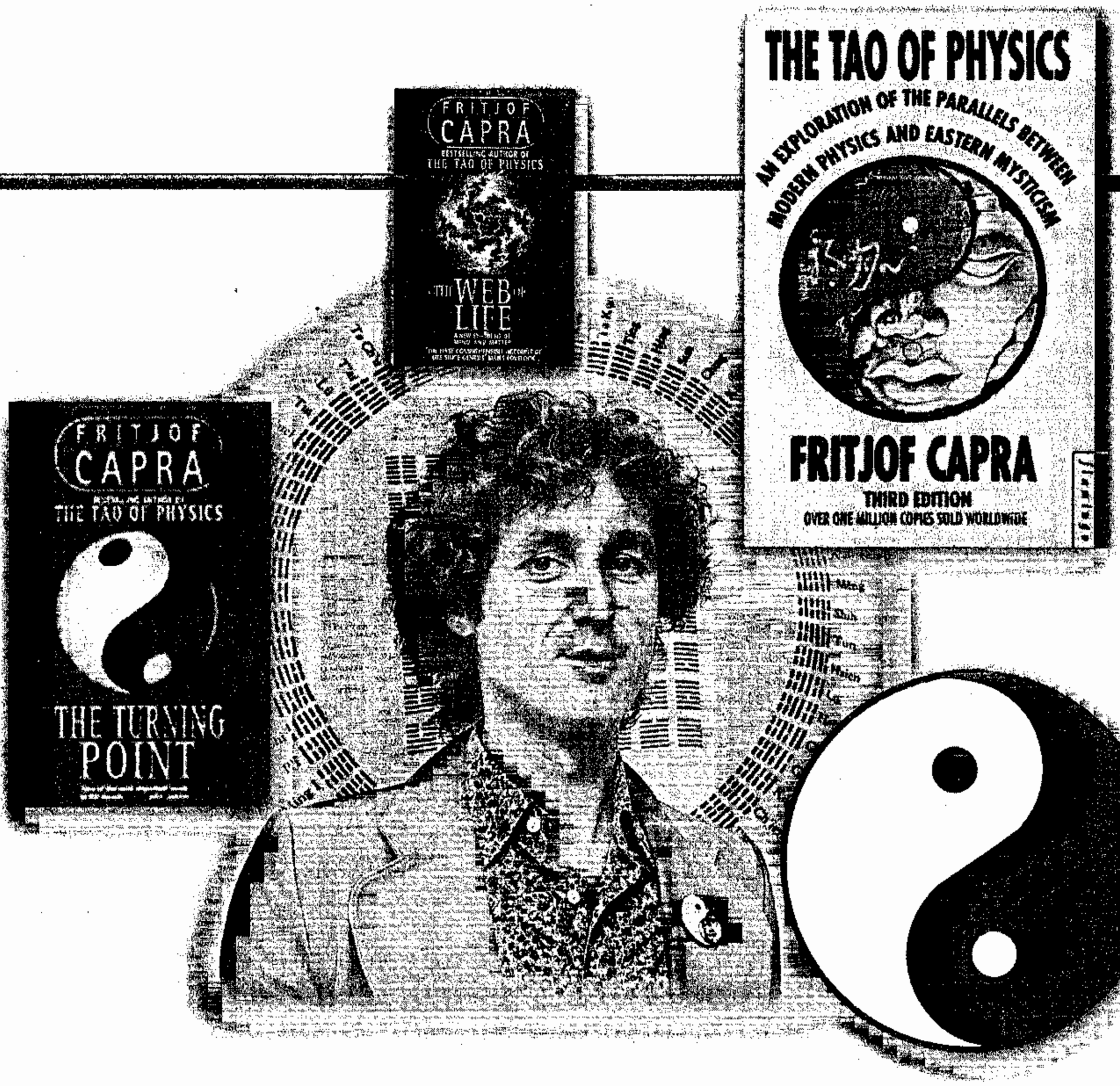
How Do You Solve a Problem Like a (Fritjof) Capra?

