NOTATION SYSTEMS IN ARCHITECTURE

by

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Coolidge Corner, a medium size communal urban area in Brookline, was surveyed by means of several systems of urban space notation. The first four, namely Lawrence Halprin's, Philip Thiel's, Donald Appleyard's group, and Stuart Rose's included movement as a conscious effort to describe the environment. The last two, Stanford Anderson's and mine, look at the environment from the point of view of interaction between use and form (space).

It was found that since environment and movement are a function of one another, it would be useless to have separate representations for each of them. Also movement from a single pedestrian's point of view is highly unrepresentative of the environment. However, Rose's system had the potential of being developed into a more suitable means for computer graphic simulation.

Thesis Supervisor . . . . Stanford Anderson

Title . . . . Associate Professor of Architecture

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INTRODUCTION

In the past thirty years, significant attention has been focused upon media and methods for presentation in the design process. Morton Subotnick and John Cage developed means of music representation which take into account performers' movement and electronic music. Rudolf Laban and Avraham Wachmann in dance, have worked on a symbolic system for choreographic representation, much like an orchestral score, to specify the synchronization of body movements in a more exact way than verbal description. Serge Eisenstein's system of cinematic construction divides the film into independent elementary components: musical, thematic, and pictorial time, pictorial space, and movement of both music and picture.

New techniques of representation in architecture and planning, in addition to the traditional diagrams of plan, section, elevation, isometric and perspective view stem from the increasingly complex set of variables which designers must take into account. Numerous descriptive and representational systems, particularly in the field of urban design and analysis, have concentrated upon ways of showing the properties of the environmental elements with which a designer must deal.

None of the traditional methods for environmental representation show human movement in time. Rather, it has generally been taken for granted that plans, elevations, sections and perspectives provide sufficient information for one to imagine such movement.

Four of the new methods were intentionally formulated to indicate specific human movement in time and space, thus to supplement and expand the levels of complexity and exactitude which have been possible with conventional drawing techniques.

1. Lawrence Halprin's MOTATION.
2. Philip Thiel's NOTES ON THE DESCRIPTION, SCALING, NOTATION, AND SCORING OF SOME PERCEPTUAL AND COGNITIVE ATTRIBUTES OF THE PHYSICAL ENVIRONMENT.
3. Donald Applyard, Kevin Lynch and Jack Myer's THE VIEW FROM THE ROAD
4. Stuart Rose's A NOTATION/SIMULATION PROCESS FOR COMPOSERS OF SPACE.

My procedure has been to study the intents and objectives of these four methods, to consider them in terms of theory and practice, and by applying all four to the close scrutiny of a common area, to empirically evaluate their relative usefulness. In addition to the four systems noted, I include diagrams based on two other systems, one developed by Professor Stanford Anderson and one which is my own.

I selected Coolidge Corner in Brookline, Massachusetts as the testing ground for my study, referring to its medium-urban scale as an intermediary between the larger city scale and the smaller architectural scale. I also chose to concentrate my attention on diagrams which explicitly regarded the pedestrian and his association with the environment. The Appleyard-Lynch-Myer system, although specifically designed for vehicular movement, was nevertheless applied to the Corner from the pedestrian's point of view. For the traditional-type diagrams of Coolidge Corner, I have relied upon those which Hiroo Kurano made for his "Studies Into the Growth and Form of an Urban Activity Center". (MIT architecture thesis, 1971.)

My purpose in this study is to determine the appropriateness/usefulness of the proposed representational methods for architectural/urban analysis and design, and to select or synthesize from them a simulation system which can facilitate notation of the physical environment.

My thesis is divided into four sections. The first one deals with the existing four systems of notation. This includes an explanation of the structure of each system with its own criticism and conclusion. The second section looks at the process of movement in an environment. It also takes collectively the four systems and discusses the reasons, ambitions, successes and limitations involved with such work. The third section is devoted to the study of "traditional" means of notation. Traditional in the sense that a plan of the area is used as a base for notating the movement and the space where the movement takes place. The last section is an overall conclusion with recommendation for further work.

Section A

MOTATION

Lawrence Halprin's MOTATION system first appeared in 1965. It is comprised of two sub-systems:

a) the symbols; and

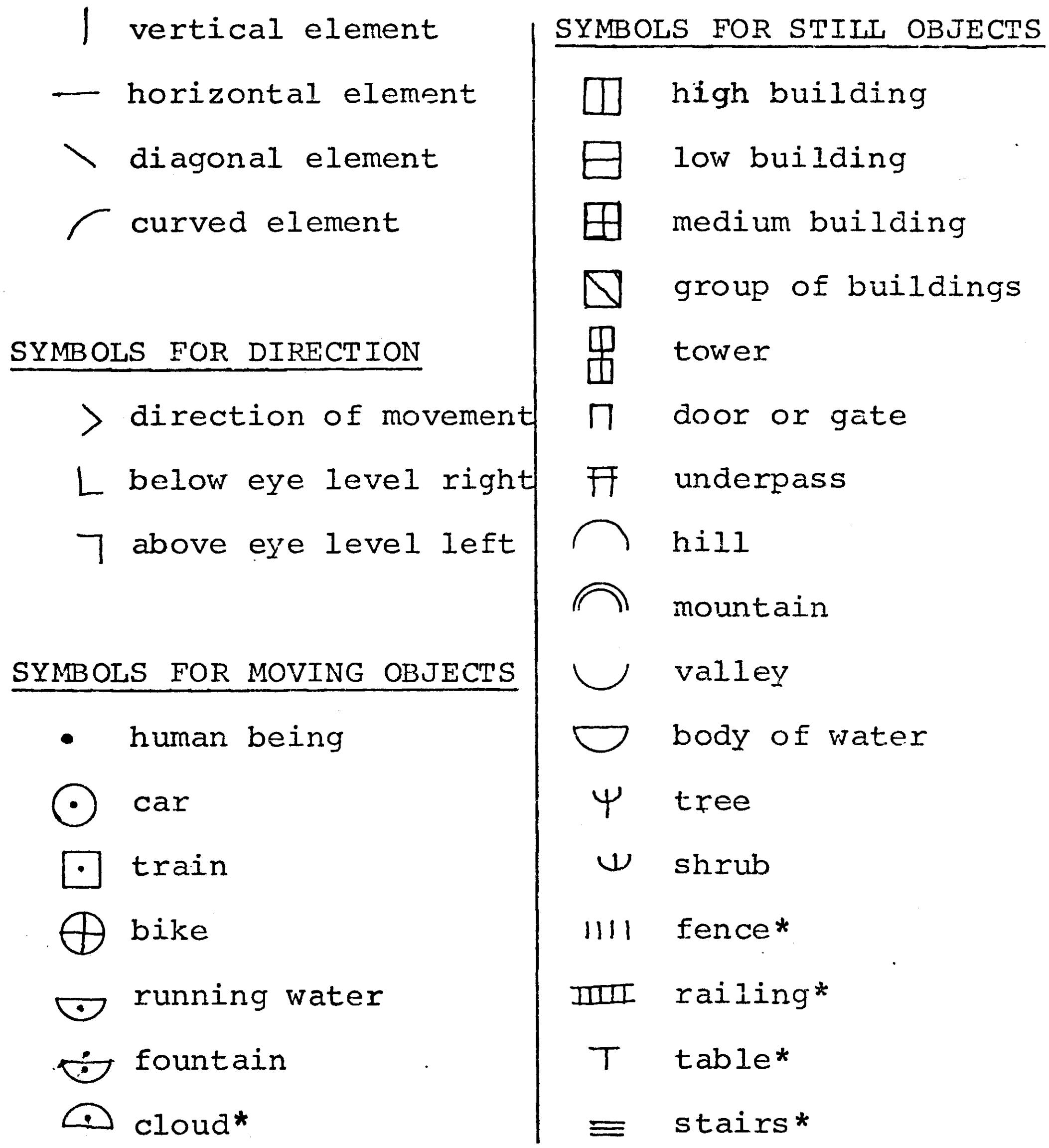
b) the format on which the symbols are recorded.

There are three basic concept-related symbols: the dot, the arc and the straight line. Alone or in combination, these geometric elements produce the basic image-related language symbols. The dot and the circle (considered by Halprin as an open dot) represent objects that move. The arc and the straight line, and a combination of both, denote still objects. The dot also represents a human being, the circle a wheel, so a dot within a circle symbolizes a car. The structure of the system is shown in Figure 1.

Halprin divides the symbols for still objects into Structure Symbols (only man-made objects) and Landscape Symbols (which include both natural and man-made objects, e.g. fountains.) In Figure 1, I classify the symbols in terms of still objects and moving things. This categorization is, I think, more consistent with Halprin's concern about movement.

A standard format sheet is used (figure 2) on which the symbols are recorded. "Standard sheets can be joined end-to-end to form a movement composition or record of any length; this is convenient to read, like scroll. Secondly, movement notation on standard sheets are easier to compare with each other."[1]

The sheet is divided into two halves. The right half includes a constant reference list of the symbols and any additional symbols



*Added to the original symbols.

THE MOTATION SYMBOLS

Figure 1.

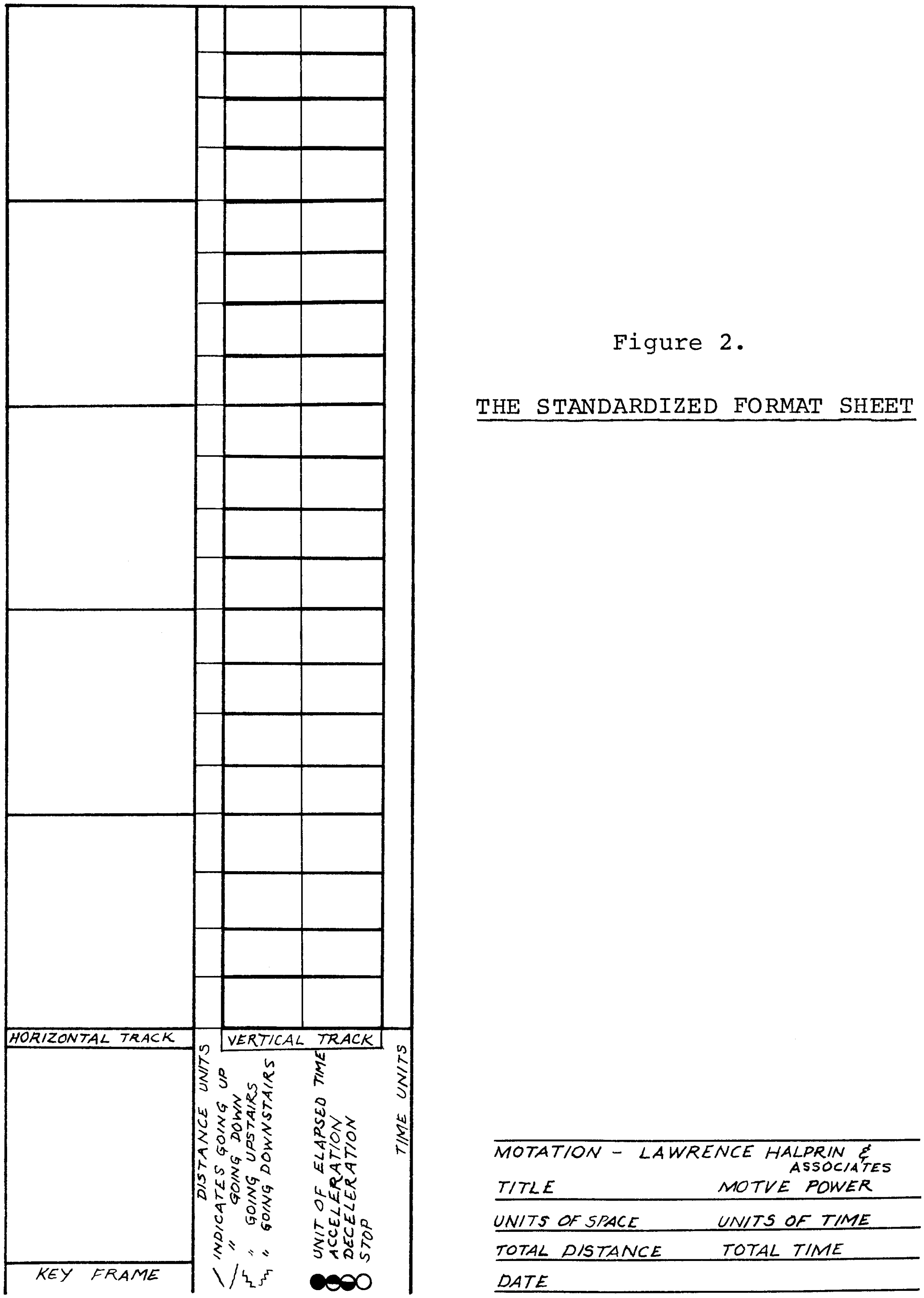


Figure 2.

THE STANDARDIZED FORMAT SHEET

or notes one might have (not shown in figure 2.) Below this there is the title block where the title, means of movement, units of time and distance are recorded. The left half of the sheet is used to record the experience itself on two separate tracks. The horizontal track is a row of large frames used to map the path of travel and to record all the changes of direction in the plane of movement, as well as to plot other mobile elements related to this movement. It starts at the bottom with a key frame showing the basic voyage. Essentially, this is an imposition of a particular movement pattern on a roughly sketched conventional plan of the area where the movement is taking place. The successive frames of the horizontal track repeat only the section of the trip that is being notated in the corresponding frames of the adjacent vertical track.

The vertical track is to the right of the horizontal track and is composed of smaller frames. It is used to record the " normal visual horizon - which we see ahead of us as we ride or walk."[2] The vertical frame is divided by a center line to account for objects to the left or right of the observer. The center line itself represents the movement path. Read together from bottom to top, the vertical and horizontal tracks describe the qualities of three dimensionality, that is, of height as well as horizontal distance. Two extra strips to the left and right of the vertical track indicate distance and speed, respectively. The distance strip shows the rise and fall of the surface that is moved upon by means of a diagonal which corresponds to the angle of slope. Sound, smell, color and climatic elements such as rain are also recorded on the strip. The time strip utilizes dots. Irregular spacing of the dots indicates change in speed, the closer the dots the slower the movement and vice versa. A break in the track represents a change in the means of movement. This is also accompanied by a change of units for distance and time.

The combined tracks when plotted on the standardized form describe the apparent movement of a person through a space.

Motation is, in a few cases, inconsistent in its use of the symbols. My first objection with respect to the directional symbols is the lack of arrows. Arrows are universally accepted as indicators for direction. Halprin's lines with the same general dimensions as those used for objects are sometimes confusing. For example, the symbol ┐ (above eye level left) is clarified by drawing ←┐. In my example I used ┐ to indicate a slab supported by columns to the right and a wall on the left (photograph #26 in the Appendix). Similarly the symbols └ and 〉 indicating below eye level right and direction of movement can be represented as └→ and →.

Another confusion arises in indicating several objects of the same kind. The dot, denoting moving beings also indicates plurality, (example on page 132, where tables are indicated by . and trees by .) This is not the case when showing a group of buildings. The symbol for that is . The use of the diagonal, which stands for diagonal elements, is inconsistent with the use of dots as indicators of plurality, e.g. or or . However, it is possible that Halprin was thinking of a group of buildings as perceived from a highway (example on page 131) or such a distance that one cannot distinguish diagonal elements. In my example, the scale is much smaller than that of a highway, which justifies the use of , and for a row of buildings . A more consistent symbol would be (a tower tipped 90) and a group of tall buildings could be represented by . Similarly trees can be shown as and tables . All the symbols used, whether on the vertical or horizontal track are elevation views. This is confusing, at least at the beginning. One exception to this rule is the symbol for a man, where he is represented by a dot (a plan view) and not, say, , or .

