CHAPTER 18

Cartographic Symbols

SPATIAL data constitutes such objects as are positioned at some places and can be represented on a map. It is concerned mainly with point locations (no dimension), lines (one dimensional), areas (two dimensional) and volumes (three dimensional). Spatial data of to-day being of a great variety and complexity is studied first to understand its characteristics and then put in order systematically. There are four categories of spatial data : positional, linear, areal and volumetric.

(i) Positional data or point data. The objects occurring at individual locations are termed as positional or point data. A big city though spread on a large area is considered as located at a point. A point it may be noted has no dimension.

(ii) Linear data. Being linear, it is one-dimensional data. If the data has some width, its great length lends it the special qualities of linearity. State boundary, railway lines and canals are examples of linear data.

(iii) Areal data. Here we are concerned with the data that is related to an area. Thus, areal data is two-dimensional. Landform features and vegetation types are examples of areal data.

(iv) Volumetric data as the name suggess is three-dimensional. Number of storeys of a building and amount of rainfall (expresses volume) that a place has, are examples of volumetric data.

Categorization of spatial data is, however, flexible. For example Delhi as spatial data can be positional as well as areal on small and large scale maps respectively.

Discontinuous and continuous data. Spatial data can be discontinuous or discrete and continuous. The discontinuous data is mads up of distinct or separate parts which are not attached to others. For example, data relating to temperature is continuous while that to irrigate area is discontinuous. The continuous data is that one which goes on or extends without interruption. It is derived through measurement at points and there occur no sharp breaks in the distribution of values.

Scaling of data. It requires skill to describe statistical data of to-day. Likewise it is not so simple to measure or scale the data. Before we proceed to measure the data it is imperative to know how positional, linear, areal and volumetric data are different from one another and to recognise differences between the various components of each class of data. Keeping these ponts in view we divide the data into 4 'levels of measurment' or 4 scales each of which has its own special characteristics. These characteristics are influenced by the quantity of facts. The four scales are—nominal, ordinal, interval and ratio.

(i) *Nominal scale* is of the lowest order. The data available is in its simplest form but classifiable. The information is arranged in some order to form groups according to similarities of source. The items of these groups are expressed by names only. The main criterion used to identify the difference between one thing and another is qualitative characteristics and not quantitative. For example, on examining the distribution of villages in a district, we may differentiate among the villages located in the sandy tract, the alluvial tract and the forest tract of the district. The number of the villages of each of the three tracts are counted separately and then totalled up. Such data are known as counted data.

Examples of the nominal positional data are Delhi and Gurgaon, those of linear data are a stream and district boundary, those of areal data are forested area and stony wastes and those of volumestric data are *kutcha or pucca* houses.

(ii) ***Ordinal scale.*** According to this scale data are arranged in an order and ranked. As the data are ranked we can know which measurement is smallar or larger than the other but without any reference to quantities. Thus measurements are differentiated in accordance with their sizes. Small, medium and large towns are differentiated by layman from one another without taking into account the quantitative aspect of the data. Likewise, tehsil headquarters are differentiated from district headquarters, and minor road from major, etc. The individual items are numbered and the information is known as measured data.

The ordinal data, whether positional, linear, areal or volumetric since vary in size, are minor or major smaller or larger, etc., without pointing to the quantitative aspect.

(iii) ***Interval scale.*** Interval scaling of data involves the difference (i.e. interval) in the values of various objects. In this scaling of data, the individual items are also numbered and the information is called measured data. Altitude (in metres) and temperature (in degree Celsius) are examples of interval scale data.

(iv) ***Ratio scale.*** When the scale has a true zero, the interval scale is known as a ratio scale. It may be pointed out that some quantities may have also minus values i.e. below zero as –5°C, –30°C, etc. The zero of temperature scale in degrees Celsius is fixed arbitrarily and is, therefore not a true zero. The zero of temperature scale in Kelvin degrees is, however, at absolute zero and is equal to—273.15°C. Ratio scale it may be noted is applied to quantities which are measured from true zero such as rainfall.

