LETTERS TO THE EDITOR.

The reefs, keys, and peninsula of Florida.

THE recent appearance of the admirable memoir of A. Agassiz on the reefs of Florida, which I have read with intense pleasure, furnishes me a proper occasion for calling attention to my paper, published in 1857, 'On the agency of the Gulf Stream in the formation of the peninsula and keys of Florida,' [1] and especially to the fact that the most important results reached in that paper have been substantially confirmed by subsequent observations. These results are as follows: —

1. The reefs of Florida are unique, and therefore were formed under peculiar conditions, and therefore, also, require a peculiar explanation.

2. The continuous growth of land by coral agency, in the case of Florida, is also wholly unique, and obviously connected with the peculiar conditions under which the reefs were formed.

3. The main peculiar condition in this case was the formation and southward extension of a submarine bank upon which the corals grew in successive reefs.

4. This bank was due to the agency of the Gulf Stream.

In addition, I supposed that the bank was built up by mechanical sediments brought by the Gulf Stream mainly from the Gulf rivers. In this I may have been mistaken, although no other explanation was conceivable at that time. The recent examinations of the course of the Gulf Stream, which, it seems, does not sweep about the Gulf, as was formerly supposed, and examination of the nature of the material forming the Florida bank, render this view no longer probable.

A. Agassiz in his memoir accepts the progressively formed bank, and also that it is due to the agency of the Gulf Stream, but thinks that it is formed, not by *mechanical* sediments, but by *organic sediments*, partly *brought* by the Gulf Stream from other coral banks (e.g., the Yucatan bank), *but mainly* formed *in situ* by the growth of deep-sea animals; the Gulf Stream bringing not the materials, but only the conditions of heat and abundant food necessary for rapid growth.

This is certainly a very important modification of my original view; but the fundamental ideas expressed in the above four propositions still remain.

I ought to add, that, following L. Agassiz, I had exaggerated the probable amount of land added to Florida by the combined agency of Gulf Stream and corals. The recent investigations of Smith [2] on the geology of Florida show that the process cannot have commenced farther north than the north shores of the Everglades.

JOSEPH LECONTE.

Berkeley, Cal., Nov. 24.

Musical sand.

In the early part of the summer of 1883, the writer, in company with several others, was sent from Wood's Holl to Monomoy Point, Mass., by Professor Baird, to look after a whale reported to have been stranded there. Wandering around the island, we found an extensive tract of sand, which, when rubbed under the feet, produced that peculiar singing sound so often heard by the writer upon the beach at Manchester, Mass. The singing portion seemed to be confined to a narrow strip several hundred yards long, between the very dry sand above high-water mark and the sand moistened by the tides. Knowing that the phenomenon was a rare one, specimens of the sand were obtained; but I am not able to tell where they are at present. Monomoy Point is a long, narrow, sandy piece of land projecting out from the south-eastern end of the base of Cape Cod towards Nantucket Island. It is composed entirely of sand; and the blowing of the particles, as also the force with which they are blown, were well illustrated by the fact that all the windows of the fishermen's huts were ground so perfectly that nothing was visible through them. We paid one fisherman to break a square of glass for us. It had been there sixteen years. Even in cases where new glass had been put in within two years, nothing was visible through the panes. At a distance of thirty feet from the house on all sides, sand was piled up nearly as high as the tops of the cabins. The lighthouse-keeper upon the island would undoubtedly obtain specimens of the sand; the strip being found near the place where the whale lay, — in fact, just a few feet inland from it. The writer will be glad to give any further information desired upon the subject.

R. S. TARR.

Smithsonian institution, Dec. 4, 1883.

[1] *Amer. journ. sc.*, Jan., 1857. [2] *Ibid.*, 1881.

Rings of Saturn.

Apropos of the abstract on the 'Rings of Saturn,' published in SCIENCE for Nov. 16 (p. 660), it appears that Professor Alexander Winchell of the University of Michigan, in his work entitled 'World-life,' assumed and explained the gradual descent of the matter of the rings toward the planet, and also denied that the period of the inner satellite of Mars furnishes any objection to the nebular theory. The ultimate result of solar tides on the rotations of the planets is also referred to in the same work, though this has, I believe, long been an accepted conclusion by leading physical astronomers.

W. B. T.

ARCHEOLOGY IN PORTUGAL.

