ART. XXX.—*On a new method of measuring the Velocity of Rotation;* by Prof. A. E. DOLBEAR.

WHILE experimenting with the gyroscope, I have often wished to know its velocity, but knew of no way to determine it when it was set in motion in the usual way with a string. I have lately found a simple and exact way of doing this, and a description of the plan may be of interest to others, as it can be used to measure the velocity of wheels of every size, and every possible speed, without inconvenience and without expense.

If a short piece of wire be soldered to the end of one branch of a common tuning fork, one end of the wire projecting a little on one side, and the fork made to vibrate at the same time that the point of the wire is drawn over a piece of smoked glass, an undulating line is made, and if the rate of vibration of the fork is known, the velocity of the moving hand can be found by counting the number of undulations in an inch on the glass. This has been used to determine linear velocity; but it can also be applied to rotary with great precision. I have a large fork

with branches eight inches in length that vibrates one hundred and seventy-one times in a second as determined by a resonant tube; it has copper wire fastened to one branch and projecting about one-fourth of an inch,—made for showing to a class the waving line upon smoked glass. A brass disk four inches in diameter, mounted gyroscopically, was smoked upon one side and set revolving by a string. The vibrating fork was then brought to it in such a manner that its vibrations were along the radius of the disk, but as soon as it touched it bounded away and nothing could be determined with it. A *cone of india rubber*, about a quarter of an inch in height, was then fastened with sealing wax near one end of the branch, and this tried as before with entirely satisfactory results, the markings being well defined and unmistakable.

When the number of vibrations the fork makes a second is known, and the number of undulations made once round the disk, the former number divided by the latter will give the rate per second of velocity. Thus if the fork made 100 vibrations in a second and the disk turned round but once in the same time, it is evident that there would be a hundred undulations on it, and if the disk turned 50 times a second, there would be but two undulations for each revolution. In any case, if a equals the number of vibrations per second of the fork, and b equals the observed number of undulations in a single turn of the disk, then $V=\frac{a}{b}$.

A single wave, or even half of one, is sufficient for determination if the length be measured in degrees, in which case if $d=$ the length of one wave in degrees, the formula will stand $V=\frac{ad}{360}$. If the rotation be very rapid the quickest possible touch is needed or the undulations will return and confuse each other; but this is not troublesome at any speed I have been able to obtain, which is in the neighborhood of 90 per second.

I have found that a common pocket tuning fork, either an A or a C, answers very nicely with one of india rubber fastened as before. So far as I now know, the swiftest motion that has been given to a disk was that in Foucault's apparatus for showing the motion of the earth which he estimated at from 150 to 200 revolutions per second. Such a velocity would be recorded by from 2 to 3 undulations of a C fork, making 512 vibrations per second. If it would not be best to smoke the disk, a piece of white paper can be pasted upon it and smoked without burning, and it answers every purpose. To the certainty and ease of this method may be added another advantage, that the slightest touch needed for this cannot sensibly retard the motion of the disk, as any mechanical fixture attached for such a purpose must do.

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