tance of the Zodiacal circle; now it is certainly true that a much smaller weight will suffice to produce equilibrium. Suppose, for instance, that the Zodiacal circle has a radius equal to the distance of the moon, or sixty times the earth's radius; then $22,400 \div 3600$, say, 6 lb., suspended near the earth's surface at the end of the string, some 240,000 miles long, will suffice to balance 100 tons in the other scale pan, close up to the Zodiacal circle. But if the 100 tons is also lowered down by another mathematical string to the surface of the earth, then 100 tons is required to equilibrate it; and so it will for any intermediate position, when the lengths of the strings are equal; so that it does not tend to any clear or useful end to say that the weight of 100 tons at the distance of the moon is only about 6 lb. On the contrary, the weight of 100 tons is everywhere 100 tons.

The *wright* of a body is the *that which* is measured in lb., tons, kilogrammes, or other standards of weight; and these standards are certain lumps of metal licensed by Acts of Parliament, and carefully preserved against change or degradation.

The weight of the Earth, for instance, as determined by the Cavendish experiment, is about 6×10^{21} tons; and it is not necessary to dig up the Earth and to weigh the fragments at the surface of the Earth for the determination of this weight.

It is too late now to change the meaning of a word that has been in immemorial use in all languages; such a quasi-Gothic revival would have to restore all literature, as, for instance, the lines of Quod (Art. Am. 3, 319):—

"Quæ nunc non neni habent operosi signa Myronis
Pondus iners quondam duraque massa fuit."

A. G. GREENHILL.

The Niagara River as a Geologic Chronometer.

WHEN we quote an author whose views coincide with our own, we are apt to speak of him as an authority on the subject; but when we dissent from the views we quote, we are not so apt to recognise the high authority of that author. This reflection on a phase of mental bias is suggested by a personal experience with reference to the age of Niagara Falls. The geologists and others who have discussed the length of post-glacial time may be rudely classed as minimists, maximists, and agnostics. Within the past five years I have been frequently and approvingly quoted by the minimists as estimating the portion of time consumed by the Niagara River in cutting its gorge at 7000 years, and the reputation thus acquired has not been noted without personal appreciation. But self-complaisance in that regard has been somewhat impaired by the thought that the honour is ill-founded, and that the insecurity of its foundation would sooner or later be discovered. Not less disturbing was the fear that when the maximists or agnostics took their turn at writing, I should be classed with the goats instead of the sheep. There can be no doubt that the manly and in every way proper course would have been followed had I years ago disclaimed the glory accidentally thrust upon me; but it is easy to bask in the sunshine of even unmerited applause, and conscience was too weak to determine action until another motive was added by a blow from the agnostic side. In his recent book Dr. James Geikie, after quoting me as an authority for the 7000-year estimate, adds that "all such estimates are in the nature of things unreliable." I now hasten to declare that I never said or thought that the period in question was about 7000 years. What I did incautiously say was, in effect, that the time allowance for the cutting of the gorge would be about 7000 years if the rate of the cutting were uniform, but that there was good reason to believe the rate had not been even approximately uniform.

Dropping personalities, which lack interest for your readers unless they involve principles, I beg to say a few words on the actual value of Niagara Falls as a chronometer. In 1844 James Hall made a map of the brink of the Falls, and established bench marks to which changes could be referred. Within a few years several other surveys had been made and connected with the first bench marks. It has thus become known, first, that in the middle of the Horseshoe Fall, where the principal body of water descends, the brink retrogrades at the rate of four or five feet per annum; second, that the American Fall, carrying a much thinner sheet of water, retrogrades so slowly that its rate is concealed by errors of survey. The gorge, which has been cut since the ice sheet retreated from the region, is six miles long, and the division of this distance by the annual rate determined for the Horseshoe Fall yields a period agreeable to the

minimists. Had the conditions remained uniform, no fault could be found with this estimate, but there is reason to believe that the conditions have varied enormously in nearly every particular. The thickness of the resistant bed at the crest of the Falls is far from uniform, and it was altogether wanting for part of the distance. During the period of gorge-cutting, the height of Lake Ontario, which gives base-level to the river, has varied through a range of several hundred feet. The volume of the river has doubtless varied somewhat through climate, but it has probably varied enormously by reason of changes in drainage systems, resulting chiefly from differential uplift. The Niagara now carries surplus water from the basins of Lakes Erie, Huron, Michigan, and Superior. There was probably a post-glacial epoch during which three of these lakes discharged their water in other directions, and only the basin of Lake Erie fed the Niagara River. During that epoch the volume of the river was so small that canyon-cutting was effected only by the feeble process now illustrated by the American Fall, instead of the vigorous process illustrated by the Horseshoe Fall. These considerations, which the inquiring reader may find more fully set forth in the annual report of the Smithsonian Institution for 1890, tend strongly to sustain the agnostic view of the Niagara River as a geologic chronometer.

