A Linear View of the World: Strip Maps as a Unique Form of Cartographic Representation

Alan M. MacEachren

ABSTRACT. Strip format maps constitute a unique, but often overlooked form of cartographic representation. The purpose of this paper is to combine a historical overview of cartographic applications of the strip format with an evaluation of current implications of continued use of this technique. In addressing these goals, four factors that relate to use or selection of strip maps at various points in history are considered. These include two limiting factors that have at times dictated use of a strip format: map construction materials and the information available to the cartographer. The remaining two factors, map purpose and strategies for cognitive organization of geographic information, are considered as positive factors that have led to strip maps being selected over other map forms. The limiting factors are demonstrated to have been significant primarily in a historical context. Map purpose, on the other hand, appears to be a consistent factor in selection of strip formats throughout history with route following applications predominant. Correspondence between the strip format and the likely strategy used by persons when learning new environments is also considered. Evidence is presented to suggest that strip format maps are not only easier to use when navigating through a new environment, but that they may actually aid the user in learning that new environment.

KEY WORDS: Strip maps, historical and contemporary applications, map materials, map purpose, available information, cognitive organization

Strip format maps constitute a unique form of cartographic representation. Infrequently considered in the cartographic literature, the significance of the strip format as a cartographic method is demonstrated by persistent use throughout recorded history. Strip maps, when considered at all, have generally been identified as a category of road map (Woodward 1978). Although often adopted for travel maps, the strip format can also be considered a method of organizing map information and as such a distinct form of cartographic representation rather than simply a sub-category of road map. The purpose of this study is to examine the strip format as a category of cartographic representation and to explore the continued popularity of the technique, situations in which it has been most effective, and reasons behind that effectiveness that may be relevant to current cartographic problems.

Historical evidence has seldom been incorporated in attempts to develop an understanding of contemporary map use. Efforts, of the last two decades, to understand the process of map communication and thereby improve map design have focused on experimental methods designed to elicit information concerning the perception, and to a lesser extent, the cognition of maps. Evolution of cartographic methods, the extent to which these methods are common to different cultures, and their resiliency through changes in technology and geographic knowledge have only occasionally been considered in evaluating cartographic representation methods.

From a corresponding perspective, the

Alan M. MacEachren is an Associate Professor in the Department of Geography, 302 Walker Building, The Pennsylvania State University, University Park, Pennsylvania 16802. The author thanks Ted Myers for comments on the manuscript. Special thanks are also extended to Gregeory B. Johnson for the considerable part he played in identifying original source materials drawn on here and to Frances MacEachren for the drawing of the carved coastal map in Figure 2.

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history of cartography has seldom been considered from a viewpoint that reflects the needs and interests of present cartography. Although an extensive body of literature exists, the approach taken is generally one of the map collector interested in first-of-a-kind maps (e.g., Uhden 1938; Foncin 1961; Andrews 1969); the historian directed to contributions of one person (e.g., Thrower 1969; Phillips 1980), or one region (e.g., Whittington 1980; Heidenreich 1981); or the historical geographer interested in the influence of maps on historical spatial behavior (Brown 1948; Dunbar 1973).

Such topics certainly deserve attention. Of greater relevance to present day cartography, however, is development of mapping directed to a particular topic (e.g., geology, population, vegetation, etc.) or the evolution of specific methods of cartographic representation (e.g., isolines, color, choropleth mapping, cartograms, etc.). Although topics mapped have been addressed to some extent (Gilbert 1958; Ristow 1968; Robinson 1982), methods of representation have less often been examined from a historical perspective (one exception is a study of the evolution of isopleth mapping by Robinson (1971)).

The present paper addresses the latter need by examining the evolution of one form of representation, strip format maps. Beyond the specific focus on historical development of this map format, however, a second objective is to demonstrate the utility of integrating historical and contemporary evaluation of cartographic representation methods.

INTRODUCTION

Examples of strip maps can be found throughout recorded history. The best known early example, and often considered the first strip map, is the *Peutinger Table* (Gohm 1972, a Roman road map known from a copy made in about the fourth century, A.D.; for a good reproduction of the existing copy see Macchi 1980, pp. 108–9 and 114–15). Maps that could be considered in strip format, however, existed as early as 2000 B.C. in the form of Egyptian "guides to the beyond" drawn on coffin bottoms. While used to represent almost any linear features, including the Great Wall of China (Meijer 1955) and the Mason-Dixon line (Schwartz and Ehrenberg 1980), strip maps are generally associated with travel. In spite of the persistence of the strip format across time and culture, it has received virtually no attention in the cartographic literature.

Strip maps are distinguished from other maps in part by their distinctive proportions, usually being considerably longer in one dimension than the other. An elongated shape, however, does not in itself define a strip map nor are all strip maps elongated. It is probably best to consider the term "strip map" as defining a continuum of map forms that exhibit increasing degrees of abstraction in relation to a central linear feature. The following characteristics, with each successive characteristic generally incorporating the previous ones, represent increasing degrees of "stripness":

a) linear form omitting geographic detail beyond a central corridor;
b) orientation with a direction other than north at the top (with a non-cardinal direction being more indicative);
c) total lack of concern with geographic orientation, oriented in an unconventional direction and no indication of cardinal directions;
d) relaxation of planimetric accuracy (changes in scale and orientation within map segments to adapt to the linear format);
e) strict linear representation of a central feature with little consistency of either scale or direction.

Having a range in level of abstraction within one method of cartographic representation is not uncommon in cartographic practice. Graduated point symbols have an analogous range of representation methods. The graduated point symbols closest to reality are those bearing some resemblance to the topic mapped (graduated barrels to represent oil production). These are followed by graduated abstract symbols such as cir-

cles, while area cartograms represent the extreme. With area cartograms, as with strictly linear strip maps, geographic accuracy is sacrificed in the attempt to improve communication of a very specific message.

As a step toward understanding the role of strip format maps in cartographic communication, factors leading to selection of this representation method in its varying degrees of abstraction are examined. Factors considered as determinants of strip map selection include: map construction materials, information available to the cartographer, the purpose of the map, and strategies for cognitive mapping of geographic information (defined by Downs and Stea [1977] as the collection, organization, storage, recall, and manipulation of spatial information). Seldom is a single one of these factors completely responsible for choice of a strip format. Often, however, one or two factors have obviously dominant roles in that choice. Initially, therefore, it is instructive to examine each factor's individual influence. Each is considered as it relates to both historic and contemporary strip map applications, drawing on examples from various cultures.

MAP CONSTRUCTION MATERIAL

Historically there are numerous examples of map materials (or sometimes lack of them) having an influence on maps of all kinds. In the Middle Ages, for example, Matthew Paris, the cartographer of a strip map (circa 1250) depicting a pilgrimage route, noted on his general map of England that "The whole island should have been longer but the page was not big enough."

In addition to such general limitations of material, certain mapping media were uniquely suited to strip maps and probably had as much to do with the choice of format as did map objective or any of the other factors considered. The earliest strip maps yet identified, the Egyptian "guides to the beyond" painted on coffin bottoms, provide one such example (Figure 1). These maps have been described "as a kind of road map for the dead" and are thought to be modeled after real maps of the Nile river (Tooley and Bricker 1968, p. 11). A typical format was to divide the length of the coffin into two paths representing the "land way" and the "water way" the deceased might follow on his journey in the afterlife (Bonacker 1950).

