ECOLOGICAL THEORY

J. J. Gibson's Ecological approach to visual perception is radically different than the theories of his predecessors.[1] He does note that he owes a "debt to the Gestalt psychologists, especially to Kurt Koffka. I have extended many of his ideas, [and] I owe a great deal to the functionalists in American psychology."[2] But this does not mean that Gibson accepts the basic premises of these theories. In fact, he does not, and he takes pains to explain the differences.

Gibson argues that other psychological theories of perception deal with irrelevant situations. He contends, "The vast quantity of experimental research in the textbooks and handbooks is concerned with snapshop vision, fixed-eye vision, or aperture vision, and it is not relevant."[3] Gibson holds that our experience is actually continuous and recorded over time.

He singles out the concept of figure/ground as a prime example of irrelevant research:

> The figure-ground phenomenon does not apply to the world in general. The notion of a closed contour, an outline, comes from the art of drawing an object, and the phenomenon comes from the experiment of presenting an observer with a drawing to find out what she perceives.[4]

According to Gibson, the real environment has edges, not outlines, and an edge is perceived differently than an outline. In Ecological theory, visual perception is paying attention to the flow of the light array impinging on the retina. Every material and form is specified by characteristics of the light array's change, and learning is the process of distinguishing these characteristics. Reflected light specifying outlines behaves differently than light specifying objects, and these differences are learned. Gibson contends that people first learn about the real environment of objects because it is imperative that they do, and that understanding two-dimensional figures comes later as it is needed. Therefore studying two-dimensional phenomena to understand three-dimensional phenomena is inappropriate.

Another difference between Gestalt research and reality is the perception of an object in perspective. Gibson points out that "the progressive foreshortening of the face of an object is perceived as the turning of the object,...and is never perceived as a change of form."[5] This leads Gibson away from studying the figure/ground phenomena of two-dimensional design to the

study of flowing light arrays in the environment; these light arrays have predictable behavior which defines form.

Although other sources of the following information have been reviewed, including Gibson's earlier work, the primary source for this exposition is Gibson's The Ecological Approach to Visual Perception, 1979. This latest book of Gibson's represents a lifetime's work and the evolution of several ideas, as well as the rejection of some earlier constructs. He presents his theories as several hypotheses with varying degrees of specificity and actual experimental corroborating data. He feels he has defined an area that can now be elaborated upon by others, including, interestingly enough, teachers of drawing and basic design, and architects. The following explanation of Gibson's theory emphasizes the human perception of the world and highlights what Gibson conceives as the attributes of environments that are manipulatable and subject to human composition.

The Ecological approach to visual perception refers to the fact that there is an integral relationship between people and their environment to the extent that people cannot be defined as separate from their environment, that there is a general scale to the environment that we live in, and that the perceptual system of the species is an integration of the senses, the brain, and the body, and is functionally inseparable. Perception itself is said to be paying attention to attributes of the flowing energy arrays in the environment that are registered by the perceptual system. Visual perception is attending to the registration of the flowing light arrays on the retinas of the eyes.

Living things and their environments evolved together over millions of years. The evolution of sense organs is directly related to particular aspects of the energy flowing in the environment that can be sensed. Gibson notes, "the fact is worth remembering because it is often neglected that the words animal and environment make an inseparable pair. Each term implies the other."[6] Only recently, in evolutionary terms, have people become particularly successful in adapting the environment to the species. Gibson's point is that our general evolution has been the other way around, and all of our organs have evolved to take advantage of what our environment affords us.

Therefore, he starts his inquiry into the nature of perception by looking at our environment. The environment he sees is complex, but the behavior of objects and other attributes of the environment is consistent in certain ways, which has allowed Gibson to categorize their behavior and evolve a theory of perception. He notes, "The fact of an environment that is mainly rigid but partly nonrigid, mainly motionless but

partly movable, a world that is both changeless in many respects and changeable in others but is neither dead at one extreme or chaotic at the other, is of great importance for our inquiry."[7] His analysis of the environment and what the perceptual system registers and can perceive is related to the character and rate of change of various attributes of the environment. Gibson contends this character and rate of change provides the information necessary for perception. All one needs to do is pay attention to it. The perceptual system registers an environment that surrounds the individual and is not simply a scheme in front of him.

This suggests that perception requires exploration over time so that the nature of closure and surround can be understood. In most respects, perception is part of a sequential process in the continuing flow of events; it is dynamic instead of fixed. It centers on the individual's relation to his environment and not simply his environment. This all implies new ways of thinking about architecture and architectural eduction which are fundamentally different from what is suggested by the two-dimensional world of plans, sections and elevations.