It may be noted that no distinction is made between interval and ratio measurements and they are considered on par with each other for preparing maps.

CARTOGRAPHIC SYMBOLS

A symbol is a sign or mark which represents an object with or without quantity, on a map. There are three types of symbols (a) *point*, (b) *line* and (c) *area*. They are called cartographic symbols because of their extensive use in map making. These symbols may vary in size, shape and colour. Point and line symbols in particular, vary in size and shape.

(a) ***Point Symbols.*** A sign prositioned at a particualr point on a map is known as a point symbol. It marks on the map the point where the object or the quantity is located on the ground. Point symbols are, thus, drawn to represent data pertaining to individual locations. They represent quantities which are in absolute figures such as districtwise population, districtwise area under a crop in hectares, etc., and which are unevenly distributed on the ground. Thus, point symbols like the line and area symbols can be both qualitative i.e. non-quantitative and quantitative@ (see Fig 180). Even when a point symbol covers map area that is larger than the area occupied by the object, it indicates an individual loction only. It may be pointed out that though round dots are commonly used, a point symbol of any shape can be selected to symbolise

@ Qualitative symbol is a symbol which is represented without its quantitative aspect. For example, when you quantitative data. Point symbols are generally of small size. They should, however, be distinct and able to enhance contrast.

Students are familiar with the *conventional signs* (see p. 181) used on topographical maps. The signs representing various objects of the ground are placed on those points of the map which represent locations of the objects on the ground. Many of the conventional signs serve as point symbols such as signs of a light house, a temple, a deserted village, etc. Some are line symbols such as roads, boundaries, coastlines and some area symbols such as grasslands, stony wastes, tea gardens, aerodromes etc. Point symbols on the topographical sheets generally do not represent quantities. The forms of the symbols used on the topographical sheets and some distribution maps are so designed as to conform to the shape of the object. This is done with a view to facilitating an easy identification of the objects. For example, signs of a village, a temple, a mosque and a battle-field easily identify these objects.

Non-quantitative symbols are also marked on maps to represent spatial distribution of objects. These symbols are easy to draw and the map on which they are marked is easy to understand. Quantitative comparisions are, however, not possible.

We do have a variety of maps using quantitative point symbols. Here we assign to a point symbol, a certain number of the quantity to be represented on a map, and find out the number of point symbols to be placed on the map by dividing the total number of the quantity by the number assigned to the symbol (see pp. 249 to 252). Quantities which vary gently, are represented by point symbols, mostly round dots of uniform size. However when quantities vary rather abruptly, they are represented by a point symbol (simple bar, circle & square) of varying sizes. The size of the symbol varies because it is made proportional to the quantity it represents. The point symbols whose sizes are proprtional to the quantities they represent are termed as *proportional* or graduated symbols (see pp. 207 to 209 for proportional squares and pp. 212 to 215 for proportional circles). The proportional symbols are used to represent population of towns, cities, cargo handled at ports and air-ports, etc. Production figures of a commodity of different districts or states are also illustrated by these symbols. Though located in administrative sub-units, these symbols are taken as point symbols.

Among proportional symbols, it is easy and simple to use proportional one dimensional or two dimensional symbols. Simple bar which is a one dimensional symbol (see p. 263) can be easily extended to represent increasing quantities. It is easy to draw it besides it is easily commensurable. It is, however, not suitable for representing a very large quantitiy for in that case it becomes very long (see pp. 262 & 263). Therefore, propotional simple bar is used when range of data is small. The bar is drawn generally vertically letting its one end touch the point which indicates the location of the quantity to be represented. Among the two dimensional symbols, circles and squares are commonly used. These are area symbols and their areas are proportional to the quantities they represent. As compared with proportional simple bars, proportional circles and squares can represent data of greater range. It is also easy to draw them. Another advantage of one and two dimensional symbols is that they can be sub-divided to represent components of the quantities (see p. 200 for sub-divided bar diagram, p. 211 for divided square and p. 215 for divided circle). Three dimensional symbols namely spheres and cubes are volume symbols. They are difficult to construct and visual comparisons of quantities represented by them, are far from accuracy. Even though data of very great range can be represented by spheres and cubes they are generally avoided. Among the above mentioned symbols proportional circles are more commonly used for the reason that they can be drawn more easily and give better visual comparison than spheres and cubes.