Fritjof Capra's popular books purport to expound modern thinking in science by promoting "system thinking." Really, they are naïve and misleading, ignoring the success of detailed "mechanistic" explanations, especially in biology.

BURTON S. GUTTMAN

How do you solve a problem like a Capra?
How do you catch a cloud and pin it down?
How do you find a word that means a Capra?
A flibbertigibbet!
A will-o'-the-wisp!
A clown!
Many a thing you know you'd like to tell him,
Many a thing he ought to understand,
But how do you make him stay
And listen to what you say?
How do you keep a wave upon the sand?
Oh, how do you solve a problem like a Capra?
How do you hold Dr. Moonbeam in your hand?

With apologies to Oscar Hammerstein II



To add to our burden of pseudosciences such as astrology and homeopathy, we now have to contend with a brand of popular writing about science and the philosophy of science that I dub "Gee-whiz New Science." To explain it, I want to focus on its principal practitioner, one Fritjof Capra. Capra first came to public attention through his book *The Tao of Physics* (Capra 1975) in which he claimed that the theories and philosophy of modern physics, especially quantum mechanics, lend support to Eastern mysticism and religions such as Buddhism. For these ideas, he began to acquire a kind of cult following in the Age of Aquarius. The best response I know of to Capra was written by the physicist Jeremy Bernstein, which appeared originally in the Winter 1978–79 issue of *American Scholar* and was reprinted in his collection *Science Observed* (Bernstein 1982). Knowing how science operates, how its advances are so prone to error and constant revision, Bernstein commented, "In short, if I were an Eastern mystic the last thing in the world that I would want would be a reconciliation with modern science." He identified the heart of what is wrong with Capra's book as "Capra's methodology—his use of what seem to me to be accidental similarities of language as if these were somehow evidence of deeply rooted connections." It is this methodology, and the pseudoscientific preaching that comes out of it, that I examine here.

An illustration of Capra's inability to discern the meanings of words beyond their surface appearances comes from page 41 of his book *The Turning Point* (Capra 1982), where he begins, "It is now becoming apparent that overemphasis on the scientific method and on rational, analytic thinking has led to attitudes that are profoundly anti-ecological." "Rational thinking," he tells us, "is linear, whereas ecological awareness arises from an intuition of nonlinear systems. . . . Ecosystems sustain themselves in a dynamic balance based on cycles and fluctuations,

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which are nonlinear processes." Now, any good philosophy student can see what's wrong with this passage. In the first instance, Capra uses *linear* to mean discursive and analytical; in the second instance, he uses the word in its simple, mathematical sense, $f(x)=kx$. But never mind; to Capra it's all "linear," and being "linear" is bad. Regarding complex ecological systems, which entail some cyclical processes such as the carbon cycle and nitrogen cycle, Capra uses the same kind of language trick to say that one cannot think about cyclical systems by using linear thinking! That worries me. All through school, my teachers admonished me to learn to "think straight," and they particularly warned me about circular reasoning. Is Capra saying that they were all wrong and that the new way of thinking in science is to avoid straight thinking and to reason in circles?

The overall thrust of Capra's later books is to conduct a crusade, with himself riding bravely at its head, brandishing the sword of his version of a New Science. He would have us believe that he can frame a general viewpoint in biology—one can hardly call it a theory—that encompasses everything . . . .

The overall thrust of Capra's later books, including *The Turning Point* and *The Web of Life* (1996), is to conduct a crusade, with himself riding bravely at its head, brandishing the sword of his version of a New Science. One purpose of the crusade is, frankly, admirable: to lead humanity away from its currently devastating anti-ecological practices and toward a sustainable way of living. I will return later to this point and ask whether Capra's goal is worth the price we have to pay in terms of scientific rationality, because the crusade entails much more. Capra's intention, particularly in his latest book, is to show us that the standard contemporary ways of thinking about and doing biology are very, very old-fashioned and misguided. He would have us believe that he can frame a general viewpoint in biology—one can hardly call it a theory—that encompasses everything, from the most fundamental biological processes through the operation of the nervous system (and subsequently the mind-body relationship) and of ecological systems.