NOTES ON DESCRIPTION, SCALING, NOTATION AND SCORING OF SOME PERCEPTUAL AND COGNITIVE ATTRIBUTES OF THE PHYSICAL ENVIRONMENT

Thiel for more than twenty years has been interested in developing a notation system for representing the environment. His most recent work "Notes on the Description, Scaling, Notation, and Scoring of some Perceptual and Cognitive Attributes of the Physical Environment" was first published in a smaller version in 1961.

Thiel developed four means to describe an experience through space. The first and most important for the "envirotect" is the Sequence Notation and Score, which consists of separate motion channels describing "a proposed or an existing potential sequence of distal stimuli and/or signals, at the appropriate level of detail.[3] The channels show information for time, horizontal distance, and for horizontal and vertical direction.

The second notation has to do with orientation. The five physical visual form elements developed by Kevin Lynch in The Image of the City (1960) are supplemented by a sixth element, signs. Thiel groups the five elements in terms of conceptual dimensionality: the two dimensional elements are the districts and nodes, one-dimensional elements are paths and edges, and the nominally no-dimensional point with the attribute of position only are landmarks and signs.

The third way for describing the experience, is the physical environment where the experience takes place, or the anatomy of the visual space. Here distinction is made between the several types of spaces a person might occupy. There is the primary space, the "smallest space that is most explicitly established",[4] the sub-spaces, the smaller and less explicit spaces, and secondary spaces which are larger than the primary spaces. By definition then, at no time does a person not occupy a primary space. In sequence, the person moves directly from one primary space to the next. Thiel summarizes the basic requirements for the system:

> "We conceptualize a visual world, existing all around us in three dimensions. At a given moment our perceived visual field encompasses approximately half this visual world and may be schematized as occupying a concave hemisphere symmetrical about our (usually nearly horizontal) line of sight. The differentiation of this field of view constitutes the "environmental display", or "scene". The scene, in turn, is seen to be composed of the in-spaces, or momentarily occupied sub-spaces, primary, secondary, and other spaces: and the out-spaces, or non-occupied spaces seen as views. Scenes are notated in a hemispherical projection: in-spaces by SEEPIs (to be described subsequently), and out-spaces (views) as part of the orientation scoring."[5]

The Space Establishing Elements (SEEs) fall into three categories: objects, surfaces and screens.

> "Any space is established by the perceived relationship between surfaces, screens, and objects. Objects may be thought of as three-dimensional forms existing as separate, isolated visual entities in a larger space than that smaller space which they help establish. (In the context of the larger space, the object no longer functions as a space-establishing element and consequently becomes a furnishing.
>
> Surfaces are two-dimensional plane forms, limited in spatial effect to that space they help establish, although they may be part of a larger object when experienced in a

> larger context. Screens, as perforated surfaces, or as closely spaced objects, obviously are an intermediate condition between the above two limiting types."[6]

The characteristics of SEEs are:

1. position, whether the SEE is above, below or to the side of the observer.

2. direction, of the major dimension and angular position relative to the horizontal and vertical axes of space itself.

3. shape, the overall profile or contour and its surface configuration.

The SEEs are related to each other in one of these basic relationships: jointed, separated, continuous, overlapping or overlapped.

The space itself defined by the SEEs has the following characteristics:

1. degree of explicitness: level of clarity or vagueness in the definition of a space. A numerical index and a graphic notation are established from zero to ten.

> "Zero explicitness is denoted by the absence of all SEEs; it is represented in the projection as a visual field consisting of half sky and half empty ground, as on the ocean or in a level uniform desert. Complete explicitness, on the other hand, is represented by the presence of SEEs in all five positions. Between these

extremes other combinations are grouped in a tentative pattern proposed as a base reference."[7]

2. degree of enclosure: the extent to which a space is confined. "The degree of enclosure is postulated as a function of three factors: the degree of explicitness, the absolute volume of the space and the relative proportions of the configuration of SEEs."[8]

The fourth and last essential means for describing an experience is the form quality of the space. This is independent of its explicitness or degree of enclosure. Form quality is described in many ways, two of which have been notated by Thiel. The first considers "regularity, closure, rest, completeness or symmetry (the classical or Apollonian), on one hand, to X-characterized by irregularity, randomness, dissolution, unbalance, incompleteness, mobility, or expansion (the romantic or Dionysian) on the other."[9]

The second reflects proportion. If one dimension is two and a half or more the other two dimensions, then the space is described as a "run", otherwise the space is simply referred to as "area". Sequential spaces can be connected according to how a person moves through them. Specifically, three areas have been notated: the merge, the area of interaction of two or more spaces; the port and the end, which occur when there is a constriction. Whether a space is a port or an end depends on the direction in which the participant moves.

An overall understanding of the experience results when all four means are combined. These are recorded along a vertical line, read upward. Other factors contributing to the experience can be notated and added to the system. These may include light, temperature feeling, shade and shadow pattern, the mood (which summarizes the overall subjective effect of the preceding attributes), texture of an area, sound and/or noise quality, etc.

Thiel's system is easy to use and it is comprehensive in its description of a certain experience. The scoring system for the movement sequence and orientation (based on the hemispherical projection) are extremely precise and refined. Absolutely consistent and unambiguous, the notations for SEE's, explicitness of establishment and form quality, are the product of 20 years of continual re-evaluation and modifications since Thiel's initial development of the system.[10]

VIEW FROM THE ROAD

The notation system set forth in The View From the Road consists of two categories, which, while poorly integrated graphically, are nevertheless parallel. The first, borrowing from Thiel's symbols, deals with motion and space. The second treats orientation.

Motion and Space is subdivided as follows:

"1. Apparent self-motion: speed direction and their changes (stop-go, accelerate-decelerate, up-down, right-left).

2. Apparent motion of the visual field: passing alongside, overhead or underneath, rotation, translation, spreading or shrinking of outline or texture, general stability or instability, apparent velocity or lack of it.

3. Spatial characteristics:

a. Presence and position of enclosing objects or surfaces, their solidity and degree of enclosure.

b. General proportions of the space enclosed, scale with respect to the observer, position of the observer.

c. Quality of the light which makes the space apparent, intensity and direction.

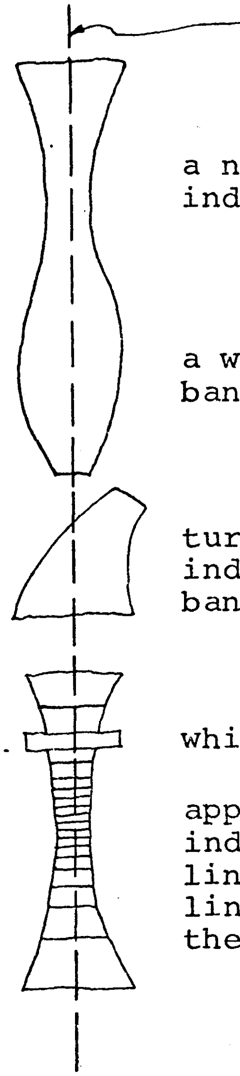
d. Relationship of spaces in sequence: joining and overlapping.

e. Direction of principal views, which draw the eye toward different aspects of the spatial enclosure."[11]

Figures 3(a, b, c, d & e) show the notation developed to illustrate the above categories.

Acknowledging that an experience through a highway involves not only the immediate perception of motion and space, but also the development of "general image of the landscape that develops in the mind, partly of what is presently visible, partly as a result of the memory of past experience."[12] The authors take the image elements formulated by Lynch in The Image of the City (i.e. paths, nodes, districts, edges and landmarks) to develop an orientation sequence. The orientation diagram is intended to show:

"1. The image strength and continuity of the path,



base line

a narrowing in the band indicates descent

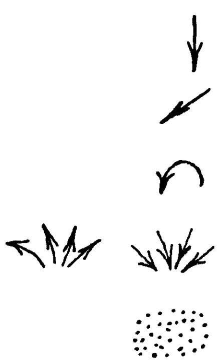
a widening in the band indicates ascent

turning movements are indicated by turning the band to the left or right

white bars indicate stops

apparent velocity is indicated by horizontal lines, the closer the lines the greater the speed.

APPARENT SELF-MOTION



moving alongside or overhead

apparent sidewise movement

apparent rotation

apparent growth or shrinkage

apparent immobility

these symbols are drawn directly alongside or on top of the self-motion band

APPARENT MOTION OF THE VISUAL FIELD

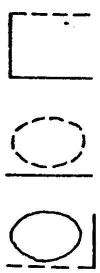
Figure 3a.

these symbols refer to the characteristics of the general field and are shown at the point where they are perceived and not where physically located.

the dot ● refers to a single important feature.

increase in apparent velocity of the field is indicated by increasing the length of the arrow.

APPARENT MOTION OF THE VISUAL FIELD(continued)



solid floor and left wall, screen over

solid floor, screen ahead

solid right wall and ahead, screen under

these cross-sectional diagrams, showing the characteristics of the space being traversed, are drawn to the right of the motion band.

strongly defined

defined

somewhat defined

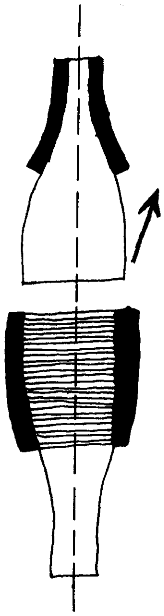
ill defined

undefined

these appear to the right of the space section to indicate the degree to which the total space is defined.

SPATIAL CHARACTERISTICS

Figure 3b.



dropping into a cut

the added black edge indicates strong confinement occurring at the side of the road

rising into a tunnel

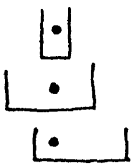
the dark tone, laid over the motion band, indicates that the road is passing under a bridge or into a tunnel.

SPATIAL CHARACTERISTICS (continued)

Figure 3c.

observer between two walls, a floor common to larger space with distant left wall and end screen

spaces that are perceived concurrently can be shawn overlapping in section



observer rising in, and moving to center of a narrowing slot

series of diagrams are used to indicate progressive change in space

( ) a gradual merging

>< an intervening portal or constricting gateway

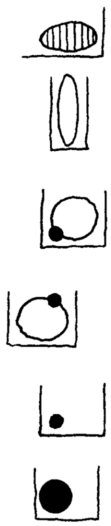
— an abrupt shift

 dissolution and chaos between two spaces

these symbols, indicating the duration and nature of the transition from one space to another, are drawn to the right of and between the diagrammatic sections

OVERLAPPING AND CHANGING SPACES

Figure 3d.



wall close ahead, high wall right

narrow slot, distant end

observer low and left in trough distant end

same space observer high and right

low and left in very large trough

same observer position smaller trough

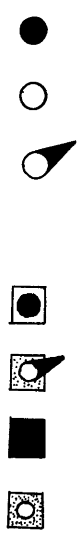
relative lengths of lines in section show the general proportion of the space

shading of the oval symbolizes a close surface

the position of the observer in the space is indicated by a dot in the section

a large dot indicates a small space relative to the observer, and vice versa.

<u>PROPORTION AND SCALE</u>



backlit

frontlit

crosslit

diffuse (no dot)

these are drawn to the right of the space section

bright, backlit

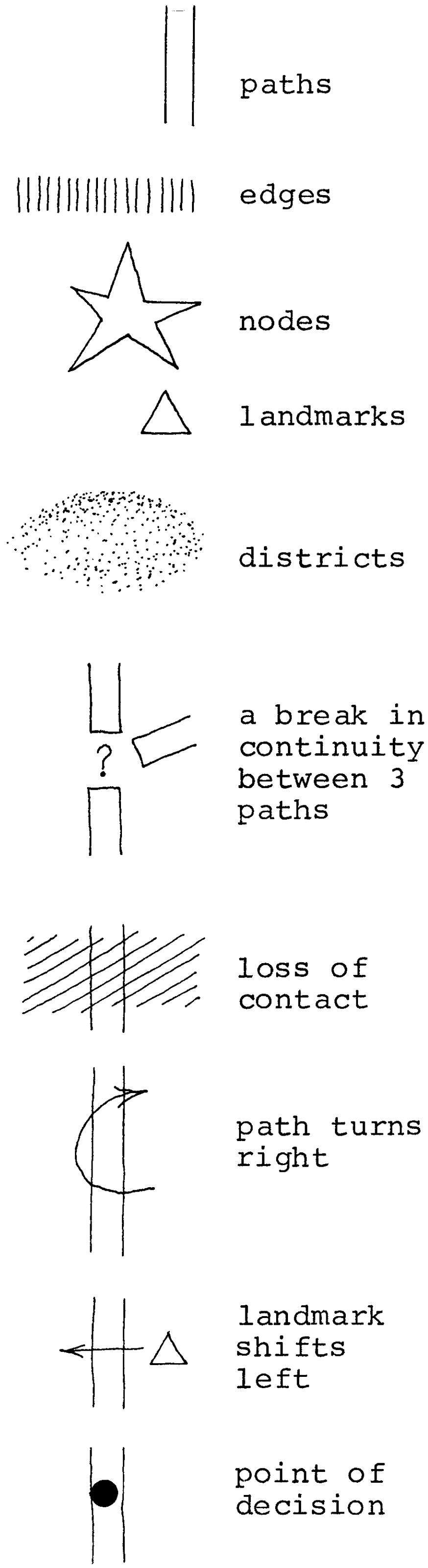
dim, crosslit

dark, diffuse

subdued, frontlit

<u>LIGHT</u>

Figure 3e.



the five "image elements" developed by Lynch, are used to indicate the sense of orientation – 'the general image of the road and the landscape that develops in the mind, partly as a result of the memory of past experience, partly as a result of what is presently visible.'

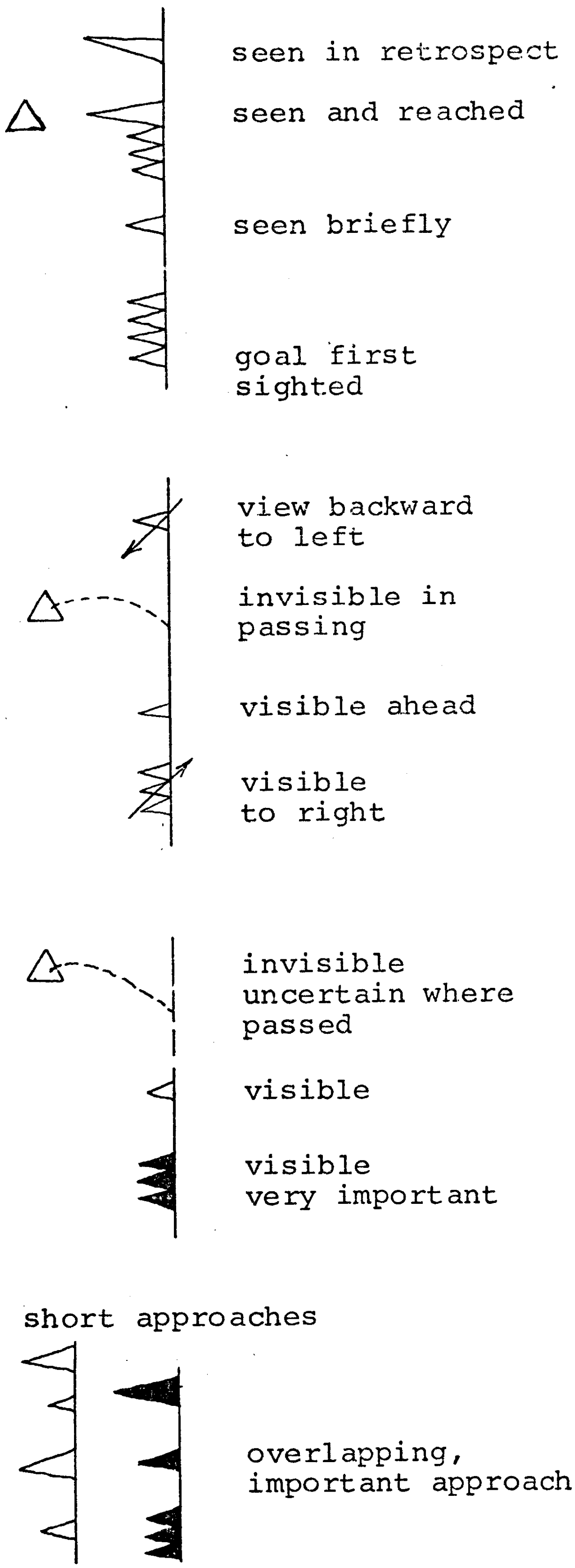
these symbols are shown along a vertical axis to the same scale of elapsed time as the space and motion diagram

they are shown where they are physically located, not where they are perceived

increasing intensity, clarity and importance are indicated by increasing the size and darkness of the node or landmark symbol, darkening the district tone, and thickening and darkening the line of path or edge

(p. 24)

Figure 4a.



