

## APPENDIX "E."

## HISTORICAL SKETCH OF THE TRIANGULATION CARRIED OUT IN SOUTH AUSTRALIA.

*Contributed by E. M. Smith, Esquire, Surveyor-General.*

Colonel William Light, the first Surveyor-General of South Australia, was appointed in London by Imperial authority early in 1836, with full control of surveys to be commenced in the new land.

He arrived in August, 1836, selected the site for the capital city, Adelaide, and completed the survey in March, 1837, after which he began the survey of holdings, containing 80 acres and 134 acres respectively, fixing the survey by triangulation which consisted of eight stations, comprising about 75 square miles, details of which he sent to the Imperial Government; afterwards deposited in the British Museum.

Colonel Light's surveys were carried on in October, 1839, by Captain E. C. Frome, R.E. (afterwards Lieutenant-General), author of a work on surveying.

He brought with him a staff of sappers and miners from the corps of the Royal Engineers, who were at once actively employed in carrying out detailed surveys in the hilly districts around Adelaide, concurrently with a trigonometrical survey, commenced *de novo* by Frome, from a base line measured between Adelaide and Glenelg, and carried on in advance of the requirements of settlement for the purpose of tying in and fixing detailed surveys as they proceeded.

The trigonometrical observation books are dated 1840-2, and comprise work extending from 50 miles south of Adelaide to 150 miles north of Adelaide, embracing an area of 8,000 square miles.

The observations were made with 5-in. Y theodolites, reading to minutes only. The programme consisted of several rounds of instrumental bearings from different settings of the vernier. Many of the triangles close within a few seconds, others of less importance within 20 seconds.

Observations for true meridian were made here and there, and the result of the survey has been most useful, and has answered the purpose admirably for which it was intended, viz., to prevent any overlapping of detailed surveys, or errors of chainage accumulating to any considerable extent; it also supplied material for a good skeleton map of more than 100 miles of coast line. No record of the cost of this trigonometrical survey is available.

Captain Frome relinquished office in February, 1849, and was succeeded in the following July by another Imperial officer, Major, afterwards General, Sir Arthur H. Freeling, K.C.B., an officer of sound views on the administration of his Department, and firmly convinced of the importance of a trigonometrical survey being carried on in advance of settlement, to fix natural features from which stock-holders and others could describe the land they wish to occupy without fear of overlapping other claims. Major Freeling had sufficient personal influence with the Government to obtain funds to defray the extra cost of the triangulation he contended for; and continued to be surveyor-General until the end of 1860.

Soon after the arrival of Major Freeling, a question arose as to the position of certain cattle runs in the far north, and in 1851 Mr. H. W. Rawnsley, Assistant Colonial Engineer, was despatched to measure a true meridian line from Mt. Remarkable to Wilpena Pound, where the termination of his work was marked by a trigonometrical station bearing his name. The length of this line was 107 miles, and from it the following hills were fixed:—Mount Eyre, Mount Brown, Mount Aleck, Mount Arden, The Dutchman, Castle Rock, The Devil's Peak, Watt's Sugar Loaf, Wonaka Range, Kanyaka, Hat Hill, Morris' Hill, Coomooroo Hill, and Chaces' Range. Towards the end of 1853 a Government surveyor, Mr. Richard Loveday, was despatched to extend the trigonometrical survey in the direction of Mount Templeton and Wakefield's Scrub. This was continued to 1854, covering an area of 1,000 square miles, very well done, at an average cost of 8s. per square mile.

In order to map correctly various starting points for pastoral leases in the far north the able services of Mr. J. M. Painter, licensed surveyor, was secured by the Government in 1857. He commenced his survey by measuring a base line at Mount Serle and pushed on northward to Mount Distance and Mount Hopeless towards the head of Lake Frome. He was provided with a 6-in. Y theodolite reading to 10 seconds. The closing error of the triangles varied from 3 to 10 seconds. The area triangulated by him was 1,000 square miles at an average cost of 6s. 3d. per square mile.

Mr. Samuel Parry, previously of the Ordnance Survey of Great Britain, was engaged during 1857-8-9 in triangulating a large tract of country between Mount Serle, Termination Hill, and Mount Arden. He used a 7-in. Y theodolite reading to 10 seconds, but as he frequently omitted to observe the third angle of the triangles the closing errors are unknown, and the value of his work was somewhat uncertain, but sufficiently reliable to allow of plans being constructed for occupation purposes.

In May, 1858, Mr. Parry measured a base line near Hookina between two small hills called Castor and Pollux, forming part of his survey from which the distances in the surrounding country were calculated. The area of the triangulation carried out by him was 8,000 square miles at an average cost of 6s. 3d. per square mile.

In 1859 Mr. G. W. Goyder, assistant Surveyor-General, filled in between Camel's Hump, Mount Brown, and Black Rock, then proceeded to triangulate and map new country from the head of Lake Torrens, north-west to Denison Range abreast of the northern shore of Lake Eyre. The area surveyed by Mr. Goyder was 9,000 square miles at an average cost of 7s. 2d. per square mile. Mr. Goyder measured base lines (with an ordinary chain) at Mount Margaret and Termination Hill. The closing errors of the triangles (where they were completed) ranged from 5 to 16 seconds. On the retirement of Major Freeling Mr. G. W. Goyder was

gazetted Surveyor-General on 9th January, 1861. He was a man of great force of character, resources, and practicable experience in his profession. He presented a determined opposition to all proposals for selection of land before survey, and arranged with his Government for the proclamation of new counties and hundreds to contain references to trigonometrical stations.

