MAP DESIGN AND LAYOUT

Map design and layout determines the aesthetic quality of a map. The information at the disposal of the cartographer is of great variety and complexity, but to depict them all that is available and useful with clarity, simplicity, accuracy, legibly and aesthetically is not easy. Map making is a scientific exercise but it is no less an artistic job.

Use of computers in making maps has not changed the situation. Computers only replace manual work involved in drawing symbols and placing them at appropriate places. We still need artistic bent of mind to make a good map. Like an artist, a computer operator too has to follow certain principles of visual art but he does not have complete freedom of portrayal techniques and media. A cartographer whether he prepares the maps manually or with the help of a computer shows his artistic talents within the framework of two constraints:-

1. Cartographic traditions and conventions; and

2. Basic requirements of maps themselves.

A map is designed to serve certain utilitarian purposes. Its aesthetic value is, therefore, desirable but cannot supersede its utilitarian value. The artistic talent has, therefore, to function within the framework of the utilitarian requirements. But an ugly, misleading, and difficult to read is a disaster. It detracts people away from maps and thus away from cartography, the science of map making.

A cartographer uses a variety of symbols to represent selected information on a map. Each bit of information is an integral component of the map. In order to produce a good map, it is not enough to represent each of these components clearly, simply and aesthetically. This is indubitably important but more important is the presentation of these individual components in such a manner as to create a good integrated picture of the whole. In a map, the individual components get their meaning only with reference to the map as a whole. Map design involves the development of this integrated plan and style of the map and its individual components, and layout involves the arrangement of these individual components on the map.

As mentioned earlier, there are innumerable things which can be shown on maps, But everything that exists or that can be conceived to exist is shown on all maps. Each map is made to represent only a select few features, natural and human. There are certain marginal details which are given in all maps such as the title of the map, the legend, the scale, and the land and see boundaries and the graticules. Then there are features which help the reader understand locations and distributions better such ag main roads, railways, etc.

Maps can broadly be classified into two types: general, and thematic. The maps, which represent a variety of things-the things about which people in general are more intimately concerned in their day-to-day life, are called general or reference maps. The maps which give specialized information only such as political map, physical map, population density map, etc. are called thematic maps. In these maps only a few details get visual prominence. The other details are either not shown at all or are shown merely to produce a background effect. The problem of making certain things visually significant without giving the impression of imbalance in the total design of a map is the most crucial problem in map design and layout. A map has to be an integrated whole, but within this holistic vision certain components get prominence over many others, not necessarily because they are more important in reality but because they are more important for the persons for whom the cartographer makes the map.

In order to prepare a balanced map and, yet, to make certain component of it visually more significant, we have to have the understanding of:

1. Theory of visual perception;

2. Techniques of making things visually significant; and

3. Limitations within which cartographers function.

THEORY OF VISUAL PERCEPTION

Perception means awareness of things and ideas we come across. This awareness comes through sensations like sight, sound, taste, touch, mental image, etc. The Epicurean Greek philosophers said that the objects which we see emit something of themselves to our eyes. After Newton's discoveries, it was generally believed that the objects, rather than emitting something of themselves, reflect light to our eyes, very much as it happens when we use a camera to take photographs. This image is supposed to be the exact copy of the objects seen. Experiments later disproved this theory also. Various optical illusions were given as the basis for discarding this theory. Then came the theory of perception which lays emphasis on the interaction between the perceiver and the objects perceived. This theory can be explained better by taking the example of sunlight falling on an object, say, grass. We see grass to be green because it absorbs all the light waves except the green. The light waves creating green are not green SO long as certain cells in the retina of the eye do not interact with the light wave in certain ways to produce the experience of green. Neither the light emitted by the grass nor the sensory cells in the retina are green. It is the interaction between the two, which produces green.

The most recent theory of visual perception disapproves all the above theories. It suggests that perception is in reality a transition and that various shapes, colours etc., that We perceive exist only in terms of the situation in which they are perceived. It

1. Total environment in which the object lies enters into perception as an active input, and

2. The object, if removed from the given environment, loses its whole meaning.

An example will make it clear. When we look at the sunset, we do not see certain colours, lines, shapes and shades. We see the sunset. We do see the details of the colour and shapes but only sub-consciously. What we get, however, is a total visual experience. The bright colours we see in the sunset do not bother us but they surely bother us if we have wall papers of the same colours.

The above noted shift in the theory of perception is very pertinent and relevant to map design. It, in effect, tells us that various symbols that we use to make a map, acquire their desired meanings only in the context of the map as a whole. They will convey little or no meaning if they are removed from the total situation i.e., map as a whole. Further, it also indicates, that the same symbols and their arrangements cannot be used in all maps, for each

map is designed to present a different complex of things and situations. What is good in one map may prove to be disastrous in others.