"the total distance within which a single goal is at least occasionally visible is indicated by a vertical line to the right of the imagediagram.

along it, triangular projections represent the periods in which it is potentially visible, and a triangular pennant points to the element which was the goal at the moment of arrival.

visibility marks after the arrowhead indicate that a backward look is possible."

(p. 25)

THE NOTATION OF ORIENTATION (continued)

Figure 4b.

plus the sequence of elements that are associated with the path itself, and the points at which the driver must make locational decisions.

2. The principal goals along the trip, showing when they are visible, whether they are attained, whether there is a 'back reference' to them, and how they overlap and succeed one another.

3. The location, relation and strength of the image elements of the outside environment, including periods of loss of contact."[13]

These are diagrammed in figures 4(a & b).

A NOTATION SIMULATION PROCESS FOR COMPOSERS OF SPACE

Reviewing some existing notation systems (particularly the three noted above), Rose classifies them in two principal categories: "the notation of the physical characteristics of space and the notation of the non-physical characteristics, such as images, impressions, meanings or experiences."[14] Rose maintains that notation for the spatial environment is ontologically neutral while the image notation is vague to a certain extent and lacks precision, "in that symbols may vary ... widely in meaning."[15] He views the notation systems as consisting of two basic sub-systems, "the first being a system of symbols and the second being a system for recording the symbols."[16]

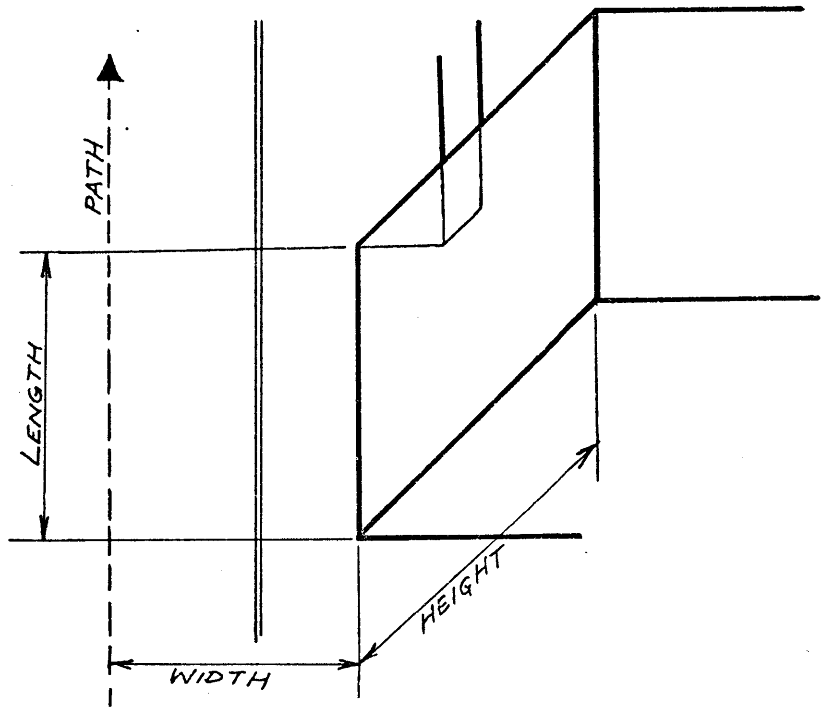
Evaluating three different simulation processes - motion pictures, television and computer graphics, Rose determined the latter to be the most direct and flexible despite its less realistic representation. "Light values, surface texture and colors are presently unavailable in computer graphic systems."[17] Software might be developed to enable the computer to receive stimulus from "notational symbols rather than from three dimensional coordinate point notations."[18]

Rose saw significant potential in the computer's ability to convert notation symbols into recognizable images while simulating a changing space and time orientation.

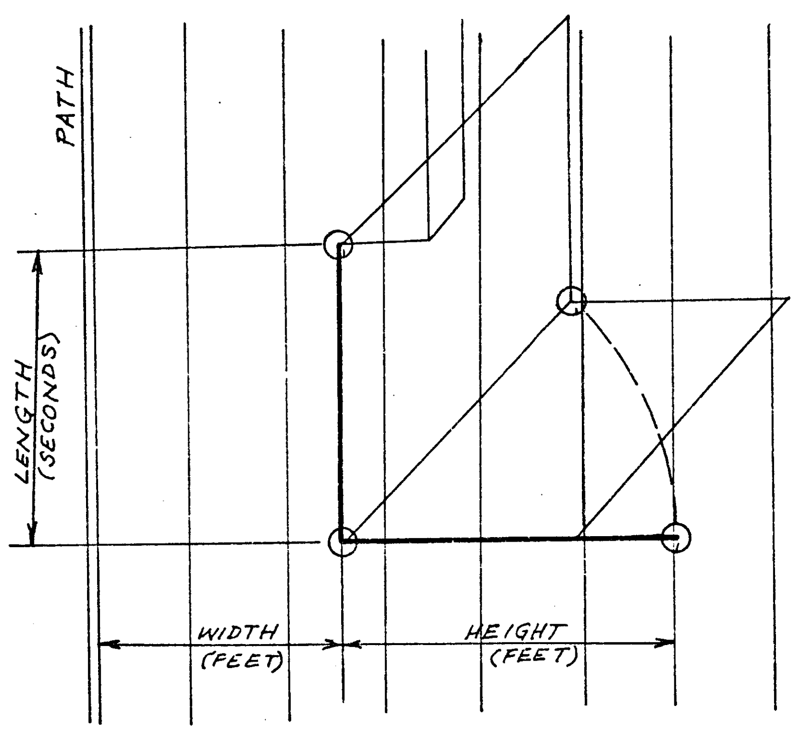
Figure 5 illustrates how the general structure of the whole system develops from the "plan oblique", by superimposing a measuring grid of parallel lines on this plan. The prominent and most general symbols of Rose's system which applied directly to the Coolidge Corner example are reproduced in figure 6. (I used 10 staves instead of Rose's 8 to allow for greater flexibility.)

Rose formulates a fairly precise means for describing Surface Characteristics, i.e. "light transmission and absorption, texture and color aspects, as hue, value, and chroma."[19]

> "Two rows of three digits each, located adjacent to the element, are required. In the upper row, light transmission may be indicated by 0-5 from opaque to transparent; light reflection by 0-5 from flat to mirror-like; and texture by 0-5 from plaster smooth to rubber-stone rough. The lower row contains the three Munsell digits for color."[20]

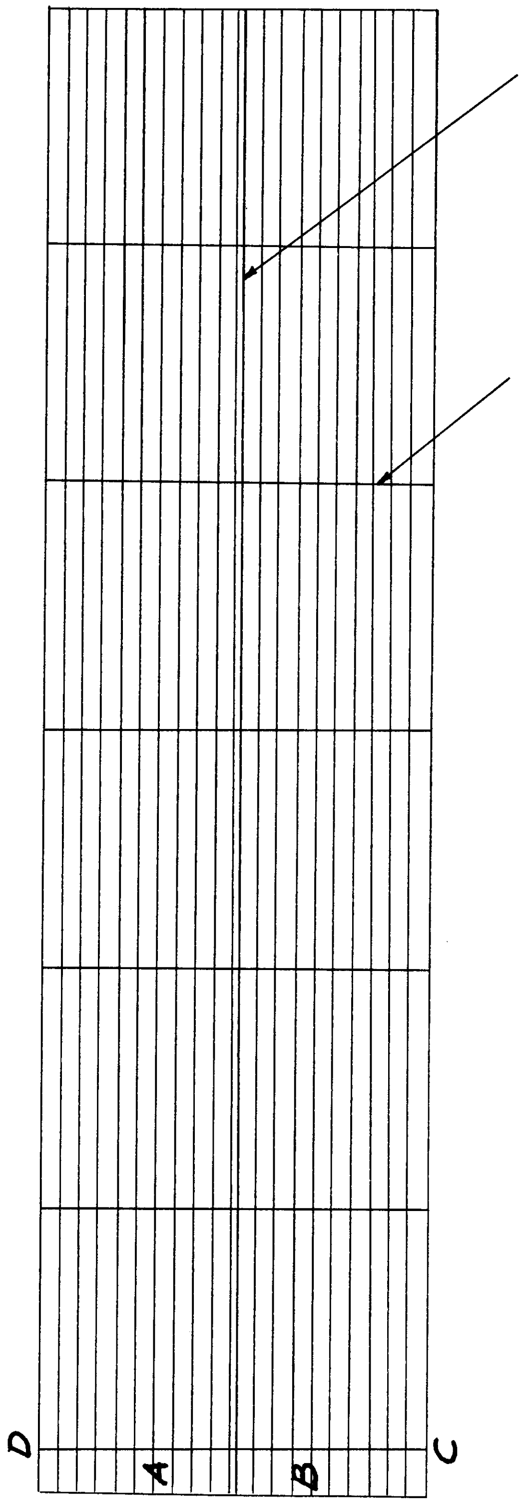


PLAN OBLIQUE DIMENSIONAL CHARACTERISTICS



PLAN OBLIQUE WITH MEASUREMENT GRID

Figure 5



the double line at the center of the scale system, indicates the path of the observer.

the cross lines, bars, divide the staves into measures; a measure being an assigned time interval.

The"A" position denotes the time interval of a measure. It is measured in seconds.

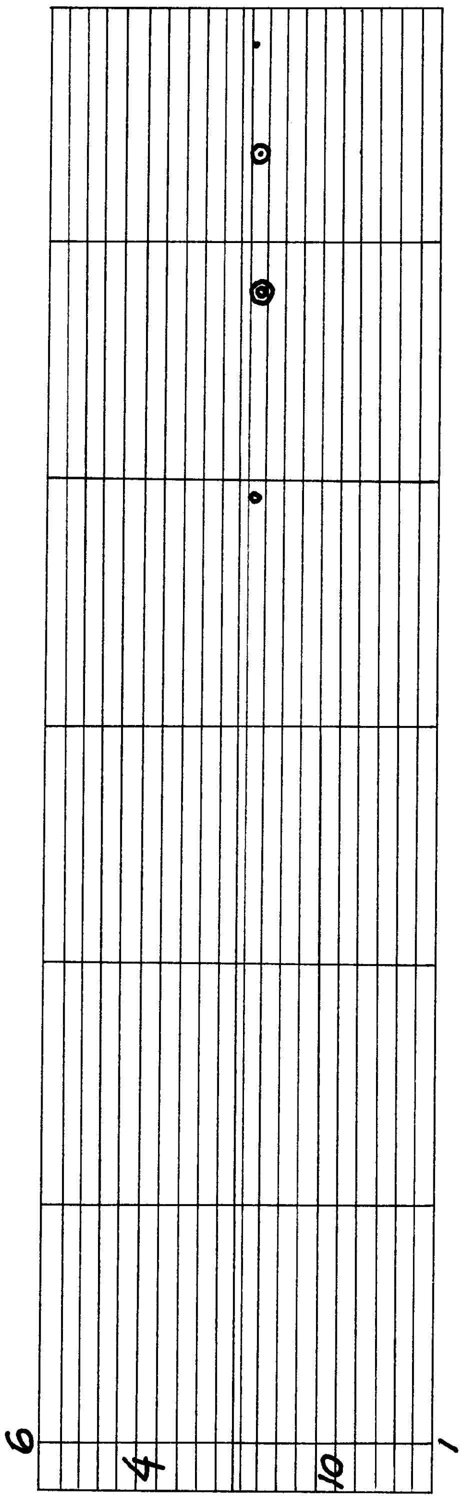
The "B" position denotes the space interval between parallel lines. It is measured in feet. "B" therefore measures the width and height of space establishing elements, and "A" measures length.

The "C" position indicates the number of seconds duration of a single unit Base Dot.

The "D" position indicates the speed of movement, in ft/sec.

<u>The RECORDING SUB-SYSTEM</u>

Figure 6a.



single unit Base Dot
one unit = one second

three unit Base Dot
three units = three seconds

four unit Base Dot
four units = four seconds

two units = two seconds

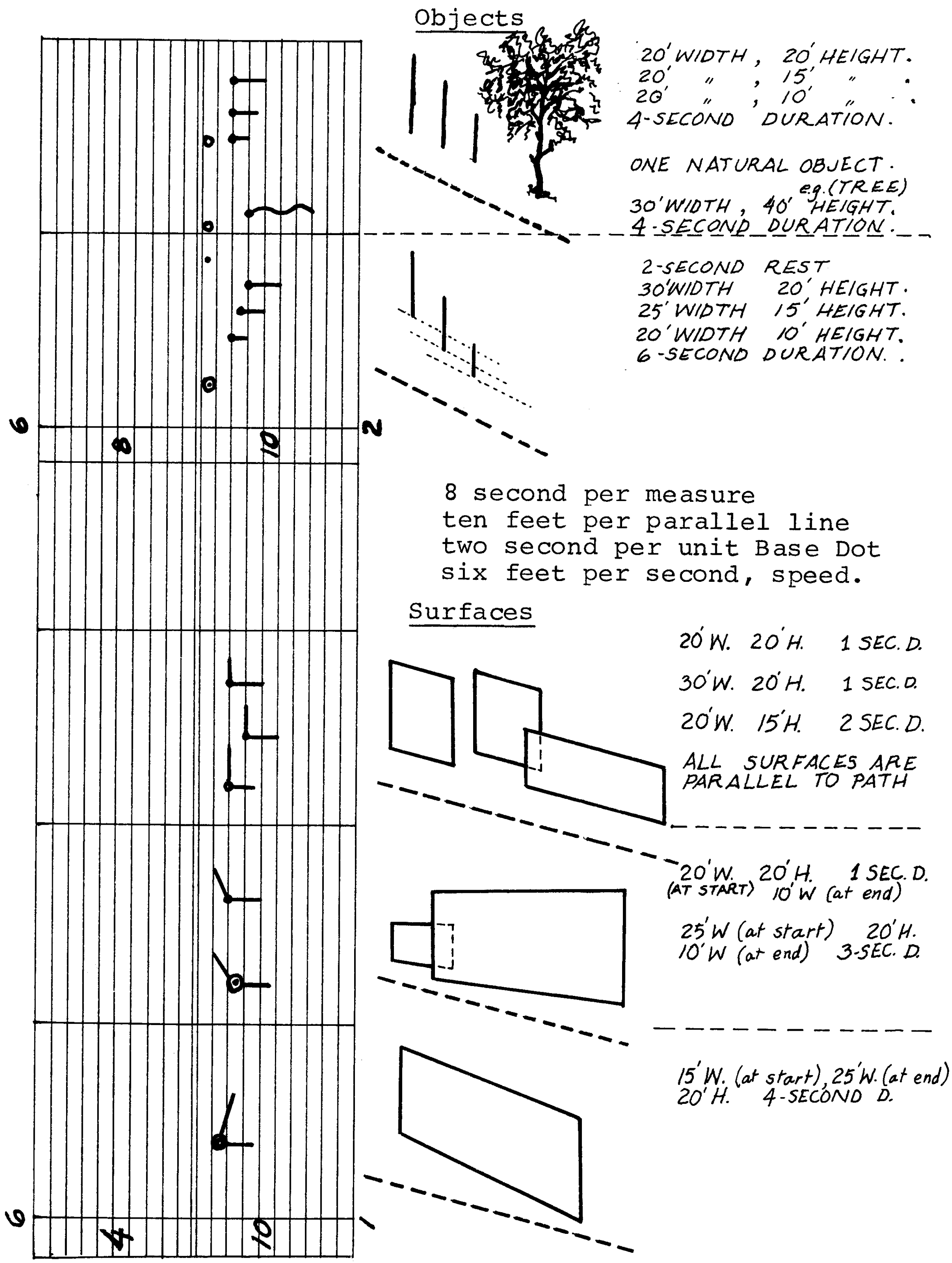
"The Base Dot is the element that establishes the time duration along the path and the basis for the lateral/vertical dimensions of the space establishing elements. When the Base Dot is shown without connection to any other symbol compononts, only a time lapse is represented; this is equivalent to 'Rest"

