in the basalt-lava, so as to give trustworthy indications of the real movements of the ground. Perturbing causes which would have kept the pendulum in agitation, such as wind, the passing of people, carriages, &c., had not on that day to be taken into account.

I think it rather improbable that secondary and subsequent shocks, coming from the same centre as the first one, were the cause of the observed fact: a much more probable explanation would be that the whole hill on which the Observatory is built maintained during the whole time the particular state of trembling produced by the first shock.

Rocca di Papa, Rome, March 18.

EMIL ODDONE.

Striated Surface under the Cromer Drift.

AT the beginning of the present month (March) there were some good Forest Bed exposures in the neighbourhood of Cromer. Somewhat less than a quarter of a mile south-east of East Runton, there was an exposure I had not noticed before. It consisted of a smooth, hard surface of ferruginous sand, not unlike some of our Trias beds, except that below it became softer. This slab of sandstone projected six yards obliquely from under the cliff, or rather talus in front of the cliff, with a slight dip to the west inwards, its outward face rising one foot above the sand of the foreshore. Upon the outer or longer exposed part there was no indication of striæ, but toward the inner or more recently exposed portion faint grooves could be distinguished, becoming more distinct the nearer it approached the cliff; two feet from the cliff they were distinct and numerous. The main direction of striæ ran due north and south, a few crossed from the north-north-west and north by east, but none deviated from the general direction beyond these points. They extended entirely across this part of the exposure, viz. 4 feet, and continued as far as the surface could be uncovered. Resting immediately above, as far as could be made out among the recent talus, was the highly-contorted drift sand and loam usually observed hereabouts; no flint nodules, stones, or boulders could be seen in them, and it is difficult to understand how these, if they had been present, could groove the bed so persistently in one direction when shoots took place.

About half a mile to the south-east and one mile to the north-west, the cliff sections this year show the soft sand and loam beds bent into anticlines, thrust back to a vertical position like a pack of cards on end, their central axes pointing to the north. This form indicates that the force came from the same direction as the mean striæ engraved upon the underlying surface. Three points of interest will be observed:—

(1) That the ice which caused the striations could hardly have contorted the beds above them; it probably shrank back and allowed the drift to be deposited, and then encroached once more and contorted the overlying beds.

(2) Soft beds of sand and loam could not be twisted or contorted into ribbon forms unless a considerable load lay above to prevent them breaking up and becoming disarranged.

(3) We should hardly expect to find striæ preserved upon a comparatively soft surface under what looks like bedded sand or loam; but unfortunately this point cannot be clearly established in consequence of talus obscuring the bed immediately above; but, bearing upon this point, it may be interesting to state during the summer of 1890 I found at Penrhyn, Nevin, Carnarvon Bay, a highly glaciated and striated rock surface which had been recently exposed. This *roche moutonnée* was overlain by a drift cliff of bedded sands and loams 100 feet high, resembling the Cromer drift in every respect except the contortions; these striations were from the east-north-east or seaward side also.

WILLIAM SHERWOOD.

Sutton Coldfield.

Pilchards.

IN this far-off corner of the world the news has only just reached me that my name has been quoted in your valuable columns with Mr. Cunningham's article on the growth of the pilchard or sardine. As it is a matter which much interests me, I should like to have a word or two on the subject. Personally, I have no doubt as to the identity of the pilchard and sardine. Seeing the matter has been so well threshed out by our greatest ichthyologists—Couch, Day, and Günther—the spawning of the fish being only a question of local conditions, and not

even giving us aid in determining the species—note the doings of the herring when about this work around the islands of Great Britain, which keeps shedding its roe for eleven months out of the twelve in these waters. As to the question of the English pilchard being so much larger than those of other countries, this to my mind is a subject of *grave doubt*, and I fear Mr. Cunningham's informants have not looked up the matter thoroughly.

When I was a juror in the London International Exhibition in 1883, in the Spanish department we gave awards to exhibitors who had pilchards of the same size and cure as those of Cornwall. Again, the principal markets for our Cornish pilchards are those of Italy. But in this business we are not alone, for side by side with our fish are the Spanish pilchards, cured like our own; generally they are a little smaller than ours, answering to our summer fish.

But in this past season they are decidedly our rivals, and in such quantities as to bring the price down in such a manner as to leave us with scarcely a margin of profit through their being just equal in size to our Cornish output.

In the past season we calculate that Cornwall and Devon have sent out about 25,000 casks of pilchards into Italy; but we should not be surprised to find that Spain has sent forwards into the same country over 30,000 casks.

We began the season by sending our fish forwards in September, and were rather surprised to find the Spanish merchants had glutted the Italian markets with fish in August, and the imports went on till near Christmas, which seems to indicate they were catching pilchards on the coasts of Spain in the summer and autumn of the year. When this question of the size of the pilchard has been fairly looked up, I think it will be found the size of the fish of any coasts will be chiefly governed by the facts that abrupt and exposed coasts, having a heavy sea and strong tides along them, will have the strongest and largest fish swimming in its waters; while the bays, and narrow and protected seas and inlets, will have the young, weak, and smaller fish in them, the nature of the foods having the lesser influence.

I have been led to believe the Bay of Douarrenz is the deepest bay on the coast of Brittany, and in it is carried on the largest fishery for young pilchards on the French coasts; while off the more abrupt parts of the coast of Spain the pilchards are large, like those on the exposed parts of Cornwall. And no doubt if the French coasts were well looked up, the same facts would come out respecting the fish there.

Fortunately for the French and Spanish fishermen, up to date they have not interfered with the food of the young pilchard; or, if they have, evidently they have substituted another in its room, viz. *cods' roe*; hence they have these little ones in their bays still; but we have driven out ours by starvation, as will be seen further on.

I was rather surprised to read Mr. Cunningham's statement when he said I had told him that I had never seen pilchards in Cornwall of the same size as the French sardines, for really I have seen millions just like them for size.

Possibly the error came from my misunderstanding his question, as we cannot see or get them now because of our altered conditions.

If Mr. Cunningham will consult F. Buckland's familiar history of British fishes (p. 109), he will see a letter from me confirming my statements, and written in the year 1872. In the year 1884 I received the medal of the Falmouth Polytechnic Society for exhibiting a series of small pilchards, showing their growth and ages in six stages—the smallest being less than an inch in length—up to the two years old full-grown pilchard.

Before the railway ran into our county, our bays were full of these little fishes in the summer months; and when our seines inclosed pilchards, the first question was their size, as pilchards under eight inches in length were useless for exporting purposes; consequently small fish were quickly turned back into the sea alive.

But sometimes, in the excitement and darkness of the night, the men were mistaken in the size of the fish, and took them into their boats; and when the daylight undeceived them the fish had to be carted off for manure. I have often seen them on our piers, piled up four feet high and hundreds of feet in length, waiting the waggons.

But all this has passed away, and we have not one pilchard seine left here to inclose pilchards should they again visit us. But their coming is very improbable, as the quantity of food necessary for their sustenance is so much diminished that if the