Nature (*London*) **82** 9 (1909)

The small motion at the nodes of a vibrating string

It is generally recognised that the nodes of a string which is maintained permanently in oscillation in two or more loops cannot be points of absolute rest, as the energy requisite for the maintenance of the vibrations is transmitted through these points. I have not, however, seen anywhere a discussion or experimental demonstration of some peculiar properties of this small motion. A brief note may therefore be of interest.

In the first place, the small motion at the node is in a phase which is different from that of the rest of the string. The exact difference of phase is shown by a dynamical investigation to be a quarter of an oscillation. The motion is of very small amplitude, and it might therefore be thought a difficult matter to verify this experimentally. I have, however, devised some convenient arrangements with which this can be effected. I shall here mention only one method: this was to compound the oscillation at every point on the string with another perpendicular to it of half the frequency, and to observe the compound oscillation at the nodes and elsewhere.

Such a compound oscillation can easily be maintained permanently by having the string attached to the prong of an electrically maintained tuning-fork, so that it lies in a plane perpendicular to the prongs, but in a direction inclined to the line of their vibration. When the load on the string is slightly greater than that necessary for the most vigorous maintenance, points on the string describe parabolic arcs with concavities in opposite directions in alternate loops, the whole forming a beautiful and interesting type of stationary vibration. This is not, however, the stage convenient for observing the small motion at the nodes. When the tension of the string is relaxed, so as to make its vibration stronger, points on the string, i.e. except the node, describe 8 curves. The curve described by the node is neither a straight line nor an 8 curve, but is a very flat parabola. From this, the phase-relation between the small motion at the nodes and the large motion elsewhere is obvious.

If the node has a small motion, then, strictly speaking, there is no node at all. There should, however, be points at which the positions of the string in opposite phases might be supposed to intersect. One might suppose that these points, or "fictitious nodes," should execute a very small, almost microscopic, movement. As a matter of fact, these "fictitious nodes" oscillate parallel to the string through a range equal to the whole length of a loop. This somewhat striking effect may be observed without difficulty by illuminating the string with periodic illumination of twice the frequency of the oscillation.

C V RAMAN

Post-Box 59, Rangoon