7. Imagining the Complex

You don't see something until you have the right metaphor to let you perceive it.

Thomas Kuhn

In her provocatively entitled article "The Web of Causation: Has Anyone Seen the Spider?" Nancy Krieger (1994) issues a challenge to epidemiology in particular, and to public health more generally, to develop a more comprehensive theoretical basis for research and practice. She exposes the shortcomings of the current dominant paradigm which poses a multitude of causal factors for disease (a "web") while failing to describe how these various factors come together in the first place to produce specific outcomes (the "spider). Drawing on the most widely used metaphor for the current paradigm, the title of Krieger's article poignantly summarizes her critique: Without a spider there can be no web, so we need either to find the spider or throw out the web idea all together. Krieger proposes the latter, and stresses the importance of generating a new metaphor to take its place, one which would take into account a more broad-based theory of disease causation, giving credence to both biological and social levels of causality—what she calls an ecosocial framework (p. 896): "Among the many obstacles to developing an ecosocial framework is one that has received relatively little attention: the absence of a metaphor that can succinctly capture the essence of this alternative view. Nothing comparable to the 'web' exists." She goes on to outline the qualities that such an image must possess (p. 896):

> *Perhaps one step toward developing an ecosocial metaphor would be augmenting the metaphor of the 'web' with two 'spiders': one social, one biologic. They would certainly reintroduce the concepts of history and agency, and would emphasize the importance of considering the origins of both social and biologic determinants of disease. Even so, the imagery of the 'spiders' may be too simplistic, and may fail to do justice to the complex origin and nature of the 'spiders' themselves. It is of little help to posit that health and disease are socially produced with evolving and socially-conditioned biologic parameters without offering insight into why and how this occurs; reducing the 'spiders' to a new form of 'black box' would only reinforce existing limitations. Nor would introducing the 'spiders' necessarily resolve the 'web's' embodiment of a biomedical and individualistic worldview. The 'web' never*

was intended to and does not jar epidemiologists from the long-established practice of viewing population patterns of disease as simply the sum of individual cases; it is far from obvious that adding the 'spiders' would address this fundamental problem.

Does complexity theory meet this challenge? What are the implications of applying complexity theory to prevention, more generally? This chapter is an exercise in re-visioning prevention by exploring the metaphorical potential of complexity.

7.1 The Paradox of Complexity

In a complex world there are no discrete subjects and objects nor are there discrete processes which can be isolated from all others. To say, for example, that a particular virus is *the* cause of a person becoming ill is to ignore all the factors which led to the person becoming infected and developing disease (e.g. genetic predispositions, the social and physical environment, specific behaviors, etc.). It is never one factor which leads to disease, but a host of factors coming together at a specific moment in time which creates the opportunity for disease to develop. In other words, a complex world is profoundly interrelated. The core image of complexity theory is that of a primary unity of all things, so that in the broadest sense, everything is somehow connected to everything else. To prove such an idea would defy even the greatest of analytical powers because it contradicts the most basic premise of conventional analytic method, namely, that the world can be reduced to its constituent parts. In proposing the unimaginable (and unprovable) as the starting point for an analytic pursuit, complexity theory confronts us with a paradox which calls attention to the limits of all causal explanations and promotes constraint in their use.

If all things are connected, then the degree of complexity is a matter of scale rather than fact. That is to say, anything less than a description of how the universe works is not taking into account all levels of causation. The appropriate scale is determined by practical considerations, the interests of those involved, and the analytical tools available. For example, because we have identified a virus in persons with disease and we can describe the biochemical mechanisms of this virus, this does not mean that we have found the unique cause for the disease phenomenon in question. If we choose to focus on another level of analysis, for example the social environment, we may find that persons with disease are more likely to live in poverty. In a com-

plex world, the researcher knows that it is the entire process which ultimately counts, and that one level defined by a handful of variables is not sufficient to describe what is happening. Theories focusing on one level of the phenomenon thus cannot produce a comprehensive explanation, but they can contribute a piece to the overall puzzle and therefore prove themselves useful in the attempt to find "leverage points" for steering events. Researchers and practitioners cannot lose site of the multiple levels at which a disease phenomenon can be generated and potentially resolved.

In such a multi-layered, interconnected world the person as agent is not lost, but s/he is set in relation to the larger forces at hand. Individual persons, groups, institutions, etc. can act on larger processes to produce change. The degree to which change occurs and in what direction is not least of which due to the timing (historical moment) of an intervention and at which "leverage points" it is executed. To think, however, that any particular agent or group of agents can somehow ultimately determine the destiny of society, whether in regard to disease or any other phenomenon, is in classical terms an act of hubris. From a complexity point of view the transgression is not against any god, but rather against the simple truth that reality itself is far larger than anything which can be perceived, let alone influenced. In short, there is always something we have not thought of, no matter how clever our approach. And history has a way of introducing new twists and turns which could never have been predicted.

