

# Map Design

Borden D. Dent: Cartography – Thematic Map Design, 5<sup>th</sup> ed. Chapter 13

Most thematic maps contain these map elements: titles, legends, scales, credits, mapped areas, graticules, borders, symbols, and place names. (See Table 13.1) The task of the designer is to arrange these into a meaningful, aesthetically pleasing design – not an easy task.

Table 13.1 typical elements of the thematic map

Name of Element	Description and Primary Function
Title (and subtitle)	Usually draws attention by virtue of its dominant size; serves to focus attention on the primary content of the map; may be omitted where captions are provided but are not part of the map itself
Map legend	The principal symbol-referent description on the map; subordinate to the title, but a key element in map reading; serves to describe all unknown or unique symbols used
Map scale	Usually included on a thematic map; it provides the reader with important information regarding linear relations on the map; can be graphic, verbal, or expressed as an RF
Credits	Can include the map's data source, an indication of its reliability, dates, and other explanatory material
Mapped and unmapped areas	Objects, land, water, and other geographic features important to the purpose of the map; make the composition a map rather than simply a chart or diagram
Graticule	Often omitted from thematic maps today; should be included if their locational information is crucial to the map's purpose; usually treated as background or secondary forms
Borders and neatlines	Both optional; borders can serve to restrain eye movement; neatlines are finer lines than borders, drawn inside them and often rendered as part of the graticule; used mostly for decoration
Map symbols	Wide variety of forms and functions; the most important elements of the map, along with the geographic areas rendered; designer has little control over their location because geography must be accurate
Place names and labeling	The chief means of communicating with maps; serve to orient the reader on the map and provide important information regarding its purpose

Map design is a complex affair involving many decisions, each of which affects all the others. Good design is simply the best solution among many, given a set of constraints imposed by the problem. The best design will likely be a simple one that works well with the least amount of trouble. The optimum solution may not be achievable, and what is good design today may be ineffective in the future.

Important design principles include *simplicity*, *appropriateness* in a functional context, *pleasing appearance*, and considerations of economy. The designer's tools of creativity, visualization, ideation, and problem solving are used to sift through the map elements in order to bring these principles into a proper balance.

## Design levels on the map

It is useful at the outset to imagine the thematic map as composed of different planes or levels. Usually the levels are differentiated by visual prominence. Each component of the map belongs to a specific level. More than one map element can be placed on a particular level, but a single element should never be assigned to more than one level. Thinking of the map in this way will facilitate the map's overall design.

*Map composition*: the arrangement of the map's elements, takes place at each level and between levels. The arrangement at a given level may be called *planar organization* and the between level may be called *hierarchical organization*.

## Elements of map composition

The map's graphic composition is the arrangement or organization of its elements. The composition principles introduced in this chapter include the purpose of map composition, planar organization, figure and ground organization, contrast, and visual acuity. Knowledge of these principles and their application assists the cartographer in seeking better design solutions.

## Planar Organization of the Visual Elements

The three aspects of planar visual organization are *balance*, *focus of attention*, and *internal (intraparallel) organization*. Each is important to the designer's language, and their visual possibilities and effects must be explored.

### 1. Balance

Balance involves the visual impact of the arrangement of image units in the map frame. Do the units appear all on one side, causing the map to "look heavy" on the right or left, top or bottom? An image space has two centers: a geometric center and an optical center (as shown in figure 13.6). The designer should arrange the elements of the map so that they balance visually around the optical center.