This, however, does not mean that individual components of a map are also map specific and vary in importance. A line, one of the simplest elements of a map, for example, can be manipulated to produce different perceptions. A line involves -relationships within itself and with its surroundings. A horizontal line produces the perception of line direction. A vertical line tends to produce more tension and excitement than a horizontal line. A diagonal line produces discomfort to the observer's eyes because it lacks balance.

The positioning of symbols in association with various types of lines produces different perceptions. For example, if a bending man is shown standing on a diagonal, he appears to be picking up something from the ground. But if he is placed beneath the diagonal, he appears to bend under the weight of space above him. Several lines put together in different orders produce different perceptions. Lines forming various shapes, like squares, triangles, etc., lose their existence altogether. When we see a triangle, we never perceive it to be three lines put in a certain order. We see a figure with three sides. The new theory of perception also tells us that like other symbols, colours are also seen against the background in which they appear.

When we look at a visual symbol or a group of symbols (map) we first perceive only vague shapes, colours, lines, and letterings. These symbols slowly begin to relate to one another. At first we perceive the distribution of land and water quickly if the two features are shown in a familiar way i.e., water is shown in blue colour. And we take quite much of time, if the colour scheme has been reversed and they are shown in not familiar.

'Once these broad features are recognized, the smaller internal relations begin to unfold themselves. We see the rivers, railways, roads, canals, and towns and the interrelations among them. This is, just like the situation of visiting a factory for the first time. At first everything is inarticulate, but soon we distinguish various sounds, machines and sections. Finally, and after a necessary period of time has elapsed, the various parts appear to present a meaningful whole.

Making Symbols Visually Significant We see the above mentioned integrated picture of maps in three phases:

1. Diffusion phase

2. Differentiation phase

3. Integration phase

Diffusion Phase

During this phase, the map reader sees only the visual outline of the map. Whether it is a reference map or a thematic map, the visual outline gives to the reader an idea of what the map is trying to lay emphasis on. According to Robinson the fundamental elements of the visual outline are:

1. The place,

2. The phenomena portrayed,

3. The position of the phenomena in the area, and

4, The relative position of the symbols.

If the objective of the map is to lay emphasis on places, they should stand out distinctly in the map. This is done when we prepare a map showing location of cities. If the distribution of certain phenomenon are to be emphasized, the specific region where they are distributed should be made distinct and if certain things are to be emphasized within that area, first the area should be made distinct from its Surroundings and then the region where the phenomenon is distributed should be made distinct from the rest of the area. Finally, if the distribution of two different phenomena is to be given prominence, they should be made quite distinct by using contrasting colours or shades.

An arrangement of the type suggested above will make the prominent aspects of the map stand out from the rest of the aspects. Such an arrangement enables the map teader to instantly know the main thrust of the map as soon as he looks at it. The visual outline serves the same purpose as the chapter headings in a book. By making the outline prominent, the map maker is able to transform his products into effective instruments of visual communication.

Differentiation Phase

In this phase of visual communication, the eyes of the map reader look for further details of the phenomenon portrayed in the map. A good map is marked with two characteristics of the data represented on it:

1. They are authentic, and

2. They are represented clearly, legibly and effectively.

Both the qualities must be present simultaneously. A clear, legible and effective representation is no substitute to correct representation, and vice versa is also true. A good balance has to be struck between accuracy and effective, clear and legible representation.

Presentation of symbols: To make a map clear and legible, symbols used must be adequately differentiated from each other. For example, all lines must be clear, sharp and uniform. To differentiate one line symbol from the other, we can either use varying thickness or varying designs of lines.

Size and shape; The size or width of symbols used in a map should be large and distinct enough to enable the map reader to see them. In this connection it should be kept in view that the unfamiliar symbols can be seen by a normally sighted person only if it subtends an angle of at least one minute at the eye. It means that farther away a symbol is from the observer's eyes, larger it should be in size in order to be legible. As all the people who have normal sight are not really so, it is better to keep this limit a bit higher. Experiments in this regard indicate that the angle subtended by the symbol with the eye should be between 1.75 minutes to 2.5 minutes.

In addition to being sufficiently large in size, symbols used on a map in conjunction with gach other should be such that they stand out individually on the map. They should present a good contrast with their surroundings. The contrast can be achieved py varying the shape, shade and size of symbols. How various line symbols can be contrasted with each other has already been discussed earlier. We may vary the thickness or the design of the lines for this purpose.

Colour and Shade: Colour is by far the most important single medium in map design: it enables us to create a better contrast in symbols. Used in conjunction with other

graphic symbols, it makes the portrayal of data visually most interesting. It also enables more information to be fed in a map without congesting and cluttering it.

In order to make an effective use of colours, we must know something about its relevant characteristics. Colour is an ingredient of sun light. It can be separated in the form of familiar rainbow or spectrum by passing light through a prism.

