

to be readily explainable as the deposits of floods produced at the final melting of these ice-sheets, which must supply both the water and the material, which had been gathered up into the ice.



The Geological and Natural History Survey and extensive plains of such modified drift (wherein drainage was obstructed, as in valley of the Red River of the North, upon Siberia, and wherever northward slopes occur in drift regions) are apparently due to such origin and mode of deposition. The stratified beds on flanks of mountains are also ex-

planable in this way, being fluvial deposits, from melting of vast sheets of ice (glaciers), - after subsequently partly excavated by streams, becoming thus terraced.

Minneapolis, Minn. - October 9, 1879.
Lately, we see the vast moraines of this land-ice, reaching from N. Saskatchewan river to Cape Cod and the Newfoundland fishing-banks. - I shall be glad to receive the results of your further study, which I believe permits you again to take up Post-Pliocene geology.

Dear Sir:
Very Respectfully Yours,
Warren Upham,
Washington, D.C.

Thanks for your letter and the pamphlets which you sent to my home, from whence they were forwarded to me here.

From the tenor of your letter, I am ^{sure} it will be better for each of us to give up expecting to convince the other. The progress of science upon the safe basis of an abundant accumulation of facts is promoted and insured by such honest differences in opinion, leading to much more careful and extensive observation and to more thorough study than would otherwise be made.

Beginning my study of the drift in New Hampshire four years ago, with no theory then adopted to prejudice me, I have since been constantly engaged in this department of geology, and think I may say that my present views have been reached by much patient study in the field, together with the books (Canadian and U. S. Geol. Reports, text-books, and magazines) relating to this subject. In several matters I have by increased knowledge found it requisite to modify and change my opinions, and expect to do the same, if I have continued opportunity for observation in this field, through many years to come. These changes in opinion have been as to particulars, and every year has added to my certainty of the theory of Agassiz, subject of course to modifications as to particulars till our knowledge of glacial geology ^{shall} have been extended to include all the northern and far southern regions of the globe. - The striae found upon all

Exposures of ledges in drift regions seem to admit no other explanation but that of land-ice, in a sheet of vast extent and depth. Scandinavia, Northern Asia, the Rocky mountains ^{in British America}, the Laurentian highlands and peninsula of Labrador, have been so thickly loaded with such land-ice, that it has been pressed outward over very uneven land surfaces, crossing the White mountains of N. H., which, though a mile high, were no sufficient barrier to stem this outflow. Over the Laurentian highlands and region about South part of Hudson Bay, it seems probable therefore that this ice-sheet was several miles thick, requiring perhaps half of 100,000 years for its accumulation. Ireland (its great central plain, though bordered by mountains), the Scotch highlands, the Swiss Alps, Greenland, ^{Patagonia,} and the Antarctic continent (now), have been similar regions thickly covered by land-ice, transporting and depositing glacial drift by its outflow. — The general stability of the continents is opposed to such general changes in the earth's form as the theory of submergence and floating ice supposes. The fresh-water Tertiary lakes of western U. S., and the Tertiary marine formations fringing Eastern U. S. (and similar observations in the Old World), show that the continents have been nearly stationary for immense ages. In the latest epoch before the present, I believe this stability of the earth's form was not much changed. The cold of the glacial period being due to astronomical causes, as pointed out by Bröller, we have in the vast ice-sheets then gathered in polar regions a sufficient explanation for all (at least nearly all) the vast and wide-spread changes in relative land and sea which attended that time. The ocean was much lowered by the removal of the water thus stored up in ice-sheets, which however were so potent as an extraordinary factor in gravitation that they caused the sea to rise above its present height in high latitudes, i.e. where great ice-sheets attracted it, as in N. W. Europe, on shores of British Columbia, in St. Lawrence valley, on coast of Greenland, and in less degree on coast of Labrador and as far S. as Boston; while farther south the sea-level was depressed, several hundred (3-400) ft. at mouths of Mississippi, Ganges and Po rivers, as shown by deep borings; while Prof. Dana, who has studied the Coral islands of the tropics, thinks they prove that in Post-Pliocene time the ocean was there 2000 feet, more or less, lower than its present level. — Sea-shells afford the only safe evidence of a previous increased height of the sea. There show for N. America only such submergence as would be due to gravitation towards the ice-sheets. The stratified gravel, sand and clay found at all heights to one mile (and more, where land reaches higher) in all glaciated regions, appear