Gibson notes that the human environment has a particular scale and order. The scale of the environment with which humans generally deal is in a fairly close definable range which is neither the largest nor smallest we can measure, but somewhere in between. Gibson's description of this range is that,

> at the level of kilometers, the earth is shaped by mountains and hills. At the level of meters, it is formed by boulders and cliffs and canyons, and also by trees. It is still more finely structured at the level of millimeters. Blades of grass are more or less similar to one another, and so are clumps of grass and bushes. These natural units are not, of course, perfectly uniform like the man-made tiles of a pavement. . . . It is stochastically regular . . . regular in a probabilistic way. . . . They tend to be evenly spaced; and if they are scattered, they tend to be evenly scattered.[8]

He contrasts this to the geometric and mathematical order found at the microscopic and vast scales of the universe; the environment inhabited by humans should not be confused with these two scales and the order they exhibit. We are adapted to a scale of environment that is not mathematically or geometrically pure.

Gibson describes our ecological environment, its scale tendencies and the basic reference system it affords us by breaking it into two categories, object surfaces and mediums. There are two basic mediums, air and water, and we can move

through both. The mediums provide sustenance and orientation. "The medium is separated from the substances of the environment by surfaces,"[9]

The first aspect of a medium is orientation. Within the medium air, Gibson says we can perceive the basis for an orientation system based on gravitational force that provides "an absolute axis of reference, the vertical axis." Further orientation is provided by the compass points for "even the two horizontal axes of reference are not wholly arbitrary, for they depend on sunrise and sunset."[10] A second aspect of a medium to sustain animals and provide greater orientation within the environment is that it allows light, sound and smells to move through it in an orderly manner. It is the order in this distribution of energy that is perceived, and without order, Gibson contends, there could be no perception. The medium is filled with light, sound and smells; any point within this medium is a potential location for monitoring the environment and orienting to the energy flow within it. Space and objects do not provide this wide capacity for orientation or locomotion.

The persisting part of the environment are the solids and they have a base. "The literal basis of the terrestrial environment is the ground, the underlying surface of support that tends to be on the average flat--that is to say, a plane--and also level, or perpendicular to gravity."[11] The persisting surfaces are those that do not change appreciably over time spans such as days, weeks or years. Buildings are examples of persisting surfaces. However, this must not be confused with the idea of an exact configuration. People, for instance, tend to persist for 80 years or so, but are not static in form. Persisting simply means that the surface does not vanish when not within view, but continues to exist and to behave in certain discernable ways. Gibson concludes the earth and "the persisting surfaces of the environment are what provide the framework of reality."[12]

The perceptual system, from Gibson's standpoint, is an integrated system. He maintains that "natural vision depends on the eyes in the head on a body supported by the ground, the brain being only the central organ of a complete visual system."[13] The complete perceptual system includes taste, smell, hearing, and touch, all similarly integrated with the body and brain. This system registers the environment as well as the individual's relation to it. Gibson says, "The optical information to specify the self, including the head, body, arms, and hands, accompanies the optical information to specify the environment. The two sources of information coexist. The one could not exist without the other."[14] Gibson argues that the purpose of vision, "is to be aware of the surroundings, the ambient environment, not merely of the field in front of the

eyes...visual perception is panoramic and, over time, the panorama is registered."[15] Perception as a function of motion through an environment is one of the most striking differences between Gibson's description of perception and other theories. It requires a totally new definition of what and how we see.

Perception is not part of a stimulus response system; it is an activity of the entire perceptual system. Gibson's point is,

> perception is not a response to a stimulus but an act of information pickup. Perception may or may not occur in the presence of information. Perceptual awareness, unlike sensory awareness, does not have any discoverable stimulus threshhold. It depends on the age of the perceiver, how well he has learned to perceive, and how strongly he is motivated to perceive.[16]

Man can see, Gibson claims, because reflected and direct light has structure and the structure at any location is different than the structure at another location; this provides the information required to perceive one's location. Light comes from either a direct source such as the sun or is reflected from surfaces in the environment. Reflected and direct light fills the medium and is called ambient light. The ambient light is structured in certain ways by its source and this structure defines the source. Gibson's theory is that ambient light converges to all points within the medium and that the structure of light is different at every point within the medium. A point can be occupied by an observer. Gibson notes, "When the position becomes occupied, something very interesting happens to the ambient array: it contains information about the body of the observer."[17] This information is conveyed by light reflected off of parts of the body such as hands, as well as from the sense of light converging on the observer. Body movements or locomotion register the environment in relation to a center, the perceptual system.

