SAND-TABLE CONSTRUCTION.¹

By Captain W. A. D. DRUMMOND,
Royal Army Medical Corps,
Late Adjutant, 47th (2nd London) Division, R.A.M.C., T.A.,
AND
SURGEON F. W. STEVENS,
Royal Army Medical Corps,
47th (2nd London) Division, R.A.M.C., T.A.
(With Diagrams.)

Sand models used as aids to instruction in elementary tactics, hill warfare, systems of supply and evacuation and so on, often fall far short of the hopes and expectations of the instructor.

More often than not this is due to gross inaccuracies of proportion, form and colour in the model which render it unnatural and crudely artificial. Much useful work can, of course, be done on models which do not pretend to reproduce any known piece of country, but, where reproduction is intended, it must be accurate.

In this short article it is proposed to describe a method of achieving this accuracy in the hope that it may be of use to those who have not so far succeeded in solving this problem for themselves.

The Table.—The table built under our direction at the R.A.M.C. School of Instruction, 47th Division, T.A., Duke of York's Headquarters, Chelsea, consists of an inch timbered box measuring 12 feet by 5 feet by 9 inches, resting on a trestled under-structure at a height of 3 feet from the floor. The internal surfaces of the sides of the box are marked off longitudinally by parallel lines one inch apart, and this ruling affords a correct and ready method for measuring the heights of contours.

Sand.—For a table of the above size one cubic yard of the best river sand is sufficient. It is advisable, before placing the sand on the table, to have it carefully sieved in order to remove stones and gravel, which are likely to interfere with the construction of the model.

The sand is evenly spread on the table and thoroughly moistened.

Preparation for Construction of a Model.—In order to make an accurate model of any area, it is essential to build the model actually upon an enlarged map of that area.

Scale.—For Royal Army Medical Corps purposes, which involve the working out of intra-regimental evacuation, siting of regimental aid-posts and advanced dressing-stations and so on, we have found by experience

¹ Reprinted, by permission, from The Army Quarterly, Vol. xxix, No. 1, October, 1934.
that a scale of approximately 30 inches to the mile is most useful. Larger scales are difficult to make with any degree of accuracy, while smaller scales fail by leaving too much to the imagination.

**Enlargement of the Map.**—Two copies of the enlargement are required. The best enlargements are made from a 1/20,000 O.S. map.

The following are the methods of enlargement:

(a) By means of a pantograph.

This is a simple instrument used by architects and surveyors, but tedious to use, requiring a considerable amount of time.

(b) By means of a magic lantern.

The area of the map to be enlarged is cut into inch strips which are rendered translucent by heating in oil. Black paper is pasted on a plain glass lantern slide in such a way that only one square inch in the centre of the slide allows light to pass through. Spherical aberration is reduced to a minimum in this way.

The translucent strips of the map are attached by adhesive tape to the back of the lantern slide, and, inch by inch, the map is projected on to sheets of newspaper, or white paper with a texture similar to that of newspaper.

The sheets are placed at a distance which gives the required enlargement, and the contours, roads, rivers, houses, and so on, are traced on the paper by means of differently coloured chalks.

(c) By means of the epidiascope.

This apparatus affords the easiest and quickest method of enlargement. The map is projected on to paper pinned to a wall. The map is marked out in two-inch squares, and the paper on to which it is projected into twenty-inch squares, and the epidiascope is so focused that the two-inch square is projected exactly over the twenty-inch square. Distortion is avoided by moving the map only, the epidiascope and the position of the paper remaining fixed.

**The Construction of the Model.**—The two copies of the enlarged map, the one fitting exactly over the other, are pinned face upwards upon a firm bed of sand one inch thick, and, to mark outstanding features on the map, e.g., cross-roads, trig points and so on, thin metal skewers (bicycle wheel spokes) are inserted through the maps and sand layer into the floor of the box. The upper map is then lifted off, but can be replaced accurately over the site of the lower map by means of the skewers.

The level of the sand bed corresponds to the lowest ground level.

