

gether as a not very pertinent or useful one. Nevertheless, it is plain that a cable fixed at two distant points and hanging free between them is liable to break, whether it be hanging downwards or floated upwards, *i.e.* whether it be supported too little or too much; and it further appears that if it be stretched to the curvature of the earth the slight difference between its true and apparent weights, *i.e.* its centrifugal force alone, is sufficient to break it.

But now returning to the main proposition, that the critical velocity at which a whirling ring breaks is the square root of the ratio of its tenacity to its density, no one calls it in question; some, indeed, say it is well known. That it was known, or at least so easily knowable as to be practically known, to applied mathematicians, is manifest; but that it is well known to practical men I have some reason for doubting. However that is of no consequence. What I write to point out is how singularly nearly the result for a ring agrees with the result for a disk of the same size.

For, as Prof. Ewing's letter shows, the critical peripheral speed of a uniform disk with a very small hole in the centre, when it is on the point of flying, is

$$\sqrt{\left(\frac{4T}{(3+\mu)\rho}\right)},$$

whereas for a ring it is the same expression without the $4/3$.

Thus, then, a perforated disk of uniform thickness, although its greatest stress occurs round its central aperture, yet can stand only 11 per cent. greater angular spin than a ring of the same material fitting its circumference and devoid of all radial support.

A disk without a hole can, as Prof. Ewing says, stand 40 per cent. more rotations per minute than a perforated disk can stand (*i.e.* $\sqrt{2}$ times the speed), even though its perforation is a mere needle-prick or indeed is absolutely infinitesimal, so long as it destroys radial coherence across the centre.

I learn also from Prof. Ewing that Mr. Chree has obtained results for an oblate spheroid, which, reduced to an approximate disk, show that the stresses and strains at any point of the ellipsoid are $\frac{8}{11+\mu}$ ths of what they are at the corresponding point of an unperforated disk of the same size but of uniform thickness (μ being Poisson's ratio).

I am obliged to Mr. Boys for calling attention to Maxwell's early memoir on the subject ("Scientific Papers," vol. i. p. 61), with which I was not acquainted. Since Maxwell uses an unusual notation, it may be convenient to note that his μ is volume-elasticity, his m is twice rigidity, and $E = \text{Young's modulus}$; so that his E/m is merely $1 + \text{Poisson's ratio}$. There are, however, a few misprints with regard to signs.

Prof. Worthington's remarks refer to a straight bar with free ends, not to an endless band. It is true, however, that there was no need to drag in vibrations; the dangerous tension will be set up in a straight portion of any endless band, running in the direction of its length with the critical speed $\sqrt{\left(\frac{T}{\rho}\right)}$, by the agency of the curved portions, which necessarily exist somewhere.

It may save some confusion to mention that the suffixes of Prof. Ewing's radial and tangential tensions have become interchanged in the first column of his letter on p. 462 (March 19).

The observations of Prof. Greenhill are best dealt with under a separate heading.

OLIVER J. LODGE.

March 21.

Formation of Language.

PERMIT me to reply to your correspondent Mr. W. J. Stillman, on the "Formation of Language" (NATURE, March 26, p. 491). The interesting fact he records of the spontaneous invention and use of child-names for objects is not unknown to philologists. The phenomenon has been previously noticed, among others, by Miss Watson, of Boston, and Dr. E. R. Hun, of Albany, U.S.A.; by Archdeacon Farrar, in the case of Indian children left by themselves for days together in Canadian villages; and by M. Taine, in his work "De l'Intelligence." Numerous examples of children's language are given by Dr. Horatio Hale (philologist to the U.S. Wilkes Exploring Expedition), who has made a special study of the spontaneous develop-

ment of roots among children the basis of his remarkable theory of the origin of linguistic stocks. Full details will be found in a paper on the "Development of Language," read before the Canadian Institute of Toronto, April 1888, and in an address on the "Origin of Languages and the Antiquity of Speaking Man," in the Proceedings of the American Association for the Advancement of Science, Buffalo, 1886, vol. xxxv. The occurrence has been often noticed in the families of philologists—the most noteworthy instance being that of the young nephew of the well-known Sinologist Dr. George von Gabelntz. This boy, before he learned his mother-tongue, called things by names of his own invention. The constant elements were the consonants, the vowels being varied, and employed as they were deeper or higher to denote greatness or smallness. The root for round objects was *m-m*; a watch, plate, and the moon was *mem*, a large round dish or table, *mum*, and the stars *min min min*; an ordinary chair was *lakail*, a great arm-chair *lukull*, and a little doll's chair *likill*. A distinguished Accadian, Chinese, and Semitic scholar, the Rev. C. J. Ball, makes no secret of the fact that, between the ages of six and eight, he and his young brother had names of their own devising—perfectly arbitrary monosyllables and disyllables for several of the small tools and toys they valued most. Mary Howitt relates in her autobiography (edited by her daughters) that the silent sadness of the Quaker home circle extended to the nursemaids, and that in consequence of this the eldest child, her sister Anna, did not learn to talk until she was four years old. Long after they could talk, "being left chiefly to converse together, our ignorance of the true appellations for many ordinary sentiments and actions compelled us to coin and use words of our own invention. To sneeze was to us both *okis-kow*, the sound which one of our parents must have made in sneezing." Here we get a true *onomatopœia*, as in the monosyllable *mea*, employed by one American child for "cat"; in another child's vocabulary the extraordinary trisyllable *shindikik* designated that animal. The association of ideas and extension of meaning are often very suggestive—viz. *migno migno* = water, wash, bath; *waia waia* = black, darkness, Negro. As in the case of the name for water, *humb-boo*, cited by Mr. Stillman, the vocables are often of two syllables, rarely of three. It is interesting to note the continued use of the little boy's own name for water as a means of identifying the acquired Italian *acqua* for the same object, as frequently happens with adults struggling to express themselves in a foreign tongue. Reduplication seems also to characterize these "child languages" like those of some savage tribes, and plurals are formed by repetition. The syntax, Dr. Hale remarks, resembles that of deaf-mutes and gesture language. If left to themselves there seems no reason why children with this aptitude should not develop a vocabulary at least as extensive as that of Dr. Farrar's three peasants, "who conversed for a long while without employing more than one hundred words." Many cases of "child language," no doubt, have passed away unrecorded. Soon after the children mix much with adults, the special vocabulary begins to die out. It is possible that the use of such spontaneously developed root-words might be prolonged among the children of the poorer classes, so often cared for by children but little older than themselves. The *crèches* of our large towns might afford further evidence of abnormal developments of this apparently inherent inventive linguistic faculty.

Brighton, April 2.

AGNES CRANE.

MR. W. J. STILLMAN winds up his interesting letter on the above subject by inquiring whether any of the readers of NATURE have made observations analogous to his own on the development of language in children.

I have on several occasions requested parents to note down the sounds emitted by their children from their birth to the time when those sounds seemed to become developed into articulate words with a certain amount of intelligent meaning, but I have not obtained any satisfactory results. The subject has, however, been studied, and described with considerable detail, by that well-known member of the French Academy, M. H. Taine, in his work, "De l'Intelligence" (2 vols., 3rd edition, Paris, 1878). I would particularly refer to chap. ii., sec. 5, and also to that part of a long note at the end of vol. i., entitled "Acquisition du Langage par les Enfants" (pp. 356-383).

C. TOMLINSON.

Highgate, N., March 31.