the name was not known. I cannot at present tell whether my letter reached you. Your last letter was dated from Ithaca, but the telegram was dated from New York.

I said I was sure the Committee would be extremely glad if you could come over to swing the pendulums at Kew and perhaps also at Greenwich. It would seem indeed to be an almost necessary supplement to the American work. Obviously the value of this would be greatly enhanced if a thoroughly trustworthy connexion were established between American and European stations. A connexion has indeed been made by Col. Herschel but he employed a new method of adjusting the agate planes, which *à priori* would seem to be rather precarious, and at any rate has not yet received that degree of examination which would seem requisite to inspire full confidence.

It would be most desirable as you have been swinging the pendulums at American stations that you should yourself complete the connexion by swinging them in this country, as that would ensure the strict comparability of the observations on the two sides of the Atlantic Ocean.

It has been suggested to me that if I put "U.S. Coast and Geodetic Survey" on the letter it would be pretty sure to find you.

I am, dear Sir, yours very faithfully,

G. G. STOKES.

DISTURBANCE OF GRAVITY BY CONTINENTS.

To Prof. E. HULL.

26 *Feb.*, 1887.

I am afraid you will think I have forgotten the question you asked me in your letter. It is not so, but I thought that before answering it I would look into Professor Suess's book if I could find it....But if I had found it I do not know that I should have been much the wiser, for as you say he gives no numerical data as to the dimensions of the supposed continent, nor does he specify what the continent actually is if he is dealing with a real, not an ideal, continent.

In a paper "On the Variation of Gravity at the Surface of the Earth*," which I wrote long ago, and which is published in the *Transactions of the Cambridge Philosophical Society*, and in my Collected Papers, of which as yet only two volumes have appeared, I showed that the effect of a continent would be to make a slight apparent diminution of gravity in continental stations as compared with detached oceanic islands. It operates in this way:—that the attraction of the land causes the surface of the sea level, the level surface, that is, which would be determined by a system of geodetic levelling carried from the coast inwards, to stand higher from the centre of the earth than it would have done had the place of the continent been occupied by ocean. The raising of the sea level is greatest inland, but it is quite sensible, and even important, at the coast itself of the continent.

How much the raising amounts to, depends of course on the dimensions you attribute to the continent and the height you give it above the undisturbed level of the sea. To take a numerical example, I suppose the case of a circular island, or continent, whichever you please to call it, 1000 miles in diameter, and elevated a quarter of a mile above the sea level. I suppose the depth of the ocean in which this island is supposed to be placed to be 2 miles. I make the usual suppositions as to the average density of the rocks &c., in the neighbourhood of the earth's surface, and as to the mean density of the earth, which is fairly well ascertained. I find the elevation of the sea level in the interior of the island or continent (Australia), a good way from the coast, to be about 400 feet. Of course in a great continent it might be considerably greater. This would cause an apparent diminution of gravity in continental stations, I mean of course in gravity as reduced by the usual methods to the level of the sea. In the first place in reducing to the level of the sea we leave out of consideration the attraction of the stratum of earth between the actual sea level and what the sea level would have been if the continent had been away. As far as this goes, corrected gravity ought to appear too great. But in the second place, in reducing to the level of the sea we reduce to a point further from the centre of the earth than we should have done if the sea level had been unchanged, and therefore in correcting we

* *Cambridge Phil. Trans.* vol. viii. (1849), pp. 672—695. [*Math. and Phys. Papers*, vol. ii. (p. 155).]

don't add enough to bring it up to what it would have been if ocean had been beneath us instead of land. On this account therefore gravity should appear too small, I mean reduced gravity. The two effects on apparent gravity are antagonistic, but the second is the stronger, so that on the whole gravity ought *caeteris paribus* to appear a little less on continents than on detached islands. Sabine and Airy have pointed out that such appears to be the result of observation, but so far as I know I was the first to point out that such a result ought to follow from the attraction of a continent, by disturbing the sea level.

Far inland, the thing could only be tested in those cases where the sea level has been accurately determined by geodetic operations. We could not accordingly throw much light on the question by means of pendulum observations in Thibet.

I am, dear Sir, yours very truly

P.S. You will find Airy's discussion in his article "Figure of the Earth" in the *Encyclopaedia Metropolitana.*

An elevation of 400 feet, even if there had been no intervening attraction to reduce the resulting diminution of gravity, would only alter the number of vibrations per diem of a seconds' pendulum by about one and a half. Of course apart from disturbance the difference in the number per diem at two stations on the same parallel of latitude would be nil, and therefore the small difference of 1·5 would be infinity times that. I do not know what the term of comparison used by Fischer may be.

To E. F. J. LOVE.

7 Queen's Parade, Bath,
6 *August*, 1891.

Dear Mr Love,

I have come here for a week or two, and have brought your letter of June 19 with me to answer it from this house, which is that of one of my sisters.

You do not say expressly, but I take for granted that in the contemplated gravity survey [of Australia] you mean to use invariable pendulums, not Kater's pendulum or some other form available for absolute determinations. It is generally, I think,