This is one of the most disturbing aspects of Capra's writing—the basic chutzpah of his undertaking. Some physicists have written about a "theory of everything" that will unify and make sense of all basic physical phenomena, but none are so bold—or foolish!—as to think that such a theory will also encompass all the phenomena of biology from cellular organization through ecology and even clarify the whole mind-body issue. And yet Capra boldly plunges ahead and tries to convince us that his worldview can do just this. It is a chutzpah that no serious working scientist would dare exhibit. But Capra tries to do it by explaining that X has a theory about this phenomenon and Y has a theory about that phenomenon, and X's and Y's theories have a vague similarity, so out of this vagueness, we can imagine that the two theories together can form a powerful theory of everything under the sun. I am reminded of the old logician's joke, "Each of these arguments by itself is invalid, but taken collectively they constitute an impressive body of evidence."

Much of Capra's writing is now focused on biology. He contends that mainstream biology is limited by being reductionistic and that a truly successful biology must use "systems theories." Capra's worldview may be characterized as being opposed to reductionism and entranced by systems; unfortunately, it isn't clear that he understands what reductionism means, but whatever it means, he's agin it. Unfortunately, also, his understanding of systems is naïve and wrongheaded.

Reduction, or *reductionism,* has been used in several senses in science. For instance, Schaffner (1977) distinguished between ontological and methodological reduction. *Ontological reduction* in biology would mean that every biological entity is "nothing but" a chemical, physical entity, so a gene is ontologically nothing but a particular part of a nucleic acid molecule. Unless we are to admit magical, insubstantial substances into science, this must certainly be true. Organisms are chemical entities. In contrast, *methodological reduction* would mean that the methods of physics and chemistry alone are adequate for a complete investigation of biological structures and phenomena; and this is certainly not true, for while those methods are extremely important in modern biology, other peculiarly biological methods have proven essential in research, especially a general methodology called genetic analysis, which I will explain below.

Another classical species of reduction is *theoretical reduction,* which would mean that the entire theoretical structure of some science could be reduced to a more basic science by systematically replacing all the terms and concepts of one with terms and concepts of the other. If theoretical reduction were generally possible, it might mean that a complete physics could encompass and thoroughly explain all of chemistry and all of biology and perhaps even go beyond biology. The only successful reduction of this kind I am aware of is the reduction of thermodynamics to statistical mechanics; all the basic concepts of thermodynamics apparently can be derived by an appropriate statistical analysis of the behavior of molecules. But there has been no comparable wholesale reduction of another science, such as chemistry, to physics. And certainly, biology entails complex concepts that are not reducible to chemistry, let alone physics. Although a gene—to continue the earlier example—is ontologically a specific sequence of nucleotides in a nucleic-acid molecule, this is not true conceptually and theoretically, because this chemical description must be supplemented by concepts of information content and how the information stored in the sequence is utilized, of structures with special regulatory functions, and the interaction of the nucleic acid with specific proteins.

Capra's view of reduction is actually more simple-minded and muddled. While good analytic philosophers tease apart the meanings of words, Capra likes to mush together words and ideas that seem to him to be related, sometimes using them as if they were synonymous without realizing what violence he is doing to the complicated ideas behind each word. Thus, for him, an emphasis on the individual parts of the system is *reductionistic* or *mechanistic*, even though these words have quite different meanings; in contrast, an emphasis on the structure of the whole system is "holistic, organismic, systemic, or ecological." (Naturally, the former is bad, the latter, good.) He likes to contrast two ways of thinking about complex issues by listing contrasting qualities and ideas, such as this list of yin and yang qualities from *The Turning Point*:

