four miles and a half (7,500 metres). They are distributed as follows: in France, 144; Italy, 78; Switzerland, 471; Austria, 462. Their total superficial area is between five hundred and a thousand square miles. The longest is the Aletsch glacier in Austria, measuring over nine miles.

— Dr. Freire of Rio de Janeiro, in a letter to the Louisiana state board of health, thus speaks of the results of his inoculation for yellow-fever: "I have performed over seven thousand inoculations with full success. The immunity was almost absolute, notwithstanding the intensity of the epidemic this year. More than three thousand persons who were not inoculated died of yellow-fever; while among the seven thousand inoculated, inhabiting the same infected localities, subject to the same morbid conditions, but seven or eight individuals, whose disease was diagnosed as yellow-fever, died."

— During the year 1885 there were 246 earthquakes, according to the statistics of C. Detaille, as given in the June number of *Astronomie*. The largest number of these, 49, occurred in January; the smallest, 11, in October. For the other months the numbers are as follows: February, 18; March, 15; April, 19; May, 14; June, 29; July, 23; August, 13; September, 16; November, 16. Only 6 are given for North America, as follows: Jan. 12, Washington; Jan. 18, New Hampshire, Carolina; Jan. 26, California; Feb. 5, Virginia; Nov. 19, California.

— A. Raggi has published some observations on the intermittent variation in sound-perception in the human ear, instances of which are probably familiar to many persons. In deep stillness, if one listens to a faintly heard sound, like that of the ticking of a watch, it will be noticed that at irregular intervals the tones are wholly inaudible, while at other times they are distinctly recognized. Mr. Raggi ascertained, by experiments on different persons, that the intervals of silence usually varied between seven and twenty-two seconds; while the periods of sound-perception were between seven and eleven seconds in duration, with a maximum of fifteen. He also found that the variation was not due to extraneous sounds, nor to the blood-circulation or respiration, and concludes that it results from the inability to keep the attention for long periods at a sufficient degree of tension for the perception of faint sounds, or possibly to a variable physiological receptivity in the auditory nerves.

— A legacy of some $75,000 has been left to the Jena university to be applied in zoölogical research on the basis of Darwin's evolution theory. The testator is Herr Paul von Ritter of Basle, who believes the teaching of Darwin to be the greatest sign of progress which the century has yet given.

— According to the statistics recently published by the minister of agriculture and commerce, it appears that the quantity of olive-oil produced last year, in the various provinces throughout Italy, was 52.34 per cent below the average annual yield, which is calculated at 3,405,500 hectolitres (74,921,000 gallons), it being only 1,782,400 hectolitres (39,212,800 gallons); 11 per cent of this total amount was of superior quality, 73 per cent good, and 16 per cent mediocre.

— The Royal academy of medicine of Belgium has recently offered its largest prize ($5,000) for the most meritorious work or paper on the treatment of diseases of the nervous centres, especially for a remedy for epilepsy. The great need of some better means of controlling this last disease induced the academy to offer an additional prize of $1,600 for the best paper on that subject. The prizes are international, and will be awarded in December, 1888.

— Late deep-sea explorations in the Atlantic, carried on under the auspices of the London geographical society, have shown that the ocean-bottom in the northern region is formed of two valleys, of which one, in width, reaches from the tenth degree of east to the thirtieth of west longitude, extending to the equator, at a depth of not less than thirteen thousand feet. The other lies between the thirtieth and fiftieth degrees of west longitude. The mountain-chain separating the two valleys extends northwards towards Iceland, and southward to the Azores, and is of a volcanic character at its ends. Its greatest breadth is a little less than five hundred miles.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Is the ocean surface depressed?

Do barometric observations give any hint regarding the depression of the sea 'at the centre of the oceans'?

If, as is maintained, there be a depression of a thousand metres, the barometer should show about three inches and a half more pressure at the centre of the oceans than at what we ordinarily call sea-level.

Were there any barometric observations made on the islands where the pendulum was swung? or do barometric observations made on any of the oceanic islands cast any light on this subject? I have no authorities at hand to consult, or would not ask the question. W. H. S.

Candelaria, Nev., May 25.

The notion that there exist in the sea-surface of the earth elevations and depressions amounting to several hundred metres has recently gained a much

wider acceptance than our knowledge of the facts would seem to justify.