A second rather more practical example of map materials being at least partly responsible for adoption of a strip format is found with carved wooden maps made by nineteenth century Eskimos in Greenland to represent coasts and island chains (Figure 2). That the linear form of these maps did not simply result from a mistaken perception of the environment portrayed is evidenced by reports that the same Eskimos were able to draw quite detailed topographic plans of large coastal areas with little spatial distortion (Bagrow 1948). The extent to which the linear or strip form of these stick maps is due to the linear nature of the map medium, versus an attempt to simplify coastal navigation by eliminating non-essential details of directional change, can not be determined until the navigation methods of these Eskimos are more completely known.

Probably the largest group of strip maps for which the selection of this format can be tied to the mapping materials are scroll maps. The best known early strip map, the *Peutinger Table*, may have been of this category, although the fourth century reproduction from which it is known consists of a set of adjacent panels.

Recording important information on silk and later paper scrolls was a common practice with many early civilizations. Scrolls were a particularly frequent recording medium in ancient oriental cultures. It is no surprise, therefore, that the majority of early oriental maps known today were produced on scrolls and contain most of the characteristics cited for strip maps.

The scroll or scroll-like strip format was common for both Chinese inland and coastal mapping from the 15th through the 19th centuries (Mills 1954). Scrolls, however, were not restricted to

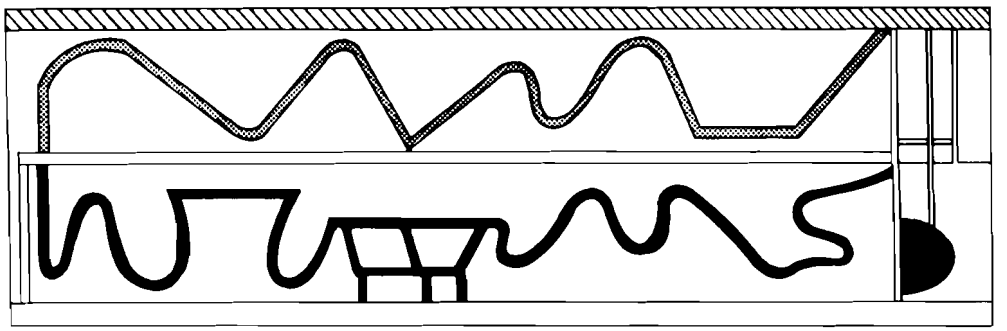

Figure 1. A representation of the main features of an Egyptian map to "The Beyond" painted on a coffin bottom. The water-way is on top and was represented in blue with the land-way in black on the lower half (after Bonacker, Figure 5, p. 13).

route following applications, and served as basic reference and administrative maps as well.

One of the best known of the Chinese scroll maps, constructed in the late seventeenth century, depicts the Great Wall of China (Kish 1973). Produced between 1680 and 1700, the map is on a scroll 11 feet long by 8.5 inches wide and represents the wall as a nearly linear feature, distorting true direction to fit the medium (Figure 3).

The linear sequential presentation dictated by the scroll carried over to folded paper maps. Even when maps were printed in sheets, the sheets were often joined together to produce a folding strip map resembling their scroll counterparts. One example is the Manchu Itinerary representing a journey undertaken by one of the emperors of the Tjing dynasty from Peking, through Shanhaiguan and Mukden (Rudnev 1955). The map, 626cm. long and 21cm. wide, is folded in accordion-like fashion into sections or pages with each representing a single day's itinerary. Thus, the format not only straightens a very circuitous route by ignoring cardinal directions, but also varies scale by using travel time rather than geographic distance as the unit of measure.

The influence of map media on selection of a strip format largely faded with the disappearance of scrolls as a common means of storing written information. It seems, however, that the advent of "virtual" computer maps creates the potential for renewed influence of the map media. Scrolling computer monitors offer a medium not unlike the ancient silk scroll. With the introduction of computerized maps as a dashboard option in automobiles and the prevalent use of strip maps for automobile travel, it would not be surprising to see the reintroduction of scrolling strip maps to depict a travel itinerary.

INFORMATION AVAILABILITY

Just as availability of map construction materials can influence decisions about map format, availability of geographic information to be mapped can

Figure 2. Example of wooden coastal maps carved by Eskimos in Greenland (after a photograph in Bagrow, 1948, p. 93)

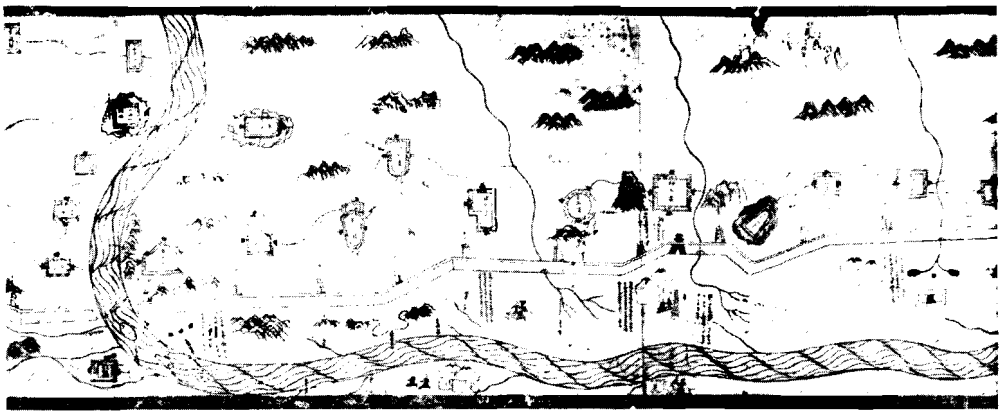

Figure 3. Section of a late 17th century Chinese scroll map of the Great Wall of China (Meijer, 1955 p. 112ff. Reproduced from *Imago Mundi* by permission of Mouton Publishers).

lead to similar decisions. In the past, lack of geographic information was a common problem for both explorers and the military in unfamiliar territory. For both groups, information could often be gathered only in a narrow band along the line of travel.

Water bodies obviously served as a principal means of transportation for early explorers in the new world. Many maps related to discovery and exploration, therefore, were centered on a river or along a coastal border. Most early explorers either drew sketch maps of their travels or collected information from which maps were later constructed. A strip format was appropriate not only because of a limited band of information along the river or coast, but also due to the sequential manner in which information was collected.

One of the earliest well-known strip maps resulting from explorations in North America was based on information from Joliet and Marquette's exploration of the Mississippi River (Kish 1973, slide 118). The Mississippi is, of course, an ideal candidate for a strip format map, being a relatively straight geographic feature running largely north-south. The map, appearing in Thevenot's *Voyages* published in 1681, is particularly interesting in two respects. First, in spite of the almost north-south path of the river, making conventional north at the top orientation practical even for a strip map, the map is oriented with west at the top. In addition, the river's course is presented as being considerably straighter than it actually is.