Yin	**Yang**
Feminine	Masculine
Contractive	Expansive
Conservative	Demanding
Responsive	Aggressive
Cooperative	Competitive
Intuitive	Rational
Synthesizing	Analytic

Similarly, in *The Web of Life*, he compares the "self-assertive" and the "integrative":

Self-assertive	**Integrative**
Rational	Intuitive
Analysis	Synthesis
Reductionistic	Holistic
Linear	Non-linear

In this great *bouillabaisse* of ideas, any rational analysis of the various senses of *reduction* would be completely lost. The whole idea of rational thinking is obviously foreign here. We are on a crusade, after all, a crusade for Right Thinking in science and society. The crusade will obviously elevate the yin over the yang, the integrative over the self-assertive. This simplistic way of contrasting complicated ideas against one another allows Capra to set up straw men to be knocked down, and it contributes generally to an overall naïveté that characterizes all of his writing, for each of these words cries out for unpacking and examination.

But it is a very seductive method. It easily draws in the sincere reader who lacks the necessary understanding of both science and philosophy, particularly because Capra cloaks his naïveté in complicated theories and models developed by serious scientists. This creates much of the "Gee Whiz" atmosphere. In *The Web of Life*, for instance, Capra devotes considerable space to the thermodynamic theorizing of Ilya Prigogine, to Manfred Eigen's theory of hypercycles as organizing principles in early evolution, and to other models related to the development of complex structures. This creates a façade of serious science over Capra's writing. The lay reader may not really understand all this, but he may easily come away convinced that the book is a weighty exposition of science to be taken seriously, because Capra cites a lot of apparently unrelated ideas that have a rough similarity to one another. And it is rather sad that Capra has to support his ideas with such complicated, even arcane, science, because he fails to grasp the simple explanation that organisms function as they do because of their intrinsic genetic nature (Guttman 1999).

I was fortunate to have learned basic philosophy of science from Herbert Feigl, one of the younger members of the Vienna Circle, the logical positivists or logical empiricists who formulated modern philosophy of science early in the twentieth century. Feigl often repeated his maxim that what we require is not a philosophy of the "Something More" nor of the "Nothing But," but one that simply asks, "What's what?" One of Capra's main problems is his conviction that a description and analysis of the parts and interactions of complex systems can never be adequate and that we must always be looking for "something more," a nebulous "something more" that will somehow explain it as a "whole system." Capra is eloquent in his praise of some scientists and philosophers who have developed "systems" viewpoints, and he tries to convince his readers that such viewpoints fairly extend from quantum mechanics to Gestalt psychology to ecology, and so on.

He begins his excursion into biology by telling his readers an absolute lie (Capra 1996, 29): "The great shock of twentieth-century science has been that systems cannot be understood by analysis. The properties of the parts are not intrinsic properties but can be understood only within the context of the larger whole." This is such a shameful distortion of the truth—certainly with regard to biology—that I will have to explain carefully why I am so outraged by it.

The outrage begins with Capra extolling two philosophies that died—or should have died—long ago: vitalism and organicism. He writes, "Vitalism and organicism are both opposed to the reduction of biology to physics and chemistry. Both schools maintain that although the laws of physics and chemistry are applicable to organisms, they are insufficient to fully understand the phenomenon of life. The behavior of a living organism as an integrated whole cannot be understood from the study of its parts alone. As the systems theorists would put it several decades later, the whole is more than the sum of its parts" (Capra 1996, 25). Now I am sick to death of the repeated admonition that "the whole is more than the sum of its parts," as if this were some deep philosophical insight. *Of course* the whole of a complicated structure is more than the mere sum of its parts, but the "more" is simply a detailed description of the *interactions* among the parts. These interactions are what make it a system. The engine and drivetrain of my car make up a system too, whose many parts interact in such complex ways that I have to consult experts like NPR's Car Guys to fully fathom its mysteries. But imagine the absurdity of taking your car to a mechanic and hearing him say, "The operation of your engine is so exceedingly complex that it is fundamentally mysterious. If it isn't operating well, there must be something basically wrong with the engine as a system, so I can't diagnose it by examining its individual parts and figure out what to fix."

