come on the stage at a comparatively late period in the world's activity, and that it would be well to inquire, before bounding with joy at his new possession, whether it may not be an old one in the world's stock of knowledge, or even valueless; but for the old boy, the incorrigible old boy, who is constantly popping up with his theory of comets, his theory of the gyroscope, or his very important measurements of the thickness of a mercury-drop, what can be done? His questions and talk may show evidences of an active mind, but of a mind working within a Chinese wall of self-sufficiency. He feels intensely indignant when told to examine the records, and compare his work with that of others. He is only working as every philosopher formerly worked, within himself; but at this age he is — a bore.

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The use of the method of rates in mathematical teaching.

IN *Science* for March 28, Professor Wood, referring to the method of rates, says, "There is the same difficulty in the fundamental conception as in the infinitesimal method;" and he represents a student as asking the questions, "'In a mathematically perfect engine, does the piston stop at the end of the stroke?' 'Does it remain at rest at any time?' 'How can it reverse its motion, if it does not stop?' 'How can it cease going in one direction, and move in the opposite direction, without stopping between the two motions?'" This difficulty, if it exists, must be met in the teaching of mechanics, and may therefore be discussed apart from the question whether it be advisable to found the differential calculus upon the conception of velocity. The form of the questions which Professor Wood puts into the mouth of the student somewhat puzzles me. I can but suppose that Professor Wood answers 'Yes' to the first question; but, in that case, how can the student ask the third or fourth question? The difficulty must lie in the answer to the second question, 'Does it remain at rest at any time?' It would not be safe to answer this question at all in this form, because it indicates a confusion of mind in the use of the word 'time.' 'At any time' might mean 'at any instant;' but the use of the word 'remain' shows that the student probably meant 'remain at rest *for* any time;' that is, for any interval of time. To the question thus amended, we can safely answer, 'No.' But having already admitted that the piston does stop at a certain instant, namely, 'the end of the stroke,' the student has no occasion to ask the third or fourth question. Of course, a student may be easily puzzled by the metaphysical subtleties and sophistries by which a certain school of philosophy persuaded itself that motion was impossible; but, left to himself, he has no more difficulty in appreciating the difference between an 'instant' and an 'interval' of time than he has in distinguishing between a point and a line in geometry.

Farther on in his letter, Professor Wood asks, 'Does change in the rate of motion take place *at* an instant, or *during* an instant?' It seems to me that if he will dispense with the colloquial use of the word 'instant' for a small interval of time, and substitute 'during an interval,' the so-called difficulty will disappear. Do his students ever ask whether the positive and negative parts of the axis of x are separated by a point, or by a space?

WM. WOOLSEY JOHNSON.

Annapolis, April 5.

Paleozoic high tides.

Your reviewer of the *Geographisches jahrbuch*, referred to by Professor Newberry in *Science* (No. 61, p. 402), was led, by the evidence given in brief below, to the conclusion that tides higher than those now observed, produced in the way explained by G. H. Darwin and illustrated by Ball, had occurred within paleozoic time. It was not, however, his intention to accept the gigantic tides described by Ball, but simply tides *significantly* stronger than those of the present time; for these seem not only warranted, but required, by the spread of paleozoic strata.

Soundings and dredgings, as summarized, for example, in the *Lithologie du fond des mers*, by Delesse, prove that the coarser land-derived sediments, such as form conglomerates and sandstones, are deposited within a moderate distance of their origin, excepting in narrow tide-ways, such as the English Channel, where they stretch out farther; elsewhere, pebbles especially fall within a very narrow fringe along shore. The paleozoic strata of the eastern United States give ample evidence of submarine transportation of land-derived sediments certainly three hundred miles from their source, of sands at least half this distance, and of clean sands with pebbles certainly a hundred miles; and this when measuring only from the present south-western margin of the Cambrian strata. In this regard, the Medina, Oriskany, and carboniferous sandstones and conglomerates, which overlie calcareous or shaly strata, from which their siliceous elements could not have been derived, give very much stronger evidence than that obtained from the Potsdam sandstone, which was formed during the advance of the sea over an old land-surface, whose local waste may have formed this basal deposit close along shore. I must consequently persist in believing that the spread of pebbles and sand over the old sea-floor during the above-named epochs implies a greater transporting-force than is now known in the modern oceans.

The Jurassic sandstones of the Colorado plateau were, according to Capt. Dutton, deposited with very little shaly admixture over an area of thirty-five thousand square miles. A liberal estimate of the Bay of Fundy gives it under four thousand square miles, and its deposits are rather muddy than sandy; that is, muds such as were washed out of the old Jurassic basin are allowed to accumulate in the Bay of Fundy. Whether the tides were much stronger in Jurassic time than now, is perhaps an open question; but that marine transportation was then stronger seems, at least from this example, very probable.

In looking for a cause of former greater activity in the ocean, we find it only in the possible variation of the tides and currents, unless recourse be had to the older cataclysmic theories. Increase in the velocity of currents needs stronger differences between polar and equatorial temperatures, or an advantageous con-