The radius of the circle representing the *smallest quantity* is chosen carefully. It should be of minimum size but clearly distinct.

While deciding upon the length of the radius of the smallest circle it should be borne in mind that the proportionately made large circles when drawn should remain within the boundaries of the administrative units.

We can also use a small square instead of a circle. The sides of the squares are increased proportionately when large quantities are to be represented. Instead of using proportional squares, we can use two small squares to represent a quantiy when it is two times larger than the smallest quantity and three small squares when it is three times larger than the smallest quantity and so on. The squares being repeated symbols can be easily counted. It is also convenient to draw them if their number is not very large (see Fig 178).

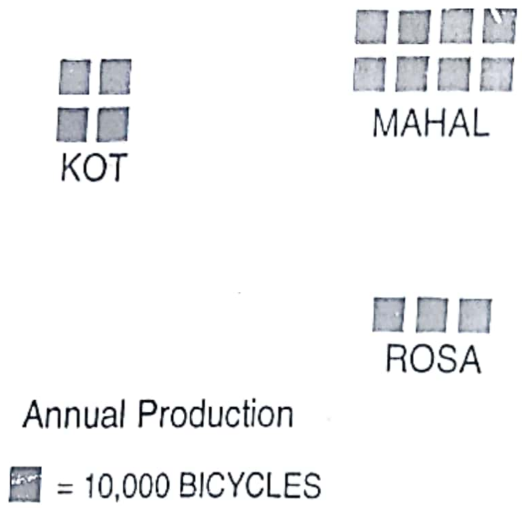

Fig. 178

In addition to dots, bars, circles and squares, etc., we also use pictorial, literal or arbitrarily selected symbols. The sizes of these symbols are also made proportional to the quantities they represent. Pictorial, numerical and literal symbols change in size as do the squares (see p. 207). It would be convenient to draw squares in lead pencil to represent various quantities and then with the help of stencils having appropriate sizes of letters or by free hand draw letters or numerals inside the squares. Erase the outlines of the squares after having drawn the letters or the numerals. The numerals represent the quantities in thousands, millions, etc., and under each numeral the name of the town it represents, is written (see Fig. 179)

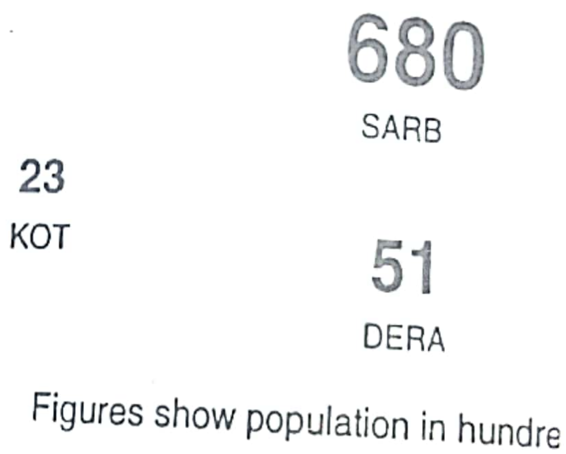

Fig. 179

Some commonly used symbols are given on the next page. These symbols are so designed as to maintain the legibility of the map.