Capra, however, persists in making a mystery out of "systems" by imagining that they have some kind of magically distinct properties that cannot be discovered and understood by even a close examination of the parts and their interactions. By doing so, he can claim superiority—indeed, *moral* superiority—for "systems theory" and "systems thinking." As support for this idea, he drags in historical figures who have shown a similar entrancement with systems, such as Ludwig von Bertalanffy, a charlatan of an earlier age, who charmed many with his "general systems theory." Part of Capra's problem is that he knows a little history of philosophy and his thinking about biology is tied to the thoughts of eighteenth-century philosophers such as Kant. Capra roots much of his thinking about biological systems in Kant and praises him for discerning the difference between an organism and a machine and for first using the term "self-organization." With such adulation of thinking that is now 200 years out of date, it is no wonder that Capra finds it difficult to comprehend what has actually been happening in biology in our time.

It is disturbing—indeed, frightening—to find someone at the end of the twentieth century praising the philosophies of vitalism and organicism, particularly vitalism. Capra doesn't seem to understand that vitalism is inherently a rejection of science, a statement that the properties of organisms can be explained only by magical qualities that science cannot discover. (And he tries to support his sympathies with vitalism by citing the vague and highly questionable ideas of Peter Sheldrake—another instance of citing any ideas that seem to support his own, no matter how useless they might be.) Organicism, on the other hand, was a kind of vague protest that "mechanistic" biology could not fulfill its promise, so "something more" was needed. This viewpoint was most fashionable during the mid-twentieth century, up to about the 1950s, before modern molecular, cellular, and genetic biology had shown how the promise was to be fulfilled. In 1940, the zoologist Libbie Hyman expressed organicist dismay by writing, "The conception of the organism as a physicochemical machine encounters the insuperable difficulties of explaining a machine which runs itself, repairs itself, alters itself to meet the exigencies of surrounding conditions, and reproduces itself; and what is still worse, attains its final form by developing from a simple beginning through an orderly sequence of forms and evolves through time into a succession of machines of ever increasing complexity of construction."

Yet the nature of the organicist protest was never clear. Beckner (1968) wrote that "The characteristic doctrines of organismic biology involve methodological proposals for investigating the behavior of systems whose structural complexity precludes, at least at the present time, explanation in physicochemical terms." Yet just what those methodological proposals might entail was never clear, and Beckner went on to say, "Organismic biologists tend to be vaguest at just those points which are most crucial for an understanding of their point of view." Similarly, Ernst Nagel (1961) wrote, "Although organismic biologists deny the suitability if not always the possibility of 'mechanistic theories' for vital processes, it is frequently not clear what it is they are protesting against."

Organicists protested that physical and chemical research methods are inadequate for the study of living systems, because they require the dissection of organisms into their parts and—Capra's repeated theme—this destroys the essential wholeness of the living system. They looked forward to the discovery of some intrinsically biological methods for investigating organisms as wholes; thus they enthusiastically embraced ethology, the study of animal behavior. It happens that such a methodology did develop later, after the most ardent organicists were all dead; the method, genetic analysis, arose quietly through the work of pioneering molecular biologists using microbiological systems, primarily bacteria and the bacteriophages (bacterial viruses or simply *phages*) that grow on them. Without going into excessive detail, the method depends on finding mutants—individuals carrying mutations in their genomes that give them interesting new properties, often specific malfunctions. These mutants can then be used in several ways. Through specifically genetic methods, the mutations can be used to locate and define the genes in which they occur; a gene is initially defined operationally as the locus of mutations that affect the same function. Each gene encodes a distinctive protein, and the mutants can be used to identify these proteins. Furthermore, by means of various clever experiments, the mutants can then be used to explore the function of those proteins and their interactions in the complex systems that carry out each process.