The wavelengths of the seven colours which constitute sun light vary from 1/79,375 cm for the red to 1/157,813 cm for the violet. Wave-lengths of less than 1/ 157,813 cm or more than 1/79,375 cm cannot be perceived by human eyes as colour. This is, however, not the case with all life forms. Some insects can perceive ultra-violet rays in the form of a colour because their sensory cells are made to respond to them as a colour experience.

The spectrum of the seven colours which we can see is derived from three primary colours. These are red, yellow and blue. These are called primary colours because all other colours can be produced by a combination of these three.

Despite the fact that our eyes perceive only a limited wavelengths as colour we can perceive a wide ranging combinations of colours. The colours that we perceive have three characteristics. These are:

1. Hue,
2. Value, and
3. Intensity.

Hue is the quality which differentiates one colour from the other. In all, there are hues:

1. Yellow-red (orange),
2. Yellow,
3. Yellow-green,
4, Green,

5. Blue-green,

6. Blue,

7. Purple-blue,

8. Violet,

9. Purple, and

10. Red-purple (magenta).

The shades between any two hues can be further subdivided into ten steps, to make 100 hues in all. Each of the hundred hues is further divided vertically and horizontally. The vertical divisions are called values. Each hue has ten shades of values ranging from white at the top to black at the bottom. Each hue is again divided into 10 shades to give the varying degrees of intensity or brightness or relative saturation of the colour area. These 10 shades vary from gray to pure colour. Thus, we get combinations to create over 5000 colours. These colours are designated to give all the three characteristics. For example, Y.R. 4/3 means (yellow-red) of fourth gradation in darkness (value) between black and white and third gradation in brilliance (intensity) from gray to full yellow-red.

Human eye is most sensitive to red, followed by green, yellow, blue and purple colours in that order. Certain colours like yellow, blue, green, red, white and black appear as distinct colours while the others appear as mixed ones. While choosing colours to depict different features on maps, these facts should be kept in view. Another thing to be borne in mind is that colours maintain their original hue, value and intensity only when shown individually. In association with other colours they tend to lose their specific characteristics. For example, a dark area shown next to a light area will make the dark appear darker and the light lighter. It means that by rearranging the location of various symbols with respect to each other, we can create different apparent values. The symbols, including colours, used in a map have a value rating. Whether they maintain the rated values or not depends on their arrangement with respect to each other and within the frame of the map.

Patterns: Patterns also help us differentiate the phenomena represented on a map. Patterns can be and are used in place of colours where use of the latter is not possible, for reasons explained later. Patterns are made by varying arrangements of lines and dots, separately or together. The possibilities of getting patterns of lines of dots or both are surely

unlimited. But not more than 100 patterns are generally used in designing maps. The most common among them do not exceed 25.

From a visual viewpoint, dot patterns are better than line patterns. As lines have directions, viewer's eyes tend to give an image of something unstable. At times they join the boundary lines and make letterings merge in patterns. Unless line patterns are formed by closely set fine lines, they are irritating to the eye. As against this, dot patterns give an indication of stability, and are pleasing to the eye.

Integration Phase

The final phase of observation of a map or perceptual development occurs when various articulated elements of a map are composed into a coherent whole. A well integrated map will give sufficient material or information to bring to light the purpose of the map. It will be simple without ornate artistry so that the attention of the reader is not diffused. Such a map will evoke similar responses among many map readers.

One of the ways of achieving better integration is the positioning of various components of a map in such a way that their relationships appear logical. In a well balanced design nothing is too small, too large, too bright, or too light. The importance of each component is directly related to its position and visual significance.

To determine whether a map is balanced or not we have to view it with respect to its visual centre which is little above the centre of the area enclosed within the neat line of the map. If an item is out of balance it may be above or below the visual plane. Cartographers aim at balancing the various components of a map so that they appear natural and realistic.

CONSTRAINTS IN MAP DESIGN

As discussed earlier, a cartographer is not as free as an artist in representing the objects he selects for the map. The constraints within which a cartographer functions can be grouped under three heads:

1. Cartographic

2. Technical

3. Resource Cartographic Constraints

1. Cartographic

A number of cartographic conventions have been evolved which are usually followed while designing a map. Many of these conventions have now been internationalized, so that any departure from them appears to be unnatural and incorrect to the map reader, Take, for example, the question of representing water features by blue and plains by green. We know that all water bodies do not necessarily appear blue nor are all the plains green. On our physical maps the evergreen Sunderban forests are shown as green as are parts of Rajasthan desert. Supposing that we try to reverse the colour scheme and show the water features by green and the plains by blue, the map users would consider it wrong. The only logic behind the existing method of representation is conventional usage.

If we compare the topographic maps published by various government agencies the world over, we will find that most of the symbols used therein are common. these symbols are often referred to as conventional signs because they have been conventionalized. Whether these symbols are logical and aesthetic or not, is of gecondary importance. The map users have become used to such symbols and hence their replacement will create confusion.