(p. 51)

four seconds per measure
ten feet per parallel line
one second per unit base dot
six feet per second, speed

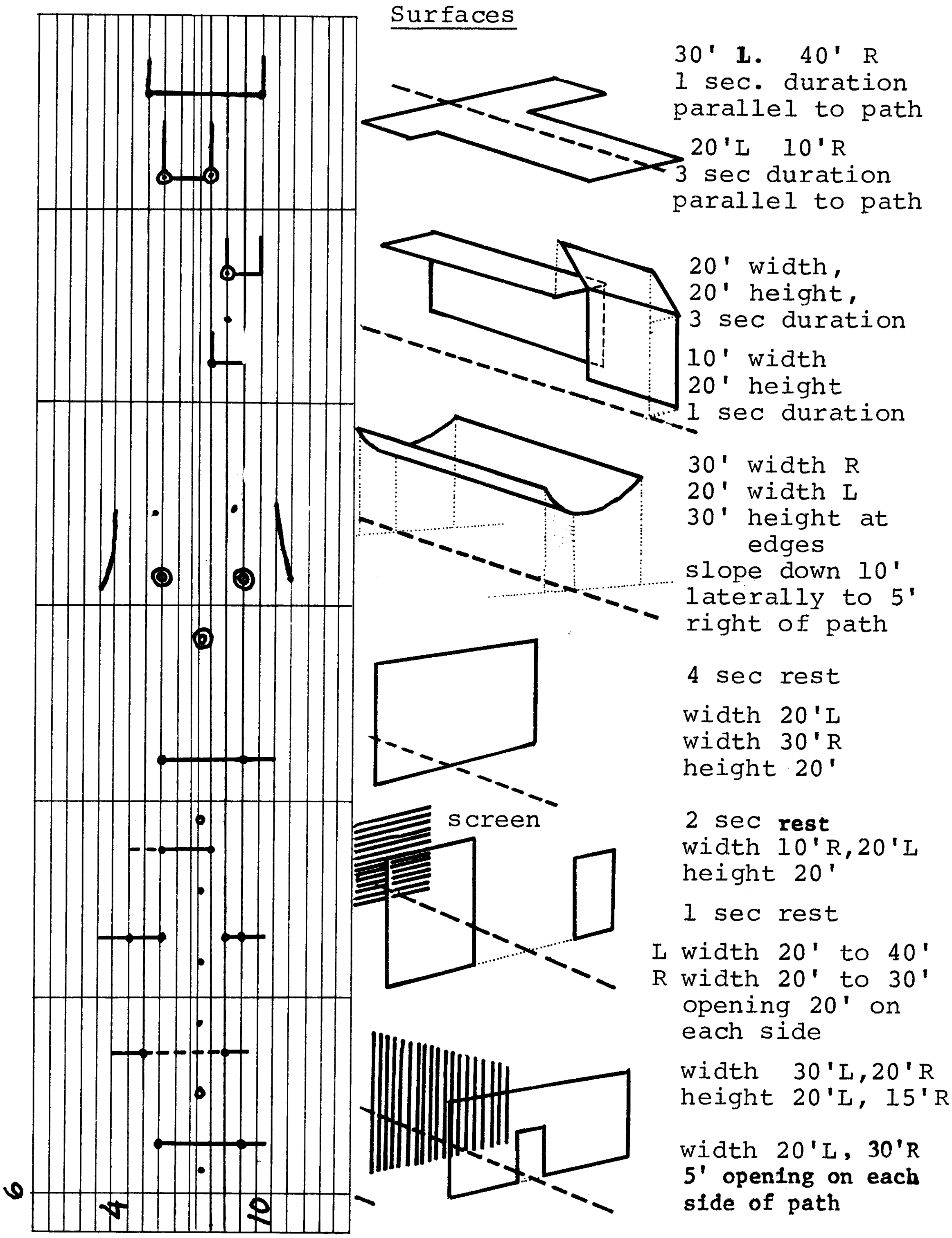
THE SYMBOL SUB-SYSTEM

Figure 6b.



THE SYMBOL SUB-SYSTEM (continued)

Figure 6c.



four second per measure
ten feet per parallel line
one second per unit Base Dot
Six feet per second, speed

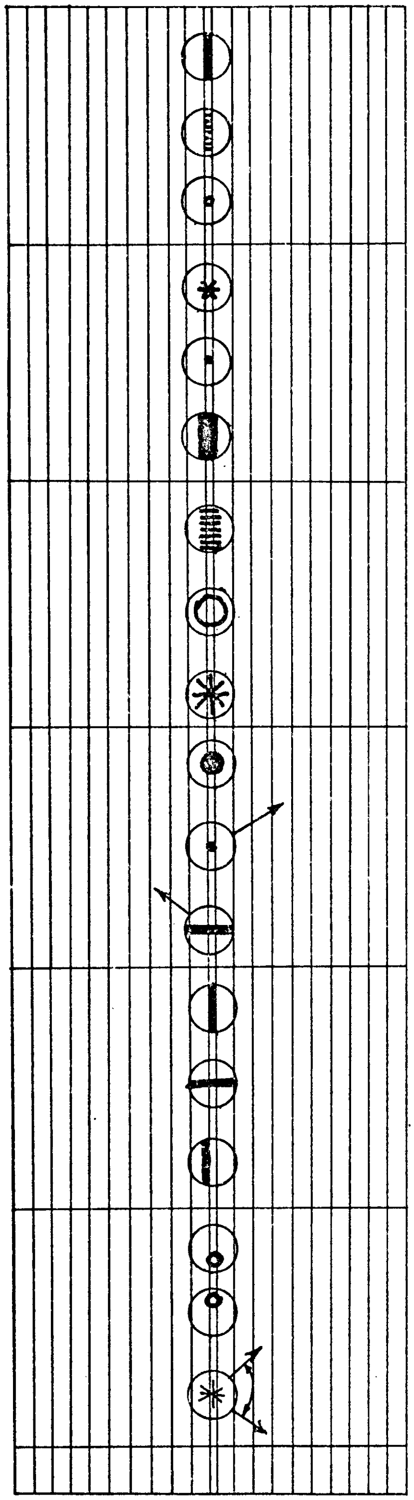
Figure 6d.

I omitted Surface Characteristics from the Coolidge Corner description, since these belong to a finer scale of detail than the overall urban structure which I chose to examine.

Since "much of our experience of space is derived from meanings associated with various elements perceived"[21] Rose appropriates Lynch's image notation and superimposes it on the observer's path (figure 7).

The only system that shows the physical environment with reasonable precision, Rose's may easily be refined to specify exact dimensions. By reducing the notation tracks to one, the system facilitates a much more legible representation of the environment than those developed previously. Its resemblance to musical notation, with the symbol and recording sub-systems carefully integrated, is striking in contrast to other systems.

Though the symbols evolve in complexity according to a logical pattern, certain modifications must be made in order for a computer to "logically" understand the system. The representation of surfaces in the direction of movement and surfaces in the frontal position is a typical problem. As the accompanying figure demonstrates, a surface in the frontal position and a column are both represented as a line across the staves. The difference is that the first has two dots (representing the two different widths) plus a line at one end showing the height, and the second has only



minor path

minor edge

minor district

minor node

minor landmark

Major path

major edge

major district

major node

major landmark

landmark at right

cross path seen at left

path followed

path crossed

path to the left

district being left behind

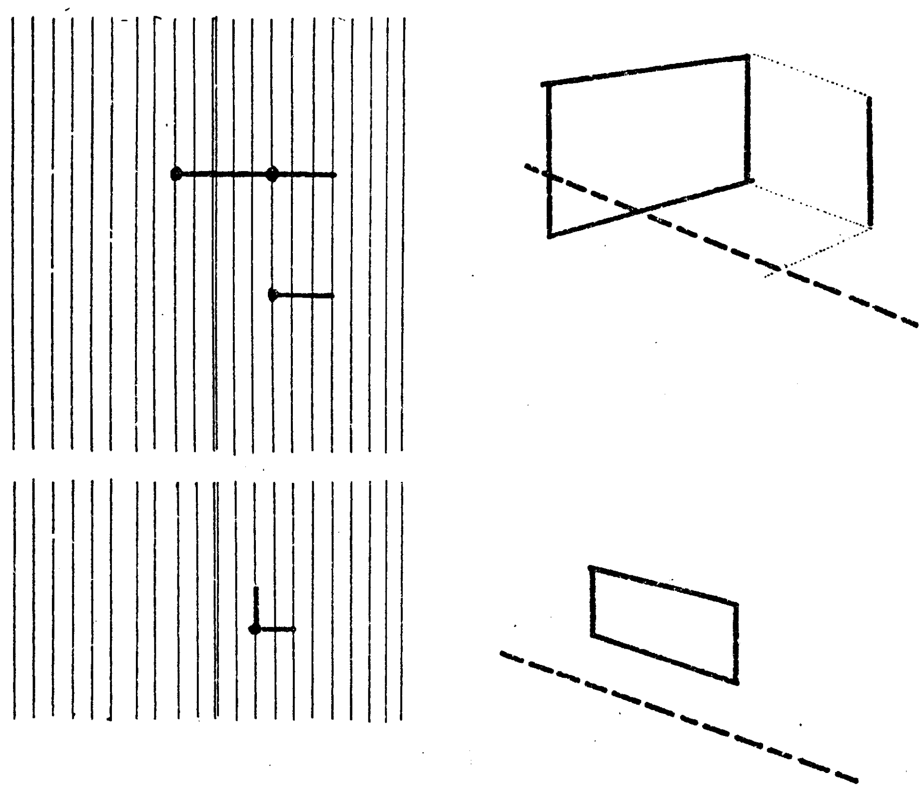
district to be entered

view may have a range, which is
shown by range limits.
Node 30° to 100° right.

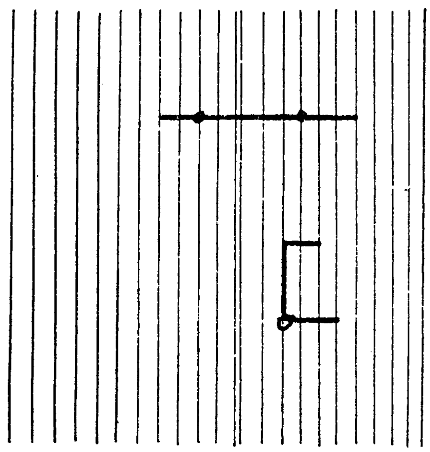
IMAGE NOTATION

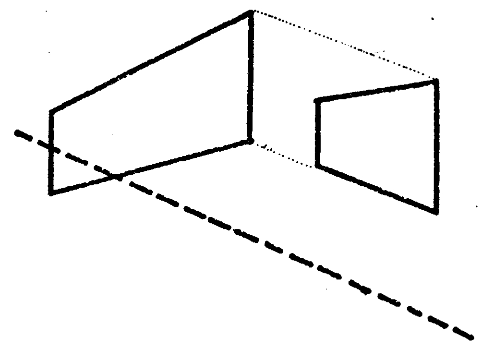
Figure 7.

one dot (representing the width at the base of the column). A surface in the direction of movement has one line parallel to the staves, one line perpendicular to show the height, and a dot at the point of intersection, to indicate width.



The inconsistency lies in the surfaces. Where a frontal surface utilizes two dots, a parallel surface has only one. A possible improvement might be to represent a surface as a line with dots at either end to indicate respective widths. The slope of the line describes the angle of the surface relative to the direction of movement of the observer. Two other lines, connected to the first at its two ends, represent the heights at those ends. Thus a parallel and a frontal surface would become:





The image notations borrowed from Thiel and Lynch, the musical notation for time, and the simple geometric symbols in conjunction with the "plan oblique" provide an extensive array of permutations with reasonably accurate reference to physical objects.

Section B

The developers of the previous notation systems acknowledge the lack of an accurate and/or less elaborate than the plan-section technique for recording the environment. Most important, they all intended to record the environment under consideration not in its totality but rather in segments as an effort to simulate movement.

Lawrence Halprin professes that conventional techniques for representing the environment are not adequate since they do not account for movement. A planner or designer "cannot design the environment for he has no tools to do so."[22] Halprin proposes to correct this situation by inventing a tool for designers of movement to represent the three dimensional visual experience abstractly. MOTATION (movement notation) focuses "primarily on movement, and only secondarily on the environment."

Halprin compares MOTATION to the sequence of frames in motion-picture film. With reference to the notation, he says, "the idea of Motation system resembles the technique of the animated film in that individual pictures or frames separated in space are related in time to form apparent movement."[23] And he refers to the environment by saying,

> "in terms of the individual whose only true continuity is his own awareness it can be said with all psychological justice that the environment moves."[24]

Halprin thus suggests that experiencing an environment is something like sitting in a theatre where the projected environment on a wide screen (possibly at the center of a circular theatre, with a 360° screen) is in apparent motion.

He explains the need for such a system as MOTATION with the theory that

> "Only after programming the movement and graphically expressing it, should the environment - an envelope within which movement takes place - be designed. The environment exists for the purpose of movement."[25]

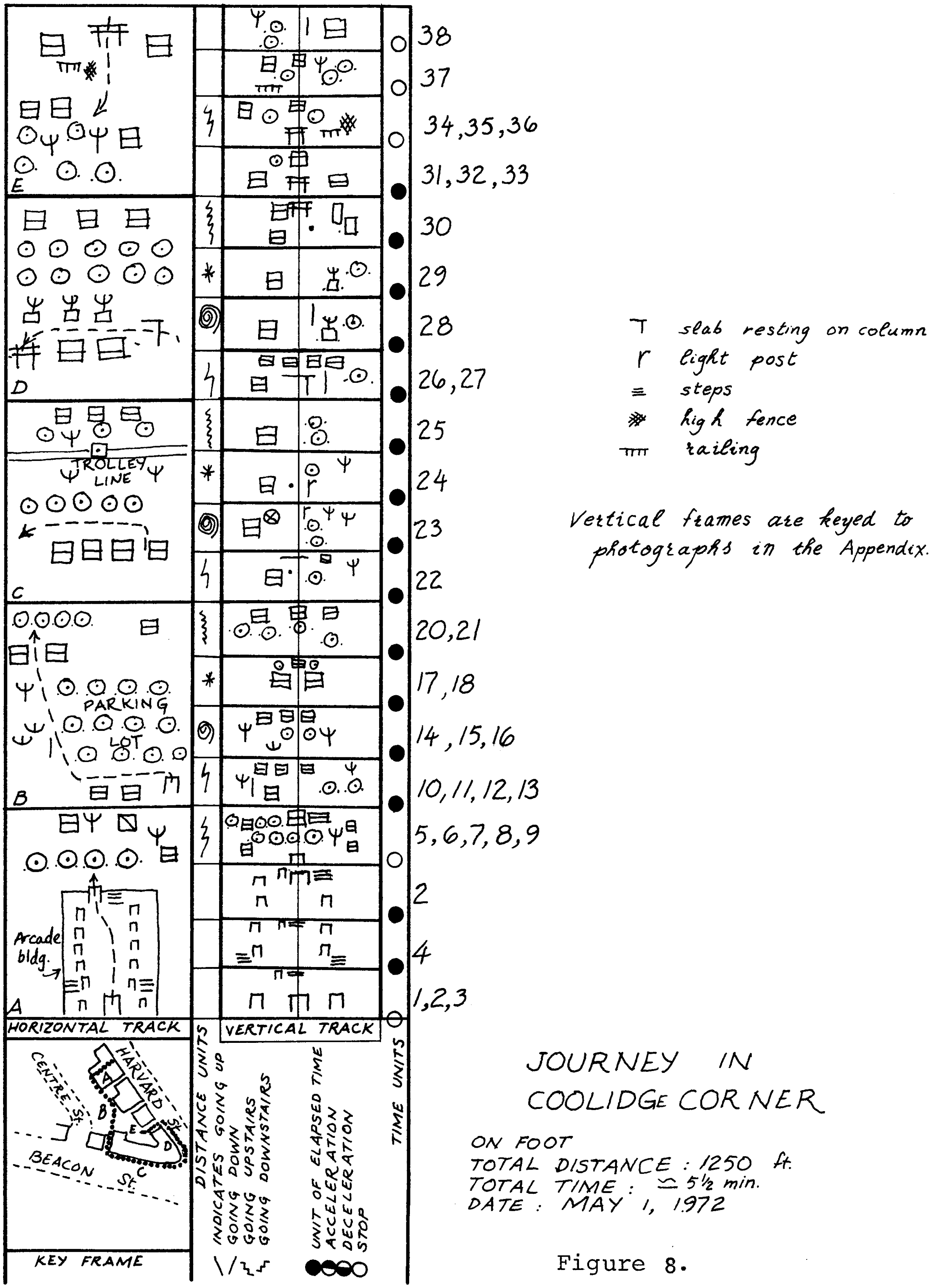
(I think Halprin is overenthusiastic about his system; how can anyone program his won movement let alone somebody else's, and worse, all the users of that environment, and how can anyone determine who the user is?)

