

Again, in like manner, a "resonator" was always found to give the node in different positions according to the size of the "vibrator" employed. This is what would be expected from the principle of resonance, a resonator being able to respond to any member of the "band" it would itself give out when acting as a radiator, the central period of course with the greatest

ease. Some such factor as $e^{-(\lambda-\lambda_0)^{2n}}$ could, perhaps, express this sort of thing, where λ belongs to the period of the radiation, supposed for the moment "monochromatic," falling on the resonator, and λ_0 belongs to the "period" of the resonator, or that of the centre of its "band."

The position of the node was also found to vary on altering the character of the dielectric surrounding the resonator; even laying a piece of sealing-wax on the wire of the resonator was sufficient to be observed. This might be employed to determine "V" in a dielectric of which only a small quantity was obtainable.

It is obviously of importance for the "central period" of the resonator employed to coincide with that of the vibrator, especially when determining the velocity of the disturbance, for this is presumably the period given by theory. This is practically always done when arranging their relative sizes, so as to obtain greatest intensity. So that the caution urged by M. Cornu in connection with Prof. Hertz's measurements of this velocity seems, from these considerations, to be to a great extent unnecessary.

It would obviously be of importance to investigate what form the resonator should take, so as to give out a radiation most approaching one definite period. FRED. T. TROUTON.

Bourdon's Pressure Gauge.

As there does not seem to be in any of the more familiar text-books of Physics or Engineering any satisfactory explanation of the action of the Bourdon gauge, the following may be of use to some of your readers.

What we have to explain is the uncurling of the gauge under internal pressure whether of gas or liquid.

Instead of the usual flattened tube of more or less elliptical section

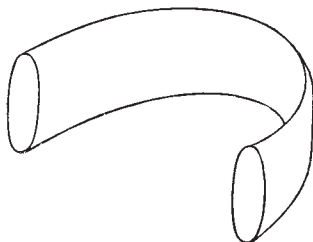


FIG. 1.

bent into the arc of a circle as in Fig. 1, think, for convenience, of one of rectangular section, such as AB of Fig. 2, in which A

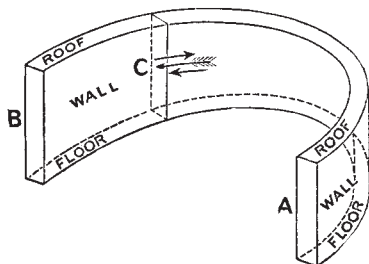


FIG. 2.

is the fixed end and B the free end, and in which we shall distinguish, as indicated, the walls, roof, and floor.

If the annulus of tube were complete, as shown in the central cross-section (Fig. 3), then it is evident that under the influence of internal fluid pressure the outer wall would be everywhere in a state of tension in the direction of its length, and the inner wall in a state of compression. In the immediate neighbourhood of the ends A and B this state of compression or

extension will be somewhat modified, but at a sufficient distance from either the condition of the walls will be the same as if the annulus really were complete.

If T be the tension of the outer wall in the direction of its length, P the pressure of the inner, and R the resultant fluid pressure on any cross-section such as A or B (Fig. 2), then for the equilibrium of the half of the annulus lying on either side of the diameter AB (Fig. 3) we must have

$$T = P + R.$$

Consider now the equilibrium of any portion BC (Fig. 2) contained between the free end B and a cross-section C at some little distance from B, when the internal pressure is applied, and before uncurling takes place.

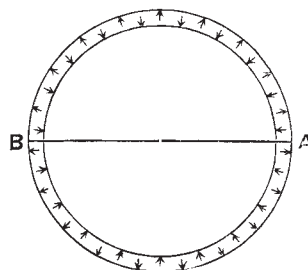


FIG. 3.

Imagine the fluid within BC to be solidified, then the external forces acting on BC (see Fig. 4) reduce to

- (1) A tension, T, due to the action of the outer wall beyond C.
- (2) A pressure, P, " " " " inner " " "
- (3) A resultant fluid pressure, R, acting at the centre of pressure of the cross-section c.

and since $P + R = T$, these reduce to a couple tending to uncurl the tube, and the same holds for all sections sufficiently removed from A and B.

As the tube uncurls, however, new forces come into play, viz. the resistance to bending of the walls, but especially of the floor and roof of the tube, whose width in the direction of a principal

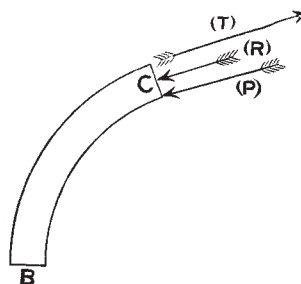


FIG. 4.

radius of the annulus, and consequently whose resistance to bending, is much greater than that of the walls. Uncurling goes on till the moment of the couple resisting flexure is equal to the moment of the bending couple.

It is evident from this explanation that even a tube of circular section would tend to uncurl, but that it would be very insensitive on account of its strength to resist flexure, and that up to a certain point sensitiveness is gained by having the walls of thin material, high, and very near together.

Devonport, December 23, 1889.

M. WORTHINGTON.

Foreign Substances attached to Crabs.

REFERRING to Mr. F. P. Pascoe's letter (NATURE, December 26, p. 176), I cannot refrain from expressing my astonishment at his inability to "see where protection comes in" in the case of crabs covered with sponges, Polyzoa, &c. I should have thought it obvious to everybody that slow-moving crabs, such as all those he mentions and many others that I have seen, would have a much better chance of escaping their enemies when