

sionally of about 1,000 feet. The deposits, where fully developed, consist of Upper Boulder-clay, Middle Sand and Gravel and Lower Boulder-clay; together they sometimes attain a thickness of from 100 to about 130 feet. Certain peculiarities in the distribution of the deposits were described. The tripartite arrangement never occurs in the valleys in the mountainous district. Boulder-clays, indeed, sometimes occur here, but sands are more common. The distribution of the boulders from the more remarkable rocks was described; tables of these were given, as also of the maximum height above the sea at which each occurs. The origin of the deposits was next discussed. The author is of opinion that the presence in the Lower Boulder-clay of boulders derived from such widely different sources can only be explained by floating ice, but that the correspondence of the materials of the clay with rocks in the vicinity shows that glacier-mud produced the finer elements. The Middle Sand and Gravel he considers due to denudation of the above materials during a period of emergence. The Upper Boulder-clay he attributes to a second period of submergence corresponding generally in its conditions with the former one. The gravel mounds are probably caused by the stranding of bergs at the end of this period.

CORRESPONDENCE.

THE SUDDEN EXTINCTION OF THE MAMMOTH.

STR,—I was flattered by finding two communications in the last Number of your MAGAZINE devoted to the papers I have, by your favour, printed in that most catholic of geological publications. It is some proof, at all events, that the papers have attracted notice. With one of these communications, signed Ignoramus, I most completely agree. There is no pedantry more transparently foolish than that which dots its pages with quotations in a foreign tongue. In my case, the excuse is that I was writing as a heretic, upon a question in which a large proportion of English geologists are ranged on the other side, and therefore in quoting critical and important passages, to avoid all pretence that I was garbling or introducing my own personal equation into my authorities, I thought it better to give the exact words of the author. I will not transgress the same way again; but if I have occasion to quote, I will give the most faithful translation I can command. To Mr. Reid I must devote a larger space. First, let me thank him cordially for the terms in which he has spoken of my papers. It is a great point gained to have no quarrel about the facts, which are therefore at the disposal of all your readers. Nor is there any quarrel about the cardinal postulate upon which my view is based, and which is shared by Mr. Reid, if I understand his letter rightly, with the Russian geologists, namely, that the Mammoth lived and died where his remains are found.

Mr. Reid says the conclusions I have drawn are *quite* unwarranted by the facts. This is merely a strong phrase to use of conclusions

arrived at by such profound teachers of physical science as Cuvier and Buckland in the last generation, and d'Archiac in this. The phrase, however, may pass as meaning merely that Mr. Reid himself does not agree with these conclusions. He also speaks of the view which is opposed to the current Uniformitarian theory as an extinct theory. Surely again Mr. Reid limits his language to the scholars of Lyell in this country. He cannot have read what the great school of geologists in France and Belgium, where so much work has been devoted to Post-Glacial deposits, has written and is writing upon the question of Uniformity, or he would not use the term extinct theory to the view maintained by its opponents.

These phrases are, however, mere prejudice. We are not theologians discussing authority, but students of an inductive science in which the facts are the things to appeal to, and not the name of this or that writer—of this or that popular school of geology. If I have quoted others, it is only to show that what I have advanced has been held by bigger men than myself. Let us then to the facts. Those who hold Mr. Reid's view have to account for two things—the presence of Mammoth remains buried in elevated clay-hills throughout the length of Siberia; and, secondly, the preservation of the flesh of these Mammoths fresh and intact. In regard to the former difficulty, Mr. Reid suggests that the Mammoths were buried by sediment from the Siberian rivers. It is true that the upper reaches of the River Obi, where, by the way, Mammoth remains are infrequent, are subject to very wide floods, caused by the stoppage of the drainage by the mouth of the river being hard frozen, while its sources are thawed; but this is by no means the rule with the other Siberian rivers, especially those of Eastern Siberia, where the Mammoths abound, and which have deep channels and steep banks. There floods are comparatively slight, nor do such floods reach the high ground where the Mammoths are chiefly found, nor is the high ground composed of river sediment, but largely of clay. The floods seen in the lower Tundras are not fluvial, but caused by the melting of the summer snow on their surface. Again, as I have quoted from Schmidt, who is the most experienced geologist who has examined the problem on the spot, the Siberian rivers do not deposit sediment that could envelope the Mammoths. Lastly, the fluvial theory requires that the Tundra throughout Northern Siberia should be submerged entirely throughout the winter months; for unless the high ground is covered, the problem is not solved. If so, how could the Mammoths live there at all? Even Dr. Tanner, with his aqueous tastes, would be puzzled to live a few months upon the frozen beverage which North Siberia supplies so plentifully, much less great pachyderms requiring immense stores of vegetable food daily.

Mr. Reid speaks of the occasional preservation of carcasses of Mammoths and Rhinoceroses. Considering that they are found in the whole breadth of Asia from the estuary of the Obi to Behring's Straits, in a region almost deserted by civilized man, and therefore beyond the reach of anything but casual inquiry, and considering the number of recorded cases and the long ages during which their

occurrence has been recorded, the word occasional seems misplaced. It seems in fact clear, from the frequency and dispersal of the carcasses, that their occurrence is according to some law, and not according to mere local circumstance; for the conditions in which they are found are the same over 120 degrees of longitude.