Just because a *round dot* is easy to draw, it is commonly used to represent the number or quantity of an item on a map. A map representing the distribution of an item by repeated dots of uniform size and same value is termed as a *dot map*. The size of the dot is neither too small nor too large. While selecting the size of a dot, the aim should be to create an effective variation in the density of the dots marked on a map. Dots may touch each other in the areas of high density and lie wide apart in the areas of low or very low density. Very fine dots are avoided. Bold dots of about 1 to 1.5 mm (or about 1/16 inch) diameter are drawn instead (see pp. 249 to 252 for a detailed account of a dot map).

When it is desired to show the distribution of more than one commodity on a map, we make use of *coloured dots* of uniform size. Each commodity is represented by a dot of a particular colour. Thus, to represent

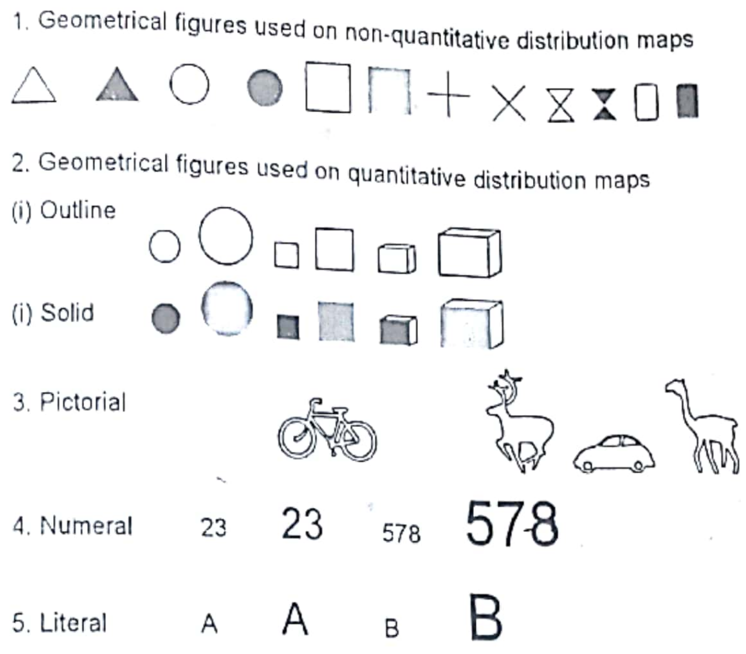

Fig. 180

distribution of areas under rabi crops—wheat, black gram, barley and mustard—we may use coloured dots. Distribution of ethnic groups can also be represented by coloured dots. The colours selected for the dots should contrast clearly. The advantage of this method is that changing patterns are easily discernible.

Sometimes we may be required to represent on maps different kinds of information about the same item. For example, when distribution of small villages, medium-sized villages and large villages, is to be shown on a map, this may be done by using dots of different sizes. Locations of small villages, medium-sized villages and large villages are represented by dots of small, medium and large sizes respectively. These qualitative dots of different sizes are termed as *multiple dots*.

It is easy to understand and execute the technique of preparing a dot map. Moreover when there are noticeable variations in the distribution, the dot map represents them effectively.

Though it is easy to draw a dot map, it is often difficult to keep an exact count of dots especially when their number is large. Though each dot represents a quantity, there being numerous dots, it is very difficult to even estimate quantities of different parts of the map and thus compare them satisfactorily. Since dots are placed on small scale maps, exact location of the point where the dot is to be placed, may be missed. Thus, positions of dots are imprecise. A dot map also fails to bring out small variations in the distribution and, thus it gives an impression that a quantity is evenly distributed in the areas where the variation is small.

Dot map requires a great skill and knowledge of the area. Thus, there is a need of topographical sheets for preparing a population distribution map.

A dot map has a special merit. It can be transformed into a choropleth map as well as into an isopleth map. The dot map meant for transformation into these maps should, however, be drawn accurately. For methods and advantages of transforming a dot map into a choropleth map see p. 257 and for transforming a dot map into an isopleth map see pp. 260 & 261. See also p. 245.

