from the logs of some of the vessels caught in the Straits of Sunda at the time (see *Nature*, 1884, Jan. 10, p. 240).

A careful consideration of the data there available would seem to render it almost certain, that, in this Krakatoa explosion, something like two or three cubic miles, perhaps more, of earth which formed the northern part of the volcanic island and its underlying strata, were blown into the air to some unknown height, and clearing entirely Lang Island, lying immediately north-east, came down again six or eight miles to the northward and eastward. As this probably took place at a single explosion, and as large amounts of gases under enormous pressure were almost certainly suddenly set free, to say nothing of the sudden generation of steam, it is, perhaps, not to be wondered at, that this immediate demand for 'more room' should have started a series of waves in the atmosphere (like those in a mill-pond from the plunge of a stone) which travelled several times round the globe.

The vessels' logs above referred to — one reporting the barometer fluctuating between twenty-eight and thirty inches and violently agitated, and another the same rising and falling from half an inch to an inch in half an hour — show how violent was the local disturbance, which, by the time it reached this country, amounted to only about two millimetres.

Doubtless some slight effect of this kind must follow every large explosion, like that of a powder-mill, over some limited area; and it is worthy of note, that Mr. Scott, the secretary of the London meteorological council, in his paper communicated to the Royal society on Dec. 4, 1883, states that the traces of these Krakatoa waves "exhibit considerable similarity to that of the King's barograph at the Liverpool observatory, at the Waterloo docks pierhead, on the 15th of January, 1864, when the Lottie Sleigh, loaded with about twelve tons of gunpowder, blew up. The ship was lying about three miles from the observatory." But this phase of such explosions is entirely distinct from their sound and their window-shattering character. H. M. PAUL.

Washington, April 21.

Osteology of the large-mouthed black bass (Micropterus salmoides).

Very recently my studies have required me to make several dissections of the large-mouthed black bass, and carefully prepare two or three skeletons of this fish. These skeletons are now before me, and in two of them I notice a very interesting anatomical point. During the course of my reading upon the skeletons of fishes, I have failed to discover any account of a similar condition in any of the Teleostei, and note it here, trusting that I may learn from others, interested in the anatomy of this class of vertebrates, whether or no they have ever observed the same. This consists in a pair of freely articulated ribs at the base of the occiput. Their heads are received in a shallow facet on either side, situated just above and rather internal to the foramen for the vagus nerve. Immediately below each rib occurs the projection of bone that bears upon its entire posterior aspect one of the pair of articular condyles for the first free vertebra of the spinal column. Still beneath these condyles is seen the conically concave facet for articulation, with a similarly formed surface occurring on the centrum of the vertebra just mentioned, and the one which I believe would be described as the atlas.

This pair of ribs is directly in sequence with the abdominal ribs on either side. Their occurrence in this situation might be accounted for by saying that several of the anterior vertebrae of the column had been absorbed by the occipital elements. Mr. Bridge found such a condition in Amia, though no free ribs were present (*Journ. anat. phys.*, xi. 611, Lond., 1877). In the cranium of Micropterus, however, I should think that this would be highly improbable. Both the first and second vertebra of the spinal column of this bass support each a pair of free ribs, and a mid-series of the other abdominal ribs bears epipleural appendages. Dr. Günther states in his account of the osteology of the Teleostei, in article 'Ichthyology,' of the Encyclopaedia Britannica (vol. xii., 9th ed.), that "the centrum of the first vertebra or atlas is very short, with the apophyses scarcely indicated. Neither the first nor the second vertebra has ribs." I have a yellow perch (Perca americana) in my possession where both of these vertebrae support a pair of free ribs.

Should an examination of the young of the black bass show that none of the anterior vertebrae of the column were included with the occipital segments, but that these ribs are truly occipital ribs, then they become of interest from several points of view.

R. W. SHUFELDT.

Washington, March 31.

Caulinites and Zamiostrobus.

As *Science* has devoted a page of its valuable space to Mr. Joseph F. James's copies of Mr. Lesquereux's figures of these plants and his remarks thereon, in which, without having seen the specimens, he essays to overthrow the determinations of the venerable paleontologist, a word in reply may be justified as tending to correct the impression, already quite prevalent, that the determinations of vegetable paleontologists are in large measure mere guess-work.

As regards Caulinites fecundus, little need be said, since its problematical character was sufficiently insisted upon by Mr. Lesquereux in his description. The 'capsules' are much smaller than those of Onoclea sensibilis, and are found in intimate relation with the stems which have been called Caulinites. The matrix is a light, fine-grained shale, showing the longitudinal, parallel nervation of these stems very clearly. It also contains fragments of dicotyledonous leaves which may have belonged to the plant that bore the fruit; but no ferns are present, as these would be clearly shown by their characteristic nervation. It is safe to say, that, if Mr. James had examined the fossils, he would not have said that there was "no doubt" in his "mind that Caulinites fecundus is nothing but a part of the fertile frond of Onoclea sensibilis."

As regards Zamiostrobus, however, there is 'no doubt' that Mr. James is egregiously in error. His confident statements well illustrate the folly of discussing mere figures of objects that are in existence. He has entirely misapprehended the nature of the specimen; and this is not altogether the fault of Mr. Lesquereux's figure. The fossil is a segment of a zone, cut out of a cylindrical or conical body which must have measured about eight inches in diameter. This segment was placed with the exterior surface upward in the drawing, in order to show somewhat in perspective both this surface and the radiate structure of the cross-section from the direction of the centre. The figure is defective in not showing the manifest angle which all the dark spots have on one side, and which fixes their true character as scars of former leaves. It is probably not a cone, as Mr. Lesquereux supposed, but a fragment of one of those