Strip format maps depicting exploration along rivers in North America are common to virtually all countries that explored the territory. In most cases, orientation was other than to the north. Henry Timberlake in 1765, for example, depicted the west to east flowing Tennessee River with east at the top (Figure 4). Swedish maps of sections of the Delaware River by Lindhestrom (1691) and Haagh (1696) are oriented to non-cardinal directions, allowing the map to efficiently conform to a narrow vertical or horizontal page (Kohlin 1948). Maps of the Lewis and Clark expedition (1804–1806) also contain many strip format sections, each of which is oriented at whatever direction conveniently fit the page. Considerable detail is provided along the route of travel with adjacent unknown areas left largely empty (see Thwaites [1959] for reproductions of these maps).

The decision to opt for a strip format by explorers may provide a good reflection of the "cartographic honesty" of individual map makers. Presentation of information collected in a strip format is an admission of incomplete knowledge concerning the region mapped. More often than not, maps of early explorations

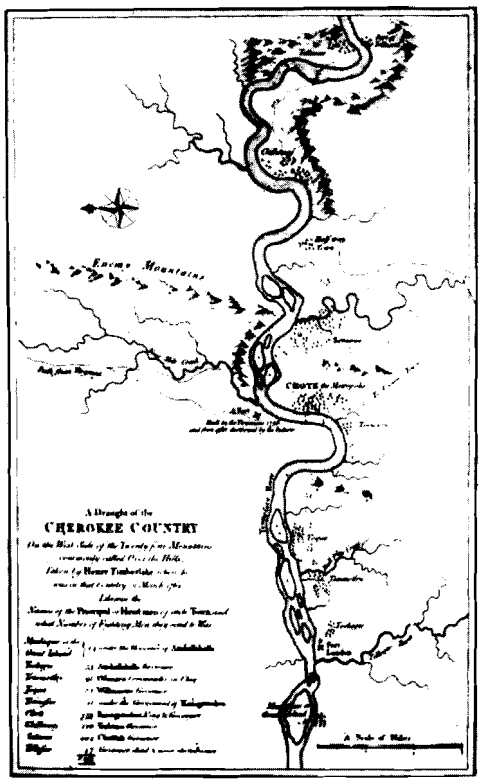

Figure 4. A strip map produced by Henry Timerlake in 1765 providing the first representation of the Tennessee River (Schwartz and Ehrenberg, 1980, p. 176, plate 106. Reproduced by permission from Harry N. Abrams, Inc.).

did not provide such an admission, but, instead filled in large areas between exploration routes using second-hand information, native myths, or simply the cartographer's own considerable imagination.

Presumably for explorers, the map served not only as a record of their discoveries but also as a guide that would allow them or others to retrace their path. Emphasis was, therefore, on route mapping. Army cartographers, in contrast, were trained to think in terms of topographical rather than route mapping. They mapped their travel routes following the same guidelines used for mapping a city or battlefield.

This difference in approach to the mapping task between army cartographers and explorers resulted in a different level of abstraction in strip maps produced. Although the strip format itself was as common in military maps as exploration maps, lack of attention to cardinal directions and straightening of routes was much less common. Robert Erskine and Simeon DeWitt, for example, both served as Geographers of the U.S. Army during the revolution (Guthorn 1966). Their maps, based on careful surveys, typically contained detail only along a narrow line of travel but were oriented with north at the top regardless of travel direction. Similar maps were produced by French cartographers traveling with Rochambeau's army 1780–83 (Figure 5).

Strip maps produced by the military in unfamiliar territory generally represent the least abstract form of strip format maps. They can be considered strip maps only in the restriction to information surrounding a line of movement.

MAP PURPOSE

The first two factors considered, map construction materials and availability of information, are relevant primarily in a historical context. Map purpose, however, is a factor that has led to selection of a strip format in the past and continues to do so today. Two purposes for which a strip format appears to have been consistently applied are to focus attention on a linear geographic feature having some legal, administrative, or military significance, or as an aid in route following.

Focus on the Immediate Geographic Setting of Linear Features

In localized legal disputes, emphasis was often on a particular parcel or parcels of land. Orientation of the land in question and its larger geographic context were of relatively little consequence. In such cases if the land being considered followed a boundary or path of some kind, a strip-like map was often produced.

Similar applications that can be more clearly put in the category of strip maps are the linear survey maps constructed to represent administrative boundaries.

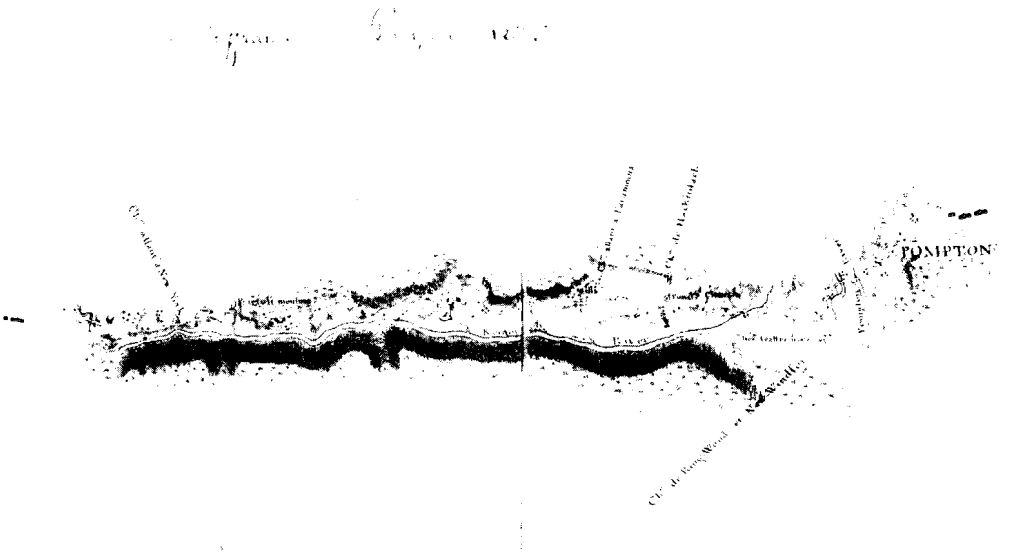

Figure 5. One of a series of strip maps by Louis-Alexandre Berthier (1780–83) depicting the routes taken by Rochambeau's Army during the Revolution (Rice, 1981. Reproduced by permission of the Princeton University Library).

These strip boundary maps were particularly popular in the pre-nineteenth century United States where political/administrative boundaries were often delineated on paper prior to their location in the real world. In such cases, a strip format was appropriate because emphasis was on the boundary, but also because of the difficulty in surveying rugged or unsettled territories. An example of boundary strip maps was produced in 1768 to represent the Mason-Dixon survey (Schwartz and Ehrenberg 1980). The maps, which together depict the entire 244 miles of the Mason-Dixon line, present a narrow band surrounding the survey line bounded by parallel lines approximately 3.25 miles on either side, beyond which no information is mapped.

A similar application of the strip format was used by Azariah Dunham in 1766 to represent the county boundary between Middlesex and Somerset, New Jersey (Rice 1981). Although this map does not depict the boundary as a specifically defined band, the map is produced as a single long strip with a non-cardinal orientation of approximately north-north-east.

Numerous historical maps produced by and for the military employ a strip format. In these applications, it is difficult or impossible to clearly separate factors that lead to selection of a strip format. Both a desire to depict only those areas for which accurate information was available and the desire to emphasize linear features of potential strategic importance are likely to have led to a strip format map. One example is a 17th century map of the Dnieper River produced by the French military engineer, Beauplan, for King Sigismund III of Poland. The map, originally constructed in the 1640s, was published in Guilliaume and Jean Bleau's *Atlas Major,* Amsterdam, 1662 (Bagrow 1953). The map depicts only a narrow band surrounding the river and has a non-cardinal orientation of approximately east-north-east.