It does not, however, mean that a cartographer has no freedom of innovation. first, there are only few symbols which have been conventionalized and secondly, even the conventional symbols to a certain extent can be modified in size and style to present a different picture. For example, it is a convention to represent water in blue put there is no restriction on using different tones of blue: flat, half-tone, etc. We can change the hue, value as well as the intensity of blue to see that the water features do not give an unpleasant look.

2. Technical Constraints

While designing a map, a cartographer has to work within a number of technical constraints such as publisher’s specifications, data availability, scale and projection of the map, and method of reproduction.

Publishers Specifications: The publishers have certain set ideas about the kind of map they want to publish. There are people who want are great variety of information to be fed in a single map. They prepare a long list of facts to be portrayed and also suggest the size of the printed map.

Maps serve a number of purposes. Some of them serve as wall maps, others as atlas maps, but a vast majority of them go as illustrations in various publications. For each purpose, the design has to be different, although the information given might be the same. Wall maps are to be seen from a distance of more than five feet. In these maps only outstanding features are depicted clearly, legibly and boldly. Atlas maps are to be seen from a distance of about 1.5 feet. Hence, the visual significance of various objects is not based on bold representation; it is based on contrasts created by appropriate positioning of symbols, and proper selection of the colour scheme. The book illustrations are used in conjunction with the text material. Although each illustration should be self-contained, it is clear that it can have no independent existence. Removed from the book, many of the illustrations lose their significance. All book illustrations have to be fitted within a given space. Not too often, is the size of a book determined by the size of its illustrations.

Data, scales and Projections: The nature of the data, including the size and the shape of the area to be represented, also influences the design of a map. For example, a map of Chile has to be an elongated one. A map of the USSR has to be longitudinally extensive and relatively narrow latitudinally. The nature of the data also influences the process of symbolization. Some facts can be shown by line symbols, certain others by point symbols, and still others by area symbols.

Scale also influences the design of a map. On a large scale map objects can be represented in greater detail without creating cluttering. If the same data have to be shown on a small scale map, many of the details may have to be dropped in order to keep the map legible.

Projections are also influence the design of a map. Projections are of different types but there is none which can represent area, shape and direction truly at the same time. Most of the distributional data have to be shown on equal-area projections, To show correct direction, one has to select the Mercator's or one of the zenithal projections. A cartographer has very little choice in this regard.

Reproduction Processes: The reproduction technique to be used has a great influence on the design of a map. If direct contact prints are to be made, using the original as a positive, as in the case of Xerox or deskjet printers the reproduced map will be of the design as the original one even if it enlarged or reduced in size. The scale of the map to be

reproduced should be linear so that the reduction and enlargement would not affect the scale of the map.

On the contrary, if the original has to be reduced photographically to get a negative or positive for final printing, it will have to be designed differently. A map to be printed in multi-colour, will have as many originals as the colours used in the map. Far more data can be shown on a multi-colour map than on a black and white map. Different printing processes require different kinds and numbers of originals, which in tum require different map designs.

In most of the printing processes maps are drafted at a scale larger than the reproduction scale. This is done with a view to get a more refined picture of the fair drawing. It is, however, often forgotten that a well designed original does not necessarily give a well-designed print. In fact the design of such maps should have the scale of the reproduced map in view.

3. Resource Constraints

The third set of constraints under which cartographers function is related to cartographic materials, instruments, time and finances. Design of a map and its quality is often determined by the training of the cartographer if computer mapping is attempted, and cartographic materials and instruments used in drawing if the map is drawn manually. Availability of time and finances also influences the design. A multicolour map is a costly proposition. If finances are limited, one will be forced to think

of a black and white map. Similarly, the time at the disposal of the cartographer influences the design.

SYMBOLIZATION

Map itself is a symbol; it is a symbol of symbols. Symbols are like words. As the words giving same meanings differ from language to language, so also the symbols from map to map. Except for a few conventionalized symbols, a cartographer has far greater freedom. to develop symbols than a linguist has to create words. Words take the meaning given by its users. Symbols take their meaning given by the cartographers. When several words are put together in a definite order, we get a sentence. Similarly when several symbols are put together in a definite order, we get a map. Similarly, many sentences put together in a definite

order make an essay. These orderly arranged symbols give a meaning which individual symbols fail to give in the same way as orderly arranged sentences convey a definite message which individual sentences cannot. Symbolization and the arrangement of the symbols in a map are, therefore, crucial processes in map design. No book can be popular if the choice of words and sentences is bad. So also no map can be popular if the choice of symbols is bad. Symbols are of three types:

1. Point symbols,

2. Line symbols, and

3. Area symbols.

Point Symbols

Point symbols are those which give the location of an object or the quantitative value represented by it exactly at the point of its location. Point symbols are. of two types:

1. Qualitative, and

2. Quantitative.

Qualitative symbols are used to suggest the existence of an object. For example, a dot is put for a town and a cross for a hospital. Such symbols do not represent any quantitative data such as the size of the town or the hospital.

