CHAPTER V.

PLANE TABLING.

General Principles.

Plane tabling is one of the methods by which the features of an area to be mapped are drawn upon paper for subsequent reproduction.

Such features are fixed in scale and position by the points of the triangulation framework, augmented by other instrumentally fixed points, and by points fixed on the paper itself by graphical methods.

The drawing of the features is then merely the final link in the chain which includes base measurement, main triangulation, intersected and resected points and graphical fixations as means of providing the necessary control.

The necessary density of such control can be stated, in general terms, to be of the order of fixed points about two to three inches apart on the paper.

The Principle of the Method Employed.

The plane table is a drawing board, mounted upon a tripod and capable of rotation in a horizontal plane.

The essence of the craft of plane tabling is that the board should be so oriented that directions upon it are identical with corresponding directions in nature. When this orientation has been achieved, rays from a known point, representing directions in nature, can be drawn upon the board. By means of intersecting rays, drawn from different positions, or by distances measured along a known direction, points of detail in the countryside may be transferred to the paper.

The art of plane tabling can be divided for purposes of consideration, into two main sub-heads:—

1. The methods employed for fixing the position and orientation of the board.
2. And, following upon 1, the methods employed to supply the detail.

The methods of fixing the position and orientation of the board are:—

Resection.

Lining up and cutting in.

The methods of supplying detail from a point previously fixed are:—

Intersection.

Ray and Distance.

Plane Table Traverse.

Preliminary Work.

Mounting

Before being used in the field the paper on which the map is to be drawn must be securely mounted on the board. This process should be carried out when the paper, which should be linen backed, has been thoroughly damped. Subsequent drying will tighten the paper and make it proof against minor changes in humidity.

Fig. 32 shows the method of cutting the paper prior to mounting.

The damp paper should be laid face downwards on a flat surface, care being taken to ensure that the surface is clean and will not injure the drawing face of the paper.

The plane table is then placed centrally on the paper, the outlying portions of which are pasted, drawn upwards over the edges of the board and held in position by drawing pins. Opposite sides of the board should be treated first. The paste used should be cornflour, or finest flour and water.

Plotting the Grid.

When the paper is thoroughly dry, a grid, or system of true squares, must be plotted upon it.

The first step in the drawing of a grid is the accurate construction of a rectangle near the outside edges of the board. It is clear that once such a rectangle has been drawn, equal distances may be measured off along its sides and joined by a straight edge.

To construct such a rectangle, draw any two diagonals, roughly from corner to corner of the board. Their exact position is immaterial. Let them intersect at O. From O strike off equal distances of such a length as to intersect the diagonals about $1\frac{1}{2}''$ from each corner in A, B, C and D. (*See* Fig. 33). Join these four points, which will then form a perfect rectangle, inside which distances as required may be measured and the grid drawn.

This grid serves to evaluate paper distortion, may be used as a method of dividing an area up amongst several plane tablers and provides a simple method of map referencing.

Plotting the Data.

The "data" for the plane tabler consists of the instrumentally fixed points which have been provided to control the area. They will usually be given as North and East Co-ordinates in terms of the Projection adopted.

These points should now be plotted upon the board as departures from the S.W. corner of the original rectangle.

The Easting Co-ordinate is found by marking off the East departure along the North and South sides of the rectangle and by joining the two points so found. The Northing departure is plotted from the Southern end of the line forming the Easting Co-ordinate.

A check on the accuracy of the plotting is made by measuring from the point concerned to the North line of the rectangle (to check the Northings) and to the East line (to check the Eastings).

It is essential that all points should be plotted from the same corner of the original rectangle and not from the corners of the individual grid squares in which the point may chance to fall. Only thus can the extreme and essential *relative* accuracy between these points be secured.

The accuracy of the completed map depends on the precision of the plotting of the points on which it is based. The utmost care must be taken to ensure that no error that can be controlled is permitted to appear.

Each point when plotted should be pricked through with a needle and marked thus :— This, the conventional sign for an instrumental station, should be formed by fine lines and should be sufficiently large to avoid interference with the drawing of nearby detail.

