There are several other instances discussed of maps failing to agree by many miles. One of the members concludes a statement with the remark that "we have a great deal to learn in the way of map making." In the face of such a statement the ordinary engineer will be curious to know what the qualifications are for provincial land surveyors. But probably it is better to take a more optimistic view of the situation and seek for a remedy.

Combined Methods Needed

In considering the possibilities of a general topographic survey, the really important point to be emphasized is the employment of men who are proficiently trained for such an undertaking. No amount of effort spent in fitting the right men for this work could possibly be wasted, for the reliability of our maps depends on the quality of the information collected in the field.

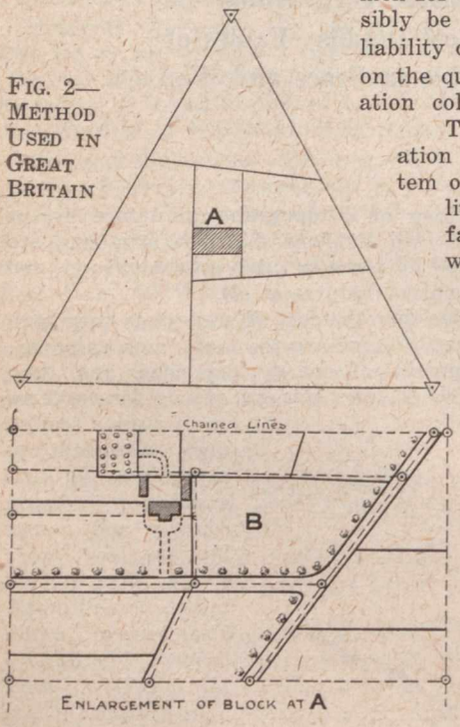

FIG. 2—METHOD USED IN GREAT BRITAIN

The next consideration should be the system of control points and lines. The most satisfactory basis on which to build a mass of detail is, undoubtedly, trigonometrically fixed points. Secondary triangulation could then be used according to class of country, with closer or tertiary triangles for cities or congested districts.

The work of filling in the detail need not be confined to any one particular method, but should be a combination of several according to the nature of the country to be dealt with. The plane table could be used with advantage over most of the open land and in lake districts; transit and chain-traverse would probably be suitable for woods and rivers; in the closer bush and ravines, compass, stadia and sketching case will generally map the necessary detail.

Lines of levels at convenient intervals are necessary, but approximate levels can be determined by means of the Abney aneroid hand level or Indian clinometer (which is unequalled when used with the plane table).

In dealing with cities and towns we would have to come to closer grips with our objective. A number of trigonometrically fixed points suitable for observing, and ranging from one-half to one mile apart, must be located around the towns; church spires, clock towers and other prominent marks inside can be resected from these. After observations have been made and a number of straight lines run to cut up the triangles into manageable portions, the transit may be laid aside, for the detail work can all be done by chain and offset staff. The surveying lines should be run through to an established line—that is, secured at both ends—and they will check themselves when put down on plot.

The method employed in the British Isles and also in the colonies is shown in outline in Fig. 2. The small shaded portion at "A" is enlarged at "B" to show the way in which the chained lines are secured. Fig. 3 is a trig. station used on tertiary triangulation and centred on a square tile; the pole is merely resting on the tile, so that if the former is pulled out the latter remains to mark the position.

The need for skilled topographers has already been mentioned. The name is often applied to persons who take cross sections or interpolate contours on small detail surveys, but in its real significance it means much more. The training of topographers for detail work is not very difficult if instructors with considerable field experience are available.

The text-books, as a rule, throw too many obstacles in the way of the aspiring plane table operator. Graphical solutions on the ground are what he should be concerned with, and no amount of literature can make him proficient without long practice in the field. Under experienced guidance the so-called "three-point problem" will cease to have any terrors for him; the old topographical hand has only a nodding acquaintance with this *pons asinorum* of theoretical scribes.

The student can also learn that resection from fixed points is the basis of good plane tabling; not interpolating positions at a distance outside fixed points, a method of locating given too much prominence by many writers on the subject. The curving lines of land and shore features as they appear to the observer in perspective will assume different shapes when adjusted to plan, but this difficulty will disappear with practice. In fact, there are a lot of useful things which can only be learned in the field and even the best books cannot attempt to explain some of the interesting developments which arise from a close study of nature's profile.

The Plane Table

The amount and variety of work that can be accomplished by the use of the ordinary traverse plane table in the hands of an experienced operator, is surprising. Some persons object that it is only serviceable on small-scale work, but almost any scale can be worked satisfactorily on it. The accumulation of field notes, tedious days spent in plotting, mapping features from memory and all the drawbacks to assembling a map perhaps several months after a survey, are eliminated by the use of the table. It has its limitations, of course, but in most cases it is economically superior to other methods of detail work.

Its Use in War

The plane table is very useful in times of peace, but during war it is indispensable. This instrument was used almost exclusively by the Field Survey Topographers of the Royal Engineers on battery positions, and the various surveys carried out by them during operations at the front. Our own Canadian Corps was not so fortunate, as good plane tablers, for some unknown reason, were not available. In July, 1918, at Corps Headquarters we had seven topographers, six Dominion land surveyors and one plane tabler. The land surveyors were very much handicapped in not being acquainted with the use of the traverse "table." The location of battery positions to ensure accurate shooting was rendered very difficult on this account, for although the men employed on this work did their best, the methods used were too slow and complicated for military operations. They were compelled to resort to angular measurements with the box sextant or transit, and as this system necessitated lengthy calculations, battery commanders were usually obliged to wait until the next day for their positions. The plane table was more prompt, the positions being resected on the spot, and the batteries had the necessary information before the topographer left the ground.

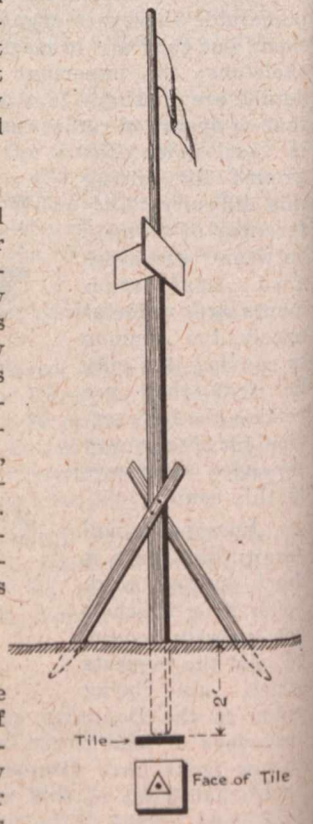

FIG. 3—TRIG. STATION USED ON TERTIARY TRIANGULATION

Fig. 1 shows an example of plane table projection which was used to make a billetting map. It is not an accurate