Ambient light is registered by the perceptual system and the registered pattern is called the optical array. The optical array is usually flowing because of eye, head and body movement. This flowing array has all the information necessary for perceiving: light and dark, color, form and location. This information is structured in that it changes in a systemmatic fashion and perception is said to be paying attention to this structure. The light reflected by any object such as a brick or water has a defining set of structures that Gibson calls invariants. He says, "The eye-head-brain-body system registers the invariants in the structure of ambient light."[18] "The main invariants of the terrestrial environment, its persisting features, are the layout of its surfaces and the reflectances of these surfaces."[19] Gibson lists several structural aspects of

the array that could be perceived, but he contends that further study is necessary to generate a complete list. An example, one that Gibson does not use, is the simple motion of flow of the array specifying a cube as one walks past it. The outline form of the array is difficult to describe, but one can imagine that there is a specific structure to the way the array flows that represents a set of flat surfaces connected at edges that cover and uncover its other surfaces and the surface on which it rests in an orderly manner. The array deforms rather radically at overlapping surfaces which specify outline or object while the surface itself is represented by a flow that changes smoothly while maintaining color and light/shadow consistency of the object. In short, the light reaching the moving eye has all the information necessary for specifying the environment.

The key aspect of our environment is that it persists. Objects that flow out of our visual array can and will return and things covered will become uncovered; Gibson calls this the principle of reversible occlusion.

> The moving observer and the moving sun are conditions under which terrestrial vision has evolved for millions of years. But the invariant principle of reversible occlusion holds for the moving observer, and a similar principle of reversible illumination holds for the moving sun. Whatever goes out of sight will come into sight, and whatever is lighted will be shaded.[20]

Perception is said to be direct; no thought or analysis of the array is necessary for perception. Gibson states

> information [about our present environment] does not have to be stored in memory because it is always available. The increasing capacity of a perceptual system to pick up information, however, does not in itself constitute information. The ability to perceive does not imply, necessarily, the having of an idea of what can be perceived. The having of ideas is a fact, but it is not a prerequisite of perceiving. Perhaps it is a kind of extended perceiving.[21]

This is a very difficult concept to understand. Gibson tries to clarify it by contrasting it to cue theories. Cue theory suggests there are cues to interpreting the environment. Cue theories suggest, for instance, that the visual perception of depth is sensed indirectly as a function of visual cues such as overlapping surfaces, texture/density gradiations, and others. Gibson says of such theories:

> It seems to me that all such arguments come down to this; we can perceive the world only if we already know what there is to be perceived. And that, of course, is circular....

> The alternative is to assume that sensations triggered by light, sound, pressure, and chemicals are merely incidental, that information is available to a perceptual system, and that the qualities of the world in relation to the needs of the observer are experienced directly.
>
> In the case of a special sense [such as vision in a cue theory], the process of attention occurs at centers within the nervous system, whereas in the case of a perceptual system attention pervades the whole input-output loop. In the first case attention is consciousness that can be focused; in the second case it is a skill that can be educated....
>
> We are tempted to think of attention as strictly a narrowing-down and holding-still, but actually this is rare. The invariants of structure in an optic array that constitute information are more likely to be gradients than small details, and they are scanned over wide angles.[22]
>
> According to the theory being proposed, perceiving is a registering of certain definite dimensions of invariance in the stimulus flux together with definite parameters of disturbance. The invariants are invariants of structure, and the disturbances are disturbances of structure. The structure, for vision, is that of the ambient optic array. The invariants specify the persistence of the environment and of oneself.[23]

The integral nature of the perceptual system and the environment is still further enhanced by Gibson's theory of what we perceive. He contends that we perceive "affordances" and "events" in the environment as integrally as we perceive the structure of the light array. An example of an affordance of an object may be that it can be walked upon, such as a set of steps. Gibson argues that, "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill."[24] He makes the point that an affordance is unique for a species, for example water affords breathing for fish, but not for man. Therefore, an affordance is not an abstract physical property, but a relationship between an environment and a species. Gibson goes on to state that:

> The basic affordances of the environment are perceivable and are usually perceivable directly, without an excessive amount of learning.[25]
>
> Perhaps the composition and layout of surfaces constitute what they afford. If so, to perceive them is to perceive

what they afford. This is a radical hypothesis, for it implies that the 'values' and 'meanings' of things in the environment can be directly perceived. Moreover, it would explain the sense in which values and meanings are external to the perceiver.[26]

The value and meaning of objects are their affordances and can be considered external to the individual in that they apply to the species' relationship to its environment and not simply the individuals. For example, the concave form of a material that fits the hand affords ladling and drinking of liquids. It is a cup to all people. While Gibson contends that this type of affordance is usually perceived directly, there are affordances that are culturally specific and must be learned. A culturally specific affordance might be a complex machine like a computer which has an affordance only to those who know its function. In this instance, the form does not suggest its use. At a basic level, buildings afford shelter and at another level they may represent their cultural or personal use to those familiar with them.