Halprin has several goals to achieve. The first one is FLEXIBILITY. The system should be applicable to a wide range of scale and activity, from free way experience to dancing. Architects, planners and landscape architects, as well as artists of "pure movement" (choreographers) should have access to it. It should be a tool not only for recording, but also for designing movement. The second goal is ACCURACY. The system should "program movement carefully and analyze it." It should serve "to schedule it on a quantitative as well as qualitative basis."[26] SIMPLICITY is the third goal. The system should be easy to learn as well as readable. It "should posess a graphic quality that expresses at a glance the nature of what is being recorded."[27]

Figure 8 describes a walk through Coolidge Corner. Appendix 1 shows a plan of the area where the tour took place and photographs of the experience. Halprin's article also includes several examples.

In terms of Halprin's goals, the system applied to a medium scale - one which falls between city scale and the small traditional architectural scale, proved disappointing. One of the difficulties is that of distinguishing between parked and moving cars (street parking is sometimes a positive phenomenon in an otherwise unsheltered pedestrian place). Motation does not convey the sense of openness or closure in a place, nor the degree of enclosure. The interaction between large and small scales, such as street activity, use, relationship between open areas and built form, etc..., is also missing.

In terms of accuracy, the system is far from the mark. Neither on quantitative nor qualitative basis does the system allow for the measurement of street widths, building heights, volume of enclosed space, floor areas, etc.., which is critical to design. Halprin explains that his main concern is to depict movement and only secondarily to describe the environment. But this is inconsistant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34,35,36
31,32,33
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26,27
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23
22
20,21
17,18
14,15,16
10,11,12,13
5,6,7,8,9
2
4
1,2,3
E
D
TROLLEY LINE
C
PARKING LOT
B
Arcade bldg.
A
HORIZONTAL TRACK
VERTICAL TRACK
CENTRE ST.
HARVARD ST.
BEACON ST.
KEY FRAME
DISTANCE UNITS
INDICATES GOING UP
GOING DOWN
GOING UPSTAIRS
GOING DOWNSTAIRS
UNIT OF ELAPSED TIME
ACCELERATION
DECELERATION
STOP
TIME UNITS
slab resting on column
light post
steps
high fence
railing
Vertical frames are keyed to photographs in the Appendix.
JOURNEY IN COOLIDGE CORNER
ON FOOT
TOTAL DISTANCE : 1250 ft.
TOTAL TIME : ≃ 5½ min.
DATE : MAY 1, 1972

Figure 8.

with ACCURACY he seeks since movement is a function of the quality of the environment in which it occurs. It is clear from the examples given in the article (including the Mysterious Journey on page 127, and my example), that it is difficult to understand the setting without accompanying photographs. Thus its usefulness as a design tool is questionable. It can be used as a crude analyzing tool, and for comparing attempted solutions of environmental experiences according to its terms, but accuracy is not one of them.

The system is simple to learn and can easily be applied to a certain experience which does not give rise to the symbolic inconsistencies noted above. As for expressing "at a glance the nature of what is being recorded," the system definitely fails without the help of words and photographs.

The comparison of MOTATION to animated film is not very convincing, since the first cannot be projected as a moving sequence which corresponds to actual perception of apparent motion of the environment. A better analogy would be a series of still photographs at intervals of an experience (similar to the examples he gives and the example in the Appendix). Halprin claims that a moving person's perception of a static environment is similar to a still person's perception of a moving environment. Counter to this, the work of Richard Held at MIT indicates that there is a strong correlation between motor output and sensory feedback signals, "humans and other mammals show a surprising liability in the responses of their sensorimotor systems. Both prolonged isolation of human observers in monotonous environments (sensory deprivation) and prolonged immobilization in relatively normal environments (motor deprivation) lead to degraded performance on perceptual-motor tasks." (underlining is my own). And that "the maintenance and development of sensorily guided behavior depend in part upon bodily movement in the normal environment."[28]

Given that a passive person does not develop normal visual-spatial capacities, it follows that the individual "whose only true continuity is his own awareness it can be said with all psychological justice that the environment moves," is not a correct statement. Indeed, accepting Held's point, then there is no method, however exact and detailed, that could represent the environment in such a way to make absolute perception and cognition possible.

The system can provide a rough sketch of one particular experience, but that hardly accounts for all possible experiences in that environment, since movement itself is a subjective experience.

The environment is a setting for a large number of activities which may or may not include movement through it as a visit to a park will confirm this. Therefore the statement that "the environment exists for the purpose of movement" is also not very true (movement, here I take to mean physical locomotion from one place to another.

Thiel, on the other hand, asserts that the conventional professions for environmental design are "established within the self-imposed conceptual boundaries of such discrete areas as ' industrial', 'interior', 'architecture', 'urban' and 'landscape' design,"[29] and proposes a new discipline, envirotecture, "which transcends these "artificial" boundaries and is concerned with continuous environmental experience."[30] His theory further states that an "envirotect does not design vehicles or rooms or buildings or gardens or cities, he designs experiences in any and all combinations of these parts of the environment."[31] The ultimate objective of the envirotect using the sequence notation and score is to "enrich the quality of the experience and promote the development of individuals and groups experiencing this total environment."[32]

Thiel's aim is to develop a "simple graphic system . . . as a means for the analysis and design of physical environments on the basis of sequential experience in real time."[33]

The Hemispherical Projection is Thiel's basis for the set of symbols which describe Space Establishing Elements (SEEs). This is described in detail in his paper,[34] therefore I offer only a brief summary. The line of sight of the moving person is taken as the axis of rotation for a concave hemisphere encompassing one-half of the visual world. The projection of the hemisphere on a plan perpendicular to this axis at the eyes of the person is a circle, the center of which lies at the exact eye-height of the person. Everything that a person can experience at any given point is assumed to be limited to a field of view which extends 180° horizontally and 180° vertically. The hemispherical projection is a section (according to traditional terms) showing what is in front of the viewer and selecting elements which contribute directly to his experience of the space.

Figures 9(a, b, & c) is an example of the system applied to Coolidge Corner. The system lacks precise means for representing the physical environment which forms its basis. This is consistent with Thiel's concern with experience in the environment rather than the physical environment itself. The treatment of movement separately from environment tends to contradict the fact that one is a function of the other. The system also ignores the particular activity which the place supports. If the ultimate objective is to "enrich the quality of . . . experience", it follows that the project must be to enrich the physical environment itself. Thiel confirms this elsewhere, declaring that the system is intended "as a means for the analysis and design of physical environments on the basis of sequential experience in real time." Yet, in some respects the task he defines is impossible, because a thorough analysis of environment "on the basis of sequential experience in real time" requires an infinite number of diagrams showing all possible combin-

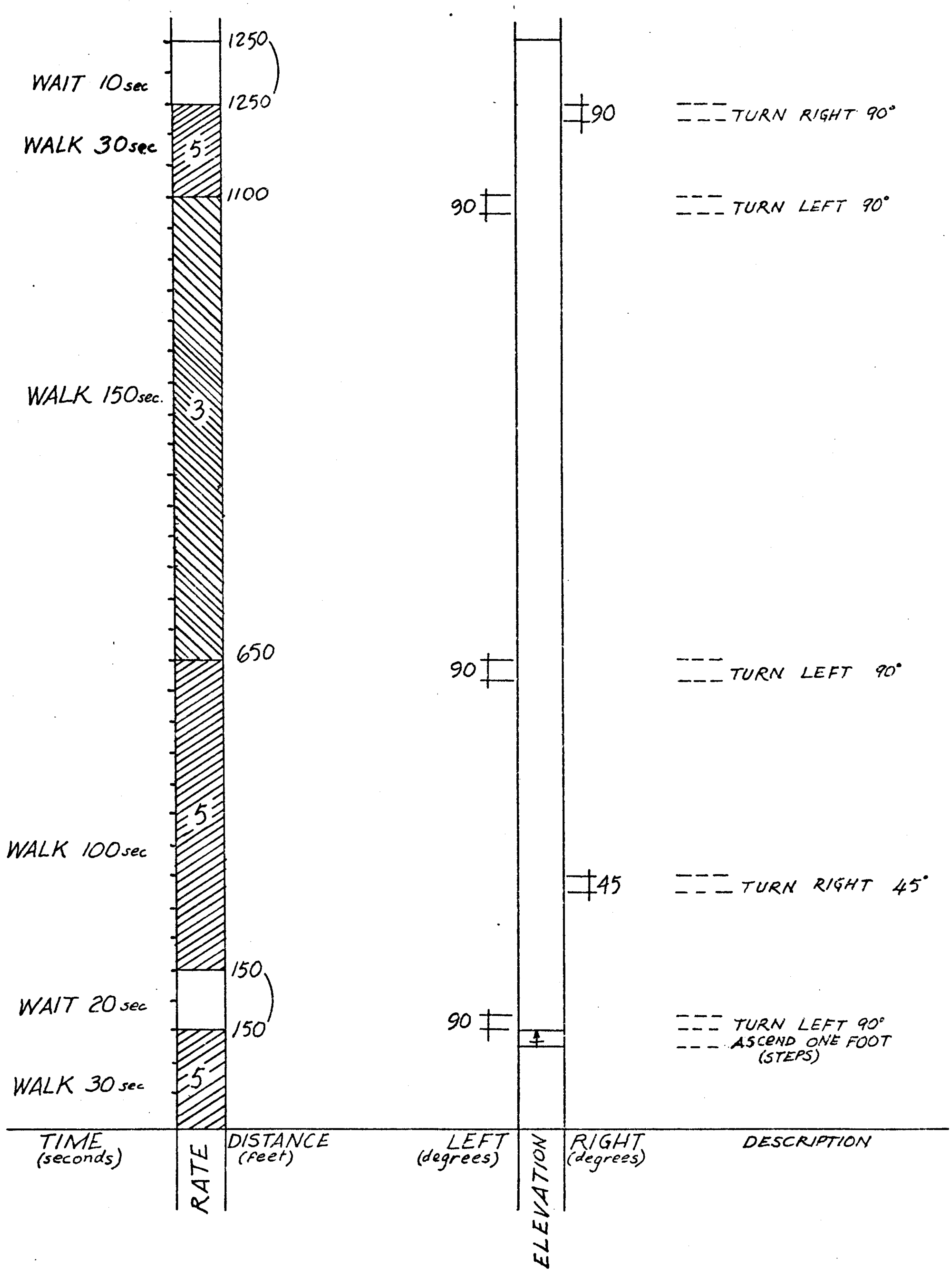


Figure 9a.

MOTION CHANNEL

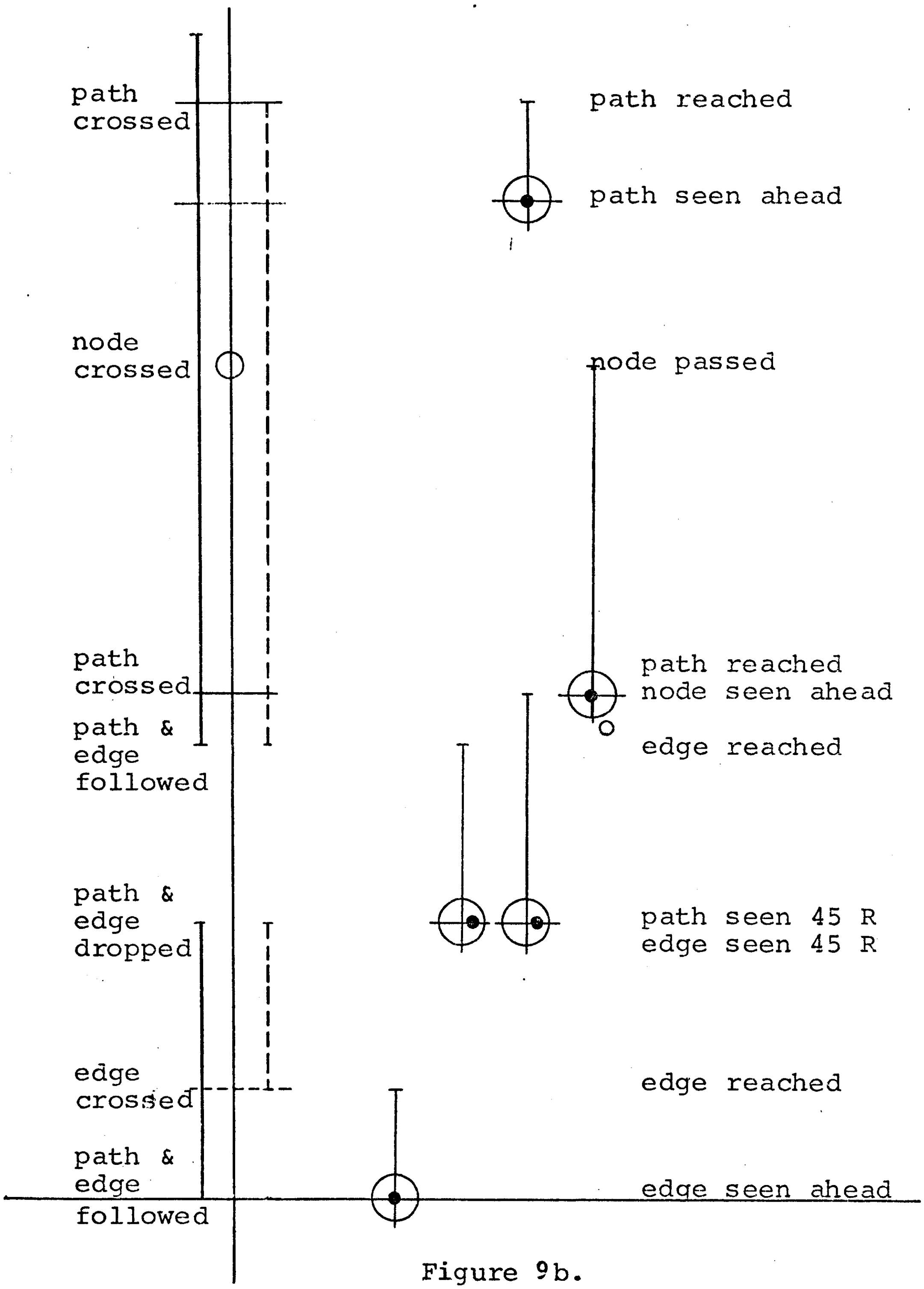


Figure 9b.