Although rivers often had strategic military importance resulting in careful surveys and associated strip maps along their course, possibly the most militarily strategic linear feature known in history is a man-made structure, the Great Wall of China. At least one detailed strip format map in scroll form of the Great Wall has survived to the present

(Meijer 1955) (see Figure 3). As with other Chinese scroll maps, the scroll itself contributes to choice of a strip format and to the level of abstraction present. The importance of the wall as a line of defense and an emphasis on immediately adjacent features, including the Yellow River, are also reasons for the willingness to sacrifice planimetric accuracy. Due to the geographic position of the Great Wall, the orientation of the map changes in an almost continuous manner with a southerly direction being most often at the top. Scale also varies from place to place, possibly as a function of the amount of information included in specific sections. Meijer (1955), in his analysis of the map, concludes that scale and orientation changes apparent in the map were conscious choices on the part of the map's cartographers to address the military problem of troop concentrations along the wall within the confines of a strip format scroll map.

Use of the strip format to depict location and immediate surroundings of linear features continues today for utility mapping. Location and maintenance of pipelines, powerlines, and communication lines demand maps that detail the immediate surroundings of those features together with considerable nongraphic information concerning exact position, ownership, etc. The computer firm Synercom Technologies has developed a convenient format in which a section of the linear feature appears across the center of the monitor, with the space on either side reserved for descriptive information that can be automatically positioned and updated (Figure 6).

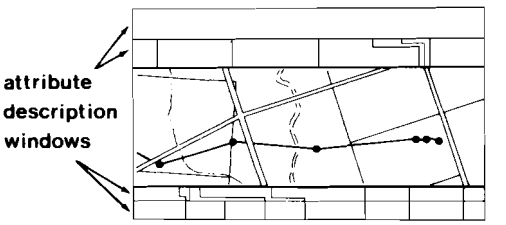

Figure 6. Format for display of a pipeline map and associated nongraphic data on a graphics terminal (after an advertisement by Synercom Technologies Incorporated, Houston, Texas).

Route Following

By far the most common use of strip maps has been for travel. Obviously not all travel maps use this format. The appropriateness of this format for a particular map is related to a distinction made by Downs and Stea (1977) between state and process descriptions. State descriptions relate location to a commonly understood framework (e.g., a standard highway map with a recognizable political border and north orientation). Process descriptions, on the other hand, represent a set of instructions for moving from one location to another. The strip format travel map is most closely associated with process types of description and is in fact an outgrowth of verbal or pictorial itineraries that were commonly used prior to development of navigational charts and road maps. By eliminating other details and focusing attention on features of a route, the strip map is ideally suited to route following, but at the same time is ill suited to route planning.

The objective of route following, as a reason for selecting a strip format, can be seen in isolated examples from the earliest periods of mapping. Even the Egyptian "guides to the beyond" reflect the perceived advantages of a sequential set of instructions for route following.

The best known ancient example of a strip map serving the need of process description is the Roman *Peutinger Table.* The map depicts imperial highways of Rome in a very abstract linear format measuring approximately 1-by-21 feet. Orientation and distance change continuously to retain the linear sequential nature of presentation. Features identified along the route, while not necessarily at the correct distance or exact direction from adjacent features, are generally in the correct sequence. Use of a strip format by the Romans does not indicate a simple lack of information or cartographic expertise. Roman cartographers are known to have produced quite accurate surveys of land parcels

for administration and taxation purposes. Their selection of a strip format for this major travel map indicates a conscious choice for a schematic process description specifically designed for ease of route following over a planimetrically more accurate state description of the geographic territory held.

During the Middle Ages, when much of cartography represented theological viewpoints rather than geographic reality, the need to travel was responsible for the few attempts at geographically accurate maps. One kind of travel specifically sanctioned by the church was a pilgrimage to Jerusalem. Such trips created an ideal context for renewed use of the strip format route map. Both length of the journey through unfamiliar lands, a definite destination, and a singular travel purpose dictated use of a process type description. Detailed written itineraries were produced along with a number of strip maps to accompany them. The best known is probably that produced by Matthew Paris, circa 1250, (Dilke and Dilke 1975). The map, like the *Peutinger Table,* depicted the route in very schematic or abstract fashion having little consistency in either orientation or distance (Figure 7).

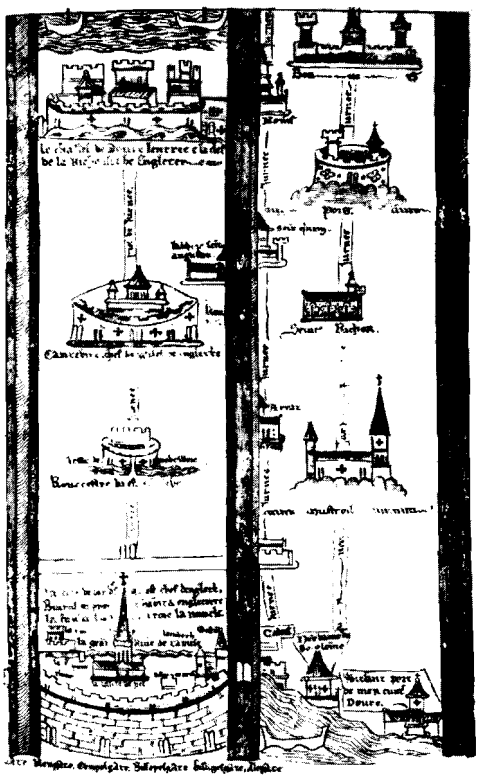

Figure 7. Section of the map from London to Jerusalem produced by Matthew Paris (circa 1250) to guide pilgrims to Jerusalem (From Map Making: The Art that Became a Science by Lloyd A. Brown) (Brown, 1977, p. ff. 102. Reproduced by permission Little, Brown and Company).

Verbal and pictorial itineraries were common in post-Middle Ages Europe not only for land travel, but for coastal navigation by trading ships as well. These coastal itineraries gave way to portolan charts and later to sea atlases. *Great Britian's Coasting Pilot,* produced by Captain Greenville Collins in 1693, is one of the better known examples of the latter.

European cartographers changed from process to state descriptions of coastal areas when they began to map those areas. Such a change had the advantage of allowing greater flexibility in choice of destinations and routes while requiring greater skills in route following. Portolan charts and sea atlases often retained a feature of earlier written coastal descriptions, a profile drawing of the coast in strip format. Inclusion of profile drawings for particularly important coastal areas on these navigational charts points to recognition of the importance of both process and state descriptions in navigation.

Chinese cartographers, for the most part, arrived at the alternative response to the same problem of coastal navigation. They chose to retain a process description in the scroll maps that replaced written coastal descriptions. The extent to which process descriptions were valued over state descriptions versus a cultural or practical bias toward scrolls as a medium for recording important information can not be determined.