Affordances are attributes of objects, while events describe changes in form which could mean a change in affordance. Gibson lists three varieties of events registered by the perceptual system: "Change in the layout of surfaces, change in the color and texture of surfaces, and change in the existence of surfaces."[27] Any of these events could specify a change in the affordance of some part of the environment. In relation to the optic array, "The beginning and end of the disturbance in the light corresponds to the beginning and end of the event in the world, but that is about as far as the correspondence goes."[28] For example, one might be viewing a doorway when the door closes. The event is the disturbance of the optical array that is registering the light reflected from an opening which one can go through to a surface that must be manipulated before it affords passing through. The same event might also be thought to afford a change from exposure to privacy depending on the social context of the event. Thus, the disturbance of the light array simply suggests that an affordance might have changed, but it doesn't define what the change might be.

The key points so far are that the perceptual system is integrated, that man and environment are intimately related, that perception is the recognition of affordances in the environment, and that this recognition normally occurs by paying attention to a moving optical array.

There are three other aspects of Gibson's theory that are of importance to architects and architectural educators. The first is a concept of nested images, implying a kind of hierarchy; the second concerns the nature of place and its attributes; the third concerns learning.

Imagine for a moment a sphere in space. Gibson contends that its outline projected back to the eye is a solid angle, in this case a cone. As one moves closer to the sphere the solid angle increases, and this affords you a knowledge of its distance. But the object is a sphere with a surface which has a texture and is illuminated. This all behaves, Gibson suggests, as a dense pack of angles similar to the outline angle; therefore the entire environment is registered in the optic array as disturbances of the array that correspond to this dense pack of angles.

The visual array is a flowing mosaic; objects, surfaces, and events are nested within each other. Perception is paying attention to different levels of disturbance of the array. One can perceive a forest, tree or leaf, but not all at once. The information necessary to perceive all three is present in the optic array, but is nested one within the other. The boundry between them is vague. One pays attention to what one wants and this is a function of motivation and affordance. As Gisbon says,

> Things are components of other things. They would constitute a hierarchy except that this hierarchy is not categorical but full of transitions and overlaps. There are no atomic units of the world considered as an environment. Instead, there are subordinate and superordinate units. The unit you choose for describing the environment depends on the level of the environment you choose to describe.[29]

The nesting of the optic array is scalar, smaller attributes within larger ones. This hierarchy must not be confused with a hierarchy of value or meaning which is based on what the environment affords an individual and to some extent on what her needs are at the moment.

Events are similarly nested, but they exhibit the attribute of being sequential. They do not repeat exactly; the flow of events is in one direction. Distinguishing between one event and another is a relative issue because of this nesting, and Gibson says that "what we take to be a unitary episode is therefore a matter of choice and depends on the beginning and the end that are appropriate, not on the units of measurement."[30]

Place recognition is of equal importance to survival as event or object recognition and the phenomena has characterstics that are distinctly its own. Place recognition has great significance because it is a basic form of orientation (along with gravitational and solar axes) and is a precondition to all human behavior. Gibson goes as far as to say, "The habitat of an animal is made up of places"[31] The principle of reversible

occlusion (i.e., that which goes out of sight is still there and can be brought back) is an attribute of place. The other basic attribute of places is that they are at fixed locations and that they differ from each other in ways that can be perceived. Places are nested, and as Gibson puts it:

> Note that the perception of places and the perception of detached objects are quite different. Places cannot be displaced, whereas objects can be, and animate objects displace themselves. Places merge into adjacent places, whereas objects have boundaries.[32]

Places are affordances of the environment as much as objects and events. An entire environment made out of nested places is comprehended through exploration. Gibson points out,

> that in a terrestrial environment of semienclosed places each vista is unique, unlike the featureless passageways of a maze. Each vista is thus its own 'landmark' inasmuch as the habitat never duplicates itself. When the vistas have been put in order by exploratory locomotion, the invariant structure of the house, the town, or the whole habitat will be apprehended.[33]

The principles for the control of locomotion from place to place within an environment involve what Gibson calls the edge of danger, the gradient of danger and symmetrizing the rate of flow of the optical array.