To sum thus far, complexity implies first and foremost a humble attitude toward scientific pursuits and toward all attempts at social change for the betterment of health or toward any other end. This attitude is reminiscent of pre-Enlightenment approaches to learning in which the fear of God impinged on human endeavor. Complexity does not reference God or any other primary cause. It does, however, correct such exaggerated notions that we will somehow through our grossly limited means be able to understand the full breadth and depth of all connections and thus always be able to act to the benefit of ourselves and others. The modernist enterprise is thus called into question, neither in terms of some theistic teleology nor in terms of a fundamental postmodernist doubt of reasoned action, but rather in face of the simple realization that the world is infinitely mysterious because it is infinitely complex. Even "known" phenomena provide inexhaustible sources of further study because of the endless levels at which they can be examined.

7.2 Disease and Health in a Complex World

Moving to the question of health and disease from a complexity perspective we are confronted with a problem of definition. Life can be viewed as a complex process which ends in death. But what is disease and what is health?

Complexity theory offers us the possibility of thinking in terms of a "state space," that is in terms of a range of conditions in which a complex process can find itself. One possibility is to consider life to be moving in a space in which both health and disease states can occur. Health and disease are thus mutually exclusive, but they are not opposites. They are conditions which life can take on; they represent the range of possibilities for life's expression. Health and disease are, according to this image, not something that *happens to* a life process, but *they are the life process* in any given historical moment when certain variables come together to produce a particular state. One can therefore not identify a disease or a health state without looking at the life process as a whole. Exactly which diseases are possible for whom is a matter of the values of the variables determining the limits of the state space, which includes biological, social and other aspects. Each person cannot have all values at all times, so for example, the state spaces for men's lives and women's lives must by necessity have areas which do not overlap.

We thus have a framework in which both health and disease have a place. However, complexity theory goes further to propose that state spaces themselves can change, thus life evolves, at both the individual and collective levels. This means that life itself has an open-ended quality and therefore all potential health and disease states, as well. The "frame" or state space of life shifts, giving the life process a unique quality for each moment in time. Any description of disease and health is therefore always contingent on a particular historical context.

To illustrate the above, we can take the case of tuberculosis. As presented in Chapter 4, we have known for some time that living conditions, which are in turn affected by level of relative wealth, is an important factor in the development of a TB epidemic. With an improved standard of living, morbidity due to the bacillus declines in a population. Over time we have seen TB resurge in industrial countries, however, most commonly among the very poor (such as homeless people). Today resurgence has occurred as well among people with HIV/AIDS as related to immune suppression. This has provided a new opportunity for the bacillus to spread and evolve into treat-

ment resistant forms. Thus, at this historical moment, the presence of HIV adds a new variable to be considered in the state space of the life of an individual and of a population, creating new scenarios or "states" in which a TB epidemic can occur. Today, improving housing conditions and other measures to improve the living situation of affected populations is no longer sufficient for prevention. Other interventions need to be undertaken related to the dynamic of the spread and natural history of HIV itself.

As a consequence of the dynamic and therefore historical nature of disease and health, epidemiology and public health need to concentrate on describing and managing the evolutionary process inherent in disease and health phenomena. The lead question becomes: Why is this disease or health state exhibiting itself in this particular way at this specific historical moment? This prompts us to think of both biological and social levels of causation and to look at how these have changed over time. Such an approach stands in sharp contrast to a more conventional, mono-causal, linear point of view which may, for example, propose a virus as the primary cause of a disease and promote eradicating the virus by treating all infected persons as the method for stemming an epidemic. A complexity perspective does not exclude identifying and treating biological agents at the individual level. However, the primary concern is for the dynamic of the epidemic as a whole. By asking the larger question "why here and now and in this form," broader changes can be initiated at the population level which can potentially prevent future outbreaks of the disease in question or similar diseases.

7.3 Finding the Right Image

Which picture best represents the metaphor proposed by complexity theory? Up to this point we have most often referred to "levels" or "layers" of causality to describe what is meant; however, this image is two-dimensional and static. We made reference to Chinese boxes and Russian matroyshka dolls to suggest how these levels are positioned in a nested hierarchy, thus adding three dimensions to our description, but still ignoring time. We have argued up to this point that disease and health states are composed of multiple factors which, in all their possible combinations, represent the total number of states in which a complex process can exist. This necessitates the

conceptualization of more than three dimensions and we still have the matter of time to consider.