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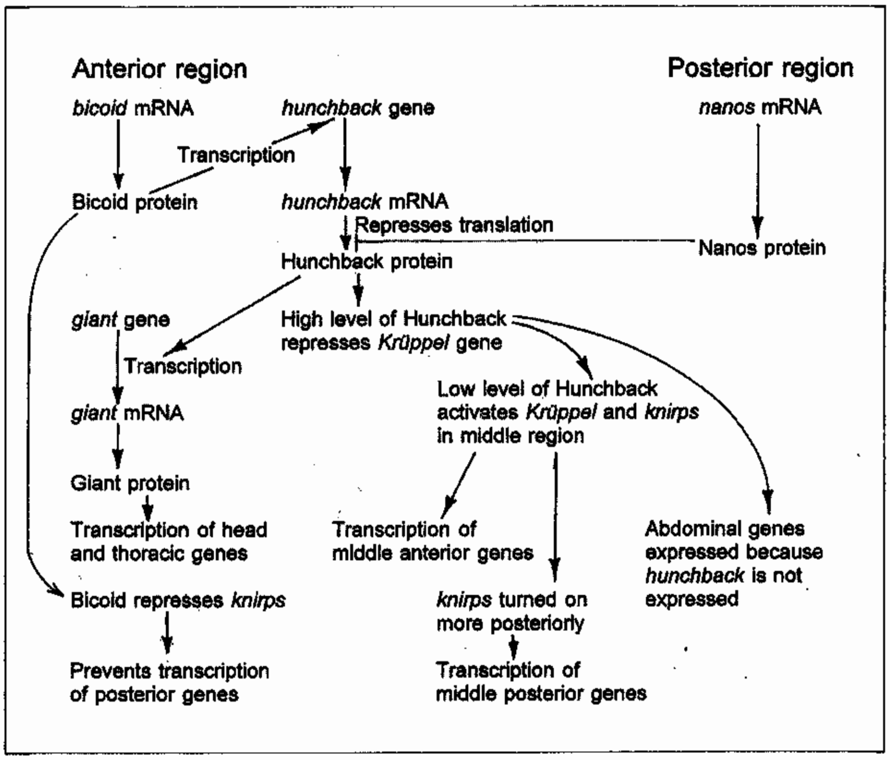
The great bugaboo of biology for organicists was embryological development. Even by 1940 or so, successful "mechanistic" explanations were emerging in physiology, such as the fact that as the pumping of the heart muscles pushes the blood onward, hormones traverse the bloodstream to carry their messages. But embryological development seemed beyond the pale. In the early twentieth century, embryologists might struggle valiantly with limited knowledge and limited tools, discern some features of the complicated process of development, and then reach the ends of their careers seeing that most of the process was still hidden in fog. Many of them then seem to have said to themselves, "If I, working hard on this problem for an entire lifetime, have not been able to penetrate its mysteries, then embryological development must entail unsolvable mysteries, and organisms must intrinsically be systems that ordinary scientific methodology cannot explain." Capra picks up this theme and writes (Capra 1996, 25) that identical genetic information resides in all cells in a developing embryo, so there is mystery in the fact that many distinct types of cells then develop. "This basic problem of development, which appears in many variations throughout biology, clearly flies in the face of the mechanistic view of life."

That sentence could only have been written in 1996 by a biological ignoramus. The simple fact is that many developmental biologists have been determining exactly how sequences of different genes are turned on and off in different parts of an embryo to finally produce that extraordinary array of distinct types of cells. No one has any business writing a book about the failure of "reductionistic" or "mechanistic" biology if he has not tried to understand how a fruit-fly embryo's anterior-posterior axis is determined by gradients of Bicoid and Nanos proteins, which translate into a cascade of activating specific gap and pair-rule genes, how Hedgehog and Decapentaplegic proteins interact to stimulate the differentiation of photoreceptor cells in the fruit fly's eye, or how Hox genes determine the placement and character of specific organs throughout much of the animal kingdom. The reader who hasn't studied developmental genetics isn't expected to understand that sentence, but Capra should. I'm sure, however, that he has no idea what I'm talking about, and no interest in learning. (The funny names of those proteins derive from the names initially given to the funny-looking mutants that were used to identify them.)

