I IMAGINE that many experimentalists who have had to employ whirling apparatus running at a dangerously high speed must have come to the same conclusion as Dr. Lodge in finding the limit of safety. When designing the magnetic ring, which the late Dr. Guthrie and I used in investigating the conductivity of liquids, I arrived at the same result—namely, that each material when in the form of a ring has a limiting linear speed depending only on its tenacity and density. The same is true of a portion of a ring held by the ends moving about its centre of curvature, provided that it is so long that its stiffness is not a material factor. It did not, however, occur to me that an Atlantic cable of the same density as sea-water would fly to pieces; and I don't now clearly understand why this should be so, or, if so, why the ocean would in such a case hold together, having the same density as the cable.

Of course in the case of a disk, such as a grindstone, higher speeds are possible, because, to use Dr. Lodge's expression, the outer parts are radially sustained. The investigation of the subject will be found in the reprint of Clerk Maxwell's scientific papers, vol. i. p. 60, where the effect on polarized light of a transparent revolving cylinder is also considered.

C. V. BOYS.

IN his letter on p. 439, Dr. Lodge points out that the tension due to centrifugal forces in a rotating band is independent of the curvature; but the deductions which he draws from this are, I think, mistaken. He argues, in the first place, that a straight band of 30-ton steel moving with a velocity of 800 feet per second in the direction of its length is in a state of very unstable equilibrium, and that the slightest shiver of a "vibration running along it would precipitate a catastrophe."

To be sure, if the band is already stretched to its breaking-strain, the equilibrium is unstable *whether it be in motion or not.* But if the band be not so stretched, and it need not be, there is no instability whatever on account of the motion, and a vibration will travel along a bar of steel advancing with this or any other velocity precisely as if the bar were at rest, and without exciting among its particles any rebellion against the second law of motion.

Further on Dr. Lodge asserts that a cable of the same average density throughout its length as sea-water, and lying across the ocean parallel to the equator in latitude lower than 60°, could not hold together unless of 30-ton steel, and the suggestion to relieve the tension of a telegraph-cable by floating it is pronounced infeasible on account of the centrifugal forces. Surely Dr. Lodge has forgotten that the buoyancy of the sea-water is already itself modified by the centrifugal force, so that such a cable would be in perfect equilibrium. Moreover, and quite apart from this consideration, since the centrifugal force on a body even at the equator is only about $\frac{1}{300}$ of its weight, there remains $\frac{299}{300}$ of the weight which might be relieved by flotation in the manner suggested without encroaching on the remaining $\frac{1}{300}$, which would balance the centrifugal force, and thus free the cable from all tension.

A. M. WORTHINGTON.

Devonport, March 15.

ONE of Prof. Lodge's results would surprise all mathematicians were it correct: unfortunately this is not the case. A submarine cable would have *no* tendency to break if supported by floating matter in the manner described by Prof. Lodge. Every particle of the cable would be under the influence not only of "centrifugal force," but also of gravity, and the upward pressure of the water would just balance the difference of these opposed forces, hence there would be *no tension whatever* in the cable, and it would remain in neutral equilibrium, no matter what the latitude.

Prof. Lodge's other results are well-known to most students of dynamics. His general statement that "an Atlantic cable is only held together by its weight," is merely a particular case of the fact that all bodies, whether cables or otherwise, would fly off or burst away from the earth if gravity did not exist. Had Prof. Lodge realized this fact, he could hardly have made such an obvious mistake with regard to the behaviour of a *supported* cable.

G. H. BRYAN.

Peterhouse, Cambridge, March 14.

Modern Views of Electricity (Volta's Force).

I THINK that the difficulty which Mr. Burbury expresses on p. 439 (March 12), under the above heading, probably rests on a misapprehension. He says: "When zinc is isolated, a negative charge is on it, and therefore at an outside point there is a positive slope of potential upwards from the zinc." My statement, on the contrary, is that a piece of zinc immersed in an oxidizing medium possesses no charge so long as it is isolated, but experiences a lowering of potential by reason of the chemical tendencies of its surface-film—*i.e.* the contiguity of a number of negatively charged oxygenations. In this film, indeed, there is an electrical double-layer, consisting of equal opposite charges, the negative facing the zinc, the positive facing outwards; but there is no charge such as will produce the slightest effect at an external point. Contact with copper of course changes all this; displacing negative electricity from zinc to copper across the junction, from copper to zinc through the air. It is this displacement which affects all external points; and it is this which electroscopic experiments have displayed. There is nothing whatever to be detected in the neighbourhood of a piece of isolated zinc, unless its surface-film itself be explored. The range of its effect is sharply bounded by the thickness of its infinitesimal air-film, on which the whole of the molecular strain is thrown: much as is expressed by Mr. Chattock in the latter half of his letter on p. 367.

If Mr. Burbury does not object to contemplate a piece of isolated zinc surrounded on all sides by straining oxygen atoms, each negatively charged, he can have no difficulty in realizing its depression of potential; nor can he fail to appreciate the momentary transfer of electricity, accompanying the sudden approach of the crowd of oxygen atoms, which occurs as soon as a way of escape for negative electricity is opened by the sweeping away of some of them by copper.

OLIVER J. LODGE.

Ratio of Centimetre to Inch.

PROF. BOYS' letter on p. 439 (March 12), reminds me that I have never seen stated a very simple approximate relation between centimetres and inches, viz. 33 to 13, which is correct to one part in 1700.

OLIVER J. LODGE.

Potassium Salts in Sea-Water.

A CORRESPONDENT in NATURE of January 1 (p. 199), in asking why it is that the water of the ocean contains such a large proportion of sodium and so little, comparatively, of potassium salts, raises one of the most instructive inquiries in the whole range of mineral physiology. The waters which flow into the sea convey the soluble salts derived from the land, and these often include a considerable proportion of potassium. The sources of these salts are two-fold: (1) the sub-aërial decay of crystalline rocks, which give up their alkalies as carbonates; (2) saline solutions and solid salts which have come from evaporated seas or lake basins, and have thus been withheld or abstracted from the ocean's waters. In the latter case they are fossil sea-waters, as in many saline springs from the older sediments. These waters show that the proportion of potassium salts was then not greater but less than at present. Of the alkaline salts of the St. Lawrence River estimated as chlorides, the potassium equalled, by my analysis, 16 per cent., and the Ottawa 32 per cent., the remainder being, of course, sodium chloride. In the numerous saline and alkaline springs which rise from the Palæozoic strata throughout the great valley drained by these rivers the proportion of potassium chloride is seldom over 2 or 3 per cent. of the alkaline salts, and often less, while in the waters of the modern ocean it is found to be not far from 3 per cent.

There are, then, two questions before us: (1) Why do saline springs and ordinary potable spring-waters contain so small a proportion of potash salts? and (2) What prevents their accumulation in the waters of the ocean? The evaporation of sea-water in limited basins gives at first pure sodium chloride, and it is only in the mother-liquor that the potassium salts are found, and, as in the Stasfurth beds, are deposited above the rock-salt. The researches of various chemists have long since shown that surface waters, in filtering through the soil, give up potash, ammonia, silica, and phosphates, retaining, however, lime, magnesia, and soda—a beautiful provision by which the earth retains the elements necessary for the life of plants, while the filtered water thereby becomes purified and fit for ordinary uses. A process not unlike this goes on in the sea. It is well known to chemists that the ashes of sea-weeds abound in potassium salts, and contain, in most cases, from 15 to 25 per cent. of potassium oxide; so that kelp is valuable, not only as a