Danger is an affordance of the environment. For humans, it is perceived as a looming up on the optical array, a dropping away precipitously or several other obvious experiences, all of which produce an alarming visceral response. A looming object quickly expands in the visual array and suggests physical contact is eminent if no diffensive action is taken. A door swinging into one unexpectedly has the prerequisite rapid looming characteristic. A steep hill exemplifies the other condition where either the rate at which the texture of the surface changes is alarming or an abrupt dropoff is specified by a considerable difference of texture on either side of the edge. These are all dangerous conditions that are controlled by moving away from them or at least by insuring that they pass by at a safe distance. Thus, part of the act of locomotion is avoiding danger.

The other part is the pursuit of goals which Gibson hypothesizes occurs by visually locating a goal and symmetrizing the rate of flow of the visual array around the goal in question. Symmetrizing the rate of flow of the visual array simply means that the rate of flow of visual information passing is even on all sides as the goal is approached. The activity of

approaching a goal is more complex than this because we also scan the environment as we move, and motion is judged in relation to a framework, but nonetheless the general concept still applies. This particular concept introduces an interesting aspect of symmetry that has had little investigation in architectural terms.

Another architecturally interesting aspect of Gibson's theory is its emphasis on the integral nature of things and the inherent inability to describe objects and events without abstracting them. The abstracting process is different from perception, which is flowing and nested. What we describe is what we can most easily separate; this depends on our motivation and how well we have learned to discriminate. But no matter how well we discriminate, we can not reproduce what we perceive in words or lines. We perceive much more than we can relate. For example, it is impossible to exactly represent what is perceived through all of the senses when sitting in a forest. And if this is not difficult enough, it must be remembered that the event is simply one in a non-reproducible, continuous flow of events.

This point is being made forcefully because architecture tends to rely on the measurable aspects of things, while it is quite clear that the immeasurable sense of things is equally important. Architects and architectural educators can not avoid using the measurable, but they should not suppose that it is all that is perceived. Gibson addresses this point in the following quotations concerning the relative value of color and how perception begins:

> From an ecological point of view, the color of a surface is relative to the colors of adjacent surfaces; it is not an absolute color. Its reflectance ratio is specified only in relation to other reflectance ratios of the layout. For the natural environment is an aggregate of substances. Even a surface is sometimes a conglomerate of substances...the colors are not seen separately, as stimuli, but together, as an arrangement. And this range of colors provides an invariant structure that underlies both the changing shadow structure with a moving sun and the changing perspective structure with a moving observer.[34]

> The animal or child who begins to perceive substances, therefore, does so in a different way than one who begins to perceive places, attached objects, and detached objects. Substances are formless and cannot be counted. The number of substances, natural compositions, or mixtures is not fixed. . . . We discriminate among surface colors and textures, but we cannot group them as we do detached objects and we cannot order them as we do places.[35]

Knowledge, thought and learning are also significant issues to architectural educators; of course, they are the basic realities of education. Gibson's theories provide a unique outlook toward these issues that is worthy of further study. Gibson is wary of the idea that knowledge or learning is a higher, supposedly more intellectual, process than perceiving. Perception from his viewpoint includes, to some extent, memory, experience, and knowledge:

> Knowledge of the environment, surely, develops as perception develops, extends as the observers travel, gets finer as they learn to scrutinize, gets longer as they apprehend more events, gets fuller as they see more objects, and gets richer as they notice more affordances. Knowledge of this sort does not "come from" anywhere; it is got by looking, along with listening, feeling, smelling, and tasting. The child also, of course, begins to acquire knowledge that comes from parents, teachers, pictures, and books. But this is a different kind of knowledge.[36]

Knowing and learning are extensions of perceiving. Creative thinking is a further extension of the perceptual system where the system begins to work without exterior stimulation. Gibson hypothesizes that,

> a perceptual system that has become sensitized to certain invariants and can extract them from the stimulus flux can also operate without the constraints of the stimulus flux. Information becomes further detached from stimulation.[37]

> To expect, anticipate, plan, or imagine creatively is to be aware of surfaces that do not exist or events that do not occur but that could arise or be fabricated within what we call the limits of possibility.[38]

A very different type of knowledge is developed through education. Things are abstracted and ordered as tools for gaining knowledge, but they are not knowledge themselves. Knowledge is the individual's relating these orders back to his experiences and finding consistency with it. Gibson discusses how extremely abstract our modes of communication are and how far from an ecological reality they get.