Études préhistoriques en Portugal. Notice sur quelques stations et monuments prehistoriques. Mémoire présenté à l'académie royale des sciences de Lisbonne. Par CARLOS RIBEIRO, chef de la section des travaux géologiques, etc. Lisbonne, *Imprimerie de l'académie des sciences*, 1880. 88 p., 7 pl., and numerous engravings in the text. 4°. [Also in Portuguese.]

THIS publication, which has only recently been received by us, is the second instalment of a work the first of which appeared in 1878 (72 p., 21 pl.). We will accordingly give a brief account of the contents of both parts. Contrary to our expectations, we find in them no discussion of the important question of the alleged discovery of traces of the tertiary man in the valley of the Tagus; neither do they deal with quaternary times. They contain simply detailed accounts, with ample illustrations, of various discoveries, all belonging to the age of polished stone, made by the author in several localities in the immediate neighborhood of Lisbon, which are all laid down upon an accompanying map drawn to a large scale. The completed work will comprise six sections, three of which are contained in the two portions already published. Of these, the first describes the station of Licca, and the second,

the megalithic monuments near Bellas; both of which places lie a short distance west of Lisbon. The latter also contains an account of the prehistoric remains at the Serra de Cintra, several miles farther west.

Licea is a little hamlet built upon the projection of an elevated plateau, of which two of the sides are naturally defended by deep ravines. In this respect it resembles other sites of human habitation in the age of polished stone, which were usually placed upon commanding positions, easily defensible, and having plenty of water. This naturally strong position was rendered more secure by having its sides sharply scarped in some parts; while in others, not so protected, there can still be seen remains of a wall built of huge unhewn stones. The whole area was thus converted into an intrenched camp of an oval shape, nearly half a mile long by half as broad. Within this space, excavations have brought to light various objects of the usual types belonging to the industry of the age of polished stone. There were numerous celts made of diorite or of basalt, some finely polished, well shaped, and with sharp cutting-edges, while others were of a ruder fabric; and also several hammer-stones. Knives, flakes, scrapers, arrow-heads, and lance-points abounded, made of different varieties of flint, many of which must have been brought from long distances. Rude clay vases, hand-made, and some of a large size, all baked in an open fire, together with a few bone implements, complete the catalogue of objects found. Associated with these relics were the remains of shell-fish, and the bones of several species of animals common in neolithic stations, such as the horse, ox, stag, goat, pig, wolf, and hare. There was also discovered a sepulchral grotto containing bones belonging to nine individuals of both sexes, half at least of which were those of very young children. We have good reason to believe that other similar caverns have been either destroyed, or filled up with the rubbish of the chalk-quarries that have been extensively worked in this locality. In the absence of a perfect cranium, nothing more could be determined than that the type was brachycephalic. From the general result of all the discoveries, the conclusion seems warranted that Licea was the habitation of a large population during the neolithic period. Signor Ribeiro, however, brings forward certain arguments to prove the existence of a second prehistoric civilization upon this same spot, belonging to the period of transition between the age of polished stone and that of bronze. But we must confess ourselves unable to perceive their pertinency; neither can we agree with him in thinking that any of the implements discovered here have 'a striking paleolithic appearance.'

In the vicinity of Bellas there still exist megalithic monuments, consisting of a half-dozen ruined dolmens, in which but little of importance was discovered, owing to their having been visited by previous explorers; nevertheless, two or three singular objects were found in them, which will be described later. Hard by, however, at Monte Abrahão, there is a covered alley in an excellent state of preservation, which has yielded important results. It is composed of a polygonal chamber some ten feet in diameter, and a gallery twenty-four feet long by six wide, extending in an easterly direction. The walls of the chamber are constructed of eight large slabs of hard gray limestone, rough, and entirely unhewn, planted more or less upright, and projecting some nine feet above the surface of the soil. It is evident, however, from the inclination at which the largest stone is placed, that it was not intended to be roofed over by a similar slab after the usual method of constructing such monuments. There had first been made with infinite toil, by the help of fire, an excavation in the solid limestone strata of the whole size of the chamber; and in this the large slabs were set. Of those with which the gallery was originally constructed, only three now remain in place; but the rows of smaller stones, by which they had been supported, were discovered when the surface-soil was removed, so that there can be no mistake as to the existence and extent of the gallery. It is admitted that dolmens and covered alleys were erected to serve as burial-places of the men of the neolithic age: consequently we are not surprised that Signor Ribeiro found this monument to contain human remains; but the number of them was quite unusual, amounting to as many as eighty individuals. This can be accounted for by the fact that certain circumstances seem to indicate that some of the remains had been interred elsewhere before they were removed to this resting-place. They were found in the gallery, as well as in the chamber; and it seems reasonable to suppose that there had been successive burials at intervals of time, and consequent disturbances of the soil, which would account for the situation in which many of the bones were found. Their condition was such as to allow but few inferences to be drawn as to their ethnic relations, no whole cranium having been found: sufficient, however, remained of one, to show it to be