Before the field work is commenced, it is necessary to visit some point from which all the trigs. which have been plotted can be observed, to set the board on the most distant, and to check the remainder by aligning on their direction in nature with an alidade. This also enables the appearance of the trigs. themselves to be observed and to be readily recognised subsequently.

Work in the Field.

Instruments Required.

The following instruments are required in the field :—

1. Plane table, complete with legs and cover.
2. A sight rule, or alidade.
3. An Indian pattern clinometer.
4. A boxwood scale.
5. A trough compass.
6. Field glasses.
7. Penknife.
8. Pencils.
9. Rubber.
10. Emery, or a match box, for touching up the point of the pencil.
11. Needles (with home-made sealing-wax heads).

The Plane Table.

The *Plane Table* may be either square or rectangular. The "waterproof" cover often belies its specification and is a frequent source of dirt and friction on the drawing surface of the board. Precautions, such as wrapping the board in linen, should be adopted.

The *plane table legs* are sometimes fitted with a slow-motion rotary movement. Many experienced plane tablers, however, consider that the additional load involved outweighs any advantage which may accrue from this attachment.

The Sight Rule.

The sight rule, or alidade, consists of a straight edge, to each end of which is attached a vertical arm. One vertical arm has an eye slot and the other acts as a frame for a taut alignment wire. Spare wire should be part of the plane tabler's outfit. By means of the slots in these arms the rule may be aligned ; directions observed in nature may thus be transferred in pencil to the board.

A parallel arm is a convenience. The rule must be made of non-magnetic material, as long as the shortest side of the plane table and the straightness of the ruling edge should be occasionally verified.

Such verification can be carried out by ruling a line and then reversing the straight edge end for end. A line ruled under these reversed conditions should be coincident with that originally drawn.

The alignment of an alidade against a point on the board is best carried out by placing the flat base of the pencil against the plotted position of the point. The rule may then be aligned against the pencil base. The *point* of the pencil should never be used for this purpose.

For long rays in geographical triangulation the extra weight of a telescopic alidade is sometimes justifiable.

Indian Clinometer.

The Indian pattern clinometer consists of a level bubble in a frame with a vertical arm at each end. The instrument is levelled by means of an adjusting thumb screw and the elevation (or depression) of an object is measured by reading the tangent of the angle against a scale on one vertical arm viewed through a pin hole at the opposite end of the instrument.

By it, heights above M.S.L. are obtained. (*See* later, under Contouring, page 40)

Boxwood Scale.

The Scale should be tested for straightness. If where special parts of the plane tabling are carried out in the first instance on squared paper at an enlarged scale, care must be taken that the necessary scales are in fact available for use as required.

The Trough Compass.

The Trough Compass consists of a magnetised needle, about six inches long, suspended in a rectangular container. The compass is usually housed in a wooden box with a sliding lid. The closing of this lid throws the compass needle clear of its pivot.

When the orientation of the board has first been established with reference to distant fixed points, the compass may be placed on the board so that its needle reads in a central position. The position of the compass box should then be drawn in pencil on the board and will serve as an aid to correct orientation on future occasions.

It must, however, be remembered that the compass is subject to random displacements caused by the presence, often unsuspected, of nearby iron, and that any setting of the board by compass alone must be considered suspect until verified by other methods.

Field Glasses

The uses of field glasses in locating distant fixed points are obvious.

Penknife.

A penknife and a fine emery paper, or the side of a match box, are essential for keeping that sharp point on the pencil by which alone neatness and accuracy can be ensured.

Rubber.

Rubber should be soft and of good quality. If it is likely to be dirtied by the inside of the pocket it should be given a trial on the edge of the board on each occasion before use. If likely to be lost it should be cut into several pieces.

Needles.

Whenever a point, whose position is to be used for subsequent fixations, has been determined, its position on the board should be marked by a fine needle. Such a mark is unaffected by subsequent use of the rubber.

Fixation of Position.

Fixation.

