingency; and much confusion might be avoided if we called the fraction, not the "probability," but the "*modulus of the evidence*," and the so-called equally likely cases not "equally likely" but "*equi-evidential*," or by some more convenient name conveying the same idea.

But it must be insisted that the above is only one way of measuring the evidence, and is not applicable to all cases. Indeed, the more important matters of daily life usually do not admit of it, for there are qualitative differences in strength of evidence which cannot really be measured quantitatively, and that is why the application of mathematical probability to the testimony of witnesses is so obviously futile.

The solution of every mathematical problem in probability is in the last resort only the finding of a modulus of evidence, in the ratio of the part of the whole number of equi-evidential cases which involve a given contingency, to the whole number of such cases; and with the finding of the modulus the strictly mathematical work ends. Mathematics, as such, has nothing to do with the inclination in our minds to expect the event for which the modulus of evidence is greatest (or "the probability" greatest), or the inclination, when some practical step has to be taken, to act on the hypothesis that the event will happen for which the evidence to us seems strong.

Unfortunately, however, there is too often a tendency to confuse the mathematical measure of the mere state of our minds with the measure of something in reality; and this produces various mistakes—*e.g.* the inclination to expect that the actual proportion of the occurrences of the event will tend to conform to the proportion represented by the mathematical probability, *i.e.* conform to a formula of our ignorance. This is an insidious fallacy, and we are not unlikely to fall into it in one form when we have escaped it in another; the mistake of supposing the mathematical probability could be confirmed by actual observation belongs to the head. The attempt to regulate betting by mathematical probability is another instance of the fallacy of confusing the subjective with the objective. The truth is that an observed average may be made the basis of a mathematical "probability" or modulus of evidence, by a process which could easily be explained; but though a "probability" may be based on an average, an average can never be based on a "probability."

J. COOK WILSON.

Instruments of Precision at the Paris Exhibition.

I WAS glad to see your appreciative article upon the German instruments of precision at the Paris Exhibition, in which you refer, among other things, to the splendid catalogue which was freely given away to any one who showed any interest and desired to have a copy.

As a member of the Jury of Class 15, I naturally was led to duly appreciate both the German productions and their catalogue, and fearing that this valuable record might too soon become inaccessible, I asked Dr. Drosten if he would send a copy to the Science Library of the Victoria and Albert Museum, so that it might be permanently available for many who might wish to see it. This he most willingly did.

If copies are becoming scarce, it would be more to the point that public libraries attached to scientific institutions should have them than that they should run the risk of being buried and lost in private hands.

C. V. BOYS.

A New Form of Coherer.

DURING the past eighteen months I have been called upon to demonstrate the principles of wireless telegraphy in connection with my regular lecture courses, and now and then, while wireless telegraphy was still the latest scientific novelty, in popular lectures.

For the latter purpose it was necessary to have the receiving apparatus as simple as was possible, compatible with a moderate sensibility and regularity of action.

I found the Marconi arrangement, consisting of the separate instruments, coherer, relay and decohering devices, to have the disadvantage, for my purpose at least, of requiring long and careful adjustment each time the apparatus was set up.

It occurred to me that if the functions of the three instruments could be performed by a single instrument, an easier adjustment would result.

This would, perhaps, be of no advantage in the case of a permanent set up, but would be of considerable advantage in apparatus designed for the purpose of demonstration.

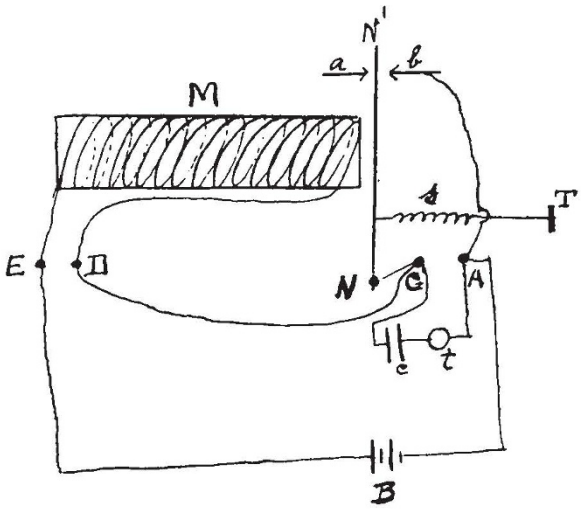
By a slight modification, which need not be permanent, an ordinary telegraph relay of moderate sensibility may be made to serve the purpose of the coherer, relay and decoherer of the Marconi arrangement.

The ordinary telegraph relay is shown in the accompanying sketch.

M is the electromagnet, which in most cases is mounted so that its distance from the armature, NN′, can be varied by a slow-motion screw, E and D are the main circuit terminals, A and C the terminals of the relay circuit, C is connected with the armature NN′, and A is connected to the stop *a* when the instrument is used as a relay. T is a screw connected to NN′ by a spiral by means of which the pressure of the armature on the stop *b* may be varied.

Usually the stop *b* is of hard rubber, and *a* and *b* may be interchanged. If this interchange is made and if C is connected with D, then the battery B will send a current through the electromagnet M and the loose contact N′*b*.

The tension in the spiral, *s*, and the position of the electromagnet may be adjusted so that no current flows, on account of the very high resistance of the loose contact (coherer) N′*b*. If this resistance is lowered by electromagnetic radiations, then the



current through the electromagnet rises and NN′ is attracted towards M and the circuit at N′*b* is broken. The spiral *s* draws NN′ back into contact with *b* and the instrument is ready to again respond to electromagnetic radiations. The adjustment of M and T are easily made, and once made the coherer works very steadily.

The motion of NN′ is too slight to be visible or to close an auxiliary circuit with a sounder, but if a telephone, *t*, in series with a condenser, *c*, is put in parallel with the coherer (*i.e.* across A C) the make and break of N′*b* are clearly audible.

If a "loud-speaking" telephone or a telephone with a manometric flame are used, the make and break can be made audible or visible to an audience.

If the distance between sending and receiving stations should make it necessary, C can be earthed and A connected with a vertical wire. It is well to have the resistance of the electromagnet as low as is compatible with moderate sensibility in order that the normal high resistance of the coherer shall form the major part of the total resistance in series with the battery.

In adjusting the contact N′*b* it is convenient to set M and T so that the armature NN′ vibrates automatically, and then relieve the tension in the spiral *s* until the automatic vibration just ceases.

When this adjustment is made, a "dot" signal from the sending station gives a single "tick" in the telephone—a dash gives a series of ticks.

I have never attempted to telegraph over a distance exceeding