

the two pointings to the boat, when plotted on the chart containing the points of observation duly plotted, will be the plotted position of the sounding.

Two observers are required, which makes this method somewhat objectionable, and these must be transferred at intervals as the work proceeds, and in order to see the boat, P, at all times. Usually, three or more readings can be made from each position. For example, in the plot four positions of the boat at P are taken.

The base, A B, across the bay, was made by a stadia reading. The transit was set up at A and the rod held at B. Two other base lines were also laid off, as shown in the dotted lines, one from A westerly to point shown as landmark, and the other from B easterly to "landmark. For the three-point readings flagpoles were erected about the centre of the base lines and to the south in the same manner as A' B' C' in the plot. These are shown in the plot.

The shore line was first traversed at the water's edge. Offsets to the bank were estimated, and sometimes paced; no measuring was done. The first part westerly was rocky, with high, steep banks. Along the cove, or natural harbor, there was a sandy beach, with low banks. Around the point, again, it was rocky, with high cliffs. This is shown by the topography on the chart. The direction of the land lines, width, and property-owners were made, taking bearings with the compass. Direction and position of roads were determined, and everything necessary to complete the plot and give all the information required.

The cove or harbor was a natural one. A wharf could be built, and was later, below the cannery, making it convenient for landing fish. The anchorage was good for boats and small craft, and perfectly safe, except with north-east winds. The harbor was well sheltered from south, west and north-west, and these were the prevailing winds. A north-east storm would, however, drive right in to the harbor, and no craft could live at anchor in such a storm. With regard to the smaller craft, provision was made for hauling them up on the sand beach in the rare times of such storms. Larger craft would either have to ride it out or get away in good time.

The soundings in the boat were taken with lead and line marked in fathoms. At even fathoms positions were taken and the triangulations made either with sextant from the boat or with transit or compass from shore.

In plotting those soundings no calculations were needed. The intersections of the two or the three points showed the position of the boat at one fathom, two fathoms, etc.

The soundings in the harbor were mostly made by using a long 30-fathom marked line for distance, and the bearings from a known point on shore were made with a prismatic compass. No one method answers for this kind of work. One has to have a certain amount of initiative or originality in this kind of work.

Latitude and longitude were ascertained, the former by a reading of the sun's altitude with the sextant at apparent noon, and allowing for dip, semi-diameter, parallex, etc. The sextant is much more convenient and accurate for taking astronomical observations than is the transit. Longitude was calculated from the ascertained longitude of a lighthouse some twenty miles distant, assuming, of course, that the longitude of the lighthouse was correct. The magnetic declination was ascertained by an azimuth observation of the sun.

Surveys of this nature are very rare, and confined to marine and fisheries in Canada and to the coast and geodetic surveys in the States. In the building of breakwaters and harbor improvements by the Public Works Department such hydrographic surveys are always made. It is, therefore, confined largely to Government work, though in the case here described it was of a private nature.

ORGANIZATION OF A STATE HIGHWAY DEPARTMENT.*

By Maj. W. W. Crosby.†

The essentials for a successful state highway department may be said to be:—

1. An established demand for it.
2. A proper organization of it.
3. Sufficient funds for its work.
4. A well defined policy.
5. An honest, tactful, capable head.
6. Suitable locations for its headquarters and branches, proper equipment, and loyal and skilled employees.
7. Perfection in designs for its work and efficient execution of such designs.
8. A comprehensive system of accounting from which intelligible public reports are regularly made.

The title of this paper, and, as I understand, its purpose, confine the speaker to the second essential except as reference may seem necessary to one or more of the others, and such will be his effort.

From the speaker's experience, he believes that the subject of the organization of a state highway department should be viewed from two points. First, from the point of establishing such a department as will most likely succeed in acquiring for itself and for the movement for better roads sufficient stability to endure, and, second, from the point of view, after such a stage has been reached and public support both moral and financial assured, of then increasing its efficiency.

Now for the stable upbuilding of a state highway department, the speaker believes a state commission of three is best. Five are ordinarily unnecessary and less likely to form a facile and mobile unit. They are likely to separate into five units and not to amalgamate into one uniform and homogeneous body, and this lack of unity will surely produce rivalries and schisms.

One commissioner, on the other hand, is ordinarily weak in a number of points. The selection of one man with the necessary tact, honesty, and executive ability, and, at the same time, possessed of either the proper engineering skill or the recognition of his lack of it and with the breadth to acknowledge such lack by the employment of a skilled engineer assistant, is a most difficult task to set any appointing power. Further, with "but one neck to be lopped," a single-headed commission is far more susceptible to the temptations of politics and to the attacks of enemies. The demands of questions of policy, of law, of administration, of execution, and of engineering are too great and diverse to be satisfactorily and permanently met by more than one man in a thousand and the chances for the appointment of that man in any case are probably not one in one hundred when the various influences concerning such appointments, the salary likely to be offered, and all the other factors are considered. With a commission of three, properly selecting and protecting its engineer, the latter can do the public, his board, his subordinates and himself, much more nearly actual justice than if he is obliged to act as both commissioner and engineer.

Under any commission there should be employed a trained and competent chief engineer. Probably the commission will also need to employ a secretary and certain book-

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