dolichocephalic, and one of the jaw-bones was prognathic. In this interment, however, was one peculiarity which we have never seen noticed before. Over the whole interior, but particularly at the eastern extremity of the gallery, there was spread a layer of rounded pebbles, covering the human remains. They ranged in size from an almond to a large apple, and were mostly of quartzite, though many were of limestone, and several of basalt. Evidently they had been brought from the beds of neighboring brooks lying some three hundred feet or more below the level on which the monument stood. That they were not intended merely to protect the bodies from wild beasts was plain, from the fact that the adjacent soil was filled with angular fragments of various rocks equally well adapted for that purpose. Here we have evidently a funereal custom analogous to the heaping-up of cairns over the dead by many primitive races.

Numerous objects of great beauty and interest were found accompanying the skeletons. Among them were only four celts; but there were no less than one hundred and twenty flint arrow-heads, very many of them of the choicest workmanship, and including all the well-known types which are figured in excellent woodcuts. There were found two very fine specimens of flint lance-heads, or more probably daggers, more than six inches in length, and of exquisite workmanship; and more than thirty knives, ranging in length from five inches down. There were also scrapers, numerous flakes, and fragments of worked flint of various sorts. Our author devotes an entire plate to a delineation of some twenty little instruments, some of which he thinks were "designed for delicate work, such as *the surgical operation of circumcision* (?), *and trepanning.*" Another of larger size, disk-shaped, and terminating in front in a little point, and capable of standing upright on its base, his imagination has magnified into 'an idol, or some sort of symbol.' To our more prosaic vision the 'surgical instruments' are only ordinary little stone implements, which in this case happen to be made of transparent quartz; while 'the idol' is merely a piercer for making holes in skins, such as we have often found in our Indian shell-heaps.

There were half a dozen objects of unusual character, which Signor Ribeiro designates as 'war-clubs,' and two others, which he thinks were 'badges of authority.' They are quite similar in appearance, are of cylindrical shape, and made of limestone; and the largest is about a foot in length, and nearly two inches in diameter. A few bone implements were found, among them a button of a conical shape, and pierced at the base with two converging holes. The pottery consisted only of portions of some half a dozen small, rude vases. Two ornaments were found of considerable size, celt-shaped, and made of thin plates of gray argillaceous schist. One face was smoothed, and decorated with figures made by scratching lines upon it in the triangular pattern known by the name of the 'dog-tooth;' and it was pierced with a hole for suspension. Besides these, two smaller heart-shaped pendants were found, and more than a hundred beads of various shapes and sizes, made of different green minerals, out of which the author has reconstructed several tasteful necklaces. Taking every thing into consideration, this covered alley may be said to be one of the richest ever discovered; and we feel grateful to the author for his careful study and faithful delineation of it.

We have already stated that two or three peculiar objects were obtained from some of the ruined dolmens. They are made of thin plates of argillaceous schist, about a foot in length, and some two inches broad, and are shaped somewhat like the curved blade of a sword, having the end rounded, and pierced on the back side with a hole for suspension. Both surfaces are smooth, and are decorated with varying patterns of 'dog-tooth' ornamentation. Two similar objects have been previously discovered in Portugal; but we are confident they have never been met with elsewhere, and their use is entirely unknown. The third object is a sort of stone hoe, according to our author's opinion, shaped very much like a human foot, and having the lower portion of the leg for the handle, the top of which is sharp enough to be used as a scraper. Objects similar to this have been discovered in a cave a short distance to the south.