In Great Britain particularly, the strip format was developed as the primary format for maps used in land travel. John Ogilby must be credited, in large part, with popularization of strip

maps for highway travel. His road atlas *Britannia,* published in 1675, contained one hundred strip road maps of England and Wales (Booth 1978). This work set a standard for British road maps that carried into the 19th century. Many of his maps were later published by others with little or no alteration, and nearly all cartographers who produced highway maps of Great Britain for the next century adopted Ogilby's style of several sequential strip maps adjacent to one another on a page. Among those publishing similar strip map road guides of Great Britain were Thomas Gardner, John Senex, Emanuel Bowen, John Cary, and Edward Mogg.

Ogilby's maps depicted each section of road at an orientation allowing the strip to be aligned vertically. Each strip had a directional indicator to alert the user to the variable orientation from strip to strip. Individual strip map sections contained information about the route relevant to carriage or horseback travel. Outside of England, strip format highway maps achieved greatest success between 1780 and 1810. Examples include maps by Taylor and Skinner (1785) in Scotland (Fairclough 1975), Colles (1789) in the United States (Colles 1961), Grovier (1793) in Italy (Elias 1982), and Mathew Carey (1802) in the United States (Carey 1802). In all of these cases the basic format and kinds of information presented were similar to that developed by Ogilby, although often somewhat less ornamental (Figure 8).

As with highway development and travel associated with it, development of canal and rail travel in the United States resulted in a new application of strip format maps. In these cases a limited number of fairly straight routes existed, making the strip format map ideally suited to representing them. Strip maps were particularly prevalent in depicting both potential and actual railroad routes (Modelski 1984). Most of the earliest of these strip maps were topographic and exhibited little or no distortion of the route, but showed minimal detail away from it and used any orientation that proved to be convenient.

After a brief decline in popularity, use of the strip format for highway maps was revived with the advent of automobile travel. Most early automobile travel guides did not incorporate maps, but were instead analogous to the early coastal navigation guides containing written descriptions and pictures of important landmarks or intersections. It was not long until the strip map began to supplement and later replace these descriptions entirely. One of the earliest strip maps designed specifically for automobile travel was produced by G. S. Chapin in 1907 (Schwartz and Ehren-

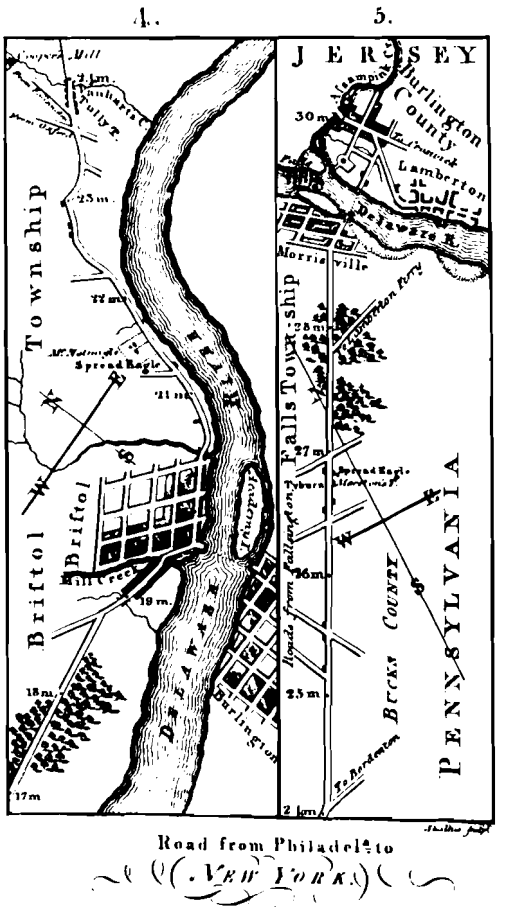

Figure 8. A page of Mathew Carey's strip map from Philadelphia to New York, from the 1804 edition of his *Traveler's Companion.*

berg 1980). It shows only the highway and adjacent features of importance to travelers. Like earlier Ogilby style maps, this map is oriented in a convenient direction for the page, with east at the top, and includes information along the route about distances, bridges, viaducts, railroad crossings, location of service centers, and major landmarks (Figure 9).

Shortly after publication of Chapin's map, a number of regional automobile clubs began producing route guides, some of which contained strip maps along with route descriptions. An interesting feature of these early auto strip maps is the lack of concern for cardinal directions. Some maps were actually produced at unusual orientations without any directional reference (Figure 10).

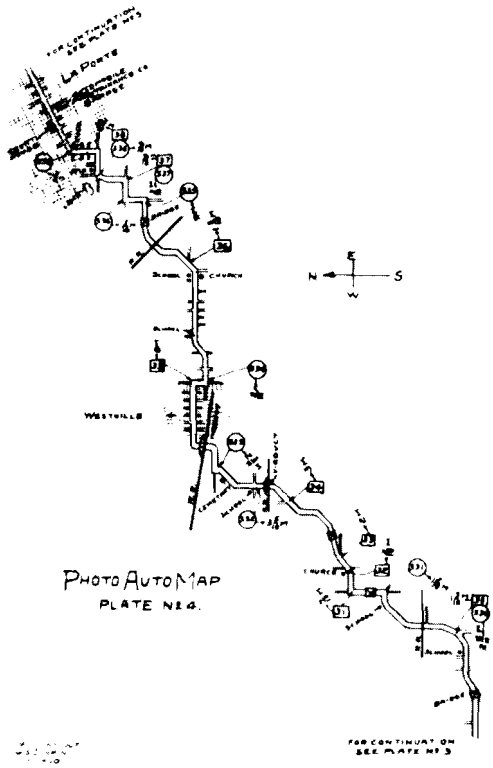

Figure 9. One of the strip maps included in G. S. Chapin's "Photo Auto Map" series from New York to Chicago. This section details a stretch of road in Indiana (Schwartz and Ehrenberg, 1980. Plate 203. p. 326. Photograph of the original in the collections of the Library of Congress, reproduced by permission from Harry N. Abrams, Inc.).

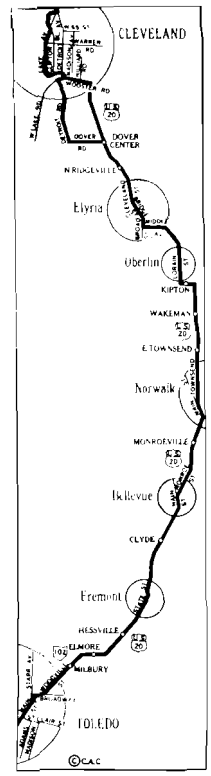

Figure 10. A typical strip map included in an early automobile route guide produced by the Cleveland Automobile Club in 1929 (Allyn, 1929). The map is roughly oriented with east at the top and route sections are straightened considerably.

In 1917 the American Automobile Association tried a version of its well-known strip map series (Ristow 1946). The series was initially unsuccessful and disappeared until the later half of the 1920s. From this reintroduction, the maps evolved through various forms to the present day *Triptik* that combines a strip map process description with the state description of a simplified regional map provided on the reverse side (Figure 11).