(b) *Line Symbols* are individual lines drawn to indicate positions on maps. Many objects such as roads, foot-paths, streams, etc., are delineated on maps by lines. These symbols are also used to represent boundaries of administrative units, steepness of slopes and size and direction of traffic. An interesting case of line symbols are the hachures which represent steepness of slope. The symbols representing the size and direction of traffic are known as *flow-lines*

Line symbols can be both qualitative and quantitative. The qualitative ones show linear distribution such as roads, streams, boundaries, etc., without giving any quantitative information. The quantitative ones represent some data in respect of linear distributions. These include among others, isopleths & flow lines.

Isopleths are imaginary lines which join places of equal values in respect of some distributions. Examples include contours, isohyets, isotherms, etc. Isopleths which show distribution of quantities as percentages, (e.g. percentage of net sown area to total area of a district) spatially are also line symbols (see pp. 257 to 261). Since they are independent of administrative units and since they are drawn with the help of nearly accurately placed dots, isopleths give a more accurate picture of distribution than area symbols (choropleths) (see p. 252). Unlike dots, isopleths are used when variation in the distribution of quantities is small. The shaded portion of an isopleth map, however, fails to bring out variation in the distribution effectively. To represent percentages by isopleths, we first represent the distribution of quantities in absolute figures by dots and then transform the dots into isopleths. See pp. 260 & 261 for the method of transforming a dot map into an isopleth map.

Flow-lines. These lines generally show the size and direction of traffic on a route map. The width of traffic flow-line is determined by using a suitable scale. A certain volume of traffic is represented by a line of convenient width. The width of this line since serves as a measure of the volume of traffic, two such lines represent two times the volume of traffic, three such lines represent three times the volume of traffic and so on (Fig. 210). These lines are drawn close to one another. Volume of traffic is also shown by bands the widths of which are proportional to the volume of traffic they represent (see p. 309 for details).

(c) *Area Symbols* can be both qualitative and quantitative. Symbols used to delineate areas occupied by desert, forest, industrial belt, soils, etc., are area symbols. These area symbols, however, do not represent any value or quantity (see Fig. 181). They are, therefore, known as non-quantitative or qualitative symbols. They are used for preparing chorochromatic maps (see p. 248 for details).

Area symbols used on quantitative maps since show 'ratios' are different from those drawn on qualitiative maps. They denote various shades of black or other colours drawn in the areas delimited by administrative units to bring out relation between the areas and the quantities represented by them such as average density per unit area, percentage of net irrigated area to net sown area, percentage of area under a crop to total cropped area, etc. (see Fig. 182).

The data is divided into about 5 or 6 groups and a range of shades is selected (see p. 253). Each group is represented by a shade different from the other shades. Intensity of darkness of shades decreases gradually from the darkest shade representing the group of the highest value to the lightest shade representing the group of the lowest value. In Fig. 186, we have made 5 groups of the districtwise areas under wheat. These areas have been expressed as percentages of the districtwise total cropped areas varying from 4.2% (lowest) to 41.9% (highest). If the class interval is 10%, percentages less than 10

