The whole of this country, in fact, belongs to friendly tribes, who have made no use of it for the last twenty or thirty years, and who are desirous of selling or leasing it through the Court, as soon as purchasers or tenants can be found. From the great amount of rain which falls in it, as compared with the lower country near the coast, it is doubtful how far it is adapted to the growth of grain crops; but as a grazing district, and for dairy farms, it is certainly second to none, and the richness of the soil and the immense amount of water power available throughout it, seem to point it out as likely to be an important centre of the flax cultivation and manufacture. The absence of high winds, the warmth of the valleys, and the fact that the salt gales which occasionally do so much damage near the coast, do not extend so far inland, also indicate that fruits, and other productions, which do not thrive in the coast settlements may be grown here without difficulty. In fact, near Pipiriki, a place which enjoys a similar climate, there is an orange tree which has borne fruit in the open air for some years; and grapes have been grown abundantly, and even wine made from them, for a long time past near Ranana. Tobacco is also cultivated to a considerable extent by the natives at most of the pahs on the Wanganui river, and grows luxuriantly, and there can be no doubt that it can be grown at least equally well throughout the country I have been describing. If the country about the head of the Wanganui should prove to be auriferous, as I have already stated there is reason to suppose it, or if the Kaimanawa or Kaweka should ultimately prove so, as those who have visited them seem still to think they will do, the importance of the Murimotu region can scarcely be estimated, for, as far as I can learn, there is no other locality equally near and rich, from which goldfields situate as above could draw their supplies. All these things seem to combine to show the desirability of calling public attention to this portion of the province, and as I have reason to believe that your society would not object to the means of doing so, I have ventured to trouble you with these remarks respecting it.

ART. XI.—*A Description of the Foundation of the Lighthouse in the Ponui Passage.* By J. STEWART, Assoc. Inst. C.E.

[*Read before the Auckland Institute, 31st July,* 1871].

THE sandbank known to those engaged in the Thames traffic, and to all who have journeyed there during the last four years as the "Sandspit," is a well defined feature in the route, narrowing as it does the navigable channel at Ponui, to a passage one-tenth of a mile wide.

At extreme low water it dries to within about forty fathoms of its extremity; the water thence abruptly deepens from six feet to fifteen feet in the channel. In the greater part of its length it is a narrow ridge stretching three-quarters of a mile in a direction E.N.E. from Pahiki; thence it curves backwards W. by N. for about three-eighths of a mile, assuming a hook-shape. On a flattish table bank in the bend of this hook, the lighthouse has been erected, the depth of water at low springs being five feet, and at high water sixteen feet.

At the request of the late Colonial Marine Engineer, the structure of the sandspit was ascertained—about two years ago—by Captain Burgess, Chief Harbour-master, Auckland, from borings made on the site of the proposed works. It was found to consist of loose sand and shells, with shingle, overlying at a depth of seven to fourteen feet a hard crust, the exact thickness of which was undetermined.

Below this was a homogeneous sub-stratum of soft muddy and sandy clay; a very hard, but not rocky bottom was reached at a depth of thirty-one feet from the surface of the sand.

At the time of Mr. Balfour's death, he was understood to have made some progress with a design for this lighthouse; however, no sketch or trace of such was found, and the writer was intrusted by his Honour the Superintendent with the design and erection of the work.

In determining the *nature* of the foundations, the question was a narrow one. Screw piles offer by far the most advantageous method of supporting heavy weights on sub-marine sandbanks. But the *details* of form of screw, area, and pitch of thread, etc., have to be adapted, as well as can be, to the nature of the material in each case; not only with a view to the efficient support of the structure, but also to the screwing, and the amount of torsion necessary to be borne by a long pile (in this case forty feet) working down through stiff material. It is unnecessary to describe in full the calculations leading to the form and elements of the screw pile adopted; it may be sufficient to remark, that for the sake of permanency, cast iron was used for the complete pile (excepting the joint bolts); the stem is ten inches outside and eight inches inside diameter; diameter of screw flange, three feet three inches; pitch, six inches. The form of screw is conical, the thread commencing at nothing, near the pointed end of the pile, and attaining its full width of fourteen and a half inches in one and a half turns, it then made one turn more at the full diameter. The conical shape was found of great service in penetrating the hard crust existing a little way below the surface. Imbedded timber was the only contingency to be feared, and its actual existence at the bottom was proved by one of the borings made by Captain Burgess. Several tests were made before screwing down, to guard against this contingency, and the nature of the ground may in a measure be judged from the fact that little more than the weight of the rods was necessary to send them from the surface to the hard. This required the best efforts of four men about ten minutes to penetrate, which being effected, a further depth of twenty feet was easily done in about two minutes more. The crust was, in these trials, estimated at a thickness of four inches.