ORIENTATION SCORING

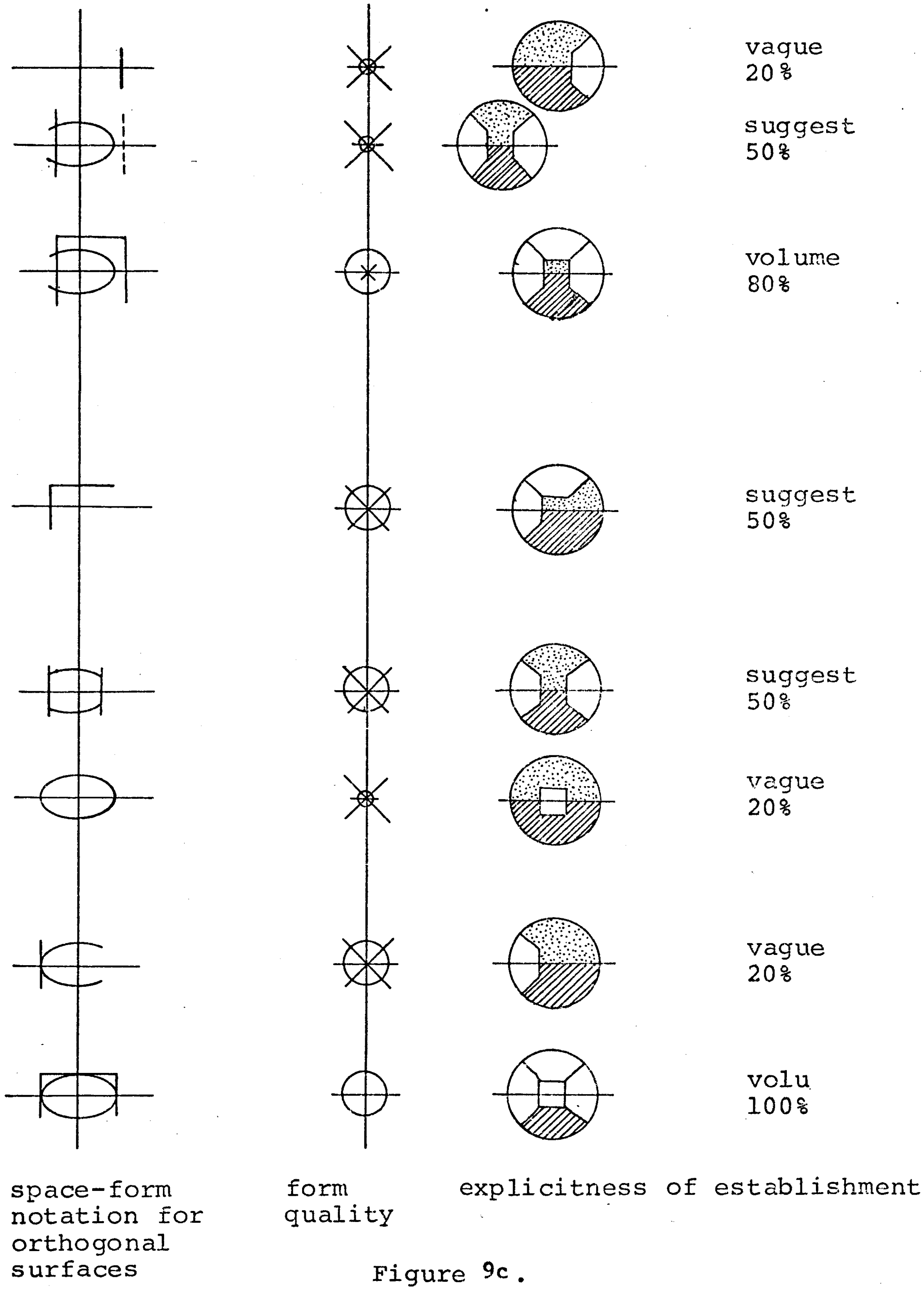

vague
20%
suggest
50%
volume
80%
suggest
50%
suggest
50%
vague
20%
vague
20%
volu
100%
space-form notation for orthogonal surfaces
form quality
explicitness of establishment

Figure 9c.

ations of individual experiences. As for the system's applicability to design, all the means for representing the experience are potentially usable except the notation for the movement sequence, that which Thiel ranks first: for, human behavior, although measurable to a certain extent, is unpredictable.

The notation system of Appleyard, Lynch and Myer originated as a response to the lack of available techniques for recording, analyzing and communicating the visual sequences of a highway. The main objectives were to develop a method which could abstract the essential elements from the mass of things potentially perceivable, to facilitate visualization of the recorded view from the road, and to improve upon conventional methods by representing the experience as a dynamic experience rather than as a static pattern. The graphic technique provided a simple means for communication in a small reproducible format.

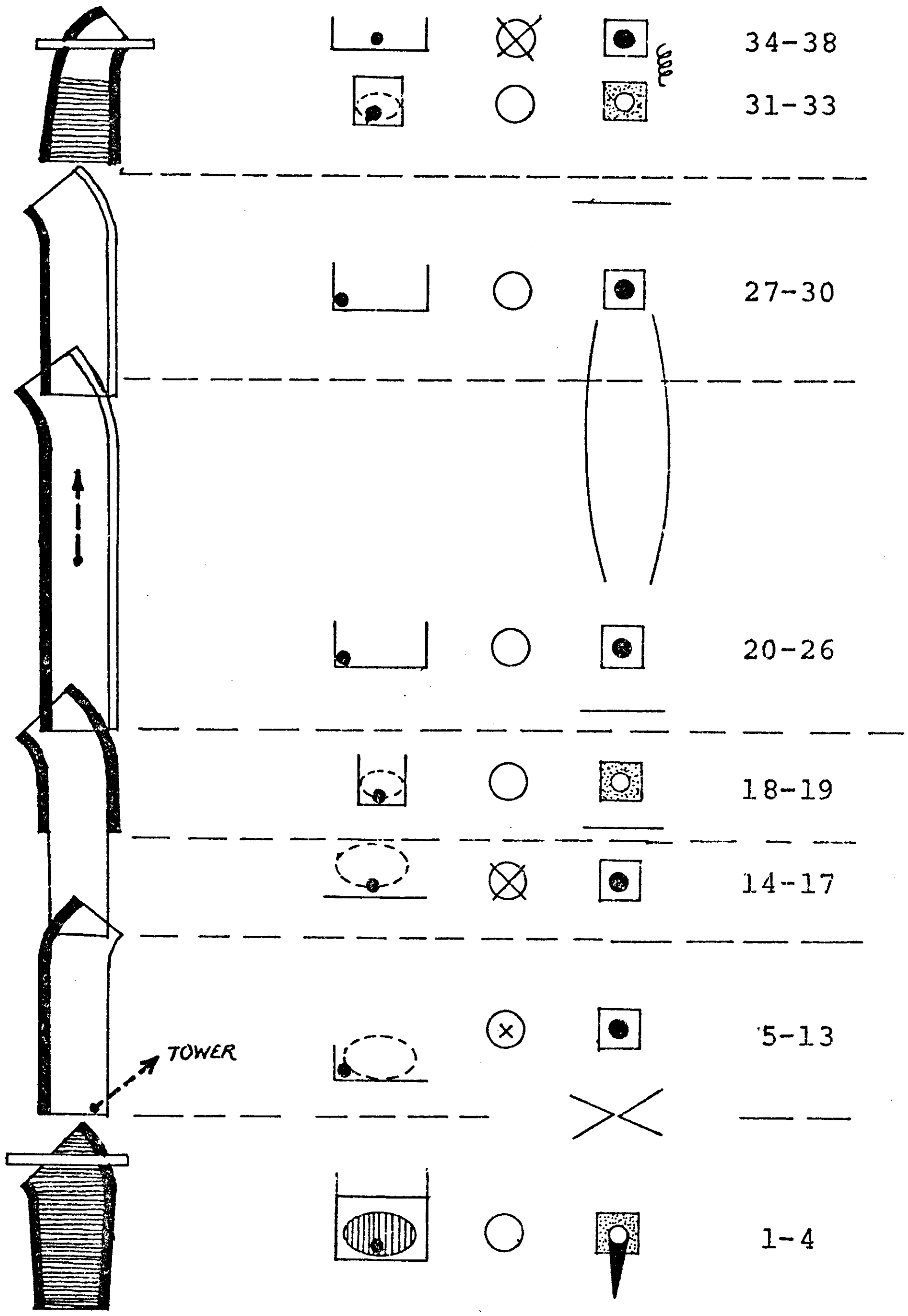
The authors of The View From The Road acknowledge the importance of "maps showing location and elevation of the road, plus topography and natural features, land use, building mass and open space,"[35] (traditional tools) for recognizing and thereby avoiding or ameliorating certain severe faults in road design. They contend however that a new technique must be developed in order to facilitate the expression or refinement of such design objectives as presenting the viewer

> "with a rich, coherent form, a form which has continuity and rhythm and development, which provides contrasts, well-joined transitions and a moving balance. To give him a picture which is well-structured, distinct, and as far-ranging as possible. To deepen his grasp of the meaning of his environment: to give him an understanding of the use, history, nature or symbolism of the highway and its surrounding landscape."[36]

Mainly because of the cost and complexity of such available non-traditional techniques as photographic and cinematic simulation, Appleyard, Lynch and Myer determined instead to use the conventional graphic means as a basis for developing a more satisfactory approach to recording highway experience.

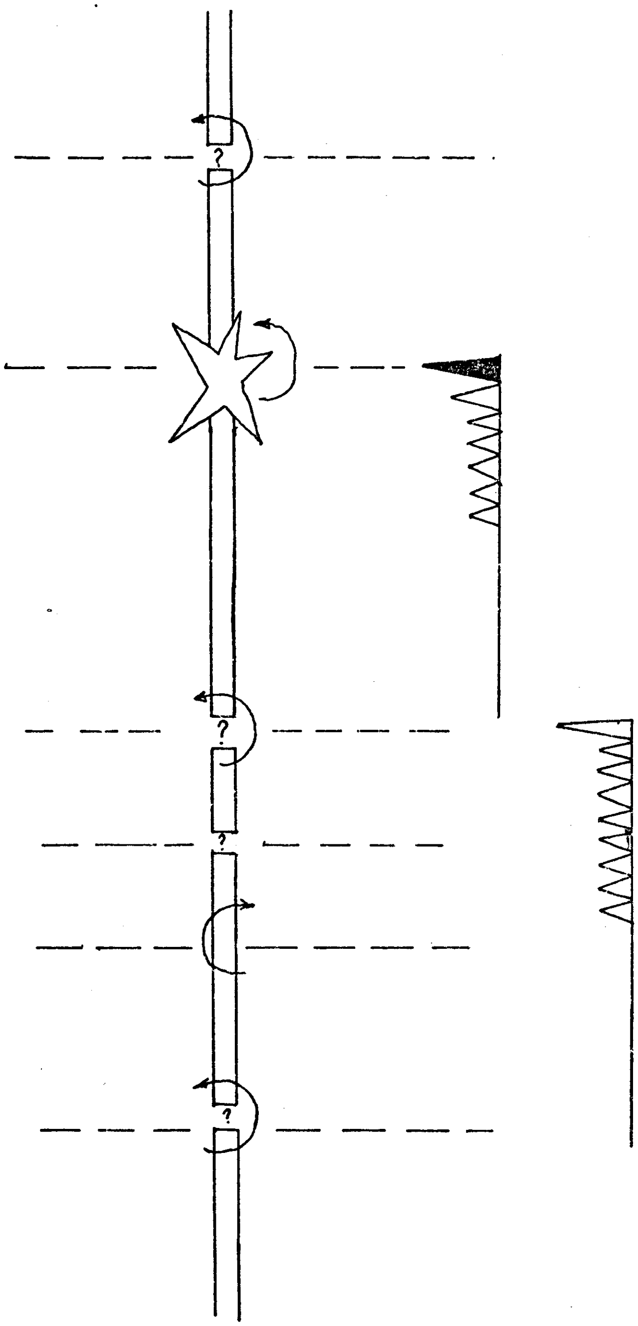
Although the system is vehicle-oriented (and therefore linear), and geared to a scale much larger than the intermediate one, and for a speed much faster than the pedestrian's, it did prove applicable to the Coolidge Corner tour insofar as it acknowledges changes in the spatial characteristics of the urban scene, proportion and scale of the general space, light quality, and image elements in the urban environment. The authors in fact comment that "the highway is a good example of a design issue typical of the city: the problem of designing visual sequences for the observer in motion."[37]

Figures 10(a & b) (limited by available reproduction means to the black color) takes the Appleyard, Lynch, Myer symbols to describe the experience previously diagrammed with Halprin's and



SPACE MOTION DIAGRAM

Figure 10a.



ORIENTATION DIAGRAM

Figure 10b.

Thiel's systems.

Since the high speed of a vehicle causes the occupant to perceive environmental elements differently from the way a pedestrian perceives them, the notation for apparent motion of the visual field was not successful to my Coolidge Corner study. A pedestrian approaching an object does not perceive it as "growing", but rather, constantly, he reasesses his distance from the object according to its apparent size, and thus perceives that he is getting closer to it. His rate of locomotion is slow enough that the impression of the environment as moving is far outweighed by his reflective sense that he himself is moving. As Held demonstrates, the difference is also of that between active and passive motion.

In other respects the notation worked well enough, though perhaps for a pedestrian situation, the apparent self-motion band could be replaced with one that indicates abrupt level changes rather than the continuous surface appropriate to the car.

This system makes several improvements on the symbols developed by Thiel. With respect to space-form notation, the general proportion of the space is shown together with the observer's position. Acknowledging the fact that these sectional diagrams do not "read easily in sequence" symbols for transition from one space to another is developed, specifying the nature of the transition. Another departure from Thiel is the use of Thiel's own symbols for form quality (regularity, balance, etc. on one hand, and incompleteness, mobility, etc. on the other) to indicate the extent to which a space is formally defined.

The system does not attempt to describe the physical environment in a precise quantitative way. Dimensions for highway width, building height, angle of turn, etc. are not included. The authors rather intended that the system would be used in conjunction with traditional maps and diagrams which give such information.

This notation, in its intent, is more "neutral" than Halprin's or Thiel's systems inasmuch as it does not describe the experience of one individual, but rather defines a particular track (the highway) common to all moving people in a more or less similar mode of transportation. Only in the space sections is an individual's position indicated. Applied to an urban environment this might be interpreted as the "preferred" position (e.g. sidewalks, to the pedestrians).

The system developed by Rose, like the previous ones, aims at finding a method "for achieving order and organization in the physical environment."[38] According to Rose, the lack of such order and organization stems from the expansion in scale of cities and metropolitan areas, which confuses the sense of orientation and poses difficulties for the designer who is trying to understand the total environment. This scale enlargement "appears to have relegated the environmental designers to detailed patchwork which has, at best, helped to sustain existence in the city, but has rarely contributed towards the type of urban environment that might enrich the lives of its inhabitants."[39] The study thus aims to assist designers through "expanding their scale of comprehension and degree of understanding of their urban spaces."[40]

In accordance with this intention, Rose explains the purposes of the study to be:

"1. select, or recommend the development of a simulation medium that exhibits suitability for adaptation to a spatial notation/simulation process;

2. develop a system of symbols for expressing the characteristics of the elements that establish and qualify space, in a manner that may be readily adapted to the most suited simulation system; and,

3. correlate the systems of simulation and notation into a single process."[41]

Rose bases his own formula on several principles:

1. Terms used in the spatial notation, spatial definition or simulation systems must be clearly, thoroughly and precisely defined to avoid confusion.