He points out fundamental confusions we have between our abstract systems of communication and the reality we perceive. The use of mathematic constructs to describe the environment is one. Gibson contends, "the faces of the world are not made of some amorphous, colorless, ghostly substance, as geometry would lead us to believe, but are made of mud or sand, wood or metal, fur or feathers, skin or fabric."[39]

We talk of planes, lines, and points in architectural education and basic design. Gibson contends that while they are reasonable parts of a mathematical theory, they are not parts of the environment, nor should they be used exclusively in developing theories of design. He states these differences between abstract geometry and what he calls surface geometry.

> A surface is substantial; a plane is not. A surface is textured; a plane is not. A surface is never perfectly transparent; a plane is. A surface can be seen; a plane can only be visualized. Moreover, a surface has only one side; a plane has two....a surface has the property of facing a source of illumination or a point of observation; a plane does not have this property.[40] [and]...surface color is inseparably connected with surface texture.[41]

He suggests that new terms for surface geometry are needed in "ecology, architecture, design, the biology of behavior, and the social sciences instead of the planes, forms, lines, and points of geometry."[42] Two-dimensional representations (drawings), as has been stated earlier, are abstractions. Perception is principally of the three-dimensional world and the understanding of two-dimensional layouts is a special case which Gibson feels requires study as an exception instead of the norm. He acknowledges, "perceiving, knowing, recalling, expecting, and imagining can all be induced by pictures, perhaps even more readily than by words.[43] However, he warns that there is no comprehensive theory of how drawing communicates and that this lack makes the teaching of drawing less precise and communicative than it could be.

In summary, perception is an awareness of a wholeness, not in the gestalt terms, but in terms of the integrity of what things mean (affordance), their form, color, texture and relation to context (place and event). The image is much too complex to describe, and yet, the intent of architectural education is, in some aspects, an attempt to simulate the experience of perceiving a real environment. At this point, Gibson would contend, we have not yet defined our tools nor attempted to address the less quantifiable aspects of design.

Footnotes

1 Gibson's theories have been compared to other theories of visual perception in:

William Epstein, "In the Eye of the Beholder: Competing Theoretical Formulations of Visual Perception," Psychological Studies, V. 24 No. 2 (July 1979):82-97.

Ralph N. Haber, "Visual Perception," Annual Review of Psychology, 29 (1978): 31-59.

Harry Heft, "An Examination of Constructivist and Gibsonian Approaches to Environmental Psychology," Population and Environment, Vol. 4(4) (Winter 1981): 227-245.

Jon Lang relates Gibson's theories and Gestalt Psychology to 'Formal' design in: Jon Lang, "Theories of Perception and 'Formal' Design," in Designing for Human Behavior, ed. Jon Lang, et al., (Stroudsburg, PA: Dowden, Hutchinson & Ross, 1974) pp. 98-110.

2 James J. Gibson, The Ecological Approach to Visual Perception, (Boston: Houghton Mifflin Company, 1979) p. xiii

3 Ibid., p. 3.

4 Ibid., p. 66.

5 Ibid., p. 84.

6 Ibid., p. 8.

7 Ibid., p. 14.

8 Ibid., p. 10.

9 Ibid., p. 22.

10 Ibid., p. 18.

11 Ibid., p. 10.

12 Ibid., p. 100.

13 Ibid., p. 1.

14 Ibid., p. 116.

15 Ibid., p. 114.

16 Ibid., p. 57.

17 Ibid., p. 66.

18 Ibid., p. 61.

19 Ibid., p. 87.

20 Ibid., p. 92.

21 Ibid., p. 250.

22 Ibid., p. 246.

23 Ibid., p. 249.

24 Ibid., p. 127.

25 Ibid., p. 143.

26 Ibid., p. 127.

27 Ibid., p. 94.

28 Ibid., p. 103.

29 Ibid., p. 9.

30 Ibid., p. 101.

31 Ibid., p. 34.

32 Ibid., p. 199.

33 Ibid., p. 198.

34 Ibid., p. 91.

35 Ibid., p. 242.

36 Ibid., p. 253.

37 Ibid., p. 256.

38 Ibid., p. 255.

39 Ibid., p. 87.

40 Ibid., p. 35.

41 Ibid., p. 31.

42 Ibid., p. 44.

43 Ibid., p. 262.