

Assuming the width of the seas and continents to be 3,900 miles, the rigidity of the earth to be  $3 \times 10^8$ , as above, and the range of the tides to be 80 centimetres, Mr. Darwin computes and gives tables of the slopes, real and apparent, of the land at various distances from the coast. Such deflections, he thinks, might actually be observed at points near the coast, and the measurements thus obtained might possibly serve as a basis for computing a more trustworthy value of the earth's rigidity than we now possess.

Under the conditions above assumed, the amplitude of vertical displacement between high and low tide is 11.37 centimetres on the land at the coast.

"As long as  $h \neq 1$ "—i.e., the semi-range of the tide multiplied by the width of a sea or continent—"remains constant, this vertical displacement remains the same; hence the high tides of ten or fifteen feet which are actually observed on the coasts of narrow seas must probably produce vertical oscillations of quite the same order as that computed." E. H. HALL.

### 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.]

#### Age of the rocks on the northern shore of Lake Superior.

PERMIT me, through the medium of your journal, to correct a mistake which Prof. N. H. Winchell has made (*Tenth ann. rep. surv. Minn.*, p. 125) in stating that I regard the trap and sandstone of Lake Superior as Huronian.

Up to the present time I was not in a position, never having examined them, to express any opinion about the Lake Superior formations referred to.

During the past summer I have somewhat closely examined these around the whole of the Canadian shores, from Prince Arthur's Landing to Sault St. Mary, including the shores of Thunder Bay, Black Bay, and Nipigon Bay and Straits. I spent two months in this examination, travelling from point to point in a small boat.

My opinion now, respecting the character and age, — within certain limits — of these rocks is very decided, and is as follows:—

They occupy the geological interval elsewhere filled by those divisions of the great lower paleozoic system which underlie the Trenton group. Various considerations point to the Potsdam and Primordial Silurian (Lower Cambrian) as their nearest equivalents. They are entirely unconformable to, and physically distinct from, the Huronian. They are divisible on the Canadian shores into two, perhaps three, groups, between which there may be slight unconformities. These, however, are quite likely only such as might result from the intermingling of ordinary sedimentary strata with irregular layers of erupted volcanic material, molten, muddy, and fragmentary; the whole being subsequently, and even during their accumulation, further disturbed by faulting, and the irruption of igneous dykes and masses.

To my mind, there can be no doubt as to the nature of the causes which have built up the vast masses of strata, which now, together with ordinary sedimentary layers, form the so-called upper copper-bearing rocks of Lake Superior. They are essentially volcanic, subaërial, and subaqueous formations, and in every sense analogous to the wide-spread tertiary volcanic rocks of Australia and other regions. The only differences are their greater antiquity, and the consequent greater changes and modifications they have undergone through the operation of long-con-

tinued metamorphic agencies, disturbance, and denudation; though these changes are far less than those which the rocks of the same age, and to some extent similar origin, have undergone in eastern America and in Britain; and in this they correspond with the higher fossiliferous groups in the respective regions.

The groups in ascending order are, —

1. Black shales, flinty and argillaceous, banded chert, with black dolomites and beds of fine-grained dark-gray sandstone with mica in the bedding planes; the whole interbedded with massive diabase or dolerite, often columnar, the columns vertical. — Pie Island, McKay's Mountain, Thunder Cape, etc.

2. Red conglomerates, red and white and green mottled shales, red and white sandstones and dolomites; no gray or black beds. At perhaps a hundred and fifty or two hundred feet from the base, these become interstratified with massive beds of volcanic material, amygdaloids, melaphyres, tuffs, etc., making many thousand feet of strata. — East shores of Black Bay, Nipigon Strait, St. Ignace and other islands, Michipicoton Island, Gargantua, Mamainse, etc.

3. The Sault St. Mary sandstones. These may be only the upper part of 2, without any intermingling of volcanic material. The exposures on the Canadian side are too fragmentary and isolated to decide this. In any case the St. Mary sandstones are not younger than Chazy (Cambro Silurian), but in the absence of fossils it is impossible to correlate the Lake Superior groups exactly with any one of the subdivisions of the New York or the Atlantic coast series. This, however, is no sufficient reason for inventing and adopting new and unknown names for them; and I prefer to call them all Lower Cambrian, which includes Potsdam and Primordial Silurian. There is, at present, no evidence whatever of their holding any other place in the geological series. Through overlapping and faulting, all three divisions are found locally in contact, both with Huronian and with Laurentian rocks. The dips are generally south-eastward, but vary greatly in amount, those of division 2 being often locally much higher than any observed either in divisions 1 or 3. A. R. C. SELWYN.

Geol. and nat.-hist. survey of Canada.

Ottawa, December, 1882.

#### Movement of the arms in walking.

Every man has observed that the tendency to swing the arms while walking is a most natural one. The action is rhythmical, the anterior and posterior extremities of opposite sides of the body moving in unison. It is also involuntary, being performed most readily when thought is not bestowed upon it. When voluntarily suspended, as in the American army, it gives an air of 'stiffness.'

In view of these facts, does it not seem that the statement of Prof. J. D. Dana (Cephalization; *Amer. Journ. sc.*, xli, 1866, p. 167), sanctioned by Dr. T. Gill (Classif. families of mammals, 1872, p. 50), — namely, that "Man stands alone among mammals in having the fore-limbs not only prehensile, but out of the inferior series, the posterior pair being the sole locomotive organs," — must be somewhat modified? Have we not at least a ghost of a pre-existing function? Does man walk by means of his feet and legs alone? FREDERICK W. TRUE.

U. S. national museum, Washington, D.C.,  
Nov. 18, 1882.

#### Cleaning birds.

When obliged to wash birds, collectors will find it an advantage to use salt and water instead of plain