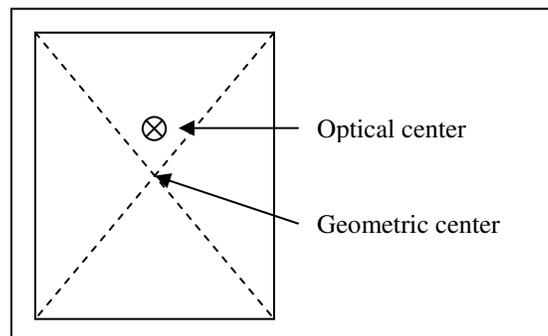


Figure 13.6 The two centers of an image space

Rudolf Arnheim, a noted author on the psychological principles of art, has suggested in his writings that visual balance results from two major factors: weight and direction. Objects in the visual field (e.g., within the border of a map) take on weight by virtue of their location, size, and shape. Direction is also imposed on objects by their relative location, shape, and subject matter. Arnheim stresses that balance is achieved when everything appears to have come to a standstill, “in such a way that no change seems possible, and the whole assumes the character of ‘necessity’ in all its parts.” In Arnheim’s view, unbalanced compositions appear accidental and transitory.

Arnheim’s observations on balance resulting from visual weight and direction can be summarized as follows.

1. Visual weight depends on location.
  - a. Elements at the center of a composition pull less weight than those lying off the tracks of the structural net. (see figure 13.7a)
  - b. An object in the upper part of a composition is heavier than one in the lower part
  - c. Objects on the right of the composition appear heavier than those on the left
  - d. The weight of an object increases in proportion to its distance from the center of the composition.
2. Visual weight depends on size
  - a. Large objects appear visually heavier than small objects
3. Visual weight depends on color, interest, and isolation.
  - a. Color affects visual weight. Red is heavier than blue. Bright colors appear heavier than dark ones. White seems heavier than black.
  - b. Objects of intrinsic interest, because of intricacy or peculiarity, seem visually heavier than objects not possessing these features.
  - c. Isolated objects appear heavier than those surrounded by other elements
4. Visual weight depends on shape.
  - a. Objects of regular shape appear heavier than irregularly shaped ones
  - b. Objects of compact shape are visually heavier than those not so shaped.
5. Visual direction depends on location
  - a. Weight of an element attracts neighborhood objects, imparting direction to them. (see figure 13.7b)
6. Visual direction depends on shape
  - a. Shapes of objects create axes that impart directional forces in two opposing directions.
7. Visual direction depends on subject matter
  - a. Objects opposing intrinsic directional forces can impart visual direction to other elements in the composition.

Of course, Arnheim recognizes that the elements of compositional balance operate together in complex fashion. He also advises not to forsake the content of a composition simply in order to create balance: “The function of balance can be shown only by pointing out the meaning it helps to make visible.” Once again, this underscores the idea that map content is more important than the map’s design.

It is often difficult to achieve balance on the map. Cartography is not an expressive art form in which the graphic elements may be rearranged at will. Many of the shapes and their locations are imposed by geographical or locational facts. The guidelines presented by Arnheim should nevertheless be applied whenever possible.

Graphic-art professionals who work with two dimensional design often speak of the golden section. This method of devising proportions is attributed to classic Greek architects and sculptors. In the golden section, the proportion of a smaller unit to a large is the same as that of the larger unit to the whole. This method of sectioning can be duplicate any number of times (See Figure 13.8a). Proportion is the relationship of a part of the visual field to the remainder or whole. Balance is achieved when pleasing proportions among the parts are maintained. In fact, one author has noted that the great violin maker Stradivarius employed the golden section in his violin proportions.

Visual balance can be looked at from a different point of view. Writing more than 50 year ago, Richard Surrey, an advertising artist, developed important ideas about composition. Survey observed that layout involves not only the arrangement of units (balance) but also the division of space. “In other word, instead of layout being a process of addition (putting together units), it is much more easily grasped when considered as a process of division.” (See figure 13.8b) His further thoughts on this idea may be summarized:

Cartographers should bear proportion in mind in arranging the different elements of the map. Applying the golden section in cartographic design is an intuitive matter, not subject to rigid quantification.