The *quantitative point symbols* are used to indicate:

1. Presence of an object,

2. Length, width and height of the object

3. Size and area of the object, and

4. Volume of the object.

Uniform dot symbols can be used to represent the existence of a certain Phenomenon in partially quantitative terms. The amount by which an object or idea is characterized can be represented either by bars or circles or spheres depending upon the type of data to be

represented. Representation by Bars indicates the length or height; by circle or squares, the size and by cubes or spheres, the volume. In this connection it may be noted that the cubes: and spheres are three dimensional and, hence, they take less space than squares and circles.

Line Symbols

Like point symbols, the line symbols too are used to represent qualitative as well as quantitative data. In the first category fall the latitudes, longitudes, boundaries, lines of transport and communication, streams, coastlines, etc. The thickness of these line symbols is not dependent on quantitative values of the objects represented. In fact certain objects like geographic coordinates and coastlines do not exist in reality. The width of the transport and communication lines as well as of the streams and boundaries are highly exaggerated. They are not drawn to scale.

Line symbols represent quantitative values too. The iso-lines such as contours and isarithm represent quantitative values. Similarly, the flow lines show the amount of the object moving from one place to another.

Area Symbols

Both point and line symbols are used to give a combined effect of spatial distribution of selected phenomena. Area symbols also are of two types:

1. Qualitative, and

2. Quantitative.

Qualitative symbols indicate the spatial spread of a given phenomenon but not its density such as the spread of swamps, forests, deserts, political units or soil types. When symbols are used to give the relative density of a phenomenon whether by administrative units or by isarithm lines, they acquire quantitative values.

Map Format

All maps must show a few common features.

These are

- title,
- legend,

- direction,
- scale,
- source of information and
- in some cases insets.

The title of a map may be placed anywhere within the neat line that makes the frame of the map. Most appropriate place is the top right of the frame. It can also be placed at the top left or bottom left or bottom right depending on the space available. The title should include the name of the area represented, and the nature of the data shown. If the data pertain to a given year this should also be given. The title should always be given in bold and simple letters.

The legend of a map is usually placed in a corner within the neat line. The position of the legend is so selected that it does not interfere with other details. Every symbol and abbreviation used in a map should be explained in the legend.

Direction is shown in one of the corners by an arrow pointing to the north. Scales can be expressed in one or more of the several ways. In an original drawn for reproduction, the scale should conform to the requirements of the printed map. If the scale is given in R.F. it should be the scale of the printed map and not of the original drawing. The best thing to do is to give a bar scale because the bar is also reduced with the original drawing. The scale of a map should be placed at is prominent place. It can be placed just below the title or somewhere at the bottom. Every map must give the source of the data used. Most of the maps we see, do not mention the source, thus they keep the map reader in suspense about their accuracy. The source should normally be given outside the frame of the map on the bottom sight. On the bottom left should be given the name of the author, publisher, etc. In many maps it becomes necessary to give an inset map. An inset map can be used to show the location of an unfamiliar area within a relatively familiar area. For example, if a district is represented on a map, an inset map may be given to Show the location of the district in the state or the country. It can also be used to give a portion of the area represented in the map in greater detail. For example, while showing the population distribution in a state, an inset can be given to show the details of the population distribution in a metropolitan region. There are many other details which can be fruitfully shown in an inset map.

The border of a map usually consists of two lines 1/4” to 1/2” apart. In between the two lines are given the degrees of latitudes and longitudes. The outer line is thicker than the

inner line. The inner line is also called the neat line. In some maps only the neat fine forms the border. The degrees are written inside the frame. The margin outside the outer line should not normally be less than 1/2". If marginal information is also given, as in the case of the topographical maps, margins will have to be wider.

Lettering and Toponomy

Letters are verbal symbols. They form words which give us certain meanings. These letters and words have to be incorporated in the body of the map along with other symbols. Letters are conventional symbols of the linguists. They have to be used as they are given to us whether we like them or not. What we can do, however, is to change the style, form, size, colour, etc. of these symbols to suit our specific needs.

Lettering has always been an important aspect of map design. In the past ornate letters were common. They were partly used as a device to fill up vacant spaces in the map. In those days all lettering was done freehand. Subsequently, it came to be engraved. In all these processes the artistic aspect of the work was considered to be more important than its usefulness. Ornate letterings are difficult to read.

The style of lettering has changed with the change in the printing technology and the taste of the people. Now-a-days one can get any style of lettering with the help of internet and computers. At present the best lettering is considered to be one which can be read easily.