G. K. GILBERT.

Washington, April 30.

The Teeth and Civilisation.

ON the 8th inst., Dr. Wilberforce Smith read a short communication before the Anthropological Institute on the teeth of ten Sioux Indians attached to the Wild West Show. His investigation showed that in regard to molars and premolars (the only teeth examined), these Indians were wholly free from caries. In the discussion which followed the reading of the paper, it was mentioned that the same fact was revealed in the skulls of the Fourth Egyptian Dynasty brought to England by Dr. Flinders Petrie, and in some skulls examined by Dr. Wilberforce Smith himself, which were derived from the ruins of Pompeii. The teeth of the Indians, both old and young, and those in the skulls just referred to, all showed more or less wear of the cusps, which is a most unusual circumstance in the teeth of modern civilised people, and it was thought that some difference in the food, or its mode of preparation, would be required to account for the absence of signs of wear in our time.

Now, it has never been proved that the increasing prevalence of caries is due to weakness of the teeth owing to comparative disuse, but there is nevertheless great probability in the inference, especially as signs of wear and freedom from caries appear to occur together, and *vice versa*. There is, however, a further point in regard to the existing liability to the attacks of caries which I think can be best explained by a transference of nourishment to other parts governed by the same nerves. On inquiry of several dentists, I find that the teeth most subject to decay are the molars, and of these the upper molars are more often attacked than those in the lower jaw. The molars of the upper jaw are fed by a branch of the fifth nerve, and in modern life this nerve has, perhaps, more strain put upon it than any other in the body. We use our eyes, partly supplied by the ophthalmic branch of this nerve, not at intervals, but often closely throughout a long day. And it seems, therefore, that with so many increasing calls on this bundle of nerve fibres, the filaments sent to the teeth are, by an automatic economy of expenditure, robbed of the energy necessary to perform their functions properly. The teeth through lack of use may not excite the nerves to natural action, and thus from both sides there is a failure of function, and the teeth are consequently more and more unable to resist the attacks of caries. I am disposed to attach some importance to this explanation, as I find that those who have great calls on their nervous energy are more liable to caries than people of quieter habit and slower temperament. Dr. Wilberforce Smith mentioned the alarming increase of dental decay amongst hospital nurses, whose occupation is certainly one demanding a constant drain on their nervous energy. It was also noted that people in towns lose their teeth more rapidly than those living in the country, which also bears out the idea here suggested. On the other hand, the savage is seldom required to strain his facial nerves continuously for any length of time, and in reference to general nervous expenditure he enjoys long periods of rest which are wholly denied to the civilised man in towns. No doubt in consequence of the excessive calls on our nervous energy the distribution of it is

undergoing modification in civilised man, and parts not used to any extent are being deprived of the supply necessary to healthy growth. It is much to be feared that the teeth, though so essential to the welfare of the body, are in this predicament. But we are sadly in need of more definite information than is at present available, and it is partly in the hope that some of the readers of NATURE, who have opportunities which I do not possess, may be induced to test this and other ideas relative to the increase of caries, that I have written on the subject. The whole question is at present much obscured by misconceptions due to ignorance. One fact, however, emerged only too clearly from Dr. Wilberforce Smith's investigation, namely, that while the grinding teeth of civilised men of middle age are either missing or practically useless for their purpose, the ancients enjoyed a perfect set of teeth till advanced years, and modern savages enjoy the same blessing.

Clapham, May 10.

ARTHUR EBBELS.

Johannes Müller and Amphioxus.

THE story of Müller's Neapolitan visit in search of Amphioxus, as copied in NATURE (May 3, p. 14) from the *Lancet*, belongs to the category of those that are *ben trovato* or the reverse. To anyone acquainted with the works of this brilliant morphological genius the tale bears internal evidence of entire lack of foundation.

Müller's chief memoir on Amphioxus appeared in the *Abhandlungen der Berliner Akademie* 1842. If Prof. Todaro had ever read the original, or an earlier note in the *Berichte* 1839, he would scarcely have related the story. Müller's work begins with an historical summary of previous researches on the animal, and in particular he relates (*Berichte* 1839, p. 199) that the first specimens he examined were obtained from Prof. Retzius. Moreover, Gosta's description, mentioned by Prof. Todaro as being the immediate cause of Müller's expeditious trip to Naples, appeared in 1839, and in the same year Müller published observations on the two specimens given him by Retzius. At this period he was in ignorance of its occurrence at Naples, for (p. 200) he says it has been found "on the English, Norwegian, and Swedish coasts." His chief work—the one before mentioned—was carried out on *living* specimens got by Müller himself near Gothenburg, on the Swedish coast, and, as is well known, and also expressly stated by himself, he worked at the microscope for twelve days in order to complete his task on the spot. The evidence goes to show that Müller obtained no Amphioxus—not even the one he is credited with!—from Naples until his work was completed; and (p. 81, foot-note) he remarks: "In Naples the capture of the animal is very easy close inshore, for it lives in great numbers in the sandy ground of Posilipo. In 1842 I brought back from Naples over 1000 specimens in spirit."