He strenuously advocated the expenditure from time to time of sums of money necessary to maintain a trigonometrical survey in advance of settlement.

To fix starting points for pastoral leases situated on the eastern plains, an experienced surveyor, Mr. James Brooks, was employed to carry a network of triangles from Black Rock to the eastern boundary of the province during 1861-2. Mr. Brooks chained a base line from Hurds Hill, south-westerly for 8 miles 33 chains, from which his work was calculated. The theodolite read to 10 seconds, and the errors of the triangles range from 3 to 15 seconds. This double chain of triangles covers an area of 8,600 square miles, completed at an average cost of 3s. per square mile.

Towards the close of the year 1863 Mr. Thomas Evans commenced to triangulate the Gawler Ranges westerly from Port Augusta to the coast at Streaky Bay and southward to Darke's Peak. The completion of this extensive survey in October, 1865 (embracing 15,000 square miles) fixed starting points for many pastoral leases. A 7-in. Y theodolite was used by Mr. Evans for this survey. The closing errors of the triangles range from 5 to 15 seconds, and the average cost was 3s. 3d. per square mile.

After a lapse of eight years Mr. William Harvey, an experienced Government surveyor, commenced the triangulation of vacant country west of Lake Gairdner with a good outfit, and under instructions to improve on the class of work previously accepted. He was accompanied by the then deputy Surveyor-General, Mr. A. B. Cooper, who personally directed the starting of the work.

Better observations of true meridian, latitude, and horizontal angles were insisted upon, and the record field-books were copies of those used on the Victorian geodetic survey. Owing to Mr. Harvey's ill-health Mr. C. H. Harris, L.S., and Government Surveyor, was sent out to take charge of the triangulation. The theodolite used was a German instrument of special construction by Ertel, 5 inches in diameter and carrying four verniers. The error of closure seldom exceeded 1 second in any triangle. The country being destitute of fresh water the survey had to be discontinued when only 4,000 square miles had been completed, costing 6s. 8d. per square mile.

During 1875-6 Mr. Joseph Brooks, a Government surveyor, carried out a triangulation of 8,000 square miles on the western border of Lake Torrens, using the Ertel instrument, and closing triangles with considerable precision, the average error being only about 1 second in each triangle. The cost was 8s. per square mile.

Good rain having fallen in the north-west country, pastoral leases were applied for, comprising all the country lying south-west of Lake Eyre and north of Lake Gairdner. In order to prepare correct maps of the land to be leased, Mr. Will. Barron, a Government surveyor, was despatched in 1877 to triangulate the country south-east of, and immediately north of, Lake Gairdner; and in 1878 Mr. W. M. Hardy, a Government surveyor, was appointed to extend Mr. Brooks' survey north-westerly to Strangway's Springs, adjacent to Mr. Barron's work. The area thus triangulated by Mr. Barron was 10,000 square miles at an average cost of 10s. per square mile, and that by Mr. Hardy, 7,000 square miles at an average cost of 12s. 6d. per square mile. In the former case a new 6-in. Y theodolite was used with excellent results, and in the latter a 7-in. Y theodolite was used, and the error of closure seldom exceeded 1 second.

Between the years 1878 and 1882 Mr. W. H. Cornish, Chief Surveyor, continued the triangulation north of Hergott to the northern boundary of South Australia, and eastward to the eastern boundary of the province, embracing Cooper's Creek country from Innamincka to Lake Eyre. The theodolite used by Mr. Cornish was a 7-in. Y, and the average error of closure was from 1 to 2 seconds. Total area of this survey amounted to 21,500 square miles, completed at an average cost of 14s. 10d. per square mile.

Mr. Cornish measured a base situated in latitude  $27^{\circ} 35'$  longitude  $138^{\circ} 22'$  several times with wooden bars and steel rods, which is thought to be correct to about 2 inches in a mile. This base has been used for calculation of triangles extending about 150 miles east to Queensland boundary, and 590 miles west as far as the boundary of Western Australia.

In 1882 Mr. E. H. Lees, licensed surveyor and Government surveyor, carried on the triangulation from Mr. Goyder's work northward from Strangway's Springs and Mount Margaret to Charlotte Waters, slightly beyond the northern boundary of the State, and westward as far as Lake Phillipson. By May, 1885, he had completed 16,600 square miles, at an average cost of 9s. 1d. per square mile, maintaining a good standard of work throughout.

Mr. Lees was followed by Mr. E. B. Jones, also a Government surveyor, who triangulated a strip immediately north of Lake Eyre, connecting the Queensland corner latitude  $26^{\circ}$  longitude  $138^{\circ}$  with Mr. Lees' survey. The area of this strip is 5,000 square miles, and his survey is well up to the standard of adjoining work. The average cost per mile was 10s.

Between the years 1888 and 1892 Mr. John Carruthers, a Government surveyor, who had previously defined the boundary line between the Northern Territory and Queensland, triangulated the Musgrave Ranges, including Everard, Tomkinson, Mann Ranges, and Deering Hills, extending to the eastern boundary of Western Australia. This survey comprises 21,000 square miles, and the angles were observed with considerable accuracy. The instrument used was a 7-in. Y theodolite. The average cost did not exceed 6s. per square mile, although so far away from settled districts.

Since May, 1892, there has been no further triangulation survey in this State, although it became necessary in 1905 to prepare to continue similar operations in the Northern Territory.