LETTERS TO THE EDITOR.

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Fresnel's Theory of Double Refraction.

THERE is a point in connection with the ordinary expositions of Fresnel's theory of double refraction to which, on account of its frequent occurrence, it is perhaps worth while to direct attention. It is found in Aldis's "Tract on Double Refraction," p. 7, in Preston's "Theory of Light," third edition, p. 328, and in Basset's "Treatise on Physical Optics," p. 115.

Having shown that when a molecule receives a displacement ρ, the other molecules of the system remaining fixed, the restoring force along the line of displacement is $F=\rho/r^2$, where r is the parallel radius-vector of a certain quadric, Preston, for instance, proceeds as follows:—"Hence, if we consider only the component F as effective, the equation of motion of the particle will be

$$d^2\rho/dt^2 = -\rho/r^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (10),$$

and the time of vibration will consequently be given by the equation

$$T = 2\pi r \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11).$$

But the velocity of propagation is connected with the wave-length and the periodic time, by the equation $\lambda = vT$, therefore

$$v = \lambda/2\pi r \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12).$$"

Now if equation (10) refer to the motion of a particle when the others remain fixed, there is no question of a wave at all, and the deduction of a propagational speed is without meaning; if, on the other hand, we are to regard (10) as giving the motion of a particle in the front of a luminous wave, then equation (11) expresses the bizarre result that the frequency, that is the colour, of the light is dependent upon the direction of vibration.

Fresnel's method was quite different; having determined the value of the restoring force on the supposition of absolute displacements, he employed it for the case of relative displacements, and regarding the component parallel to the wave as alone effective, he *assumed*, on the analogy of the transversal vibrations of a stretched string, that the propagational speed is proportional to the square root of the effective force. Hence, taking the azis of z in the direction of propagation, and making a suitable choice of the unit of mass, we should have in place of (10)

$$\partial^2\rho/\partial t^2 = 1/r^2 \; \partial^2\rho/\partial z^2,$$

giving in place of (12) $v = 1/r$.

One other point may be mentioned. Preston and Basset, quoting from Verdet, state that one of the hypotheses on which Fresnel founded his theory is that the vibrations of polarised light are at right-angles to the plane of polarisation. This is not strictly correct. There is no doubt that this assumption played its part among the ideas that led Fresnel to formulate his theory: in the theory, however, as finally presented, it does not appear as a fundamental hypothesis; it follows, in fact, as a direct *consequence*. On the other hand, the postulate that the ether is incompressible should be included among the hypotheses of Fresnel; indeed, if this be not assumed, the effective component of the force of restitution would have, as Sir G. Stokes has pointed out ("Math. and Phys. Papers," iv., 158), a value quite different from that given by Fresnel. JAMES WALKER.

Oxford, January 19.

On an Alleged New Monkey from the Cameroons.

I MUCH regret that in describing, in NATURE for October 26 last, the monkey on which I bestowed the name *Cercopithecus crossi*, I overlooked the description of *C. preussi* by Matschie. Dr. Lönnberg, of Stockholm, was kind enough to write me early in November to say that he had "a strong suspicion that your guenon may prove identical with *C. preussi*," described in *Sitz. Ber. Naturforsch. Freunde Berlin* in 1898. Only last week, however, was I able to consult this volume, and there is no doubt that, as Mr. Pocock has now also pointed out, Matschie's name has priority over *C. crossi*. HENRY O. FORBES.

The Museums, Liverpool, January 27.

FORESTS AND RIVERS.

AT the recent meeting of the International Navigation Congress at Milan, one of the questions taken into consideration was "the influence which the destruction of forests and desiccation of marshes has upon the *régime* and discharge of rivers," and seven papers bearing on the subject were read and discussed. Of these, three were from Austria, and the others from Germany, France, and Russia. The problem as to the effect of forests on the water supply of rivers and on climate is of great social importance on account of the agricultural and commercial interests which are so closely connected with the use of timber, and with the utilisation of running water.

It is allowed by all the authors of these papers that, due to the improvident way in which the forests have been dealt with, there has been a marked change in the water supply of the neighbouring rivers; that where forests have been cut down brooks have disappeared, and many small rivers that at one time were useful as sources of power are so no longer for want of water; that in the larger rivers torrents have become more impetuous, and flooding more frequent; while, on the other hand, navigation suffers at times for want of water.

The greatest harm has been done in the mountain districts, where the steep slopes allow the rain-water to run off too rapidly, carrying away the surface soil and transporting pebbles and boulders into the rivers, causing shoals, and thus decreasing their capacity to discharge the flood water.

The extent to which forests, both on the Continent and in America, are being cut down and destroyed, and large areas of land, which at one time were covered with primæval forest, have become barren waste by fire or the lumberman's axe without any attempt at re-afforestation, was one of the subjects dealt with in the presidential address of Mr. J. C. Hawkshaw at the Institution of Civil Engineers in 1902. Mr. Hawkshaw pointed out that, notwithstanding the displacement of wood in building structures by iron, yet large quantities of timber are still required, not only for building purposes, but for temporary structures, such as coffer dams and scaffolding; pit props for mining; sleepers required for the railways, which, in this country, he estimated at an annual value of 18 million pounds, and those required for renewals at three-quarters of a million pounds; while for the railway service of the United States there are required 15 millions of acres of forest land to maintain a supply of sleepers.

The question for consideration at the Congress was whether the wholesale destruction of forest land for cultivation or for timber supply is having any material effect on the rainfall and consequent water supply; and the effect of forest destruction on the rivers of the country from which the trees are removed was also considered.

The physical conditions of forest land are that, owing to the shelter from sun and wind, the atmosphere is generally colder and damper than in the open country, and evaporation consequently less. It is calculated that a hectare of forest land ($2\frac{1}{2}$ acres) gives off every day 37 cubic metres of oxygen and 37 metres of carbonic acid, leading to a great expenditure of heat; and that from every hectare of forest land sufficient heat is abstracted to melt 316 cubic metres of ice. Ligneous plants also withdraw from the ground and discharge as vapour more than 40,000 gallons of water per hectare per day, which causes a sensible reduction of temperature. When clouds pass over a forest they encounter a cool, damp atmosphere, the point of saturation comes closer, and