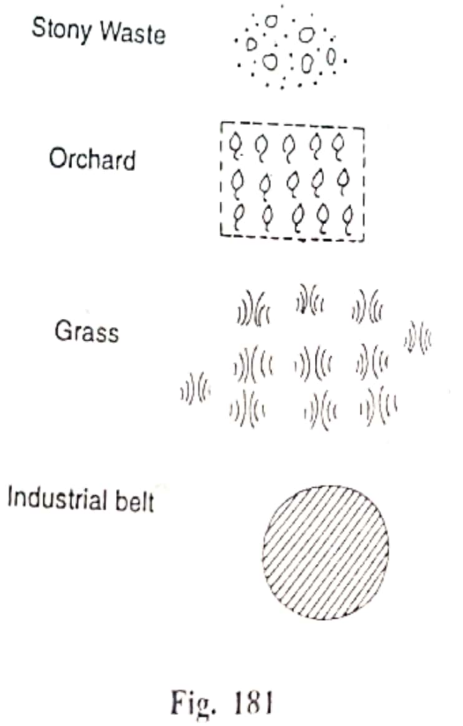

Fig. 181

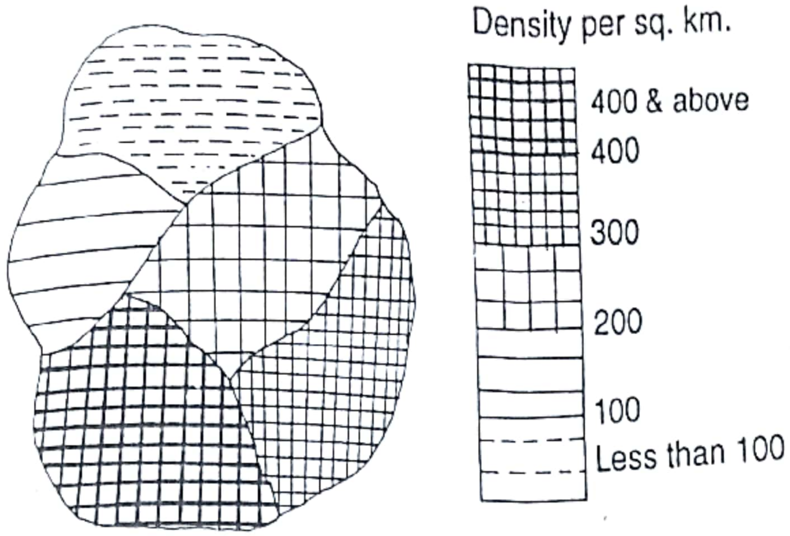

Fig. 182

are included in the first group, 10 to 20 in the second group, 20 to 30 in the third group 30 to 40 in the fourth group and 40% & above in the fifth group. Percentage of area under wheat is lowest (less than 10%) in Bhiwani (4.2%) and Mahendragarh (9.3%) districts. Therefore, these two districts are included in the first group and are represented by the lightest shade. Percentage of area under wheat is highest (40% & above) in Karnal (41.9%) and Sonepat (41.1%) districts. Therefore, these two districts are included in the fifth group and are represented by the darkest shade.

A shade suggests that the values represented by it have common characteristics and the area in which that shade has been drawn has uniformly the same distribution. Thus, different shades on a map give a clear picture of the variation in the distribution. Even small variations in the distribution can be brought out by the choropleths by adjusting the range of shades. Accordingly densities represented by various shades can be easily compared. Thus, choropleths bring out variations clearly. However, two weak points emerge from the juxtaposition of the various shades. First, the patch covered by a shade suggests that the area covered by that shade has the same density everywhere. Second, change from one shade to another suggests sudden change in the density.

When quantities pertaining to the unit areas are symbolised by area symbols, the map produced is known as a *choropleth map*. In other words, a map which illustrates variations in the distribution of average values per unit area by different shades, is known as a shading or a *choropleth map* (for details see pp. 252 to 256). Choropleth maps are essentially ratio maps such as density of population map which shows ratio between population and area. Likewise, ratio data, such as density of population is never shown by dots. It may also be noted that a choropleth map does not present data in absolute numbers such as 5810 persons in district A, 1100 persons in district B, etc., but as stated above relation between the area and the quantity represented, for example120 persons per sq. km.

In some administrative units, large negative areas such as marshy, sandy, forested and stony patches may be uncultivated or uninhabited by man. In such cases, we first show distribution by dot method and then transform the dot map into a choropleth map (see p. 257). The uninhabited areas are generally isolated when dot map is transformed into a choropleth map. If the negative areas are included in the total area of the administrative unit, actual average figure of the density, etc., will be reduced and also uncultivated or uninhabited patches obscured by the shade.