

is at their base. This will prove, if the line of argument at present in use be allowed, that all their recent accumulations, and even the railways, are pre-glacial. I have seen from ten to twenty feet of as good Glacial Drift as that from which the existence of the Middle Gravels have been proved (?), covering a recent railway, or some other modern structure; and I have heard such covering pronounced "good typical Glacial Drift" by an eminent geologist before he was pointed out what was beneath it.

WEXFORD, Feb. 6, 1875.

G. HENRY KINAHAN,
Irish Branch, H.M. Geol. Survey.

GEOLOGICAL SURVEY OF YESSO.

SIR,—While thanking you for the kindly notice (in the last received number of your *MAGAZINE*, October, 1874) of my little report of a year ago on the first season's field-work of the Geological Survey of Yesso, I beg to make a correction in the criticism on the topographical-geological method of Prof. Lesley (chief of the new Pennsylvania Geological Survey). He should not be blamed for the "confusion and unsightliness" of the lines on a map that shows the contours of the principal beds of rock as well as of the surface; for his maps are models of clearness and taste, and even on a large scale commonly show for the rocks only the outcrop and the lowest natural drainage level of the beds of chief mining importance, and the topography is often reinforced by shading, besides the contour-lines. The addition of contour-lines for such beds above water-level, and to a certain depth below, is my own idea, and what I fondly imagined to be an improvement, especially in mapping limited tracts of land where the owners wish to see at a glance as by a sort of cross-hatching on the map what portion of the ground is underlain by workable beds. In many regions, perhaps most, it is possible to draw such underground contour-lines with a degree of accuracy very useful for practical mining purposes (one coal-bed, for example, was shown by a map to be at 180 feet below the surface of the ground at a point three-quarters of a mile from the nearest exposures of the bed, and on sinking a pit proved to be at 182 feet). The rocks are not in every country tied up in double bow-knots, as they sometimes seem to be in the Himalayas. Of course it is difficult to trace out such contortions, or to represent them on a map in any way; for even every small irregularity in the surface-contours cannot be given on maps of small scale.

It must be admitted that to draw two sets of contour-lines on the same map, especially if both are black for photographing, necessarily takes away somewhat from the good appearance of either alone; but is there not some compensation in the additional information conveyed, and in the display of the relation of the surface-contours to the underground contours at every point? It must also be acknowledged that "observations made at the surface can only be taken for what they are worth," and the underground contours of a bed of rock must always be somewhat less certain than those of the surface. Still, is it not worth while for the observer to give precisely what,

from his study, seems to be the true position of the beds, without, however, exaggerating the certainty of such results? At any rate, no matter how the final map may be drawn, it is hard to conceive of any way but Lesley's (more or less perfectly followed) for making out a continuous section of rocks that are exposed only at intervals either on one stream or on different sides of a hill, if the fossils or the resemblance of beds are not (as commonly happens) a complete guide.

You seem rather inclined to regard the hope that my Japanese assistants should become accomplished geologists "in a few years" as an "Oriental exaggeration." But I still see no reason to attach a special geological sense to the expression; though it is not to be supposed that they could advance far more rapidly than we self-satisfied Anglo-Saxons. Most of them can already make topographical maps with a facility that is unfortunately rare not only among geologists, but even among railroad engineers.

In speaking of the report it would perhaps not be amiss to commend the Japanese for making public even so small a contribution to geology, not only in their own language, but in one more readily understood by a foreign scholar; the first case of the kind under any native Asiatic government. It is still doubtful whether they will be willing to publish in like manner more voluminous local details with maps and sections.

BENJ. SMITH LYMAN.

KAITAKUSHI, SHIBA, YEDO,
9th January, 1875.

QUESTIONS CONCERNING THE GEOLOGICAL ACTION OF ICE.

ADDRESSED TO THE OFFICERS OF THE ARCTIC EXPEDITION.

I HAVE been led by a long series of observations on the drifts and boulders of the north of England and Wales to conclude that we cannot arrive at a consistent and satisfactory explanation of glacial phenomena until more light has been thrown on many questions, including the following: Is the *interior* of the Greenland *ice-sheet* or *ice-sheets* free from rocky débris, or is it more or less charged with it? Is the *base* of the Greenland ice capable of pushing forward large stones to great distances? Is it capable of holding stones of considerable size firmly fixed in its grasp, or of polishing and uniformly striating any stones *not* fixed in the subjacent ground? What is the state of the *base* of icebergs as regards being charged with clay, sand, small stones, or large boulders? Can a *grounding iceberg* give a rounded as well as a flat shape to the surface of submarine rocks, or, while endeavouring to regain its normal level, striate a rock-surface down-hill? Can a *revolving iceberg* scoop out a hollow in the rocky bottom of the sea? To what extent can *coast-ice* transport earth, stones, and large boulders? Are there any instances, in the Arctic regions, of floating *coast-ice* radiating from islands so as to distribute rocky débris over an area of 90 degrees? Are there any conditions under which floating *coast-ice*, "charged throughout with detrital matter," may deposit dome-shaped masses of concentrically-shaped