Thin orange sticks marked off in half inches are inserted at intervals of one inch along the first contour lines. Into the area so enclosed damp sand is tightly packed up to the required level, i.e. of the first contour, and the orange sticks are removed. A thin wire stretched tightly between opposite sides of the box at the level of the second longitudinal marking is moved over the model and the sand is thus cut off at the two-inch level.

The upper map is replaced over the metal skewers and the second
Working map elevated to show the original map on which the model is built.

Metal skewers, bicycle wheel spokes, over which upper map is threaded.

Original map on which model is built.

Parallel lines one inch apart.

Firm Sand Bed

Working map fitted accurately over the original map by means of metal skewers, with thin orange sticks inserted through the contour line.

House. Note that top aspect is slightly smaller than the base.

Plaster with wax models embedded.
contour lines are marked out by means of the orange sticks. The same procedure is followed and the wire is now drawn over the model at the level of the third longitudinal marking. In this way the model is gradually and accurately terraced out. Where under features are of importance additional contour lines must be drawn in on the map before it is enlarged.

The sharp ridges are then smoothed off and the whole is pounded by means of a handful of damp sand enclosed in a wet duster. The model is then covered with a wet cloth and the sand thoroughly moistened with a fine rose watering-can.

**Marking of the Model.**—The cloth is removed square by square. The working map is replaced and the positions of the roads, rivers, trees, houses, and so on are indicated by pricking the sand through the map by sharp skewers. These impressions must be faint.

**Colouring.**—Pasture land is shown by covering the areas with grass-green distemper which is shaken evenly from a pepper box. Distemper has a great advantage over chalk in that it is quickly moistened by the sand. It cakes together, and in so doing binds the sand to form a fairly firm surface. Coloured areas must not be touched as the distemper comes away in large patches on the fingers.

Heather is indicated by red and blue stippling, ploughed land by brown, and cereal crops by yellow distemper.

Haystacks may be made of wax or carved out of yellow chalk. Miniature trees are made from young green sprigs of heather. These are cut according to scale and sharpened for insertion into the damp sand.

Hedges are represented by wool of varying shades of green held in position by small pins.

**Marking of Roads.**—First-class roads are shown by $\frac{3}{8}$ of an inch tape, painted dull red with oil paint, second-class roads by $\frac{4}{8}$ of an inch tape painted brown, and third-class by $\frac{5}{8}$ of an inch tape painted dull yellow. Foot-paths and bridle-paths are indicated by $\frac{2}{8}$ of an inch tape painted grey-white. Oil paint is used in order to avoid diffusion of colour. All tapes are pinned to the sand over the impressions already made by the sharp skewers. The map is consulted at each step in case impressions have been obliterated by distemper.

**Modelling of Houses.**—Buildings are made in mass from hard candle wax. Scale specimens of houses, rows of cottages, huts, and so on, are modelled in wax, care being taken that the bases are made slightly wider than the tops. These are inserted into prepared dental plaster of Paris, which, after solidification, is dried in a hot oven and hardened. Hot water is poured over the mould and the wax is melted and washed out. The mould is pared and the sharp edges are removed. It is then well soaped over with a shaving brush and molten wax is poured in. Upon solidification the cast is removed and painted appropriately with oil paint. Bridges are modelled in a similar fashion.

**Rivers and Lakes.**—Large rivers are made by cutting them out from
the enlarged map, painting the strips blue or grey with cellulose paint and pinning them into position on the sand. Ponds and lakes are similarly made.

Railway Tracks and Telegraph Poles.—Railway tracks are formed from strips of three-ply wood three-eighth of an inch in width over which strands of brass or copper wire are stretched to represent the metals. It is necessary to build in the railway tracks when building the contours.

Telegraph poles are represented by black pins inserted according to the scale.

As each square is completed the model is checked and touched up, and all pin-heads are painted the appropriate colour.

Lighting.—It is most important that the lighting should be diffuse in order to obtain the best results. It should be from above and tinged with blue. A strong direct white or yellow light gives an artificial appearance to the mould.