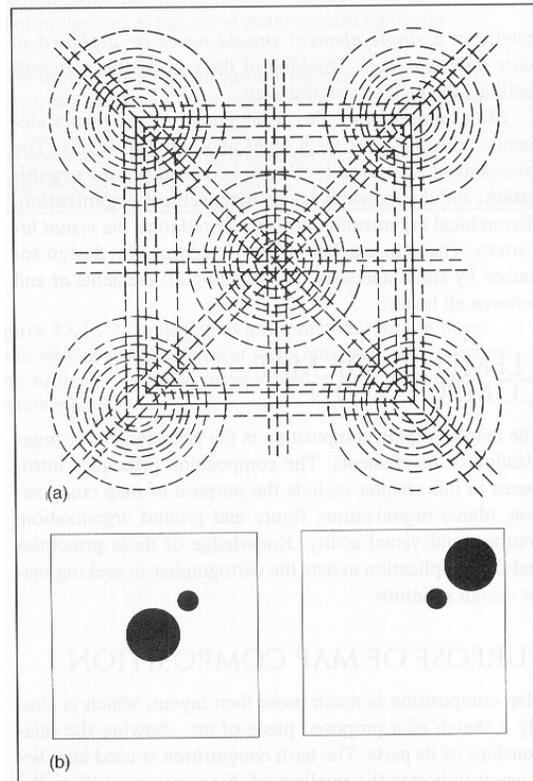


Figure 13.7 Balance in the visual field  
 Arnheim stresses that a structural net, as in (a), determines balance. Objects on the main axes or at the centers will be in visual balance. An object is given direction by other objects adjacent to it. In (b), the small disc’s directional element is shifted as the large disc’s position is changed. Each thematic map will have a unique structural net created by the locational patterns of its elements.

1. Equal divisions of space are the least interesting. In equality and the pursuit of equilibrium make layout visually alive.
2. Small spaces struggling against large spaces are visually alive.
3. Variety, for example the division of the image space into four unequal parts, creates interest. Complex designs may be more exciting than simple ones.

To illustrate how balance can affect the impression one has when viewing a map, several different locations of the shape of Africa are included in Figure 13.9. Which appears better balanced within the map frame?

Achieving visual balance, of course, is not always as simple as the case just illustrated. Normally, thematic maps contain most of the elements mentioned earlier, and all must be handled in terms of balance. Visual weight caused by texture, solid black and white areas, and other elements must figure in the planning. Open spaces take up “balance space” and must be used effectively in the overall design. Complex designs require careful planning to use all spaces efficiently while retaining a visually harmonious balance. Acceptable balance is reached when the relation of any one element would cause visual disturbance. Balance is a state of equilibrium

In at least one study using thematic map, the balance of the map’s elements is shown to have an initial effect on the way the map reader goes about looking at those elements. However, the longer the reader views the map, the less importance balance seems to have on map-reading behavior. Better balance also leads to less reading difficulty and to somewhat better memory of the map’s message. It is not altogether clear exactly what constitutes good and poor balance in such studies because these extremes are subjective at best. Nonetheless, the balance of the map’s elements is a vital concern for the cartographic designer.

