(1) Estimate of anticipated traffic.

(2) Calculation of revenue thereof.

(3) Estimate of operating expenses.

(4) Calculation of necessary capital for construction and operation.

The estimate of anticipated traffic is mostly a matter of statistics. The first reliable and simple tables were compiled by the French engineer Michel, and published in the "Annales des Ponts et Chaussées" in 1868. He concluded quite naturally that passenger and freight traffic are a function of the number of inhabitants of the tributary district, considering to some extent their mode of occupation.

While this may be tabulated and compiled in Europe and the eastern and southern part of our continent, yet it is doubtful if it would bring satisfactory results in Western Canada. Generally, of course, in our time, the settler is ahead of the railroad, but the settlement intensifies with the advent of the track, production becomes greater with easier accessibility to the markets, which all affects the traffic. Then, again, unfortunately in several large portions of our West, the population depends entirely upon the production of one commodity—for instance, grain growing. One or two successive crop failures in a district served by some railroad mean practically no outgoing and very little incoming freight.

It would be interesting, however, to compile a statement for each railroad, giving the passenger and freight traffic in tons per capita in every one of our Western provinces.

On the basis of probable volume of traffic an estimate of the revenue thereof can be made. I have some figures before me, compiled some time ago in the United States. I note that the gross revenue per head of population amounts to about $13 in the populated Eastern States and only $5 in the Southern States. Of considerable value in this respect are the tables compiled annually by the Department of Railways and Canals of Canada.

Lastly, we have to estimate the operating expenses and the necessary capital for construction and operation, which calculations can only be done conjointly with the locating engineer, except, of course, in old settled districts, where, perhaps, a new short route between two larger centres is contemplated, allowing a fairly accurate preliminary estimate of aforementioned financial points without previous or simultaneous engineering work.

Of course, a large amount of operating expenses are fixed charges, independent of the survey of the road, but it is the duty of the engineer to find a line which will keep operating expenses down to a minimum without sacrificing revenue.

SWISS RAILWAY ELECTRIFICATION.

The electrification of 67 miles of the St. Gothard line of the Swiss State Railways, now in progress, is the first step in a project ultimately to operate all the federal-owned lines in that country, aggregating nearly 2,000 miles, by electric power. The single-phase a. c. system, as is now operating on the Lötschberg line, is to be used on this and future electrifications, the commission in charge having decided that it is the only system worthy of serious consideration for a project of such magnitude. While all the usual benefits are expected to accrue from the improvement, the principal item is the economy of utilizing the immense water power resources of the Alps, thereby making the railroads independent of expensive imported fuel, there being no coal mined in Switzerland.

METHOD AND COST OF PLANE TABLE SURVEYS FOR AN IRRIGATION PROJECT.

The cost of plane tabling for an irrigation project in Alberta, Canada, was, according to a recently issued report, approximately 10 cents per acre. The work was carried out in 1915 on the Lethbridge Northern irrigation project by engineers of the Irrigation Branch of the Department of the Interior of Canada.

A party of three plane-tables was organized in Lethbridge and consisted of the following men: Field engineer in charge of party, three assistant engineers, one draughtsman, six rodmen, three teamsters and one cook, with a camp and transport equipment of 8 tents, 2 wagons, 3 democrats and 10 horses.

This party commenced field work on April 29, and finished for the season on November 22, 1915, a period of 179 working days, covering 119,015 acres of topography, which is an average rate of 221 acres per plane-table day. No account was taken of a total of 25 working days which were lost during the season on account of bad weather.

A second party of three plane-tables was put on this work in September. This party commenced plane-tabling on September 17 and finished for the season on November 19, a period of 55 working days, covering 30,500 acres of topography at an average rate of 185 acres per plane-table day.

A total area of 149,515 acres was contoured during the season and in addition 315 miles of levels were run, setting bench-marks for the plane-table work.

The total cost of surveys for the season of 1915 was as follows:—

Wages of party for the field season	$ 8,852.31
Commissary (subsistence, fuel and cook's wages)	2,918.56
Horses (hay, oats and supplies)	619.00
Miscellaneous	625.03
Draftsman (4 months extra to finish plans)	300.00
Total cost	$13,314.90
Total area plane-tabled, acres	149,515
Cost per acre, cents	8.9

Allowing a depreciation on outfit of $1,500 for the season, the cost per acre plane-tabled would be approximately 10 cents.

Each plane-table party consisted of an assistant engineer, two rodmen and teamster, the teamster acting as recorder to the instrumentman. The scale of the plans was 400 ft. to 1 in., allowing one section to be shown on each plan. Beginning with a measured base line at least 1,200 ft. long, a closed plane-table survey was made of each section. The limit of error of closure allowed was 1/20 in. in plan, which at the scale used equals 20 ft. The limit of error for plane-table levels on each section was 2/10. All plane-table stations were set by triangulation from the base line, as were also all mounds.

The greater part of the work was done by taking spot levels, over the whole area, at distances apart varying from 100 to 400 ft., depending on the roughness of the land. The contours were then sketched on the plans in the field by interpolation In giving the spot levels, care was taken to outline all sinks, knolls, drainage lines and saddle. All buildings, houses and fences were noted, also the character of the soil and the name of the owner of each parcel of land.