If the journey referred to ever took place, there is no record of the one specimen in any of his works, and Müller, who could sacrifice a very rare *Pentacrinus* to the scalpel, was not the man to spare an Amphioxus. It must indeed have been a "miraculous drught" that yielded only one specimen of Amphioxus off Posilipo.

However "interesting" and amusing the story may be to those who have a preference for fiction, it is to be regretted that, with no basis of fact to support it, a zoologist should have told it of one whom zoology will always rank as a chieftain amongst her greatest sons. To many of us, who regard Müller with something akin to reverence, the fable is less interesting than painful.

J. B.

The Scandinavian Ice-Sheet.

IN reply to the letter of Prof. T. G. Bonney (NATURE, vol. xlix. p. 338), which I by chance have read to-day, concerning the difficulty of explaining how the Scandinavian land-ice could have crossed the deep channel of Skagerak and Kattegat, and have reached the East Anglian coasts, I should like to remark that this difficulty is not new to me, and will exist after it has been explained how the ice-stream from Norway could have crossed the named channel and extended over Denmark and North-western Germany. It is, however, an undisputed fact that certain Norwegian boulders are very common in the most northern parts of Lyland, and from there dispersed over the whole Lyland (though their rarity increases with distance

from Norway), the northern parts of Fyn and Sjælland, over Slesvig and Holstein and North-western Germany from Fehmarn towards the west, further over Datchland and Belgium to several localities at the English east coast, under such conditions that they could not have been transported by floating ice. It is consequently a fact that the ice-stream from Norway has crossed the named channel. I think, therefore, that the best explanation is that the Skagerak channel in its present condition was at first formed after or during the period of largest glaciation, to which the Norwegian ice-stream belongs, but before the Baltic ice-streams, both of which, I suppose, are posterior to the greatest extension of the land-ice. The chief reason for the formation of these ice-streams is the existence of the above-named channel, which has prevented the ice-stream from Norway from extending over Denmark for the second time.

Copenhagen, May 2.

VICTOR MADSEN.

The Earliest Mention of Dictyophora.

TWAN CHING-SHIH's "Miscellanies," compiled in the ninth century A.D. (Japanese edition, 1637, book xix. n. 7), has the following note:—"In the 10th year of the period (Tá-Tung (544 A.D.)) a fungus grew in Yen-hiáng Gardens owned by the Emperor Kiên-Wan. It was eight inches long with a black head resembling the fruit (that is, the *Totus*) of *Euryale ferox*; stem hollowed through inside like the root of *Nelumbium speciosum*; skin all white except below the root, where it was slightly red. Portion like the fruit of *Euryale* had below a joint like that of the bamboos, and was removable; from the joint a sheet was developed, simulating a network, five or six inches in circumference, surrounding the stem in the manner of a bell, but distant and separate from it. The network was fine and lovely, and also removable from the stem. It is allied to Wei-hi-chi (the Auspicious Fungus of Graveness and Pleasure) of the Taoist writings." This description seems to have been passed over by readers as a mere fiction, but I find that it agrees very well with the figure of a Dictyophora, and may probably be the earliest mention of it. A Japanese botanist, Kōzō Sakamoto, has figured the two forms of Dictyophora in his "Monograph of Fungi" (1834, vol. ii. p. 15), but has not referred to the above-cited description.

KUMAGUSU MINAKATA.

May 4.

The Scope of Psycho-physiology.

I HAVE no wish to enter into a triangular duel with Dr. Titchener and "the writer of the note" who has provoked his fire. But since my name has been introduced, a word or two of explanation seems necessary.

Some time before Dr. Titchener discharged his first barrel, I was requested by the editor of this journal to contribute a popular article on "the scope of psycho-physiology." In complying with his request, I accepted (1) the conditions implied by the word popular, which no doubt laid me open to the criticism that my "whole treatment" was "a little general and superficial"; and (2) the title suggested to me, since I regarded it as comprehensive and not specially provocative of terminological controversy.

C. LLOYD MORGAN.

Bristol, May 10.

The Aurora of February 22.

THE splendid aurora of February 22-23 began on the Pacific coast of North America on the former date, extending unusually far south in California, New Mexico, and Arizona, but did not become conspicuous on the eastern half of the continent until the day following. The earth currents affecting the telegraph lines were troublesome west of Chicago exclusively on February 22 also, not being felt east of that point until the day following. This localisation of the aurora in longitude has been noted in numerous other instances as well. An arrangement has been made to secure records of the geographical distribution of earth current disturbances on the lines of the Western Union Telegraph Company, which extend very widely over the North American continent. From what appears in the case above described, such records are likely to prove to be of very great interest.

April 30.

M. A. VEEDER.