roof, facing north; at Truro they are placed on the roof of the Royal Institution, about forty feet above the ground, in a wooden shed through which the air passes freely; at Falmouth they are eleven feet above the ground, close to a wall, and in a confined situation; at Helston we are not informed how they are placed; and at the Scilly station we are only told that they "are well placed"—a statement which the observations themselves render very doubtful.

The times of observation are hourly at Falmouth, 9 A.M. and 3 and 9 P.M. at Helston, and as respects the other three stations we have no information. In reducing the observations, "corrections for diurnal range" are used in some cases, though the observations themselves show that the range corrections adopted are plainly not even approximately correct for the place.

A system of meteorological observation which would furnish the data for an inquiry into the important question of a comparison of the local climates of Cornwall requires yet to be instituted. Such a system must secure at each of the stations included within it, uniformity in exposure of instruments, uniformity in hours of observation, and uniformity in methods of reducing the observations. Till this be done, such climatic anomalies, as we have pointed out in the case of Bodmin, will continue to be published, certainly misleading some, and probably leading others to dispute the usefulness of meteorological observations.

We have much pleasure in referring to the additional meteorological information given in the tables, which is often of considerable value, particularly that supplied for Helston by Mr. Moyle, whose tables have the merit of giving the results for the individual hours of observation, as well as deductions from these.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Vibrations of a Liquid in a Cylindrical Vessel

IN NATURE for July 15, there is a short notice of a paper read before the Physical Society by Prof. Guthrie on the period of vibration of water in cylindrical vessels. It may be of interest to point out that the results arrived at by Prof. Guthrie experimentally, and many others of a like nature, may also be obtained from theory.

In the first place the fact, that the period of a given mode of vibration of liquid in a cylindrical vessel of infinite depth and of section always similar to itself (*e.g.* always circular) is proportional to the square root of the linear dimension of the section, follows from the theory of dimensions without any calculation. For the only quantities on which the period τ could depend are (1) ρ the density of the liquid, (2) g the acceleration of gravity, and (3) the linear dimension d. Now as in the case of a common pendulum it is evident that τ cannot depend upon ρ. If the density of the liquid be doubled, the force which act upon it is also doubled, and therefore the motion is the same as before the change. Thus τ, a time, is a function of d, a length, and g. Since g is $-$ 2 dimensions in time, $\tau \propto g^{-\frac{1}{2}}$, and therefore in order to be independent of the unit of length, it must vary as $d^{\frac{1}{2}}$ inasmuch as g is of one dimension in length. Hence $\tau \propto d^{\frac{1}{2}} g^{-\frac{1}{2}}$. This reasoning, it will be observed, only applies when the depth may be treated as infinite.

The actual calculation of τ for any given form of vessel involves, of course, high mathematics, the case of a circular section depending on Bessel's functions. But there is an interesting connection between the problem of the vibration of heavy liquid in a cylindrical vessel of any section and of finite or infinite depth, and that of the vibration of gas in the same vessel, when the motion is in two dimensions only, that is everywhere perpendicular to the generating lines of the cylinder. If λ be the wave-length of the vibration in the latter case,* which is a quantity independent of the nature of the gas, and $\kappa = 2\pi \div \lambda$, the period τ of the similar vibrations in the liquid problem is given by

$$\tau = 2\pi \div \sqrt{\frac{gk\,(\epsilon^{kl} - \epsilon^{-kl})}{\epsilon^{kl} + \epsilon^{-kl}}},$$

l being the depth. The formula shows that in accordance with Prof. Guthrie's observation τ diminishes as l increases, and that when l is sufficiently great

$$\tau = 2\pi \div \sqrt{gk}.$$

If x be the value of k, viz. $2\pi \div \lambda$, for a circular vessel of radius unity, then the values of x for the various modes of vibration are given in the following table extracted from a paper on Bessel's functions in the *Philosophical Magazine* for November 1872.

Number of Internal Spherical Nodes.	Order of Harmonic.			
	0	1	2	3
0	3·832	1·841	3·054	4·201
1	7·015	5·332	6·705	8·015
2	10·174	8.536	9·965	11·344

Thus if d be the diameter of the vessel, the period τ of the liquid vibrations is given by

$$\tau = 2\pi \sqrt{\frac{d}{2gx}};$$

so that if d be measured in inches, the number of vibrations per minute, n, is given by

$$n\sqrt{d} = \frac{30}{\pi} \sqrt{24 \times 32{\cdot}19 \times x}.$$

For the symmetrical mode of vibration considered by Prof. Guthrie, $x = 3{\cdot}832$, giving

$$n\sqrt{d} = 519{\cdot}4$$

agreeing closely with the experimental value, viz. 517·5. Even the small difference which exists may perhaps be attributed to the insufficient depth of the vessels employed.

This mode of vibration is not, however, the gravest of which the liquid is capable. That corresponds to $x = 1{\cdot}841$, giving

$$n\sqrt{d} = 360{\cdot}1,$$

and belonging to a vibration in which the liquid is most raised at one end of a certain diameter, and most depressed at the other end. The latter mode of vibration is more easily excited than that experimented on by Prof. Guthrie, but inasmuch as it involves a lateral a motion of the centre of inertia, it is necessary that the vessel be held tight.

The next gravest mode gives $x = 3.054$, and corresponds to a vibration in which the liquid is simultaneously raised at *both* ends of one diameter, and depressed at both ends of the perpendicular diameter. In this case the value of n is given by

$$n\sqrt{d} = 462{\cdot}7$$

Terling Place, Witham,
July 15 RAYLEIGH

* Namely, the length of plane waves of the same period.

Insectivorous Plants

IF further confirmation be needed of Mr. Darwin's discovery of absorption by the leaves of the *Drosera rotundifolia*, it is afforded amply by the following experiments which I have just concluded:—

Having deprived a quantity of silver sand of all organic matter, I placed it in three pots, which I shall call A, B, and C. In each of these pots I placed a number of plants of the *D. rotundifolia* under the following conditions:—(1) Perfectly uninjured, but washed all over repeatedly in distilled water. (2) Similarly washed, but with all the roots pinched off close to the rosette, and with the leaves all buried, only the budding flower stalk appearing above the sand. (3) similarly washed, with the roots and the flower stalk left on, but all the leaves pinched off, the roots being buried in the sand. (4) Similarly washed, roots left on, four leaves buried in the sand, two leaves flower stalk, and roots left above the sand and the roots protected against the possibility of their absorbing anything from the sand. All the plants were carefully watched, so that no flies were caught.