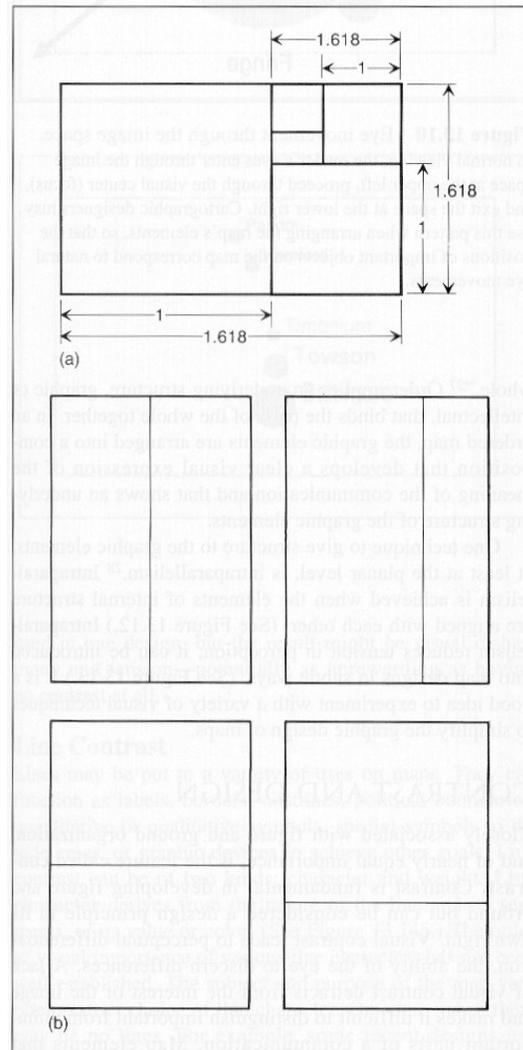


Figure 13.8 Methods of achieving balance. Balance is dynamic and will result from appropriate proportioning of the image space. The method of arriving at the golden section is illustrated in (a) and several alternatives are pictured in (b). In (b), notice that unequal division of space are more interesting.

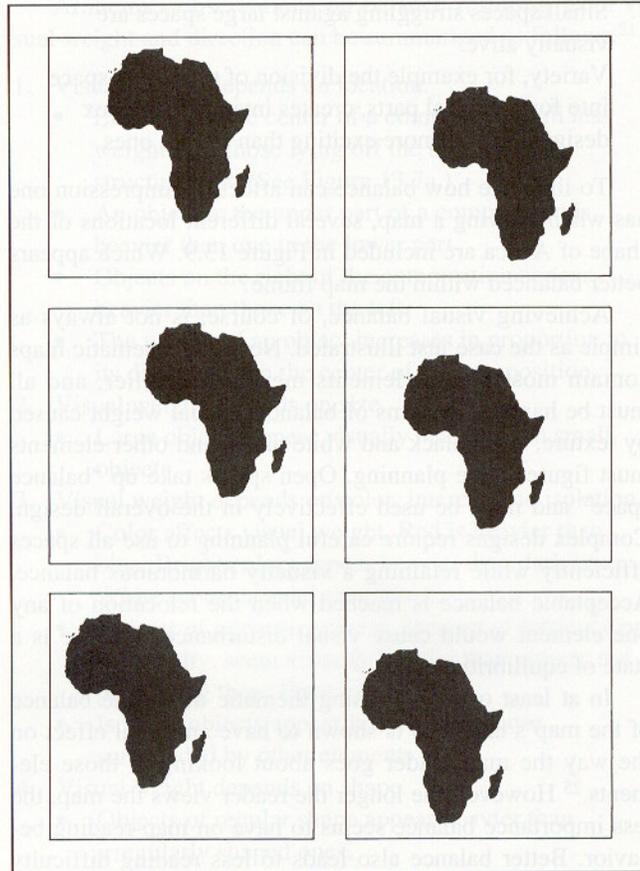


Figure 13.9 Map balance

Position of map elements in the image space affects the balance of the map. The difference can be visually subtle, as this illustration shows. In which image does a natural visual equilibrium appear to exist?

## Focus of Attention

As previously mentioned, the optical center of an image area is a point just above the geometric center. This attracts the viewer's eye, unless other visual stimuli in the field distract attention. Surrey mentioned earlier makes several other points that are significant for questions of design. He says that the reader's eye normally follows a path from upper left to lower right in the visual field and passes through the optical center. (See figure 13.10.) Further more, the point of greatest natural emphasis is where a line of space division intersects either the focus or field circles of attention. (See figure 13.11.)

Surrey's ideas were based on intuitive judgments and personal observations and have not been scientifically proven. Yet they do have appeal for the designer. An examination of recent print advertisements attests to the general applicability of his ideas. We can learn from these and other graphic designs. The map is a visual instrument, so the designer must learn what works in the visual world.