As stated earlier in this Chapter the first necessity for the plane tabler on setting up his board is to fix his position upon the paper. This may be carried out in the following ways :—

1. Resection.
2. Lining up and cutting in.

The latter method being but a special case of resection.

Resection Theory.

Resection is based on the principle that once the board is properly set, alignments drawn from three distant fixed points will meet in a point upon the board and that point will represent the position of the plane table.

Resection Method.

The procedure of resection is as follows :—

The board is set up in such a position that at least four fixed points can be identified. A reasonable estimation is made as to the plane tabler's position on the board, and the plane table is set by aligning the sight vane along the line joining this point with the most distant fixed point. When it is difficult to estimate the plane tabler's position, an approximate orientation can be obtained by the trough compass by means of its marked position on the board. (*See* Trough Compass, above).

The board is clamped and rays from three distant fixed points are then drawn inwards from their plotted positions.

These three rays will (unless the original setting has, by chance, been accurate), produce a small triangle on the paper.

The Triangle of Error.

From this triangle the observer's true position on the board may be deduced from the following rules :—

1. If the observer is *within* the triangle formed by the three fixed points in nature, then his position will be *within* the triangle of error formed by the rays on the board.
2. If the observer is *outside* the triangle formed by the three fixed points, then his position will fall *outside* the triangle on the board.
3. If the position lies *outside* the triangle, the exact point will be such that it lies either to the *right* or to the *left* of all rays. This will be possible only in *two* of the sectors formed.
4. The exact position of the point is determined by the condition that its distances from the rays must be proportional to the *length* of these rays. This will be possible in only one of the two sectors mentioned in 3. *e.g.*, in Fig. 34.

By rule 2. The point lies *outside* the triangle.

By rule 3. It must lie in sector 3 or 6.

By rule 4. It must lie in sector 6 and at A.

The position having been thus obtained, the board is re-oriented on this new point and the process is repeated. This should result either in no triangle of error at all, or in a very small one. If the latter, the process is again repeated.

When no triangle is obtained, the position is "needled" and all redundant rays cleaned up with rubber.

The "Danger Circle."

The resection method cannot be used when the observer's position lies on or near the circle which circumscribes the three distant points. This circle is known as the "Danger Circle" and on, or near it, a resection will provide no triangle of error, whatever the original setting of the board. The plane tabler should be constantly on his guard in this respect.*

Another Method of Resection.

Another method of resection, based on the graphical measurement of the angles between fixed points subtended at the observer's position, is as follows:—

A piece of tracing paper, or linen, is placed on the board. From any point on the tracing paper, rays are drawn to the stations from which it is proposed to resect. The angles so formed are therefore graphical measurements of the subtended angles from the fixed points.

The tracing is then fitted over the plane table in such a way that each of the rays drawn upon the tracing passes directly through the plotted position of the fixed point to which it refers. When this position of the tracing has been found, the observer's position (*i.e.*, the point of intersection of the rays on the tracing) is pricked through on to the board.

Stretching and cockling of the tracing paper, and slight inaccuracies of draughtsmanship, added to the inconvenience of handling a loose piece of tracing in a wind, detract from the accuracy of this method.

It may, however, with advantage, be used to give a first approximation, which in many cases will be the correct solution.

Such solutions should always be checked by the normal methods previously described.

Orientation and Position.

Accuracy of *setting* the board is ensured by aligning on the most distant point, and accuracy of *position* by the nearer points.

Checking the Setting.

When checking the setting of the board, always align the alidade between the observer's position on the board and the distant point in nature, and then make sure that the straight-edge touches the plotted position of that distant point on the board. If the edge is aligned on the short base, *i.e.*, on the two plotted positions on the board in the first instance, it will often be found that the vane misses the distant trig. station in nature. This is due, not to inaccurate setting of the board, but to errors due to the prolongation of the short base.

Lining up and Cutting in.

A special case of resection occurs when the observer's position lies on the line joining (or in prolongation of) two fixed points.

Such a position may be located by observing the points concerned with a sight rule, and moving the board to the left or right until the required alignment (or prolongation) has been achieved.