A temporary platform having been built on the site, the screwing down was effected by fitting a strong capstan embracing the body of the pile, which was moved upwards a few feet at a time as the pile descended. This capstan was nineteen feet in diameter over the ends of the bars, which were fitted so that a rope could encircle them, as round a drum. An ordinary single and double power winch was placed in a convenient position, and the power transmitted to the capstan by an endless rope coiled three times round the winch barrel, and twice round the capstan bars; the slack was usually taken up by hand. The pile could be, and usually was, screwed down about five feet, before fleeting the capstan up another lift. The winch was usually placed in single gear, and with this four men could work easily, making twenty-eight revolutions of the handles per minute. The ratios of the winch handles and radius of the barrel, and of the single gearing compounded, show that a force on the handles is increased a little over twenty-five times at the circumference of the barrel. Hence four men at the handles were equal to 100 exerting the same force at the ends of the capstan bars. The circumference of the capstan was sixty feet, and it revolved at the rate of ten feet per minute, or one turn in six minutes. As the average descent of the screw was three inches per revolution, its rate was thus one half inch per minute, requiring for actually screwing the full depth of twenty feet, a period of eight hours. A man's power, working at a winch eight hours per day, is usually taken at 2,600 foot pounds per minute, but as the men in this case never worked more than from one to two hours without stopping, and adjusting the capstan, or other parts, and rests often occurred, we may take the power exerted at 3,000 foot pounds. The circumference of the path of the handles being 8·6 feet, twenty-eight revolutions per minute give 240·8 feet, by which dividing 3,000, we have nearly thirteen pounds as continuous pressure exerted by the hands. This again is equal to (with four men) 1,300lbs. at the capstan rope, moving ten feet per minute, and as each foot required twenty-four minutes to screw down, it follows that it was also attained after an expenditure of 312,000 minute foot pounds, or a force equal to raising 139 tons one foot high had to be exerted to screw the piles down one foot. The slip is stated at an average of three inches per revolution, being 50 per cent. of the pitch. The actual descent was about two and a half inches at the beginning, one and three-quarter inches in passing through the crust, and from three inches to five in the mud, for each revolution.

The total weight of the structure is about sixty tons; this is mainly supported on the six outer piles, the centre one being relieved of nearly all direct weight, and serving to take the thrust of the other through the bracing, when the building is subjected to high winds. The area of each screw is 8·38 feet, and 1·2 tons thus fall to be borne by each square foot of surface, an amount shown by the screwing force to be far within the limits of safety. The interiors of the piles are filled with good cement mortar, to preserve the iron from rust, and the heads and nuts of the joint bolts are imbedded in the same. Tubular cast iron braces, and the lower timber frame, three feet above high water, complete the foundation which has answered all expectations in the recent exceptionally stormy season.

Art. XII.—*Work for Field Naturalists.* By P. Thomson.

[*Read before the Otago Institute, 16th September,* 1871.]

It must be evident to all the members of our Institute, that in a district like this, with such a diversified surface, where mountain and valley, hill and dale, land and water, forest, scrub, flax, and grass, are to be found in almost every possible condition, there is a very extensive field for the study of nearly all the natural sciences, and more particularly those which require work in the field. In the vicinity of the town, and within the reach of an easy hour or two's walk, lie many scenes of considerable beauty and grandeur, while the views to be had from the various hill-tops are not to be surpassed anywhere. In laying the following remarks before you, it is my object to specify a few of the more interesting localities in our neighbourhood which present facilities for out-door study. Without making any pretence to exhaust the subject, I will merely mention a few of the things to be seen in the different places.

And first, as to the geology of the district. Some very fine sections have been opened along the line of the Port Chalmers railway, and the line of the Southern Trunk promises some very interesting cuttings through the Caversham and Lookout Point hills, as well as that more distant range the Chain hills. Some very curious sand deposits have been lately cut into at Anderson's Bay; and along the beach at Vauxhall, the igneous rocks have overlain the clay and turned it brick-red in the process. (This phenomenon may be seen in a small cutting in the Town Belt, nearly opposite the foot of Howe-street.) In the valley of the Leith there are many curious places. About two miles from town there is a long steep-sided mound, probably a terminal moraine, and about two miles further up, opposite the foot of Nichol's Creek, there is another very large accumulation of rolled stones, evidently the result of a similar cause. In the Town Belt, at the back of Royal Terrace, there are some very large peculiarly worn rocks, which look as if they had long been exposed to the wash