Early 20th century air travel was faced with limitations similar to that of earlier rail and canal travel. Among

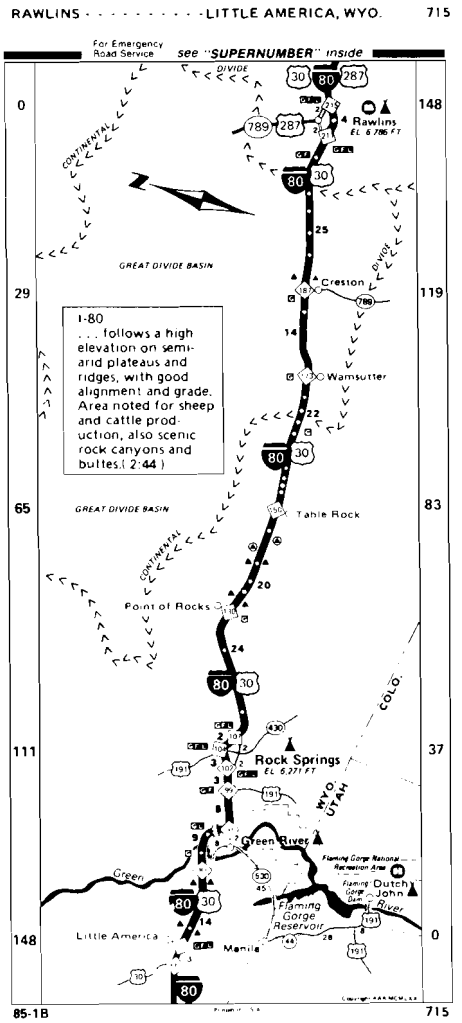

Figure 11. An example of one panel from a modern AAA *Triptik*. Each panel is constructed to be opened like a book with a somewhat smaller scale regional map in circular format filling the open page. *Triptiks* are now produced in two colors instead of the original black and white. The reproduction here is at 60% of the original size (©AAA—Reproduced by Permission).

these were a limited number of suitable airfields, restricted travel distances, and crude navigation methods. These limitations resulted in a narrow choice of origins, destinations, and routes, and a reliance on visual navigation. Strip air charts were an obvious solution to this navigational problem.

Between 1923 and 1927, the Army Air Service completed a series of 52 strip maps between principal U.S. cities (Schwartz and Erhenberg 1980). These maps were centered on the proposed route and oriented parallel to that route. As with earlier strip format highway maps, those details important to air navigation and safety were emphasized.

Strip maps are too limited to meet current air travel needs. In recent years, development of interstate highways has introduced yet another set of fairly limited land routes for which strip maps are again well suited. There has been a resurgence of strip format highway maps with a number of states including strip maps of interstate highways within their borders on the back of their standard highway maps (e.g., Alabama, Arkansas, Georgia, Kentucky, Louisiana, and Mississippi adopting this practice since 1977) (Figure 12).

COGNITIVE MAPPING OF SPATIAL INFORMATION

One reason for the success of strip maps over time and across cultures is the advantage of process over state descriptions for route following. In addition, continued popularity of the format and potential for its expanded use may also relate to advantages of such maps in helping people develop a cognitive map of an unfamiliar environment.

Indirect evidence of potential impacts of the strip format on cognitive mapping is the belief by advertisers that schematic strip maps can instill a more favorable conception of spatial relations in a person's mind, than would standard planimetrically accurate maps. Early railroad cartographers routinely straightened routes in an effort to convey an impression that their own route was the most direct (Modelski 1975). The practice continues today with tourist maps that convey an impression of routes much straighter and shorter than they actually are in an effort to lure the traveler to particular commercial facilities.

The role of strip maps, or any other form of map, in cognitive mapping is related to the process used to develop cog-

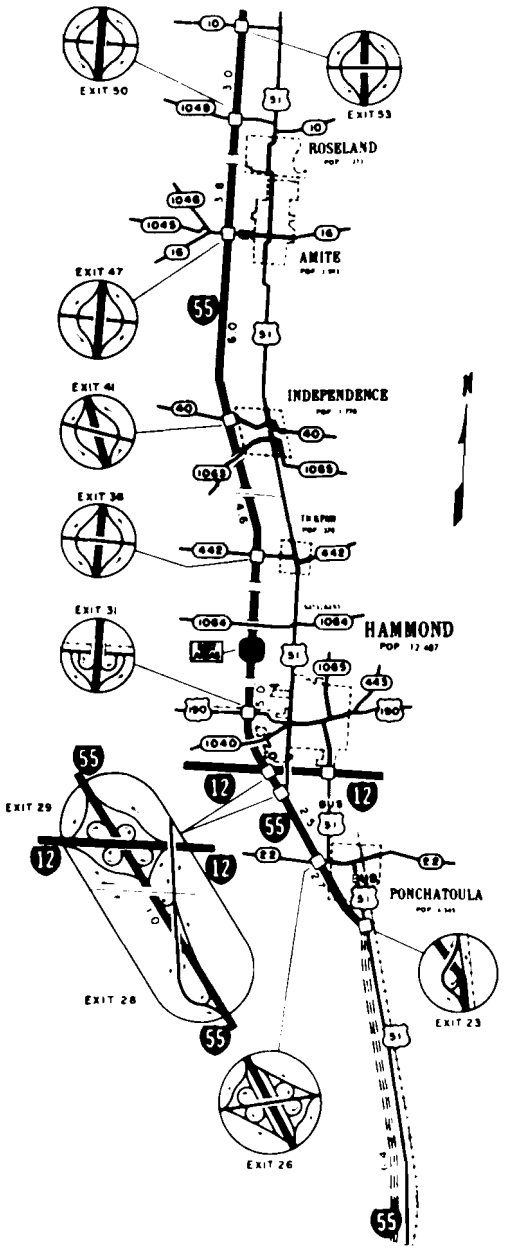

Figure 12. A section of the strip map depicting Interstate 55 from the 1979–80 official Louisiana highway map (The Louisiana Department of Transportation and Development, 1979. Reproduced by permission from the original color map at 80% of the original size).

nitive maps. It has been suggested that, as people begin to learn about a new environment, they begin with a skeletal node-path framework to which additions are made over time (King and Golledge 1978) (Figure 13). The hypothesized developmental sequence closely resembles many strip format maps. Therefore, if a person learning a new environment uses such a developmental strategy, a map with a corresponding structure would enhance the process of integrating the new information.

A related conceptualization of the process of cognitive mapping involves a distinction between "route mapping" and "survey mapping" as alternative strategies used in developing a cognitive map (Lynch 1960; Shemyakin 1962; Stea 1976). In route mapping the environment is conceived of as a sequence of features and/or actions that describe a path between two known points. This results in a one-dimensional representation of those parts of the environment that have been directly experienced. Survey mapping on the other hand is more two-dimensional, emphasizing spatial relations among places and features, resulting in a more integrated survey map. Clearly the activity of route mapping corresponds to the process descriptions

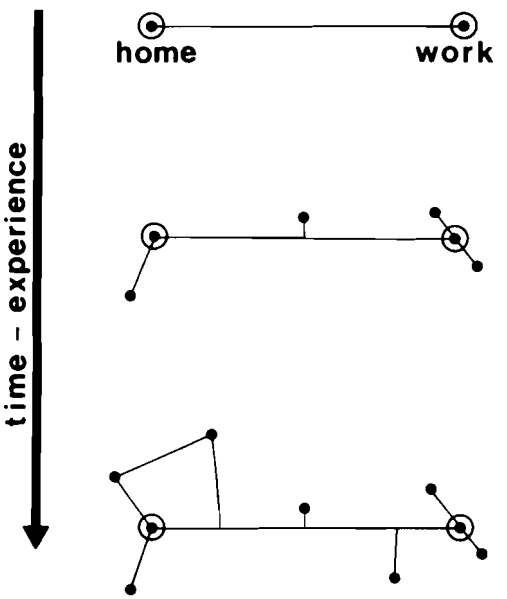

Figure 13. Hypothesized development of a cognitive map based on a framework of paths and nodes (after King and Golledge, 1978, p. 328).

mentioned previously and the product of this activity, a cognitive route map, corresponds to the strip form of cartographic representation. Survey mapping, on the other hand, corresponds to a state description and its product, the survey map, corresponds to standard regional maps.