The alignment having been thus established, a single ray drawn in from any fixed point, will suffice to locate the observer's position.

More commonly, however, a ray is taken from a fixed position to a point of detail (*e.g.*, a hedge corner) at which it is next proposed to resect. This ray is extended by "ticks" to the margin of the board. The alignment of this new point is then established, and the observer can now move to the selected position, set his board on the back ray and cut in, as previously, from any one trig. station.

Rule for Estimation.

It is clear that speed in resection is governed by the accuracy with which the board can be "set" in the first instance, and that this in itself is governed by the accuracy with which the position of the observer can first be estimated.

It is always advisable then, before leaving a station whose position is known, to draw a ray to the point where the table is next to be set up and to pace the distance.

This will give a very good approximation to the true position of the next point, the board being set on the reverse ray to the point which has just been vacated.

For this reason, the ray, when first drawn, should be carried by small "ticks" to the extreme edges of the board, so as to provide the maximum lever for the subsequent alignment. If this procedure is followed, triangles of error will often be avoided altogether; in any case, "Cape of Good Hope Stamps" will be, as ever, a rarity!

Checking.

Every resection from three points must be checked by a ray drawn independently from a fourth point.

Supplying Detail.

Procedure after Fixation.

When the observer has fixed his position on his board, he must not only supply all the map detail which can conveniently be put in from that position, but he must be constantly fixing points ahead of his direction, from which he can control his future work.

"To-day's work" and "to-morrow's control" has been adopted as a maxim by many successful plane tablers.

Intersection.

Intersection is used not only to fix detail, but also to supply those points of extra control whose fixation for subsequent working is so necessary.

Intersection possesses the advantage that it enables points to be fixed without being visited, and thereby saves time and money.

When a ray is taken to any distant object for the purpose of intersection, it should be drawn for a short length only and a ring in pencil sketched on it, to indicate the estimated position of the object. In addition the ray should be continued for a short length in the margin of the board, and a description, or small sketch, of the object should be drawn alongside it, for identification purposes. The ray should never be drawn right into the observer's plotted position.

*Cf. the pessimist, who said "I knew that I must be on the Danger Circle, because my resection came out first time."

At least three rays are necessary to fix the position of any point which is to be used as subsequent control. Two rays are sufficient for fixing points of map detail about whose identification there can be no reasonable doubt.

Care should be taken to avoid a multiplicity of rays from a station, which are difficult to identify when the object is inspected from a different position. It is a common fault of the beginner to cover his board with a dense and insoluble network of rays, of the significance of which he is in considerable doubt. A point should not be fixed by rays which intersect at an angle of less then 30°, or of greater than 150°.

Detail Drawing.

When the plane tabler has satisfied himself as to the fixation of his own position, and of all points likely to be of value to him for controlling his future work, he must undertake the drawing of the map detail at and near the position of his board.

This map detail is supplied, either by intersection, as described previously, or by direction and distance.

This latter involves drawing a ray to such points of detail as are to be included on the map and plotting a measured distance along that ray.

Pacing.

This measurement is usually carried out by pacing, though for very large scale work a chain or tape may be employed.

Every plane tabler should know the value of his paces, and should constantly check himself against known distances.

All pacing should be done at the normal walking pace of the individual. No attempt should be made to pace exact yards or metres. Subsequent adjustments of paces to the map unit can be carried out arithmetically in the head; alternatively a scale of paces may be made on a visiting card and used direct upon the board. An allowance, the amount of which can be discovered by trial, should be made for pacing under abnormal circumstances, *e.g.*, over rough ground, up or down hill, etc.

The distance up to which pacing can be trusted depends on the scale of the map and the individual accuracy with which pacing can be carried out. This is a matter which the plane tabler should investigate for himself.

e.g.—Plottable accuracy on board, $\frac{1}{200}$ inch.

Scale of map, $\frac{1}{20,000}$.

Then plottable accuracy equals (say) three yards.

A skilled man should be able to pace a distance of 100 yards over rough ground with an error of less than three yards.