The Serra (or mountain) of Cintra lies due west of Bellas, and somewhat more distant than the latter place is from Lisbon. It is the most picturesque of all the mountains in the vicinity, and attains an elevation of over fourteen hundred feet. At the very summit is an artificial excavation in the porphyritic and granitic rock, divided into two portions. The inner chamber is circular, with a diameter of twelve feet, and height of nine; the other is a kind of open vestibule about eighteen feet square; and the two are connected by a short covered corridor, while the interior of the whole monument is lined with a wall of rough stones. In it were found a flint knife, or saw (an ellip-

tical shaped implement, toothed around its whole exterior), and a few worked flakes. Fragments of clay vases of various shapes and sizes abounded, many of them having a 'herring-bone' pattern of ornament incised upon them. All of these objects evidently belong to the neolithic period; and the monument itself resembles a sort of combination of the dolmen and the sepulchral grotto.

But a novelty among neolithic interments seems to have been discovered at Folha das Barradas, a short distance to the north-east. This is excavated in the natural soil, a white limestone and green marl, and has almost the shape of a covered alley, twelve yards long, extending east and west. The circular chamber at the west was divided by pieces of thin flagstone into partitions intended to contain human remains, of which as many as twelve were found, but in so bad a condition as to be useless for study.

Accompanying the remains were a flint poniard, two very fine lance-points of unusual size, and seven large knives; also a long cylindrical stone 'war-club,' similar to those previously described, but more handsomely ornamented, and two of the 'badges of authority.' A flat pendant, like those already spoken of, and fragments of a few rude clay vases, completed the funeral furniture. But it should be noted, that both in this sepulchre, and the one last described, there was found a large number of the same kind of rolled pebbles as those which occur so conspicuously in the covered alley of Monte Abrahão.

In concluding this brief account of Signor Ribeiro's interesting researches, we can only express the hope that his recent death, which all lovers of knowledge must deplore, may not deprive prehistoric students of the publication of the remainder of the work.

THEORETICAL METEOROLOGY.

Theoretische meteorologie. Ein versuch die erscheinungen des luftkreises auf grundgesetze zurückzuführen. Von ALBERT R. v. MILLER-HAUENFELS. Wien, *Spielhagen & Schurich*, 1883. 130 p. 8°.

THE past twenty years have witnessed a great advance in the science of meteorology, viewed from a theoretical stand-point. Previous to this period, the laws deduced were derived empirically from the observations made; and this is largely true at the present time. The attempts to place the science upon a firmer basis by building upon well-established physical laws, and deducing conclusions by strict mathematical processes, have met with decided success. But this branch of meteorology is yet largely undeveloped: consequently there is no treatise that covers the ground satisfactorily, and there is a large gap between deductive meteorology and the inductive conclusions upon which meteorological text-books are based. The mathematical papers are scattered in the volumes of scientific journals, or published in separate form. Even if they were collected together, and their contents condensed into one treatise, the result would be unsatisfactory. It would be found that a large majority of familiar phenomena are yet unaccounted for, and that many of the conclusions reached by theoretical methods cannot be used for further investigations, on account of assumptions made for the sake of simplifying the work, but which are unwarranted by observed facts. The hope of meteorology as an exact science, however, lies in the success which will attend these theoretical investigations in the future; and therefore any treatise devoted to this branch of the science is welcomed, however fragmentary it may seem to the reader.

The latest publication upon theoretical meteorology is this octavo of a hundred and thirty pages, by Professor Miller-Hauenfels of Graz. It is confessedly incomplete, but seems to be worthy of the attention of the student. As its title implies, it is an attempt to refer atmospheric phenomena to fundamental laws. The author is not a practical meteorologist, but a mathematician, who treats the phenomena discussed as mechanical problems as far as possible, holding that the first thing necessary is to establish the fundamental laws of meteorology, and afterwards to build upon this secure foundation. In the first section the laws of Mariotte and Gay-Lussac are treated, the method giving essentially the same result as that deduced by Rühlmann in his well-known barometric formula. Passing then to the movements of the atmosphere, the author discusses first its general movement, and then the laws of the winds, the latter subject occupying a large part of the treatise. The laws of ascending currents as developed by Hann are briefly referred to, and the laws of moist air-currents also discussed, the formulae for which are based upon Hildebrandsson's exposition of Dalton's law. The fundamental laws of thermodynamics are the basis of the discussion of the disturbances of density giving rise to winds. Numerous theorems are laid down in connection with the phenomena of the winds, and it is recognized that differences of temperature are the original cause of them. The diurnal change of the barometric pressure is explained in a