Downs and Stea (1977) liken route mapping to the response learning of classical experimental psychology (Hull 1952) and survey mapping to place learning as described by Tolman (1951, 1958). Advocates of response learning conceive of learning as a direct response to stimuli as would occur through repeated trips along a route from a new home to the nearby shopping center. Place learning, on the other hand, does not require immediate experience with the entire environment because an overall cognitive map is created that can be used in making logical deductions concerning the presence or absence of features or the appropriate routes between locations. It is accepted that both response learning and place learning and the corresponding concepts of route and survey mapping operate to varying degrees in environmental learning (Stea 1976).

In an effort to integrate aspects of our understanding of environmental learning, Moore (1976) suggested a three-stage developmental sequence modeled to some extent after developmental theories of Piaget and his associates (see for example, Piaget and Inhelder 1956; Piaget, Inhelder, and Szeminska 1960). The stages are identified as: 1) an undifferentiated egocentric reference system (organized around a person's own position and actions in space and including only elements of great personal significance); 2) a differentiated and partially coordinated, fixed reference system (organized as clusters or subgroups of elements with only rudimentary coordination among groups); and 3) an operationally coordinated and hierarchically integrated reference system (organized in terms of some abstract geometric pattern and emphasizing coordination among elements). The second stage of this developmental system consists of three forms: a) fixed point and radial references like landmarks and intersections; b) fixed linear-route references like major streets, rivers, etc.; and c) fixed areal-spatial references like a central business district or a neighborhood.

This developmental model is hypothesized to represent the developmental sequence of children as they grow older and the sequence an adult would follow in learning a new environment (Moore 1976). Examples of each stage of development are expected to exist within a specific population for a given area. In an experiment with 15 to 19-year-olds, Moore found each stage clearly represented in sketch maps of Worcester, Massachusettes.

Route mapping and the developmental sequence presented by King and Golledge represent one form of the intermediate stage in Moore's (1976) developmental model. Route mapping, therefore, is not viewed as an alternative to survey mapping but as a preliminary step that provides a framework that would allow survey mapping to proceed. Support for this view is provided by Moore's finding that both the second and third stage of development were apparent for individuals in relation to unfamiliar versus familiar environments (Figure 14).

Further support for the developmental sequence described by Moore is provided in a study by Devlin (1976) of persons faced with adapting to a new town. Wives of Navy officers moving to Idaho Falls, Idaho participated in the study. Each produced a sketch map of the town after three weeks residence and a second after three months. Based on a description of the results, the subjects are concluded to be in the second stage of partially coordinated cognitive maps. Most subjects emphasized paths, indicating that a fixed linear-route or route mapping strategy was followed. The dominant errors, such as incorrect order of streets and inaccurate angles for side street intersections with the main arteries, support a contention that

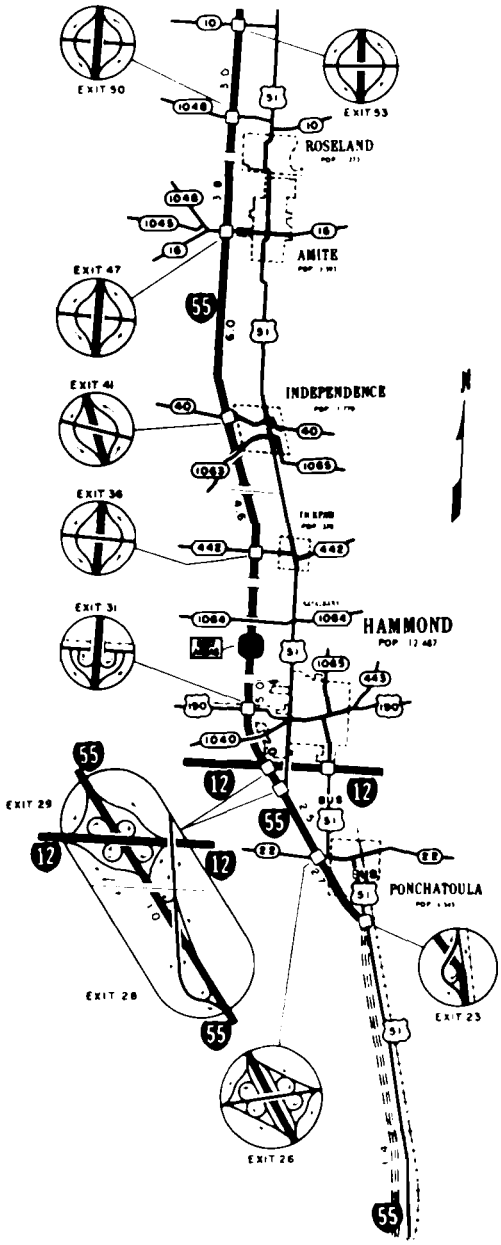

Figure 12. A section of the strip map depicting Interstate 55 from the 1979–80 official Louisiana highway map (The Louisiana Department of Transportation and Development, 1979. Reproduced by permission from the original color map at 80% of the original size).

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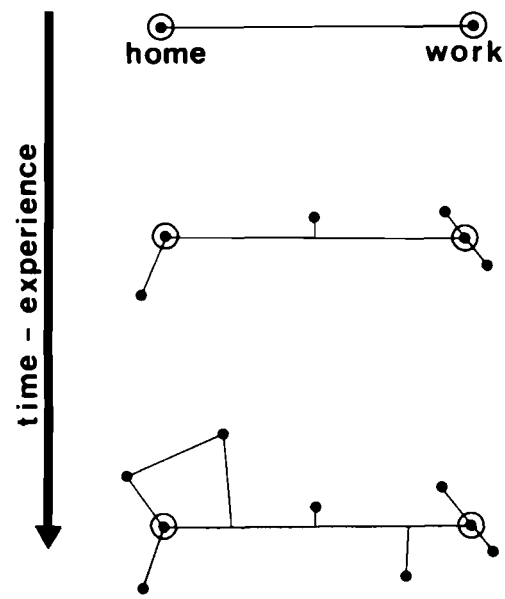

Figure 13. Hypothesized development of a cognitive map based on a framework of paths and nodes (after King and Golledge, 1978, p. 328).

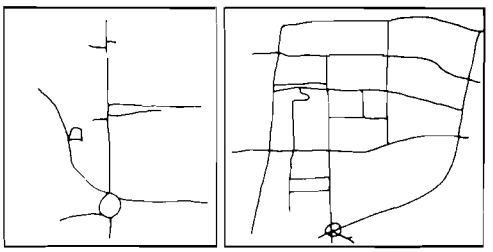

Figure 14. The main components from two sketch maps by the same individual, the one on the left representing an unfamiliar environment and the one on the right a familiar environment. The original sketches included numerous labels of both point and line features (after Moore, 1976, p. 162).

paths were learned as individual components not necessarily associated with each other spatially. After three months, the sketch maps were more complete and "filled in" suggesting that the subjects had progressed from the route to the survey mapping stage.

