In extending the Government Buildings a few years ago one of the stone blocks at the end of the standard chain was displaced. This occurred before it was observed that the operations would encroach upon the site of the standard, and no record measurement was taken immediately prior to the excavations being made.

When the new buildings were completed a large concrete footing 2 ft. 6 in. deep by 6 ft. 3 in. wide was used as one terminal, and a concrete wall 2 ft. 6 in. by 1 ft. 6 in. was built, terminated at 100 links by a stone pillar 2 ft. 6 in. deep by 2 ft. by 2 ft., tapering to 1 ft. by 1 ft. at top, the surface being flush with the surface of the concrete wall and the ground, and in 1898 a new standard chain was here carefully laid down from the same scale.

In 1878 the provincial standards were compared with the Wellington standard, and the results recorded; but it was not considered then expedient to fix a New Zealand standard, as the surveys of every province had been conducted each from its own standard, and the differences were small. The differences were: Auckland, 0″·103; Nelson, 0″·120; Christchurch, 0″·005; Dunedin, 0″·135: all too long.

On the completion of the 1898 standard at Wellington Government Buildings a steel band was compared with it and with the provincial standards, and it was found that Auckland was 0″·297 too long, Nelson was 0″·093 too long, Christchurch was 0″·220 too long, Dunedin was 0″·273 too long, which seems to show that the Wellington new standard is 0″·13 shorter than the 1878 standard, if the mean of these differences is accepted, and the district standards have remained unchanged. The figures show, however, that the provincial standards have probably changed.

The steel band used in ascertaining the differences in 1878 was also tried on the 1898 standard, and was found to measure 0″·1 longer than that standard chain.

The 5-chain standard which was laid down from the one-chain 1878 standard was compared with the new 1898 standard, and it was found to be 0″·14 per chain too long. It was carefully remeasured and reduced to agree with the 1898 standard length.

In comparing provincial standards with the Wellington standard it should be borne in mind that at Auckland and Dunedin it is known that they were laid down with the most precise care from standard brass scales which were made in London, and compared with the British standard yard, and they were probably, when laid down, as near the standard length of 100 links, or 66 ft., as the one more lately measured. All the bases in the Auckland District were, however, measured on the assumption that the Auckland standard was 792·087 imperial inches.

The measured differences may be due to changes in the ground or to the value of the corrections applied. The relation of expansion between one metal and another is still, notwithstanding many trials, an uncertain quantity in a purely scientific sense, many authorities giving extremely slight differences in the ratios. There are also difficulties in finding the actual temperature of any two metals while being compared. The original British standard yard, when destroyed in 1834, was restored from copies of the old standard, and five of such copies, in gun metal, were made and are kept—one at the Mint, one at the Royal Observatory, Greenwich, one at the Royal Society, one at the Exchequer, and one in the House of Commons. The length of this yard is marked by two fine lines about 1 in. within the extremes of the bar, and is correct at 62° Fahr.

Two standard yards were supplied to the United States of America by the British Government in 1856, one of bronze and one of Lowmoor iron. The bronze bar between two transverse lines was stated to be 1 yard at 61°·79 Fahr., and the iron bar between two similar transverse lines was 1 yard at 62°·58 Fahr. Troughton's standard scale, which had been used since 1836, when compared with the bronze yard was found to be 0·00092 in. longer, or nearly a thousandth of an inch. A comparison about twenty years after with the Imperial standard yard in London showed that the United States bronze yard was 0·000088 in. shorter, and it was inferred that Troughton's scale was too long by 0·00083 in., or that it was standard at 59°·6 Fahr. Other comparisons showed that the bronze bar and the iron bar had in twenty-five years changed their relative length 0·00025 in. From these results it will be seen how difficult it is to get minute accuracy.

While requiring all possible exactness in the measurement of a standard chain, and also in the measurement of base-lines derived therefrom, it cannot be forgotten that, however exact these are, extreme accuracy may be lost in the angular measure of the first two or three triangles. High accuracy in angular measure, if required, can be attained only at a high cost of labour and time. A base-line may be measured with a possible error of $\frac{1}{150000}$, but in minor triangulation an error of $\frac{1}{5000}$ is allowable and still is considered good work. It is for reasons such as these that the New Zealand system of survey requires a base-line to be measured about every 12½ miles, and does not insist so much on numerous observations of the angular measure, in which so many possible errors may be made.

It is proposed to obtain a new steel tape compared very carefully with an Imperial standard chain at London, or with the standard chain which has been laid down in Sydney or Melbourne.

An account of the measurement of the Wellington standard chain and the 5-chain standard is given in Appendix XIII., page 158.

The Figure of the Earth.

There has been some discussion as to whether New Zealand should now undertake the measurement of an arc of the earth's surface in this part of the globe.

Such an operation is contemplated in the Surveyor-General's report of 1877 (H.–17A, page 7), and, should the Government now think it desirable to make this contribution to science, the work could be done willingly by more than one of the highly trained officers of the department. The measurement and computations would, of course, require several years' work, and would cost a considerable sum.