19. In reply to Mr. Creighton, the witness said—That, so far as his recollection served him, the soundings taken between the Australian and New Zealand coasts showed a depth of 1,400 fathoms in some parts. It did not, however, matter so much about the depth; the main question they would have to consider was about the bottom. The witness quoted from a report by the late Mr. James M. Balfour to the General Manager of the New Zealand Telegraph Department, dated 21st October, 1869, in which it was stated—"It is impossible to estimate the amount of slack which would be required, or even to compare the several routes in a satisfactory manner, in the absence of soundings. The Admiralty Chart shows absolutely no soundings on any of the routes outside of the usual coastal soundings."

Mr. W. H. Floyd.
16th Aug., 1872.

Mr. W. H. Floyd in attendance, and examined.

20. *The Chairman.*] In reply to questions put, witness said—I hold the position of Electrician to the Government of New Zealand.

21. Are you acquainted with deep-sea cables?—I have studied the electrical conditions to be observed in the construction of deep-sea cables. I have prepared the following notes on the subject, containing information that may be useful to the Committee.

The annexed notes were then put in and read by the witness:—

Memorandum.

Assuming that an electric cable for connecting New Zealand with Australia would be laid from Cape Farewell to Sydney, and that the distance between those points is about 1,160 or 1,170 nautical miles, as stated by Messrs. Balfour and Lemon, it would be necessary to provide 1,400 nautical miles of electric cable, the extra 20 per cent. over the estimated distance from point to point being only a reasonable and usual allowance for slack and contingencies. The two Atlantic cables laid from Valentia to Newfoundland pass over a course said to be 1,670 miles long. The length of cable is in one case 1,866, and in the other 1,852 nautical miles, or 13·5 and 10·9 per cent. respectively, in excess of the distance from land to land.

Should a cable from New Zealand to Australia be as successfully laid as the Atlantic cables were, and with a similar proportion of waste, the balance of the 20 per cent. I judge to be necessary for slack and contingencies would not be too much spare stock to be kept as a provision in case of accident to the cable.

The core adopted for the Atlantic cables was determined on after careful study, much experience, and many failures. It has proved eminently suitable for the length of line intended to be worked through it, and may be safely adopted as a standard for calculating the electrical requirements of a cable from New Zealand to Australia.

The copper strand composing the conductor weighs 300 lbs. to the nautical mile; and taking 100 as the specific conductibility of pure copper, the conductivity of the copper in the Atlantic cable of 1866 is 94·63. Insulation is obtained by four layers of gutta percha and four layers of Chatterton's Compound, laid alternately around the conductor. The weight of the insulation is 400 lbs. per nautical mile. The electrical length of the cable of 1866 is 4·20 British Association units per nautical mile, or 7778·4 units in the 1,852 nautical miles of cable.

As the electrical length of a conducting wire is inversely proportional to its weight per mile, and the distance to be worked through between New Zealand and Australia would probably be only 1,300 nautical miles, the conductor of the New Zealand cable, with the same percentage of conductivity, need only weigh 211 lbs. per nautical mile to be electrically equal to the Atlantic cable of 1866; and as this decrease in the weight, and consequently in the diameter of the conductor, would allow of a corresponding diminution in the thickness of the insulation, the insulating material of the New Zealand cable need only weigh 281 lbs. to the nautical mile.

The kind of armour most suitable for the cable would depend greatly upon the depth of water it had to be laid in, and the nature of the bottom on which it would rest, and cannot be positively determined without a knowledge of those conditions. Should they prove to be similar to the conditions met with between Ireland and America, there can be no doubt that the pattern of armour should be that of the Atlantic cables. This pattern was selected for deep-sea telegraph lines after many others had failed. Its adoption was the result of experience gained in numerous costly attempts and in repeated disappointments. It has proved thoroughly efficient. It was first employed in 1865; and when the French Atlantic cable was laid in 1869, it was still considered a pattern of armour that could not be improved upon for telegraph cables to be laid in deep seas. It is composed of ten homogeneous iron wires, each wire separately covered with Manilla hemp, and the whole laid spirally on a padding of jute that surrounds the core.

The iron wires are each $\frac{95}{1000}$ of an inch in diameter. In the cable of 1865 the Manilla hemp surrounding them was tarred. In that of 1866 the tar was not used, but the cable of 1869 was treated exactly as that of 1865.

The weight of the cable of 1865 was $35\frac{3}{4}$ cwts. per nautical mile in air, 14 cwts. per nautical mile in water; its breaking strain, a little over 7 tons. The weight of a similar cable from New Zealand to Australia would be about 34 cwts. per nautical mile in air.

With reference to the nature of the bottom of the sea where a telegraph cable is to be laid, telegraph engineers and others engaged in cable-laying have frequently spoken in the Institute of Civil Engineers and elsewhere of difficulties arising from absence of survey, or from inaccuracy of surveys. It has been said that soundings shown on the charts published are not to be relied on for depths exceeding six to seven fathoms. No blame attaches to any one for this, as detailed and exact information respecting the bottom of the sea was not thought to be of great importance until submarine telegraph cable-laying commenced. Amongst other instances, I may mention that Mr. Varley and Captain Kelk, when engaged trying to lift the Atlantic cable of 1858, found it was laid upon a reef of rocks in Trinity Bay, Newfoundland, fifteen fathoms below the surface, and where the chart indicated a depth of fifty fathoms.