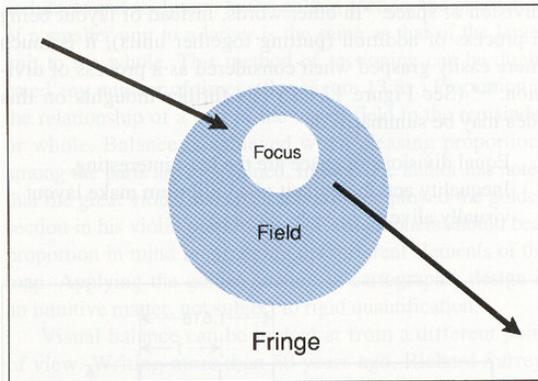
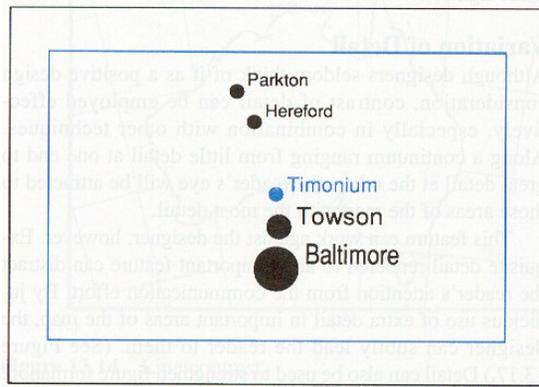
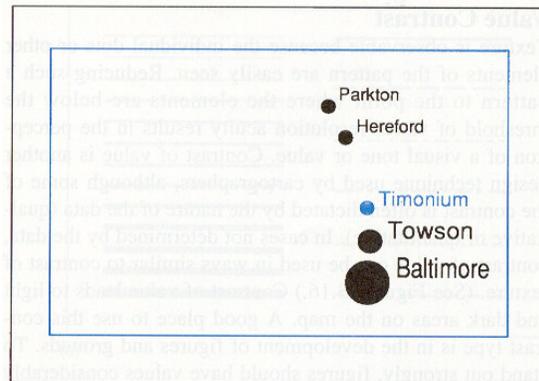


Figure 13.10 Eye movement through the image space (upper)

In normal viewing, the reader's eyes enter through the image space at the upper left, proceed through the visual center (focus), and exit the space at the lower right. Cartographic designers may use this pattern when arranging the map's elements, so that the positions of important objects on the map correspond to natural eye movements.

Figure 13.11 Recentering for greater clarity (right)  
If possible, it is a good idea to recenter the map to place the central focus (in this case, the town of Timonium) closer to the optical center.



## 2. Contrast and Design

Closely associated with figure and ground organization, and of nearly equal importance, is the feature called contrast. Contrast is fundamental in developing figure and ground but can be considered a design principle in its own right. Visual contrast leads to perceptual differentiation, the ability of the eye to discern differences. A lack of visual contrast detracts from the interest of the image and makes it difficult to distinguish important from unimportant parts of the communication. Map elements that have little contrast with their surroundings are easily lost in the total visual package. Contrast must be a major goal of the designer.

Contrast can be achieved through several mechanisms: line, texture, value, detail, and color. All of these could be used in one design, but the result might be visual disharmony and tension – potentially as unrewarding as having no contrast at all.

### Line contrast

Lines may be put to a variety of uses on maps. They can function as labels, borders, neatlines, political boundaries, quantitative or qualitative symbols, special symbols to divide areas, or graphic devices to achieve other goals. Line contrast can be of two kinds: character and weight. Line character derives from the nature of the line and its segments, or its value or color. (See figure 13.14a.) The order of visual importance of various line characters has not been well established. The subject and purpose of the map very often

restrict choice of line character. On some maps, there may be no lines. For example, some recent designs use edges rather than lines to evoke a response.

The thickness of a line is its line weight, although no clear-cut relationship exists between thickness and visual or intellectual importance. Although a broader line generally carries more intellectual importance, very fine lines also can be visually dominant. Strike a balance, keeping the map's purpose firmly in mind.

Contrast of line character and weight introduces visual stimulation to the map. A map having lines of all one weight is boring and lacks potential for figure formation. (See figure 13.14b.) On the other hand, a map with lines of several weights and characters focuses attention, is lively, and aids the map reader's perceptual organization of the material. (See figure 13.14c.) Guidelines can assist the designer in choosing lines so that discrimination between weights is possible. Generally, a line-weight difference exceeding .05 in is discernible by more than half of all map readers. A difference of .15 in is easily noticed by practically all readers.