While lettering on a map, one has to decide the following:

1. Style

2. Form

3. Size

4. Colour

5. Method

6. Position

7. Relation to reproduction

8. Standardization

Style of Lettering

There are three main styles of letterings. But now the styles of letters available on computers are so vast, that cartographers have far more choices than ever before. Here we are discussing only three types of letterings. They are:

1. Classical,

2. Modern, and

3. Sanserif.

The origin of the classical style is Roman. In this style the proportion of thick to thin lines making the letters is not great. The strokes of the letters have long and curved serifs, It is an ornate style and difficult to read. The modern style was developed around A.D, 1800. It has precise geometrical shapes, and the difference between the thick and thin lines making the letters is often excessive to give an unbalanced picture.

The lines are marked by small horizontal strokes. The san serif style is the most modern and up-to-date one. It has no serifs at all. It gives a clear cut, new and non-traditional appearance. It is the best style from the point of view of legibility.

Form of Lettering Within these styles one can develop several sub-styles or forms by changing the slant, thickness, and complexity. The style which can be considered to be good is one which is easy to read. Ornate-and fancy designs are good to look at but difficult to read.

Size of Lettering

In view of the complex and varied nature of the data represented on maps, it is often desirable to use several lettering styles to create contrast. But this should not be overdone. Within the modern style, we can have several combinations by using the capital and small letters and by varying the size and thickness of letters.

Size of lettering plays an important role in map design. It is true that certain styles are difficult to read but even the most modern and legible style will be of no use if the size is not

properly selected. The size of letters is designated by points. Points 1 is equal to one twelfth of an inch. Lettering that is one fourths of an inch in height is equivalent to 18 points. Perhaps point 3 is the smallest type which can be read from a distance of 1 foot. It is safer to use 4 or 5 point types.

The size of letters while preparing a map. For example, if we want to increase the relative visibility of a letter by 5 times (point 3 being the base), we will have to select point 12 and not point 15.

Colour and Background

Another way of creating contrasts and making letterings more legible and easily perceptible is to put them in varying colours and against contrasting backgrounds. The greater is the contrast between letters and background, the more is legibility and perceptibility. Black lettering against white background stands out most prominently on a gray background it looks faint and blurred.

Positioning of Letters

Positioning letters means placing them in relation to other symbols in the map. The layout of letters should normally be parallel to the top and bottom of the neat line. This, however, creates some imbalances if the parallels and meridians are also shown in the map, for in many cases the latitudinal lines do not run parallel to the neat line. its, therefore, desirable to eliminate the graticules from the land-areas of the map.

They can be shown by strokes along the neat line. They need not be eliminated the water bodies especially the oceans. This should not, however, be considered to be a rule, for in many cases the graticules may have to be shown even on the land to serve certain specific purposes. In cases where the features to be named have spatial spread such as countries mountains, etc., letters should be spread to include the entire feature. They should be equally spaced and easily distinguishable. Names of the rivers should be positioneq along their courses and the letters should be slanting. The alignment of lettering used for railways, roads, canals, telegraph lines, air-routes, sea routes, etc., should be the same as that of the objects. Place names should be so positioned that they do not get mixed up with symbols. They should be placed a little above or below on the right or left of the symbol, to avoid confusion. The titles and legends if put in more than one line, should be positioned around a central line to give a sense of balance.

Mechanics of Lettering

With the introduction of computers, the mechanics of lettering has changed drastically. Now it is easy to experiment with various sizes and styles and to select one that is most pleasing and clear. Until very recently, lettering on maps was a very tedious and time consuming process. For the benefit of the computer and digital cartographers, the methods used in lettering are discussed below although only briefly.

There are four methods of letterings:

1. Freehand,

2. Stick up,

3. Mechanical, and

4, Computer

Freehand Letterings

It is done with the help of a pen. It follows the guidelines drawn with the help of a ruler, curve or lettering angle. For all capital lettering only two guide lines are needed but for mixed letterings, three lines are more appropriate. First, the letters are drawn with a lead pencil. Freehand lettering requires considerable practice. It is quick and more suited for maps in which letters have to follow certain crooked lines.

Stick up Letterings

Under this system, letters were written by hand or mechanically and cut and pasted at appropriate places on the map. To make the task easier, beautifully printed alphabets and figures of various sizes and styles are available in the market which can be transferred on the map as per requirement. Quick and precise lettering can be done with the help of computers.

Mechanical Letterings

In this process, the size, style and thickness of letters is controlled mechanically. The latest instrument used is the computer. With the coming of computers, the old mechanical

devices are no longer used but one should know how the maps were prepared earlier. Among the instruments used until very recently, were:

1. UNO Pen: It was a pen attached to a small tube which contained ink. The size and style of letters are determined by the templates in which the letters are stenciled.

2. Leroy Set: It contains a scriber to which a pin and a pen are attached. The pin moves along a groove in the template and the pen gives the required letters. The templates contain a variety of letter styles and symbols.

3. Varigraph: It is the most mechanized of the lettering devices of recent past. It also consists of a template with engraved letters and a stylus. It's functioning is based on the principles of a pantograph. Adjustments to make the letters large, small, elongated, etc. are possible.