Taking into account the above, a more useful image may be that of the spiral. The simple spiral (Figure 21) suggests motion inwards or outwards (depending on the direction of the spin) for an undetermined amount of time. Visually, it is as if the arm of the spiral is perpetually going into or coming out of the core, which itself always has an undefined quality, often appearing as a hole or abyss. Let us imagine a spiral with more than one arm, each feeding into the whirling motion. Each arm can stand for a particular dimension (cf. Figure 7). This more complex spiral is composed of several strands (or layers) which are woven together within the momentum of the spinning to produce a particular state. Figure 22 represents a rendering of several strands coming together at an infinite center point. Figure 23 shows how the spinning dynamic can bring all strands together to make a whole, as if by centripetal force. Interestingly, the more elaborate spiral images are based on computer software programmed to generate fractal algorithms, a by-product of chaos theory.

7.4 The Complexity Metaphor and "Real" Life

In "real" life—that is in the everyday research and practice of public health—metaphors are central to understanding what is happening. These metaphors are often unconscious and largely linear in nature. Although any seasoned practitioner can attest to how complicated health problems actually are, the connection between intervention design and implementation on the one hand and complex understandings of causality on the other is often tenuous, as best. Throwing in the towel in the face of myriad causal factors is not uncommon, resulting in a narrow focus on a very specific area of prevention or research. The opposite reaction is to embrace more distal causes (such as political or social realities) and to champion these without establishing a clear connection between social change and any specific health outcome.

An important barrier to embracing a complex metaphor for public health is the perceived impracticality of developing and applying more comprehensive explanations of disease and health phenomena. This perception is based, however, on the premise that a more complex explanation means that we need to understand fully all causal factors and to design interventions to address each one of them simultaneously. The assumptions of the dominant paradigm concerning prediction and control are thus

maintained and extended to an impossibly large dimension. This is, however, a false understanding of complexity.

The beauty of looking at the whole, as opposed to looking at the sum of its parts, is that we can focus on the larger dynamic and find ways to make a difference in the course of an epidemic. If the dynamic is understood in broad terms, not all variables have to be manipulated in order to produce change, only some of those variables and perhaps not to a dramatic degree. Complexity theory focuses our efforts on identifying the range of questions and processes to be considered and on the most efficient ways to act in terms of the dynamic as a whole. The shift to complexity is thus a shift to a broader focus in our research and practice, even when we are attending to specific details (cf. Krieger 1994; Byrne 1998).

A further barrier to making the shift to complex thinking is the premise that, by focusing on specific variables and interventions we can, at least, gain information about what works, however modest the impact may be. The assumption is that over time we will accumulate knowledge about multiple specific variables and interventions and thus be able to have more of an impact. From a complex perspective, such partial knowledge is not only insufficient in itself but can even be deceptive when acquired in a context in which we lose sight of the bigger picture. For example, a successful clinical trial of a prevention intervention for altering certain behavior can lead the researcher to believe that s/he has a found solution to thwarting the spread of disease. Complexity theory does not preclude a focus on certain smaller aspects of a phenomenon. However, a complexity-based practice sets as its foremost priority the task of understanding and responding to the larger epidemic, however incomplete the knowledge base may be. For each research question or intervention the question must be asked: How will this particular activity change the dynamic of the epidemic for the better? In this way, complexity theory steers our limited resources toward being invested strategically, based on a broader understanding of the issue at hand. Goliath was not slain by an army of giants, but by a boy using a slingshot who aimed exactly at the right spot. Complexity theory informs us as to what spot that might be.

7.5 Who Decides Which Metaphor?

In his book *The Tangled Bank*, Stanley Edgar Hyman (1974) examines the work of Darwin, Marx, Frazer and Freud as imaginative writers. Using techniques

from literary criticism, he shows the structure and power of the metaphors found in the work of these men. Hyman concludes (pp. 446-447)[27]:

> *Ultimately, the language of ideas is metaphor, and essentially metaphor. The arguments are not* ***clothed*** *in metaphor, they* ***are*** *metaphor [. . .] But perhaps all science is metaphor.*

Hyman goes on to show how each of the four writers was a product of his own personal history and the influences of his age. And how each was driven by core images which over time became the organizing principle for scientific research. But, as Hyman makes clear, the acceptance and popularization of these images was dependent on social and political realities beyond the influence of each individual man, realities which could not ultimately be predicted and controlled, even if they could be perceived.

Is complexity theory a new metaphor for public health? Only time will tell. After all, history itself is a complex process and no one can foresee which metaphor will win people's hearts and minds, leading to a true paradigm shift, and thus providing spiritual sustenance for the next generation of researchers and practitioners in their struggle to improve the human condition.

[27] Emphasis from the orginal text.