2. The notation symbols and recording sub-systems must be clear and readable, "so that perceptual images may be readily induced."[42]

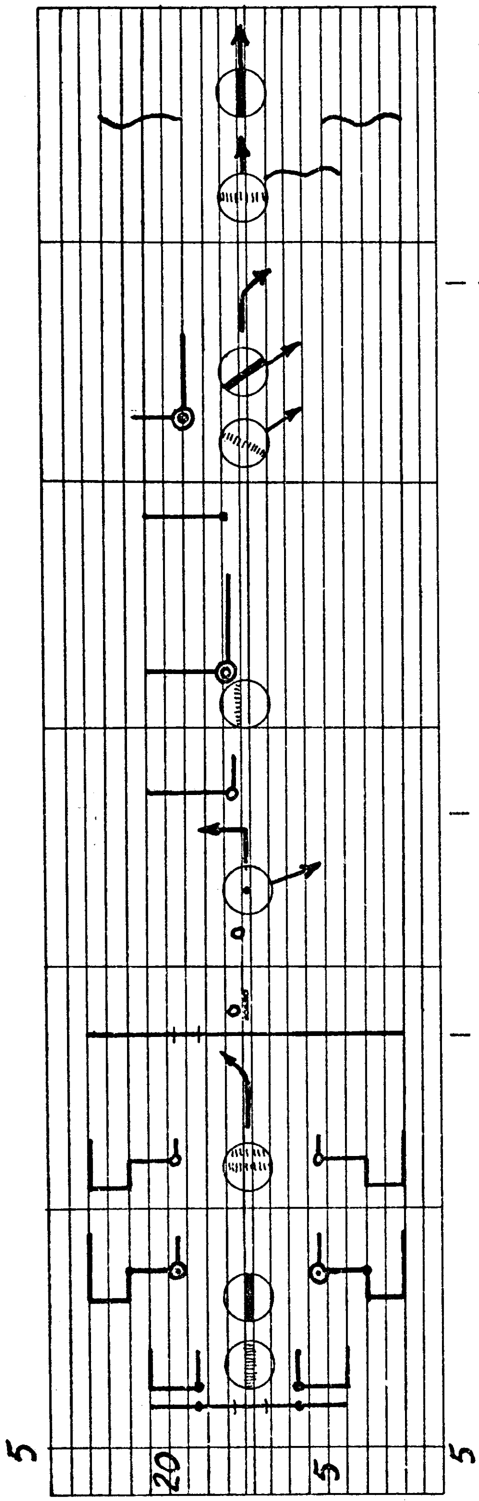
3. The symbol and recording sub-systems must maintain simplicity as degrees of superimposition and juxtaposition of components are increased.

4. The symbol and recording sub-systems must be flexible and at the same time, precise, "in order to render a meaningful degree of descriptiveness to possible permutations."[43]

5. The symbol sub-system and the recording sub-system must be formed integrally. Rose draws an analogy with music notation in which the symbol sub-system is the notes and the recording sub-system is the staves.

In Halprin's MOTATION, the large number of disparate symbols bear little relation to the structure of framed format sheet. Thiel and the Appleyard group combined the symbol and recording sub-systems so thoroughly that it is impossible to distinguish one from the other. By using two distinct, but well integrated sub-systems, Rose allows for visual measurement of dimensions. Across the staves, dimensions are directly plotted, while along the staves, distance must be calculated as a function of the specified speed and duration. Figure 11 shows the pedestrian's movement through Coolidge Corner.

Unlike Thiel and the Appleyard group, Rose does not attempt to provide a "feel" for the environment, but only to represent that environment as directly as possible. In this sense, Rose's system is more "n eutral", although it does take a single person's viewpoint,



No edge followed

No path followed 14-17

175 ft.

35 sec. 13

250 ft.

50 sec.

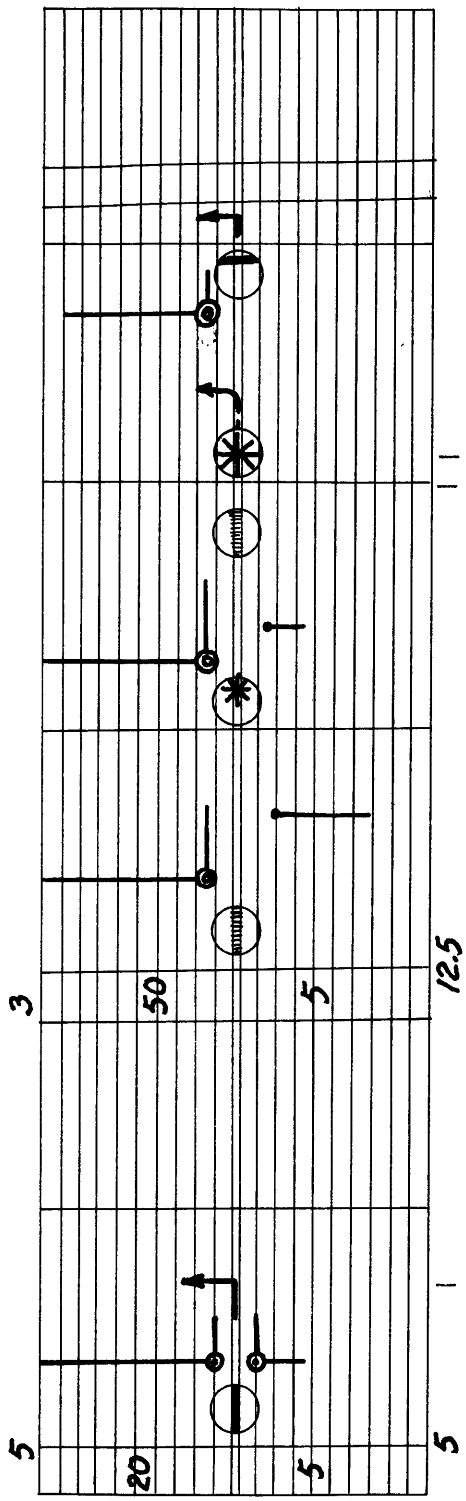
11-12

rest 20 sec. 5-10

150 ft.

30 sec.

Arcade 1-4



Harvard Street 27-30

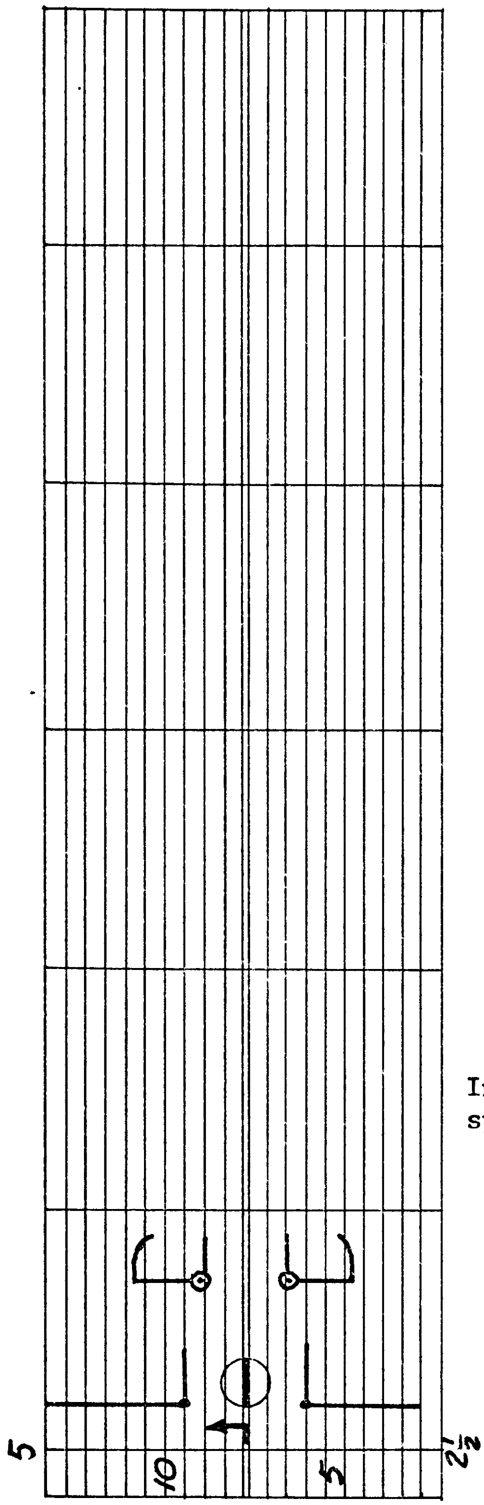
26

Beacon Street 20-25

Alley followed 18-19

75 ft.

15 sec.



Into non-homogeneous space

which the computer is capable to shift. Alternate human perceptions such as scanning are not incorporated directly, and on the basis of Lynch's image notations, the representation limits itself to elements which are selected for their visual prominence.

Much more realistically than the conventional methods, the system produces a "dynamic", "three-dimensional" diagram of the environment. Since it relies on electronic simulation, it might be a more satisfactory tool than models or traditional drawings for communicating design ideas to people unfamiliar with the system itself. It allows one to view the design while moving through it, a possibility that could be approximated heretofore by, say, the elaborate production of sequential photos of a model through a periscope.

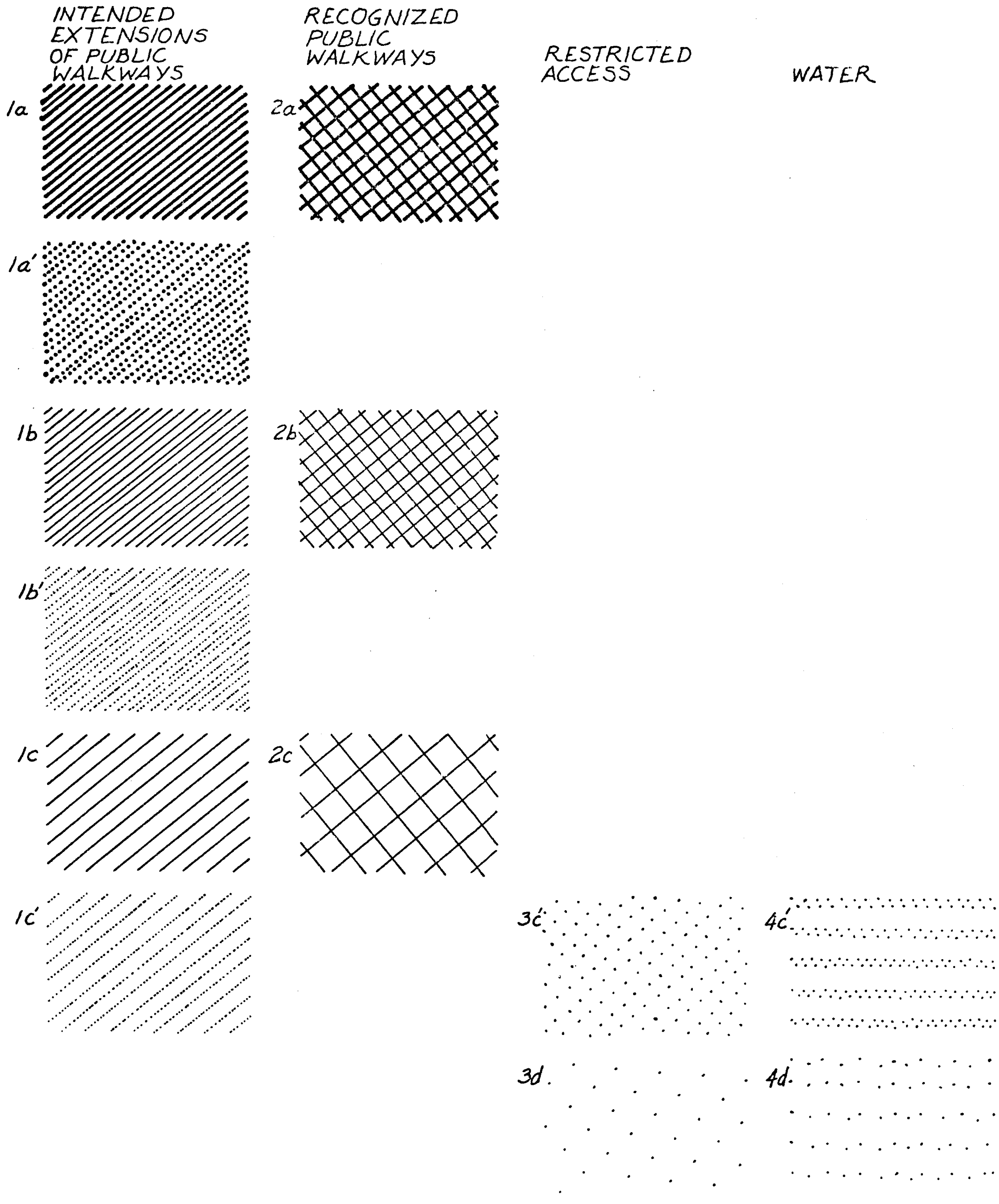
Confessing in the end that "it would be naive to presume that the problems of our physical environments are due solely to the lack of a notation/simulation system,"[44] Rose still maintains that a tool like his will expand a designer's ability to reckon with the spatial aspects of the environment. I think that one might note in caution that bad and good music are written with the same set of symbols.

Studying other computer graphic simulations of movement through space, I think Rose's system, once the necessary software is developed, would be far simpler. The reason simply being the elimination of the need to draw the building outlines on the screen for each sequence of movement. All present computer graphic techniques require this. The analogy can be made to the use of FORTRAN computer language for analyzing structures to find stresses and deflections due to certain forces and the use of STRUDL (Structural Design Language, a system developed by MIT Civil Engineering Department, where the only inputs required are the members' incidents, their lengths, position in space and the forces acting on them, thus avoiding the tedious task of writing the program.

Section C

The four systems discussed succeed in a crude way to convey movement in a three dimensional environment. Their relative success is dependent on the notation system itself and the drawing technique. Excepting Halprin's, the systems can describe the movement and environment in great detail. The amount of information and detail shown, is dependent mainly on the user of the system(s). All, however, fail to make a value judgement on the environment, i.e., is it good to have this quality of space and why? Nor do they describe the kind of activity or intensity that takes place. Therefore a real understanding of the communal spaces is not possible by these systems, thus making them insufficient tools for both analysis and design.

One two-dimensional system developed by Stanford Anderson (figure 12) describes classes and levels of activity, the degree of interaction between inside and outside, accessible and non-accessible areas, and what is perceivable by a pedestrian in the public realm (for example, a wall perceived from both sides is shown by a double line while that which can be seen from only one side, the other being private, is represented by a single line.) This is done by analyzing the urban space in terms of three constraints: social, physical and sensory, each with several degrees of constraints ranging from minimal to maximal. The goal of such a study is to improve the understanding of the communal spaces in cities. The



GRAPHIC SYSTEM FOR "TRANSACTIONAL SPACE OF THE STREET"

Figure 12a.

1a. Intensification of public walkway.

1a'. Similar to code above, but effective only at limited times or to a limited public.

1b. Obvious extensions of street space but not an assertive connection, e.g. normal glass-fronted shops.

1b'. Similar to code above, but where the use is specialized or for some other reason must be considered a less intensive extension, e.g. an exclusive furshop, lawyer's office, etc.

1c. Road surface sometimes claimed by pedestrians.

1c'. Ordinary street.

2a. Intensely used walkway.

2b. Walkway, broad middle range of intensity.

2c. Rarely used walkway.

3c'. Physically accessible but restrained.

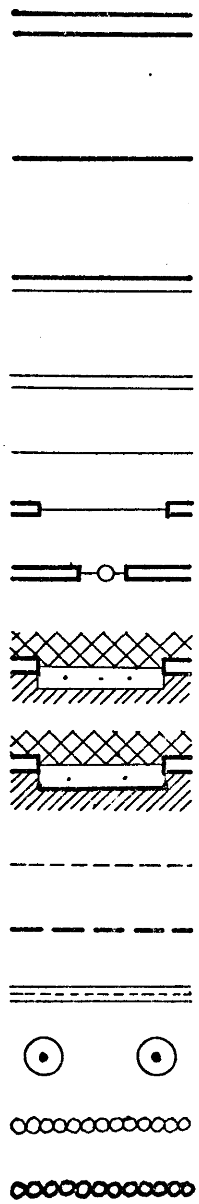
3d. Visual access only.