Assuming the continents to be simply so much matter, of half the earth's mean density, on the surface of our otherwise closely centrobaric spheroid, it may be shown that individually they will draw the sea-surface up towards their centres by considerable amounts (about a thousand metres at most), leaving corresponding though not equal depressions opposite those centres; and that collectively they will produce a wavy sea-surface, in which the maximum radial distance from crest to hollow is about six hundred metres. The theory, and the equations assigning the form and position of this wavy surface, have been developed by Helmert in his excellent treatise on geodesy ('Die mathematischen und physikalischen theorieen der höheren geodäsie'), from which the above figures have been taken. If we dropped our examination of the question at this point, we might infer the reality of the wavy surface just described. The existence of such assumed continents, however, implies a proportionate variation of gravity along the sea surface and along the same level surface extended through the continents. They would, for the most part, produce an excess of gravity over the continental and a deficiency over the sea areas. But this conclusion is in direct contradiction with the results of pendulum experiments. The assumption, therefore, that the continents are superficial masses, unbalanced in their attractive effects, is, as clearly shown by Helmert, inadequate, and must, together with the conclusions based thereon, be modified or rejected.

Some writers, notably Fischer and Listing, have proved the existence of a highly irregular sea-surface by a still more unsound process than that indicated above would be if we neglected to examine its fundamental assumption. This process, in brief, rejects in an equation a term of the same order as those retained, and arrives at a simple relation between the variation of gravity and the radial distance from the actual sea-surface (or geoid) to the mean spheroidal surface. Helmert fitly characterizes this relation as entirely worthless (*ganz wertlos*), since it fails in every case to give the proper sign when the increments of gravity and radial distance due to the combined action of the continents are substituted in it.

Those desiring to examine minutely the merits of this question should consult the above-named treatise of Helmert, who gives a critical review of the cognate works of Fischer, Listing, Bruns, and others. For the benefit of the general reader, it may be stated, that, although the sea-surface is undoubtedly somewhat irregular, geodesy and geology have as yet furnished no adequate evidence of irregularities amounting to more than ten metres. Additional information, of which it must be admitted there is great need, may disclose the existence of a surface having hills and hollows separated by an interval of fifty or possibly a hundred metres; but irregularities of any greater extent appear to be quite improbable.

The suggestion of your correspondent, that the barometer would indicate any large elevations or depressions in the sea-surface, is not well grounded. The surfaces of equal pressure in the atmosphere must approximate to parallelism with the sea-surface, however irregular it may be. In a state of quiescence the air-surface in contact with the sea is necessarily a surface of equal pressure. The barometer would therefore, if moved from one point to another along the sea-surface, register only such variations in pressure as are due to changes of temperature, winds, etc., and hence afford no indication of the elevations and depressions in question, if they exist.

R. S. WOODWARD.

Washington, D.C., June 17.

Barometer exposure.

Mr. Clayton's letter concerning the influence of wind on the indication of the barometer broaches a subject of great importance to theoretic and practical meteorology, and I trust it may lead to the execution of the experiments essential to the intelligent treatment of the difficulty. As his conclusions are called in question by President LeConte, I take the liberty of rehearsing some investigations of my own which tend to sustain Mr. Clayton's conclusions.

In June, 1873, an elaborate series of synchronous barometric observations were made by the signal office at four stations on the summit and slope of Mount Washington. In testing a special method of barometric hypsometry, I had occasion to discuss these observations, and I discovered an important anomaly which was correlated with the velocity and direction of the wind. The discussion cannot be repeated here, for lack of space; but it may be said that its method and material were such as to leave no reasonable doubt that the wind was the disturbing factor, while they afforded quantitative results far more precise than can be reached by any method of reduction to sea-level. The reader who cares to examine them should consult the 'Second annual report of the U. S. geological survey,' pp. 521–534 and 562–565. One of the specific conclusions was, that a northwest wind of fifty miles per hour, by drawing air out of the summit observatory, presumably through the chimney, caused the mercury in the barometer to stand .13 of an inch too low; and it was estimated that a wind-velocity of a hundred miles would lower the mercury more than half an inch.

I think President LeConte is mistaken in supposing that the matter could be simply tested by comparing the indications of a barometer in a room with those of a barometer out of doors. If the out-of-door barometer were placed on the windward side of a building or other obstruction, and close to it, it would be immersed in compressed air, and read too high. If placed under the lee of an obstruction, it would be surrounded by relatively rarified air, and read too low. If placed in a position uninfluenced by obstructions, the locus of difficulty would be transferred from the surrounding atmosphere to the instrument itself, for the air chamber above the mercury in the cistern of the barometer would itself be influenced by the wind so as to receive a tension abnormally high or low. These statements, based on familiar physical laws, are not individually susceptible of ready verification, because, while the wind blows, all local tensions are disturbed, and we have no standard air-pressure for comparison. I have, however, determined experimentally that the reading is higher in front of an obstruction than behind it. A difference of .15 of an inch was found between barometer-readings on opposite sides of the apex of an acute mountain-peak.

In my opinion, the proper method of escaping the difficulty is, not to place the barometer out of doors, where observation during a wind is itself a matter