4, Wrico: It uses stencils as in the case of the UNO pen but the pen is not the same.

5. Hope graph: It was the latest in the mechanical lettering devices computers came into the picture. This equipment is more functional and precise than those discussed earlier.

Computer Letterings

Introduction of computers has made lettering on maps easier, better and faster. It is now possible to print letters in:

1. Any style,
2. Any size (point),
3. Any language,
4. Any colour, and
5. Any design.

One can see the letters on a computer screen, change them to the desired size, style and format and then lift and place them at appropriate places on the map. While selecting the size and style of lettering, it must be kept in view that the letters fit the scale of the map and the size and shape of the other symbols included in the map. They should be so selected that they are legible once the map is printed.

STANDARDIZATION OF GEOGRAPHICAL NAMES

Attempts to rationalize and standardize geographical have been on for the last 125 years. The International Geographical Union (IGU) took this matter up as early as 1872, It has not, however, proved to be an easy task and the recommendations of the Union have been disregarded by almost all the member countries.

The problem involved in the standardization of geographical names can be gauged from the following example. In the 1930s a river was discovered in the western half of Papua New Guinea. It was named after its discoverer as Father Le Coq D' Armandville River. The Popuans of New Guinea could not make either head or tail of it and continued to call it 'The Broad River' (in their language). Up to 1957 the capital of Dutch New Guinea was called Hollandia. After the Dutch withdrawal in 1957, it Was renamed as Kota Bam. Subsequently, it was renamed as Sukarna Pura. Now it is called Ayapura. The principle of giving local names (advocated by the IGU) had been disregarded in this case.

The irrational changes in place names are only too common. In the USSR almost, all the names given by the Czar regime were changed to commemorate Lenin or Stalin. And now after the fall of communism, all those names have been changed again. In India, Calcutta has been changed into Kolkata, Bombay into Mumbai, Bangalore into Bangaluru, Madras into Chennai. There is also a problem of disparity between the official names and the popular names. For example, Banaras in UP. ig now officially called Varanasi but the people continue to call it either Banaras or Kashi. Duplication of place names is another problem. Many of the names are too often repeated in the same country. There are so many Washingtons in the USA.

It thus appears that it is difficult to standardize geographical names unless all the member countries adhere to the principles laid down by the I.G.U. in this regard, A cartographer has to use his judgment in determining the authenticity of place names. It may involve considerable amount of library and at times even field research.

MECHANICS OF MAP CONSTRUCTION

A good map should not only be well designed, it should be well drawn also. Drawing or drafting of maps whether manually, mechanically or with the help of computers fequires some artistic skills. And artistic skills can be acquired only by regular and patient practice. Those who do not have patience cannot become good cartographers. Apart from patience and practice they must be conversant with different computer programmes which help in creating maps. New programmes are being developed ultimately leading virtual maps. Satellite imageries are now available for countries, state/provinces, districts, cities, villages and even streets and houses. All one needs to do is to apply computer programmes to list the relevant details available on Google, etc. and transform them into good maps.

DRAWING MATERIALS

1. Drawing Surface

2. Ink

3. Pencil

Map construction, This is still being used in places where the use of computers is not yet prevalent. lrrespective of how a map is made, the paper on which it is being made or printed should be of good quality. Poor quality papers shrink with change in weather. This leads to change in scale too. If the map is drawn on a scale of 1 cm to 4 km, its reduction into half will change the scale to 1 cm to 8 km. But if the original drawing of the map shrunk or expanded, the reduction of the size of the map to half will not give the Scale of 1 cm = 8 km.

While drawing a map by hand, one should know that the quality of the paper on Which a map is drawn determines its capacity to take ink. The soft and porous papers soak ink and diffuse it through fibers. Good quality drawing sheets hold on the ink to give a sharp image. If the surface of the paper is rough the drawing on it would not be smooth. This applied to drawing by computers too. The surface of the paper should smooth and strong enough to take erasing.

The Indian ink used in original drawings by hand is a permanent suspension of fine carbon in a liquid medium. It dries dense black which is very important for reproduction and is waterproof. While using this ink, it should be kept in mind that awing surfaces easily pick up oily substances from the hand. The ink will not hold to the oily surface. The ink used should be absolutely opaque black. If the drawing is to be reproduced photographically, white opaque paint or ink can be used for corrections. This should not, however, be done on drawings which are to be used for direct contact printing.

DRAWING EQUIPMENTS

Some of the equipments used in manual drawing of maps are as follows:

1. Drawing board or table

2. Drafting machine

3. T-square

4. Magnifying glass

5. Straight edge-12" scale and a slide rule

6. Curves of various types

Maps are usually drawn on drawing tables manufactured specially for drafting purposes. A drawing table consists of a drawing board measuring at least 24” x 18” made of soft wood. A drawing table with a board is preferable. Drawing tables have mechanisms for adjusting the height as well as the tilt. The drawing paper should be affixed to the board either with a tape or thumb tacks. The latter leave holes and hence should be fixed only on the extreme corners. They also obstruct the movement of the T-square. Tapes are therefore preferable.