Obviously, studying the isolated parts of any system provides only limited understanding of the whole; the key to understanding an organism in "mechanistic" terms is understanding how the parts interact with one another. Because organisms are chemical structures, these parts engage in chemical interactions. Much of the story of biology entails one molecule binding to another, pushing on it subtly, changing its shape, and thus changing its operation. Because Capra is ignorant of the details of real biological systems, he doesn't realize how well descriptions of such interactions truly explain "what's what." He writes (Capra 1982, 114), "Obviously the study of the cooperation and integrative activity of genes is of first importance, but here too the Cartesian framework has made it difficult to deal with these questions. When scientists reduce an integral whole to fundamental building blocks—whether they are cells, genes, or elementary particles—and try to explain all phenomena in terms of these elements, they lose the ability to understand the coordinating activities of the whole system." But this is just more nonsense. Comprehensive volumes such as Alberts et al. (1994) or Watson et al. (1987) contain hundreds of perfectly satisfactory explanations of how complicated biological systems work through the interactions among specific elements. Since biology is still an active science, many of these stories are incomplete. But research programs that elucidate the structures and interactions of parts consistently elucidate the operation of the whole, and investigators are never inclined to scratch their heads and admit



In spite of Capra's claim that biological systems can only be understood holistically, i.e., as whole systems, modern biologists actually understand them in large part as operating through interactions among many distinct elements. This schematic depicts a few interactions among genes responsible for the early embryonic development of a fruit fly, *Drosophila*. The genes have unusual names—such as *nanos, bicoid,* and *knirps*—because of the appearance of the mutants used to identify them. Gene names are italicized. Transcription is the process of producing specific messenger RNA molecules (mRNA) that carry copies of each gene to the factories that synthesize the corresponding proteins. (From *Genetics: A Beginner's Guide*, B. Guttman et al. Guttman, Griffiths, Suzuki, and Cullis, ©2002. Reproduced by permission of Oneworld Publications.)

defeat by announcing, "We have examined every facet of the system with the tools and concepts available to us, and a complete and satisfying explanation still eludes us; there must be some indescribable factors regarding the system as a whole that will explain how it works."

The irony of Capra's books is that while he persistently claims to represent the cutting edge of science, his major problem is being *archaic*. Bernstein explained in 1978 that the physical theories Capra is most enthusiastic about, "S-matrix theory" and "bootstrap," had a certain vogue a decade earlier. Yet in 1996, Capra is still extolling the virtues of these ideas. And so in biology: he continues to extol the archaic ideas of organicism and even of vitalism.

The ultimate point of all this stuff is supposed to be to change the thinking of humanity about ecology and persuade us all to live in ecologically sound ways. Capra praises the "deep ecology" of Arne Naess, contrasting it with old-fashioned "shallow ecology," which he says is anthropocentric, or human centered. (And meanwhile, he wanders through such highly suspect notions as the Gaia hypothesis, which would have us believe that the entire planet is a living organism, whatever that means.) I wonder if Capra has ever really read a serious book about ecology, because all the fat, detailed ecology books on my shelf describe and analyze research projects that say nothing about humans. They are careful, analytical studies of a host of plants, animals, and microbes, revealing how they live, how their populations change, what they eat or what eats them, how they interact chemically, and how they live together in communities and ecosystems. All this work forms the basis for a serious conservation biology, and when combined with detailed studies of pollution and changes being wrought across the planet because of human actions, it forms the basis for sound arguments that if humanity continues to treat the world as we have been treating it, we are in for various kinds of disaster. And all this emerges without once having to immerse ourselves in some kind of mysterious thinking about "systems."

