Enclosure.

SIR,— District Survey Office, Thames, 19th March, 1904.

I have the honour to transmit per same mail, under separate cover, the plans and computations of the Niue Island surveys; and, as a report on the circumstances leading up to, and the conduct of, the work may prove of interest, I beg to append it hereto.

My health having been in a very indifferent state for several months last year, I applied to you for three months' leave of absence, my medical adviser having recommended me to take a trip to the South Sea Islands. On the 9th September I received a telegram stating that the leave had been granted, and at 5.30 p.m. the same day I received a "wire" from the Hon. Mr. Mills, asking if I would be willing to carry out some surveys at Niue while in that locality, and, if so, to proceed by the s.s. "Countess of Ranfurly," which was to leave Auckland at noon next day; details of the work to be arranged in consultation with the Government Resident at Niue. To this I replied in the affirmative, and, as the steamer to Auckland was to leave at 7.15 a.m. next morning, it did not leave me much time to get my equipment together, though, as a matter of fact, on arriving in Auckland, the "Countess" did not get away until two days later.

Equipment.—I took with me a 5 in. transit theodolite (Troughan and Sims), prismatic compass, Abney level, 5 chains 1-16 in. and 1 chain ¼ in. leading band in Littlejohn's drum, Nautical Almanac, Loomis's Astronomy, Thullier's Manual of Surveying, and the usual log. tables.

Scope of the Work.—We left Auckland on the 11th September, and arrived at Niue after a fine passage of ten days. I immediately called on Mr. Maxwell, Government Resident, to see what required to be done in the matter of survey, and as the result of the interview it was arranged that, if possible, a traverse of the main road round the island connecting all the villages and incidentally fixing the coast-line should be made; the boundaries of Government Reserve and Mission Station to be defined, and landing reserves to be laid off at Alofi, Avatele, Tuapa, and Mutalau. Though I had already derived some benefit from the sea trip, as I did not feel equal to starting work again straight off, I stipulated that I should go on to the Cook Group and carry out the surveys on my return. However, during the three days the vessel remained at the island, I selected a position for the initial station and made a start with the traverse-lines.

The s.s. "Countess of Ranfurly" got back to Niue from the Cook Islands on the 27th October, and I then felt so very much better that I was able to enter into the work before me with energy.

The schooner "Ysabel" was expected at Niue about Christmas, and if I had not got the work completed in time to get over to Tonga by her there would probably be no chance of leaving the island till March. This gave me a little under two months to carry out the arranged programme, and, though I felt doubtful if it could be done in the time, as I did not want to unduly protract my absence from New Zealand, I resolved to make every effort to push the work through.

Natural Features.—The island is nearly surrounded by a narrow fringing-reef of about 4 chains in width. From this the cliffs rise up abruptly for 60 ft. or 70 ft.; then there is a terrace extending right round, generally about a quarter of a mile wide, though at Tipa and along the southern coast it is much narrower. This terrace has evidently itself been a fringing-reef at one time. From the back of the terrace the rocks again rise steeply up for 130 ft.; then, generally speaking, there is a gentle decline towards the centre; in fact, inside of the second elevation the island is saucer-shaped, though there are a number of minor undulations. I had not time to traverse the road through the centre of the island and thus get a cross-section, but I am of the opinion that the middle cannot be more than 100 ft. above sea-level, and that before the second upheaval Niue would have been in the form of an atoll island. From the foregoing, and as the whole place, where not under cultivation, is covered with dense vegetation, in many parts with great trees reaching to a height of 100 ft., it will be seen that nothing in the way of triangulation to govern the survey could be attempted; and even along the coast the points keep rounding so gradually that it is impossible to get a station where you can see for any great distance in both directions.

Ground-marking.—One of the first things to be decided upon in connection with the work was as to the form of marking the traverses, the island being of such a rocky nature, that in many places it would be impossible to insert wooden pegs, and even if they could be put in the ants would soon play havoc with them. I wanted to make my work a standard to which any future subdivisional surveys could be tied on. However, when I arrived at Niue, there was no iron in the place suitable for bolts, but Mr. Maxwell authorised me to get what I could in Rarotonga, and while there I bought all the available ¾ in. bar iron and had it made into bolts—a few 2 ft. long, but, to economize, most of them were reduced to from 6 in. to 9 in. Even then I had to use a good many wooden pegs; but there are bolts in at all points passing through villages and at intervals in other parts of the traverse. In addition to this, through Alofi I had concrete set round the bolts to insure their not being disturbed. Whenever there were cocoanut or other large trees near an angle I had deep broad arrows cut in them.

Initial Station.—I selected a position on a point overlooking Alofi Bay, not far from the Government flagstaff, as the starting-place; there being fewer trees there I was enabled to get a fairly clear field for the star-work. I may state here that if I had known the scope of the work and had had more time to make preparations before leaving home, I should have obtained a much larger instrument, as well as a chronometer for the astronomical portion of the work. Having chosen the spot for observation, Mr. Maxwell had a pillar of concrete built up from the solid rock for a height of 4 ft., and tapering from a base of about 2 ft. square to 1 ft. at the top, with an iron bolt through the centre. This should be a mark for all time. When the concrete had properly set, I was enabled to dispense with the legs of the theodolite, placing the tribrach of the instrument in three small indentations on the pillar, which insured great stability.

Latitude.—As above stated, I should have liked a more powerful instrument for this work, but as I took observations to eight different stars and to the sun, I expect the mean result, which works out to 19° 1′ 42″ S. for the initial station, will be close enough for all practical purposes.