Many striking individual peculiarities were noticed in the course of the experiments, which these general averages fail to show. Three of the male observers were able to detect one part of prussic acid in about 2,000,000 parts of water. Two of these were persons engaged in occupations favouring the cultivation of this sense. Careful chemical tests failed to show the presence of prussic acid in several of the more dilute solutions, in which it could be detected by the sense of smell. We found some of both sexes who absolutely could not detect prussic acid even in solutions of almost overpowering strength. There were several instances of the same peculiarity as regards bromine. Again, our averages show that the sense of smell is in general much more delicate in the case of male than of female observers.

EDWARD L. NICHOLS
E. H. S. BAILEY

University of Kansas, November 4

Tidal Friction and the Evolution of a Satellite

ADVERTING to the correspondence in NATURE (vol. xxxiv. p. 286), I think that Mr. Darwin has not, so far, fully realised the results that would follow from the circumstance that the Martian satellite's period would be affected many hundred times more than that of the planet's rotation, as explained in the correspondence referred to. He argues that, the moon's mass being great, she should recede to an enormous distance before there will be a reversal of the direction of her tides on the earth; while the satellite of Mars, being very small, need only to recede a short distance before a similar tidal reversal ensues. No mention being made of any other supposed difference in the systems at the starting-point, it must be inferred that other things are supposed about equal. But, as a matter of fact, the present position of the Martian satellite is incompatible with an initial rotation of its planet anything like so great as that ascribed to the earth at a like stage. If Mars be supposed to rotate ten times while the satellite, at its present distance, makes nine revolutions, the satellite's period would still be affected or lengthened much more than would that of the planet's rotation. The difference between the periods of revolution of the planet and satellite would increase quickly at first, but more slowly as the satellite receded a certain distance, till at a certain time there would be no increase, after which there would be a decrease, and finally a reversal. When the satellite would have receded to a short distance, where she would revolve in the same period as Mars now rotates in, the planet would have lost but little of its original rapid rotation. Now, supposing the satellite tide to go round in the same time as the solar one, the period of the satellite would be affected about thirty times as much as that of the planet's rotation. Allowance being made for the comparative slowness of the satellite's tides, the satellite's period would still be changed more than ten times as much as that of the planet. It would be only when the little body got further out, and the planet's rotation slower than it now is, that there could be a reversal of the direction of the satellite's tides. Wherever started, the satellite must either go directly into the planet, or go out a short distance and back into the planet, before the rotation-period can have been much changed by solar tides; or else the satellite must go far out—as when it gets a fair start—and could not possibly turn back until the rotation of Mars be slower than now. Hence it seems that under no conditions could the rotation of Mars, at the birth of her moon, have been twice as rapid as now, and the evidence is very strong that the rotation-period could not have been changed more than a very few hours, if so much. Then, if the rotation of Mars was so slow in the beginning, and so little changed during the whole existence of the satellite, the circumstance does not support the view that the earth's rotation was very rapid in the beginning and so much changed during her past history, but rather inclines the other way.

Respecting the statement that two heavenly bodies cannot revolve about their centre of inertia as parts of a rigid body with their surfaces nearly in contact, unless one be smaller and denser than the other by a certain amount, I can only say, at the present time, that such was the conclusion at which I arrived when investigating the results of the tidal effects of two bodies on one another at close quarters. Without going far into the question, it can be seen that if the rule holds when the two bodies are of the same size and density, it will hold throughout. There will be no difficulty in seeing that the rule holds so far that when the difference in size between the bodies is as great as between any of the satellites and its primary, the small body must be invariably the denser. Now the argument that was supposed to apply in general would at least apply in the case of the solar system. That argument, as explained in my pamphlet, was that, if a rapidly-rotating body were to separate into two, the small body given off must be denser than the other to withstand the tidal disturbance, and that it would be impossible for the small body to be denser than the primary, since the secondary body must be formed from the surface and therefore lightest part of the other body.

JAMES NOLAN

Dergholm, Victoria, October 5

Seismometry in Japan

I HAVE read, with no small surprise, a paragraph in NATURE of November 11 (p. 36), giving a summary of a letter from Prof. John Milne, with reference to an article by me on the seismographs now manufactured by the Cambridge Scientific Instrument Company. Prof. Milne is represented as saying that, "with the exception of one or two which have been modified, a set of instruments like those recommended by Prof. Ewing are, so far as Japan is concerned, quite obsolete." His letter is not published, and it is possible that the paragraph inadvertently does him an injustice in making him assert what has absolutely no foundation in fact.

In any case the statement cannot be allowed to pass without contradiction. My seismographs have been in regular use at the University of Tokio since they were invented; they are now used for systematic observations by the Japanese Meteorological Bureau; they were sent last year by the Japanese Government to the Inventions Exhibition in London, where they were awarded the highest diploma among Government exhibits: one of them, the comparatively cheap and simple duplex pendulum seismograph, is employed by many private observers in Japan. In a letter received only a few weeks ago, my friend and former assistant, Mr. Sekiya, now Professor of Seismology in the University, says:—

"We are going to start a journal called the *Journal of the Science College of the Imperial University, Japan.* In the first number I will give a paper on 'Comparison of Earthquake Diagrams simultaneously obtained at the same station by two instruments involving the same principle, and thereby proving the trustworthiness of these instruments.' Of course I treat those diagrams recently obtained by two of your seismographs."

Other letters from Prof. Sekiya are full of accounts of the excellent work he is doing with these instruments, and of their continued and extended usefulness in his very able hands. A paper lately received from him describes a rough but effective form of the duplex pendulum, cheaply made in order to bring it within the reach of private observers, and with reference to this the *Japan Mail* of February 2, 1886, says:—

"The duplex pendulum seismograph designed by Prof. J. A. Ewing, has been employed for earthquake observations in the Tokio Daigaku by Mr. S. K. Sekiya, who has improved many of its details during his long use of the instrument. On account of the simplicity and scientific nature of its construction, and its easy management, it has found its way into the hands of many observers."

The *Mail* goes on to mention the name of a native firm by whom the instrument is made and sold. In March last Mr. Sekiya writes:—"The duplex pendulum sells well; some fifteen or twenty of them have been sold."

So much for the duplex pendulum seismograph, which is one of those described in my article, and now made with the utmost refinement of construction by the Cambridge Company. The other is a three-component instrument, of which the principal part is the horizontal pendulum seismograph—consisting of a pair of horizontal pendulums for recording separately two rectangular components of the horizontal motion of the ground on a moving surface driven by clockwork. This method of recording earthquakes was introduced by me in 1880 (*Trans. Seis. Soc. Jap.*, 1880; *Proc. Roy. Soc.*, No. 210), and has been in regular use ever since. The instruments made to my designs by native workmen are still doing good service in Prof. Sekiya's hands. Those now made by the Cambridge Company have the advantage of better workmanship and an improved arrangement of parts. As Prof. Sekiya has recently written to me with regard to the purchase of a set of them by the Japanese Government, it is probable that Mr. Milne will before long have