A special kind of table called tracing or light table is a must in a cartographic laboratory. It is used in tracing on an opaque surface. It differs from an ordinary drawing table in that its surface is made of glass and not of soft wood. The glass is illuminated from beneath.

A table can also be custom made which combines the functions of a drawing and a tracing table. In the board of the table on opening of, say, 12” x 9”, can be made to fix a glass.

All tables and drafting machines must be properly lighted. Cartographic work puts lot of strain on the eyes. The lights should be such that they do not leave shadows and are adjustable. It is desirable to use fluorescent lamps.

A T-square and a set of triangles are used in line drawing work. T-squares are made of metal or solid wood. One with transparent plastic edges is better, for it enables the draugftsman to see the drawings below. It slides up and down the side of the table or board. The triangles help in drawing vertical lines with varying slants.

The curves of various types help in the drawing of curved lines. For smaller and sharp curves, a set of ‘French Curves’ is enough, bur for large curves one has to take recourse to railway curves or spine with weights. Recently flexible curves of different make have also been introduced for drawing curves of various shape and sizes. Fot example, Japanese flexible curve is made of rubber with small steel balls inside the rectangular tube with leveled edge. It is of different lengths which could be moulded and be given the required shape. Magnifying and reducing glasses are useful in judging the look of the drawings at various scales of reduction and enlargement. Stencils of symbols of various types, if at hand, can help in quick drawing of symbols.

There are a number of drawing instruments one can get in a drawing box. It is better to have complete set, because the case in which the instruments are kept provides a convenient storage place.

DRAWING INSTRUMENTS

The basic instruments consist of:

1. pens,

2. compasses,

3. dividers,

4. computer and

5. printers.

Pens

The most common pen used by a cartographer is a 'crow-quill' pen. It is a sharp pointed pen and is used for fine drawings. The use of a crow-quill pen requires a lot of training.

Ruling pen also known as lining pen happened to be used for drawing lines of various thicknesses. It has two blades which could be adjusted as per requirement of the thickness of line, with the help of a side screw. Thus the lines of different thicknesses can be made with the same pen. It requires frequent cleaning as the ink clogs in between the blades. Some ruling pens have their blades assembly fixed in a swivel. They are used in drawing curved lines such as contours. Pens with two sets of blades make the so-called road pens which are used in drawing parallel and swinging lines.

However, in ruling pens adjustment of blades for drawing lines of various thicknesses is done manually which is difficult to maintain at precise level. Therefore, the precise variant pens have been introduced. Among these pens the most commonly used ones are:

(i) U.N.O. Pen

(ii) Leroy Pen,

(iii) Stedlars Mars,

(iv) Ratring,

(v) Payzant Pens,

(vi) Graphics, and

(vii) Keo-Aristo.

A leroy pen comes with leroy lettering set. It can be bought also separately. It has a cylinder with a point and ink is fed through an opening in the cylinder. The cylinder is attached to a holder. Leroy pens are numbered-from 0000 to 8. Each number gives a constant width of line or dot, and variation pressure does not affect the thickness of line. It is especially useful for those who do not have steady hand while drawing,

The Barch-Payzant pen is also designed for lettering. It is useful in drawing uniform lines and dots. The speed ball pens have different shapes of nibs to give different kinds of lines. These are inexpensive and easy to operate; the graphos are like fountain pens.

Compasses and Dividers

Compass is used in drawing arcs and circles and dividers are used to layout distances. A compass is a divider with one leg fitted with a holder for pencil or ruling pen. Proportional dividers have two sets of needle points one at each end. Its mechanism and use has been explained earlier.

There are several other types of compasses. For making big circles, we have the beam compass and for small circles or round dots we have drop-bow compasses.

The other important instruments are:

(1) rotameter,

(2) planimeter, and

(3) slide rule.

A rotameter is used for measuring the length of a curved line;

the planimeter is used to measure area; and

a slide rule is used for quick calculation.

DRAWING THE ORIGINALS

Patience and perseverance are the two qualities that a cartographer must possess in order to be successful. There are very few short-cuts in cartographic drawing. It requires patience to spend hours but visibly producing very little. This aspect is scarcely appreciated by a map user. He is unable to realize the amount of thinking and effort that goes in making a map. This applies not only to manual drawings but also computer mapping.

Much of the cartographic work consists of line work. A regular line is drawn with a line pen held against a drawing edge such as a T-square or a curve; conversely most irregular lines have to be drawn free hand. While drawing a line the pen or the pencil should be held against the drawing edge in such a way that it remains perpendicular to the plane of drawing. When kept in this position, it will keep a wedge between the bottom of the edge and itself. This is necessary to stop the ink from running under the edge of the guide. This also allows the cartographer to see the line as he draws it.