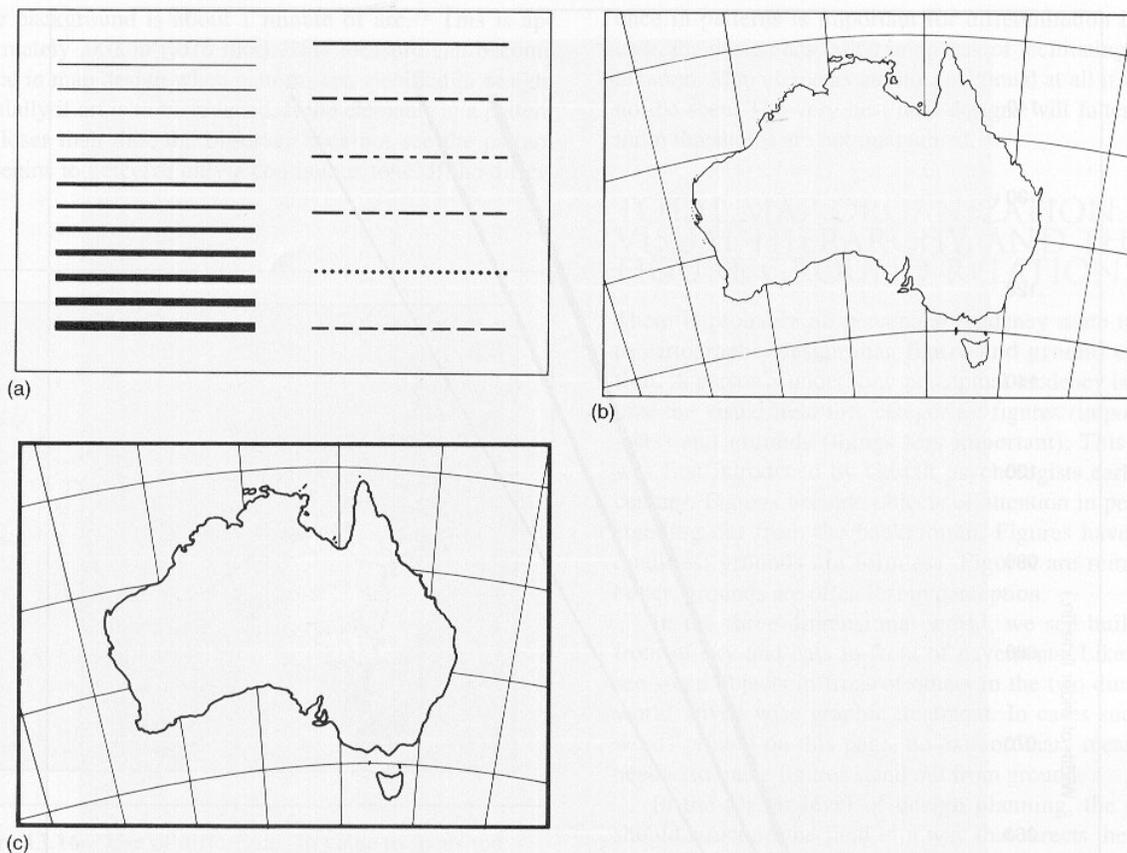


Figure 13.14 Line contrast

In (a), several different line weights and line characters are shown. The visual effect of varying line weights on a map is illustrated by comparing (b) and (c). More visual interest is achieved with greater contrast of weight. In this case, the figure and ground organization is strengthened.

### **Texture contrast**

Contrast of texture involves area patterns and how they are chosen for the map. In this context, texture is a pattern of small symbols (e.g., dots) repeated in such a way that the eye can perceive the individual elements. Texture is often determined by the selection of quantitative symbols for the map. Contrast considerations should be part of symbol selection. In some instances, patterns are selected and applied to the map solely to provide graphic contrast (e.g., in the differentiation of land and water). Texture is sometimes applied in order to direct the reader's attention to a particular part of the map.