I return to my original question: What does one do about someone like Fritjof Capra? To give him his due, he is on the side of the angels with his message that humanity must change its ways of living and adopt ecologically sound ones to avoid destroying the biosphere. It is a good message, one that many writers are trying to pound into the thick skulls of complacent citizens and timorous politicians. Capra seems to be a kind of hero to many who have already gotten this message and are looking for alternative lifestyles for themselves and for our society; he appears to be a scientist saying all the right things about ecology from a scientifically sound basis—and not only ecology, but psychology and sociology and all the rest. He is seductive in seeming to provide scientific grounds for all that environmental and human-rights activists hope to achieve.

So I might even refrain from all my criticism of Capra's ways and cheer him on. We need a transformation in society, to avoid the overpopulation and ecological crises we are creating. "Go, Fritjof, go," I might cheer. But at what cost? What shall it profit a man if he shall save the whole world in one respect but lead it into a chaos of muddled thinking? Is it worth it, to humanity as a whole, for someone like Capra to convince people to live in ecologically sound ways by promoting scientific nonsense? Let me try one answer to that question by asking what societal forces are resisting the needed transformation in human ecology. Those forces clearly are economic. Our society depends upon a flow of resources into manufactured goods, which are purchased and consumed, and this system is maintained by enormous conservative economic forces. Any attempt to alter that economy precipitately could bring the whole structure down upon our heads disastrously, though writers such as Paul Hawken (1993a) and David Roodman (1998) have explained how free-market methods can be used to create an ecologically sound economy.

Now, are these conservative forces likely to be influenced by the writings of a Fritjof Capra? Not bloody likely! I think it will be clear to "tough-minded" international businessmen that Capra's writings are just so much fluff and nonsense. Then, what might make them change their minds about their policies and actions? My suggestion: serious, hardheaded, well-done science. To take just one example, even though our current government denigrates "theories" such as that of global warming, some large corporations are taking notice and are starting to see that it is in their economic interest to take science seriously and get on the bandwagon of reducing the production of greenhouse gases. They have been convinced by carefully performed research and by the critical collection of data by equally tough-minded research scientists.

We may not win the battle for the conservation of the earth's environment for a long time, perhaps not until the human population has risen so high that the predictable disasters start to occur—mass starvation, water depletion and wars over water rights, or unbearable pollution of the air and water. But we will not win the battle any more easily through the efforts, no matter how sincere and well-intentioned, of another pseudoscientist.

References

Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson. 1994. *Molecular Biology of the Cell* (3rd ed.) New York: Garland Publishing.

Beckner, M. 1968. *The Biological Way of Thought*. Berkeley, California: University of California Press.

Bernstein, J. 1982. *Science Observed: Essays Out of My Mind*. New York, Basic Books.

Capra, F. 1975. *The Tao of Physics*. Boulder, Colorado: Shambhala Publications.

Capra, F. 1982. *The Turning Point: Science, Society, and the Rising Culture*. New York, Bantam Books.

Capra, F. 1996. *The Web of Life: A New Scientific Understanding of Living Systems*. New York, Anchor/Random House.

Guttman, B. S. 1999. *Biology*. Dubuque, Iowa: McGraw-Hill.

Hawken, P. 1993. *The Ecology of Commerce*. New York: HarperBusiness.

Hyman, L. 1940. *The Invertebrates: Protozoa through Ctenophora*. New York: McGraw-Hill.

Nagel, E. 1961. *The Structure of Science*. New York: Harcourt, Brace, and World.

Roodman, D.M. 1998. *The Natural Wealth of Nations*. New York: W. W. Norton.

Schaffner, K.F. 1977. Reduction, reductionism, values, and progress in the biomedical sciences. In *Logic, Laws, and Life* (R.G. Colodny, ed.). Pittsburgh, Pennsylvania: University of Pittsburgh Press.

Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz, and A.M. Weiner. 1987. *Molecular Biology of the Gene* (4th ed.) Menlo Park, California: Benjamin/Cummings. □