Mr. Reid says the plants found with the Mammoth do not show a warm climate. As the same trees and the same land shells have been found with the Mammoth in Germany and in Northern Siberia, it shows a climate consistent with the possible climatic conditions of Germany in Post-Glacial times—a climate inconsistent altogether with permanently frozen ground close to the surface over a whole continent, or with winter conditions such as no large herbivores could contend with. The problem further requires that over the whole of Northern Asia the climate should once have been so temperate and mild that the bodies of the Mammoth, etc., could be thrust into the ground or covered with it, and that afterwards, and from the time they were so thrust in, that same ground must have remained hard frozen to our own day. On this condition only could the flesh be preserved. If this were a mere local matter affecting one small area, we might invoke local causes like the case of Mount Etna, but the case is a continental one. The Bear Islands, where no shrub can exist at all 150 miles away from the mouth of the Lena, the occasional home of the Arctic Fox and the Snowy Owl, must, when the Mammoth lived, have supplied an abundant vegetation even in winter; so must the whole of that terribly inclement district the Peninsula of the Chuktschi; so must the tundras from the Yenissei to the Lena; and yet immediately the animals died the ground must have been so frozen for several feet below the surface as to be impervious both to the sun's heat and to the filtration of water. I never urged that the state of things existing now at Yakutsk, where it is probable the ground is permanently frozen for 600 feet from the surface, was created suddenly. It is no doubt the result of many centuries of hard climatic conditions. The presence of beds of blue ice alternating with clay and soil, and due probably to some unexplained filtration of water, is no doubt also the result of a long process; but what I urge, and have always urged, and have had my opinion confirmed by the views of many scientific men with whom I have discussed the problem, is that the Mammoth, when alive, must have been surrounded with temperate conditions and abundant food, while directly after he died Arctic conditions must have at once supervened and prevented the decay of his body. The proofs of this position, which seems to me to be more impregnable with every fresh piece of evidence, are cumulative. I have tried to present a number of them as fairly as I could. As yet I have stated but half my case. However, I hope my good friend Dr. Woodward, who has been very considerate to my heresies, will allow me to present the remaining evidence, which is more purely geological. I must emphatically say that I very much distrust all deductive methods in science. The formulating of a very plausible plea of uniformity as an infallible dogma, and then reading one's facts

up to it, is a misleading method. The only fertile method in such inquiries as ours is induction from the facts, and to this I most unflinchingly invite your readers.

If the facts are susceptible of a more reasonable explanation than that I have given, by all means let us have it, and I will surrender. At present I am a more incorrigible heretic than ever. I hope I have not said one offensive or irritating word. If I have, may it be cancelled and forgiven. In conclusion, let me quote a most weighty sentence or two from one whom both Mr. Reid and myself will agree with honouring and paying some deference to. Professor Huxley, in his address to the Geological Society for 1869, said, "To my mind there appears to be no sort of necessary theoretical antagonism between Catastrophism and Uniformitarianism. On the contrary, it is very conceivable that catastrophes may be part and parcel of uniformity. Let me illustrate my case by analogy. The working of a clock is a model of uniform action. Good time-keeping means uniformity of action. But the striking of the clock is essentially a catastrophe. The hammer might be made to blow up a barrel of gunpowder or turn on a deluge of water; and by proper arrangement the clock, instead of marking the hours, might strike at all sorts of irregular intervals, never twice alike in the intervals, force, or number of its blows. Nevertheless, all these irregular and apparently lawless catastrophes would be the result of an absolutely Uniformitarian action, and we might have two schools of clock theorists, one studying the hammer and the other the pendulum." These are weighty words, to every one of which I subscribe. In objecting to the current doctrine of Uniformity, it may be suggested that I am objecting to the government of the universe by law—a view I repudiate altogether. What I say is that the law which governs the universe is not to be grasped by those who will not look beyond what is passing now at their elbows. A beautiful city like Lisbon, where I was born, has existed for 100 years in peaceful prosperity; and yet in 1753 it was overwhelmed by the most terrible cataclysm that is mentioned in modern history. That cataclysm is the type of others. How can such an event, the only one of its extent and kind recorded in the West, be explained by the current school of English geologists? To Professor Huxley, and those who hold with him, such a cataclysm is as much the result of law as the peace which has succeeded; and to some of us a cataclysm of a much greater extent, involving a great revolution in current geological views about Post-Glacial geology, is just as reasonable *a priori*, while we affirm that it is abundantly required to explain the facts.

HENRY H. HOWORTH.

DERBY HOUSE, ECCLES, Nov. 5th, 1881.

COAL-MEASURES UNDER THE NEW RED SANDSTONES.

SIR,—Permit me to say that the discovery of limestone bands at Winwick beneath the Trias is not quite so novel a one as both Mr. Strahan and Mr. De Rance appear to think.

In a letter of mine to the *Liverpool Daily Post*, dated 15 Sept.