Little or no effort has been made to determine the role of cartographic maps in the process of cognitive mapping. A group of studies by Thorndyke and Statz (1980), however, indicate that spatial information can be learned from maps and the ability to recall information presented on maps is related to the learning strategies a person employs. Thorndyke and Statz identified strategies, or heuristics, used by good versus poor learners. They then conducted an experiment to determine whether learning of map information could be improved in all subjects by directing them to use learning strategies proven effective for good learners.

Partitioning the map into areas or categories of information (e.g., streets) was found to improve learning. Other effective strategies included imagery (i.e., creating a visual image of a dominant feature such as a coastline) and pattern encoding (i.e., focusing on a spatial detail or shape of a single map element such as a curve in a road). As subjects began to learn a map they then incorporated evaluation of their own efforts together with memory directed sampling (i.e., sampling map areas or feature types that had not been recalled on the initial effort) as strategies to fill in gaps in their knowledge. This combination of strategies for learning a map, and their order of implementation, appear to correspond to the developmental sequence described above for learning a new environment. A map format suggesting an appropriate sequence of learning strategies that correspond to this developmental sequence should facilitate the process of cognitive mapping.

Strip maps with their emphasis on linear features and process descriptions match the organizational strategy of Moore's (1976) second stage in cognitive mapping, potentially allowing the user to master this stage more quickly than with a standard map. They also are likely to suggest learning strategies that incorporate partitioning, imagery, and pattern encoding that emphasizes major transportation arteries. Regional maps, as representations of the more fully integrated survey type map, do not match the initial organizational strategy nor do they suggest any single learning strategy and, therefore, may be less likely to aid in learning a new environment. This hypothesis is supported by Devlin's (1976) finding that there was no correlation between the number of times a standard reference map was used and the accuracy of sketch maps produced. As an integrated cognitive map is formed, however, it is equally likely that a strip format map will be of little use or may even confuse the user because of the lack of correspondence with the structure of the user's more complete cognitive map. This possibility seems particularly likely with extremely abstract strip maps such as some found on recent state highway maps (Figure 15).

SUMMARY AND CONCLUSIONS

Strip maps are a form of cartographic representation that have been used with varying degrees of frequency throughout recorded history. In spite of the persistent application of this technique to

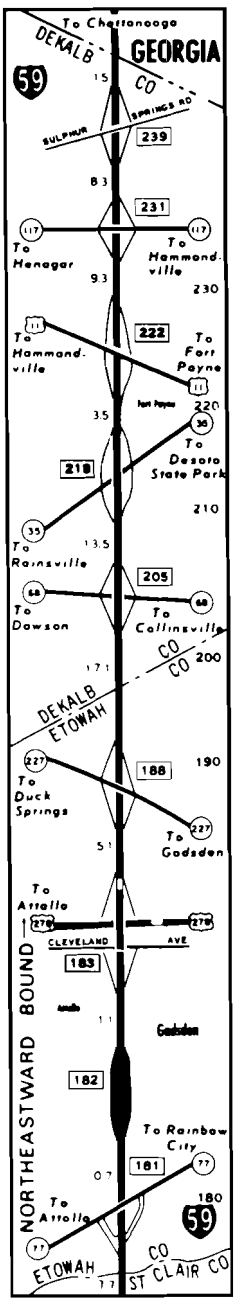

Figure 15. A panel from a schematic strip map depicting Interstate 59, on the 1979–80 official highway map of Alabama. The route runs roughly northeast to soutwest, is depicted vertically, and has no indication of orientation on any map sections. (State of Alabama Department of Highways, 1979. Reproduced by permission from the original color map at 77% of the original size).

emphasize linear features and aid in travel, strip maps have been given little attention in the cartographic literature. A primary objective of this paper has been to document the varied applications of this representation technique in both past and present situations.

Four factors were considered as possible determinants of strip map use. These included two limiting factors: available or common map media, and availability of information. The remaining factors, map purpose and cognitive organization strategies, can be considered positive factors that can lead to strip maps being more efficient or effective in specific situations. Limiting factors were shown to have been significant in historical mapping. Oriental scrolls represent the map medium with the greatest impact, resulting in a dominance of strip format maps for several centuries. For present applications, the one limiting factor that has a potential to influence choice of format toward strip maps is the scrolling computer monitor. Such an impact has not yet materialized.

Two general map purposes or objectives have led to selection of strip representation methods in both past and present applications. First, for an important linear feature, there is often a need to focus on immediate surroundings of that feature at the largest possible scale. In past applications, linear features of interest were often significant in a legal, administrative or military sense, while present examples are directed to commercial enterprises such as pipelines or communication.

Overshadowing the above applications of strip format maps are applications to route following. Process descriptions clearly are superior to state descriptions for use in route following given a narrowly defined possible route. Process descriptions, however, lack the flexibility of state descriptions in adapting to alternative routes or solving non-route following problems (e.g., initial route planning). In spite of these limitations, process description strip maps

have been frequently applied to route following situations throughout history.

Overall, abstractness of the strip representation method applied to particular categories of problems appears to be fairly consistent across time and culture. The least abstract strip representation methods are commonly applied to non-route linear features for which detail is desired about the feature and its immediate surroundings for administrative, commercial, or military reasons. This generalization applies to both past and present mapping practice with the exception of oriental scroll maps. In this case, limitations of the map media were more significant than any other factors.

Although limitations of map media can lead to abstraction, abstract strip maps have most often been applied to navigational problems in which there were clearly defined origin and destination points and limited choices of routes between them. In such situations, consistency of both scale and orientation are frequently relaxed in favor of simplified process descriptions detailing landmarks and points of action (e.g., intersections).

Relations between strip map process type descriptions of the environment and the hypothesized intermediate stage of learning new environments (route mapping) were also considered. While little direct evidence currently exists to support the contention, the strip method of organization may allow more efficient incorporation of new geographic information into a cognitive map. Virtual computer maps offer a potential to expand upon this possibility allowing for non-static maps that can change with the situation. It is possible, for example, for an initial schematic process description type strip map to undergo a developmental sequence similar to that hypothesized for the human mind. As the user's organizational strategy changes, the map could evolve to a more detailed strip format map and eventually to a complete survey type regional map. To examine these and other possibilities, considerable further investigation of the role of strip representation methods in cognitive mapping is clearly required.

Although the present paper may have created as many questions as it answered, advantages of combining historical and contemporary perspectives on cartographic methods are apparent. Not only has a historical overview of a seldom considered representation method been presented, but this overview has demonstrated the continuing role in cartography of strip format maps and identified specific questions that must be answered to use these maps effectively.

If we are to extend beyond past rather narrow investigations of map perception to appraise the cognitive aspects of map use and spatial understanding, we must consider alternatives to the tightly controlled experiments on "map-like" stimuli we have often used. One strategy is to compare past and present applications of representation methods in an effort to identify the commonalities that withstand the test of time. Surely it is in these that we may find the most lasting cartographic principles upon which theory might be developed.

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