Another possibility, not often used, is textured lettering. This differentiates labels from other lettering, enabling the designer to use more lettering in the design. Textured lettering is possible only when the letters are geometric, not composed of many thick and thin strokes.

### **Value Contrast**

Texture is observable because the individual dots or other elements of the pattern are easily seen. Reducing such a pattern to the point where the elements are below the threshold of visual resolution acuity results in the perception of a visual tone or value. Contrast of value is another design technique used by cartographers, although some of the contrast is often dictated by the nature of the data (qualitative or quantitative). In cases not determined by the data, contrast of value can be used in ways similar to contrast of texture. (See figure 13.16.) Contrast of value leads to light and dark areas on the map. A good place to use this contrast type is in the development of figures and grounds. To stand out strongly, figures should have values considerably different than grounds. Land areas, for example, should be made lighter or darker than water areas.

### **Variation of Detail**

Although designers seldom think of it as a positive design consideration, contrast of detail can be employed effectively, especially in combination with other techniques. Along a continuum ranging from little detail at one end to great detail at the other, the reader's eye will be attracted to those areas of the map with the most detail.

This feature can work against the designer, however. Exquisite detail rendered to an unimportant feature can distract the reader's attention from the communication effort. By judicious use of extra detail in important areas of the map, the designer can subtly lead the reader to them. (See figure 13.17.) Detail can also be used to strengthen figure formation.

### **Color Contrast**

Employment of color is one of the chief techniques in the development of contrast in design. Color can differentiate areas on the map for a variety of purposes.

### Visual Hierarchy and the Figure-Ground Relationship

There is probably no perceptual tendency more important to cartographic design than **figure and ground organization**. A person's underlying perceptual tendency is to organize the visual field into categories: figures (important objects) and grounds (things less important). This concept was first introduced by Gestalt psychologists early in this (20th) century. Figures become objects of attention in perception, standing out from the background. Figures have "thing" qualities; grounds are formless. Figures are remembered better; grounds are often lost in perception.

The visual hierarchy (or organizational hierarchy) is the intellectual plan for the map and the eventual graphic solution that satisfies the plan. Each design activity should contain such a hierarchy. In this phase of design, the cartographer sorts through the components of the map to determine the relative intellectual importance of each, then seeks a visual solution that will cast each component in a manner compatible with its position along the intellectual spectrum. Objects that are important intellectually are rendered so that they are visually dominant within the map frame. (See figure 13.18.)

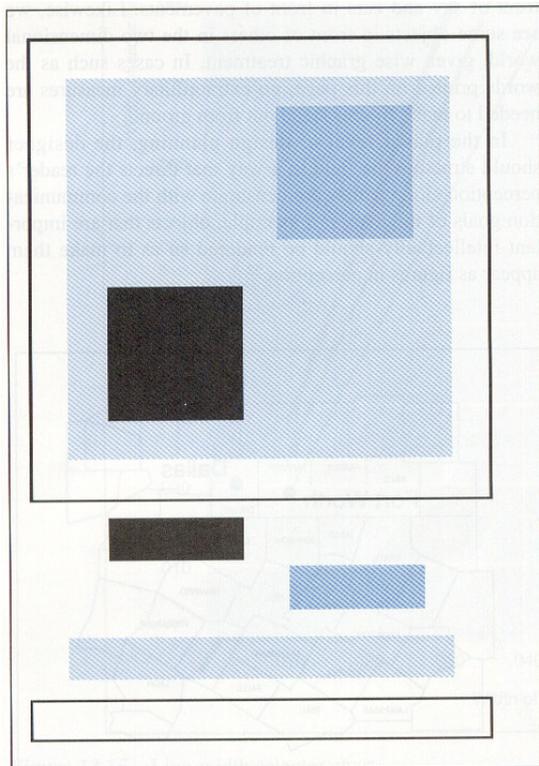


Figure 13.18 The visual hierarchy. Objects on the map that are most important intellectually are rendered with the greatest contrast to their surroundings. Less important elements are placed lower in the hierarchy by reducing their edge contrasts. The side view in this drawing further illustrates this hierarchical concept.