4c'. Wading, swimming water.

4d. Visually accessible water.

EXPLANATION OF THE GRAPHIC SYSTEM

Figure 12b.



- Wall as part of a building "Two-sided""in that both sides appear within the "transactional space".
- Wall as part of a building "One-sided" in that only one side appears as a boundary of the transactional space.
- Free standing wall or closed fence above eye height; heavy line to the more public side.
- Low free standing wall.
- Curb line, sidewalk edge, etc.
- Window.
- Entrance door.
- Display window that does not interrupt view.
- Display window that interrupts view.
- Low rail or chain.
- Open fence.
- Low wall with fence.
- Trees.
- Hedge (low)
- Hedge (obscuring)

<u>MISCELLANEOUS CONVENTIONS</u>

Figure 12c.

system is under further study and development.

Figure 13 uses the system to describe Coolidge Corner. Its applicability, however, is limited to the level at the street and to a single (or idealized "characteristic") time. The notation itself is tedious to reproduce, but the process might be expedited by quick non-drawing methods such as Zip-a-Tone, etc.

The system is clearly legible, since various intensities of use are indicated by varying the thickness and closeness of lines, such that the map reads as a combination of textures. A development of the system might incorporate a set of diagrams to represent the different levels. These could be reproduced on transparent overlays. Since the notation does not describe the change of activity in time, nor does it show the particular use which a place supports, I have developed an expanded version of Anderson's system, to supplement it. This is shown in figure 14.

Systems showing topography and microclimate have also been developed for the area.[45] Their usefulness in design has to do with considering protection from climatic elements and taking advantage of slopes to provide views or establish directions of growth for new built form.

CONCLUSION AND RECOMMENDATION FOR FURTHER WORK

While I have pointed out advantages and disadvantages of all four systems, I have discounted Halprin's system though it does have the asset of incorporating in its format a rough plan diagram of the location where the experience occurred. All the systems take a single observer's viewpoint, though the Appleyard group perhaps succeeds in making this viewpoint an accurate generality by considering the (in fact) singular and linear experience of a highway, one characterized by its constancy of information: lack of abrupt level changes or extreme fluctuations in speed.

When I applied all these systems to an intermediate urban scale and took the pedestrians as a reference, I found that the linear representation of a three-dimensional movement in a three-dimensional environment were not very inadequate. A thorough means of representation should be able to take account of every possible path of movement in an environment, and since this is clearly impossible with a linear format, we might do well to re-examine the traditional approaches.

If a two-dimensional representation was chosen instead of a linear one, this would mean that every track in linear representation would correspond to a single sheet in surface representation. The environmental characteristics important to Thiel and the Appleyard group would then require several sheets of superimposed notations on plans. This becomes a lengthy process and may defeat the simplicity goal.

Rose's system has several advantages and is the most promising of the four systems discussed in sections A & B. Further refinement in notation technique is required together with extensive computer use. Until the necessary computer software to convert the notation to comprehensible pictures gets developed, the system would be limited to subjective interpretation. This is not as bad as it seems since the same situation exists in music notation.

Anderson's system does have the advantage of relating use to form (space) and as showing the transactional space. A three-dimensional transactional space diagram can be developed for each level of activity, drawn on transparent sheets and superimposed on each other. Since the technique requires the use of various line thicknesses, the computerization of the system is well within reach, thus allowing for faster analysis and plotting.

APPENDIX I

A SAMPLE SEQUENCE

The photographs represent an experience through Coolidge Corner. The particular pattern was chosen for its wide range of space characteristics.

The photographs were taken with a 35mm. lens mounted on a Nikon FTn body.

Figure 15 represent a plan of the area. The numbers on the plan correspond to photograph numbers.

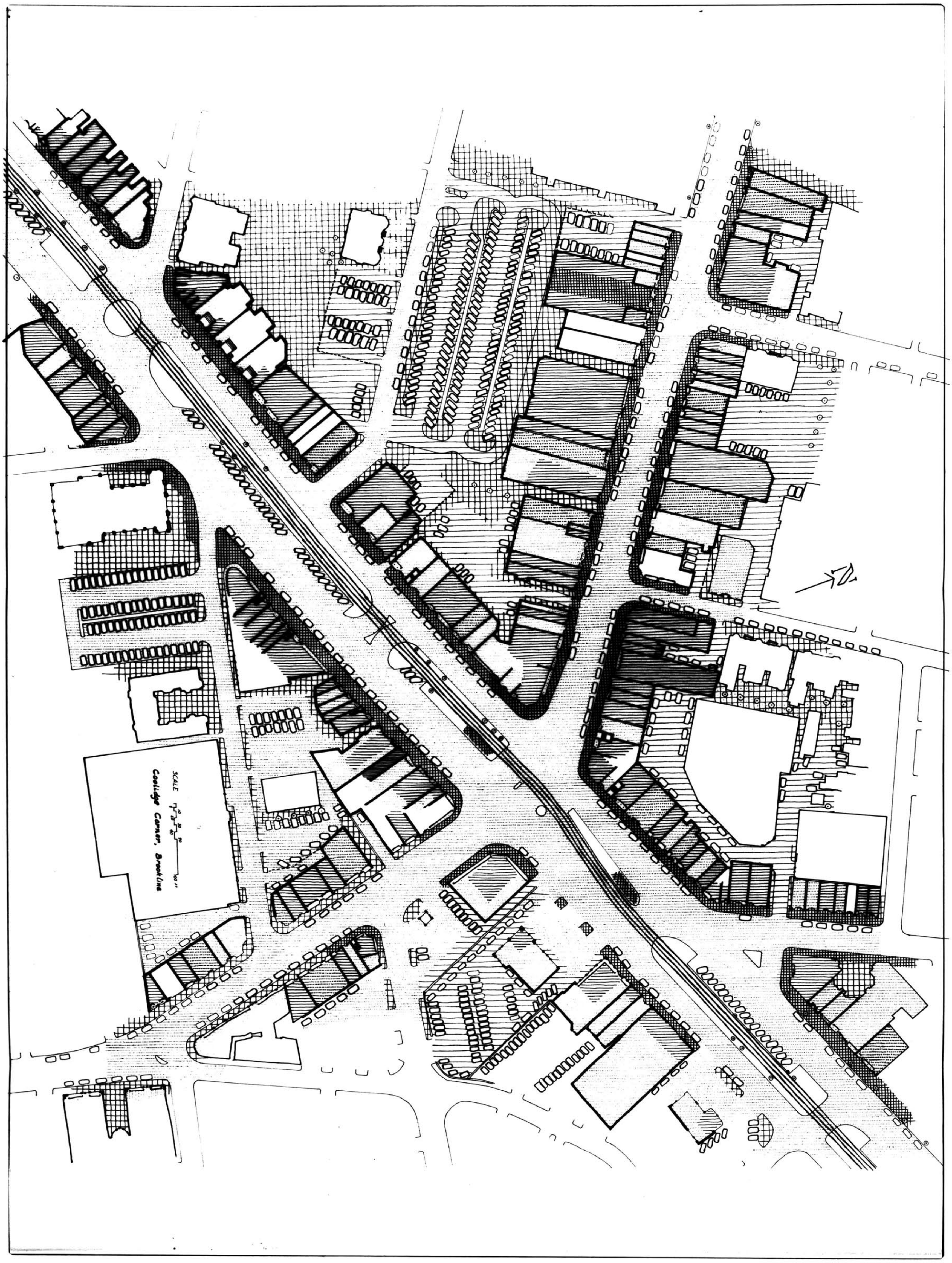


FIGURE 13
page 70

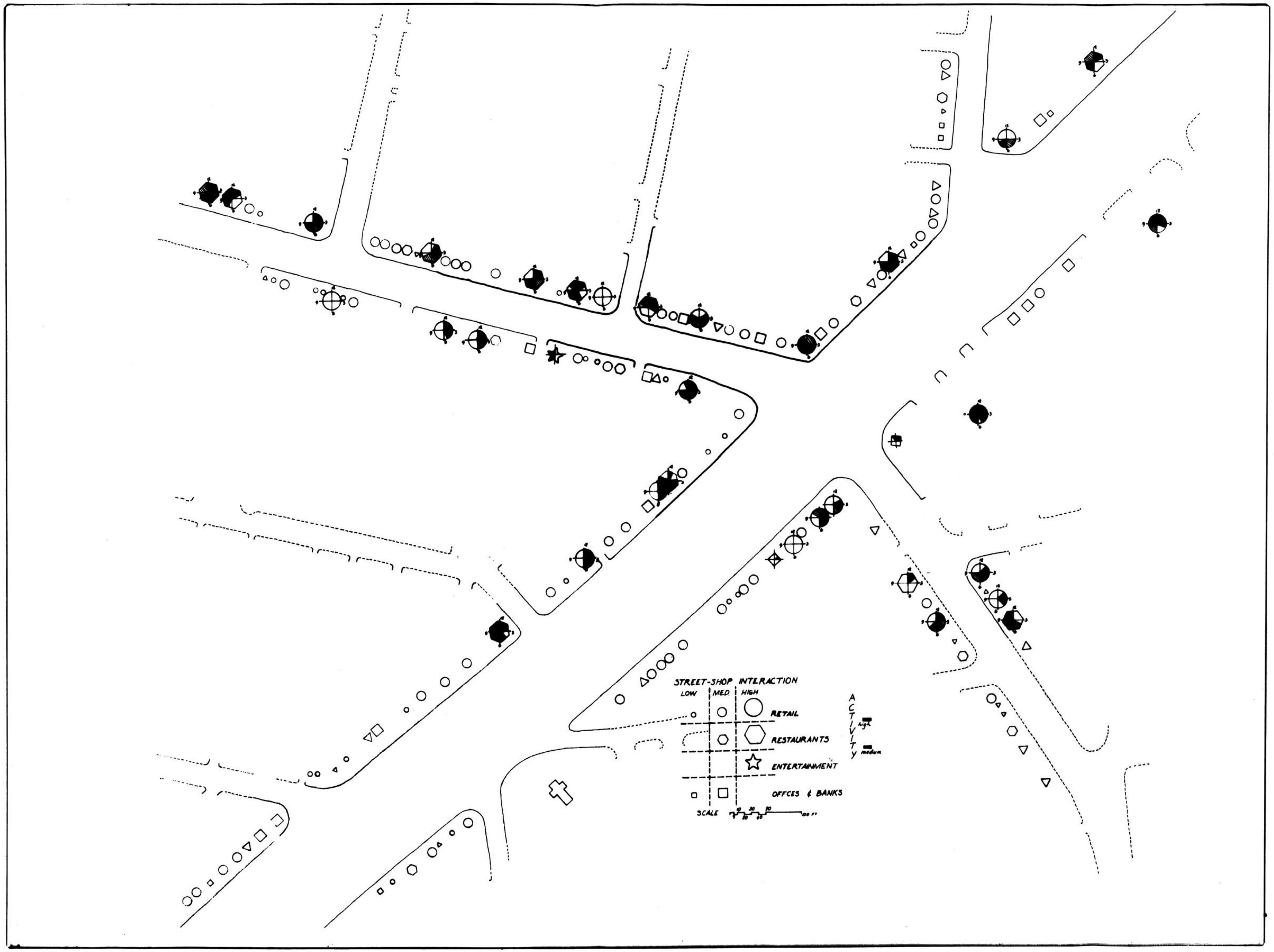
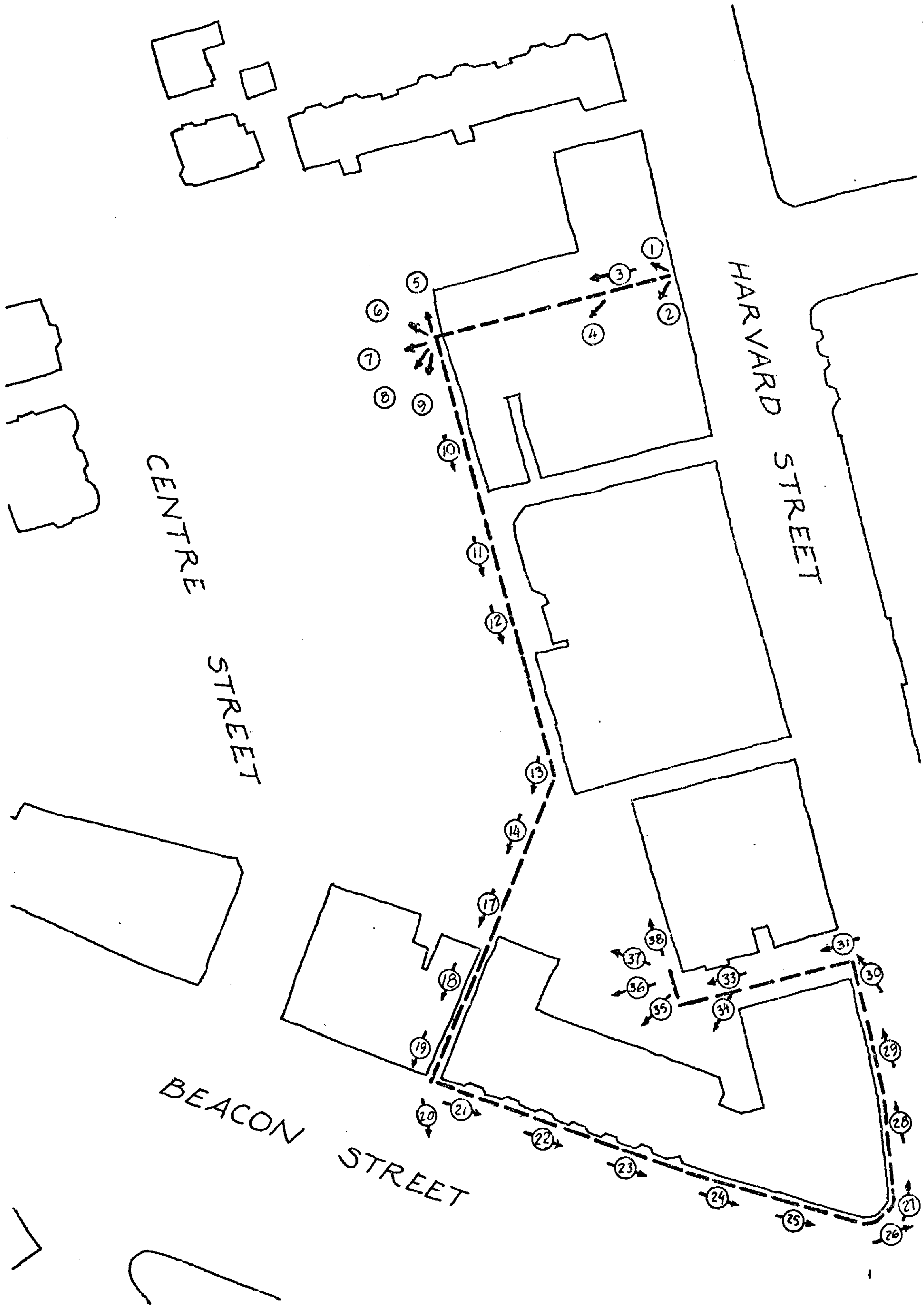

STREET-SHOP INTERACTION
LOW
MED.
HIGH
RETAIL
RESTAURANTS
ENTERTAINMENT
OFFCES & BANKS
ACTIVITY
high
medium
SCALE
100 FT

Figure 14



Plan Showing Toor in Coolidge Corner

Figure 15.

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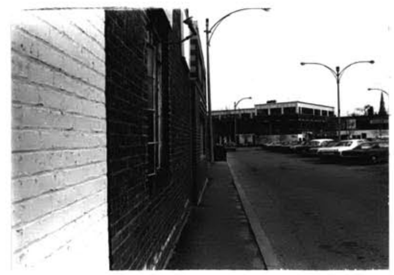

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