Therefore pacing can with safety be carried out up to 100 yards.

A small point to remember is that when the plane tabler leaves his station to pace a distance, his board is at the mercy of inquisitive cattle, who may, in a few seconds do irreparable damage.

Intersection, combined with the "ray and pace" method mentioned above, should suffice to supply all the detail required. Under certain circumstances, however, recourse must be had to traversing, which is discussed later in this chapter.

The advantages of a "set-up" in such a position that direction rays are also detail lines on the map are obvious.

For example, in many places the board can be erected at the intersection of two hedges. Rays taken along the hedges suffice to locate their *directions*, while their *lengths* can be determined by the intersection of the opposite corners of the field from successive set-ups.

Sufficient has been written to indicate the main lines along which the work of supplying the detail should be carried out.

Practice in the field alone can make for perfection, for plane tabling is an art which cannot be acquired from Text Books. Some of the experience of others is, however, embodied in this chapter under the heading "Practical Hints" but such hints can in no wise replace the value of practice in the field.

Reconnaissance.

The value of careful and constant reconnaissance cannot be over estimated. The plane tabler should always have a clear idea as to the sequence of his future work. Before taking up a new area, he should ride or walk quickly over it, to obtain an impression of the general lie of the land and to decide upon an outline of the method by which he will deal with its problems.

As a general rule high ground will command a view of sufficient trig. stations to enable the control to be amplified as necessary by resection, but the valleys will constitute difficulties. The high ground should invariably be worked over before the valleys are entered, and such working should aim at supplying, not only intersected points in the valleys, but resected points, suitably marked, in places which are visible from the low ground.

If the high ground has been adequately dealt with in the first place, valleys and other "dead" ground will be found to have lost much of their terror.

Plane Table Traversing.

Plane table traversing.

In some enclosed areas it is impossible to resect, and points cannot be fixed by intersection. In such circumstances the necessity for a graphical traverse may be forced upon the plane tabler.

The principles of the plane table traverse are identical with those discussed in Chapter IV. All such traverses must begin and end on some previously fixed point and every refinement of care, must be taken, as all errors are cumulative.

The principle of the plane table traverse consists in the setting up of the board at some known point. A ray and distance is then drawn and plotted to some point in the required direction. The point so fixed is then visited, the board is "set" on the back ray to the point just vacated and a ray and distance to some further point is taken. At each station on the traverse, nearby detail is drawn in by ray and pace, and between stations additional detail is supplied by offset as in Chain Survey.

It is clear that the accuracy of the setting of the board is governed entirely by the back ray. Such rays, when drawn, must therefore be extended by "ticks," to the extreme edges of the board, in order to give the maximum length for subsequent re-orientation.

The orientation of the board is sometimes controlled by the box compass. The advantage of this method is that an error of setting in one leg is not, as in the "back ray" method, communicated to the remainder of the traverse, for the following leg is "re-assessed" by the compass without reference to the previous direction.

The disadvantage of this method is that the compass is affected by presence of iron, of which the plane tabler may be quite unaware.

Adjustment and plotting.

It is clear that as all errors tend to be cumulative in their effect, a traverse when drawn direct upon the board, will seldom "close" directly upon the plotted position of the fixed point.

For this reason it is usual to plot the original traverse on an extra sheet of paper, squared for convenience and pinned to the plane table. It is advisable also to work at a scale twice or four times that of the plane table for additional accuracy. The resulting traverse is then reduced geometrically to the required length and "swung" into the correct orientation before being traced on to the board.

Booked traverses.

The prismatic compass may also be used as an aid to plane table traversing. By recording bearings, distances and off-sets in a book, the result may be plotted on return to camp and adjusted to fit the control in the normal manner. It should only be used for small scales.

Contouring.

On contours.

At the same time as the detail of the map is being drawn, as described above, the contours or ground shapes are also being graphically recorded.

The contours are drawn on the map by eye, being controlled by fixed heights wherever necessary.

In the estimation of the "lie" of a contour a skilled plane tabler will outshine a learner in the most marked degree. A highly skilled man can almost "see" the contour line running like a tape over the country side. The acquisition of an "eye for country" of this nature should be the aim of every plane tabler and practice alone can secure it. The data by which contours are located is the series of fixed heights which are obtained with the Indian pattern clinometer.

The clinometer.

This instrument, described on page 37, reads degrees and tangents of angles of elevation and depression and thus by multiplying the tangent of the angle by the distance to the object (scaled from the board) the difference in height between the instrument and the point observed can be deduced.

By this means heights may be "thrown" to distant points of detail, or may be "brought in" to the observer's position from some point of known height.

Booking.

All observations with a clinometer should be carefully recorded in a Note Book in an orderly and systematic manner. Hasty scribbling on odd scraps of paper is much to be deprecated, and invariably leads to mistakes. When observing to a point whose position is not yet fixed, a record should be made of the tangent of the angle, the difference in height being supplied later when the position of the point has been fixed by subsequent rays.

General.

All points should be heighted from at least two separate sources, as a check against error.

The height obtained from the nearer fixed point is likely to be the more accurate.

The maximum distance at which clinometer heights are of value is limited by the contour interval. The instrument can be read to the third decimal of tangents. This third figure is therefore equivalent to one foot in a thousand, or five feet at a distance of a mile.

When observations are being made to a high degree of accuracy and over long distances, allowance should be made for the curvature of the earth and for refraction. *See* Tables.

Any height obtained with a clinometer is known as a "spot height." A large number of spot heights will determine where each contour must be drawn. It is essential that all contours should be drawn in the field, while the ground is actually lying before the plane tabler. Any temptation to provide a multiplicity of spot heights and to interpolate contours later in the office must be resisted.

It should be remembered that contours are but a conventional method of depicting the relief of the ground and may be "sketched" to a degree quite inadmissible with the drawing of the detail, with which process contour sketching should proceed simultaneously.

A helpful practice, when the height of the occupied station has been obtained, is to set the clinometer to read zero and then inspect the country in a circle around the position, noting which points are of equal height to the plane table.

When drawing in the field it is convenient to show contours as pecked lines, to avoid confusion with other detail.

Clinometer Adjustment.

The level adjustment of an Indian clinometer should be tested at the beginning of each season and at any other time if observations carried out with it appear to be discordant.

The clinometer is placed upon a plane table, set up at point A, and the height of the sight hole is measured and transferred to a staff (*e.g.*, a thin strip of white calico tied round a pole).

The staff is held at point B, about 100 yards from A and the reading of the calico, on the tangent scale of the clinometer is booked. The clinometer is then set up at B, at the same height above the ground as it was at A, while the staff is held at A. The reading at B should be exactly the same as it was at A, only a depression instead of an elevation, or *vice versa*.

If there is a difference, half of it will be the correction to be applied. This should be done by means of the milled headed screw, the bubble being then brought into the middle of its run by the capstan headed screws attached to the level.

The Value of Method.

As in any other work which requires a constant repetition of similar actions, a defined method of procedure at every plane table station is essential. A few minutes saved at each station through time-saving devices represent several hours in the course of a complete area.

The cunning man cuts his rubber into many pieces, and keeps one in each pocket. The well trained man has no need to do so, for he always keeps his rubber, as all his other tools, in the same places and his hand goes instinctively to what is wanted.

The following routine at a station is given not as being the best, for each individual will have his own ideas of improvement, but as being one which has been found to work well in practice:—

Routine at a station.

(1) Set up firmly and level the board. This levelling need only be approximate. (A test with a circular-section pencil is sufficient).

(2) Sharpen the pencil. Fix your position and clamp the board.

(3) Mark the point with a needle and clean up with a rubber.

(4) Look around for likely points to control your future work and draw rays to them.

(5) Look for previously seen control points, still lacking rays, and draw rays to them.

(6) Draw rays to detail points.

(7) Ray and pace to all nearby detail and draw it in.

(8) Make up your mind where you are going to set up next and draw a ray to the spot.

(9) Put your alidade back into its case; set up and level your clinometer.

(10) Fix the height of your own position from points of known height.

(11) "Throw" heights to your control points and to nearby detail.

(12) Draw in contours and sketch lightly any possible form lines.

(13) Mark your own position, if you intend to use it from elsewhere. Newspaper, cloth or a flag are suitable.

(14) Make sure that you have forgotten none of the above points; only the fool has to re-visit a station.

(15) Collect your gear and see that nothing is left behind.

(16) Pace off to the new point.

It is not intended that such a routine procedure should be memorised like a parrot, but it is emphasised that all skilled and fast plane tablers adhere to some such system as that outlined above, all be it unconsciously.

Amount of detail to be shown.

The beginner often has considerable difficulty in deciding how much detail should be shown on the scale at which he is working. The golden rule is that the maximum amount of detail should be shown so long as the map remains clear and legible. Remember that the final draughtsman can *select* what he will show, but he can *supply* nothing additional.

Practical Hints.

Maxims and Practical hints.

As has been stated before, plane tabling is an art and cannot be acquired from books. The following hints however may serve to pass on the experience of others:—

(1) Neatness and cleanliness go hand-in-hand with accuracy; keep the board clean, a sheet of tracing cloth, with a flap window to expose the actual area of the day's work, is a help to this end.

(2) Accurate work requires a sharp pencil; which in itself requires a sharp knife and a match box, or emery.

(3) Use the right grade of pencil. 6H in dry weather, 3H in moist weather, an H.B. for taking notes. Use a metal pencil guard to protect the points, and don't "waste" a drawing point by scribbling notes and marginal references with it.

(4) Always clean the bottom of instruments before placing them on your board.

(5) Remember the scale at which the work is being carried out and its effect. For instance, a hedge which has departures of up to four yards from the straight, will appear as a straight line at 1/25,000.

(6) Never go to a spot at which it is intended to resect without taking a ray and a distance to it, to serve as a first approximation.

(7) Work up to and around the difficult patches.

(8) Never go down into a valley without leaving good fixed points on the crest.

(9) Keep your lettering and headings absolutely simple. Fancy lettering and "art" North Points are to be deplored.

(10) Remember that winding roads and hedges are often best managed by running a line clear of them and inserting their deviations by off-set. The beginner always tends to exaggerate a curve.

(11) Don't carry your board with the drawing surface inwards on your back.

(12) Remember that contours in a river are usually equally spaced (unless of course there are waterfalls).

(13) Don't forget the height of the plane table itself when working out clinometer heights.

(14) Don't attempt to work in the rain.

(15) Don't draw more of a ray than is necessary.

(16) Clean up rays which are redundant as soon as they become so.

(17) Don't alter the angle of your pencil when drawing a ray.

(18) Don't forget the danger circle when you are resecting.

(19) Don't swat small flies on your board; their life blood is indelible.

(20) Don't forget elementary courtesy to the owners of the land on which you are working. such as the shutting of gates.

Finishing.

Additional Information.

It often occurs that information is required of a type which cannot conveniently be shown on the plane table sheet, as follows:—Tank proof areas, administrative boundaries, etc. All such information should be shown on additional traces, keyed to the original.

Names.

Names should be collected in a note book, carried for the purpose, and if possible verified by a local resident. These should either be crossed referenced to the map by numbers, or included on a special trace. Local information such as postal and telegraphic facilities should be similarly dealt with.

Inking in.

The day's work should be inked in each evening, only those portions which require checking or are liable to later adjustment being left in pencil. The extreme edges of the work should be left in pencil until comparison has been made with the neighbouring area.

All work should be inked up in waterproof ink; a little cadmium should be added to blue detail to ensure its photographic quality. All lines should be drawn with a ruling pen, steadied against a straight or curved ruler.

Edge comparison.

Edge comparison must be made as a matter of routine and the edge should be initialled by both parties to the common line when it has been done.

Checking.

Before a plane table sheet can be accepted it should be finally checked. A high point from which a good view is obtainable should be visited and rays taken to points at random throughout the area.