AN INTRODUCTION TO COMPLEXITY

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> It seems that the idea of the simple is already to be found contained in that of the complex and in the idea of analysis, and in such a way that we come to this idea quite apart from any examples of simple objects, or of propositions which mention them, and we realize the existence of the simple object—*a priori*—as a logical necessity. So it looks as if the existence of the simple objects were related to that of the complex ones as the sense of ~p is to the sense of p: the *simple* object is *prejudged* in the complex.
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> —LUDWIG WITTGENSTEIN, *Notebooks 1914–1916*

The present volume aims to introduce a wide readership to the thought of Henri Atlan, who is best known as a biophysicist and whose impressive philosophical, ethical, and political contributions have yet to receive the full attention of Anglo-American audiences.[1] Atlan has published at length and in detail on matters as seemingly distinct as complexity and the theory of self-organization, artificial intelligence, parables from the Hebrew Bible, the faults of the "genetic program" theory in genetics, cloning and the possibility

1. Atlan's thought has been discussed and debated in scientific circles, and it has also been evoked by a number of critics and humanists (notably in matters of literature and science and network culture), including Mark C. Taylor (2001), William R. Paulson (1988), Michel Serres (2007), N. Katherine Hayles (1991), and others. Historian of cognitive science Jean-Pierre Dupuy has contributed an excellent overview ("Henri Atlan, 1931–") to the *Columbia History of Twentieth-Century French Thought*, (Kritzman 2007: 393–96). Nevertheless, largely due to the absence in translation of his books (except for *Enlightenment to Enlightenment*), discussion among humanists of Atlan's writing has usually been restricted to vague praises of their implications and scope.

of an artificial uterus, Spinoza, scientific mysticism, biotechnology, the figure of the Golem, and the idea of freedom. His contributions to biology and biological thought are marked throughout by a philosophical and humanistic sophistication that allows the "practice of science" and the "philosophy of science" to become joined in conversation while retaining their distinct characters; conversely, his work in self-organization, genetics, and systems theory links up with his work in philosophy and religious studies—deeply motivating his understanding of Spinoza's theory of freedom, for example, while refusing to offer a strict hierarchy or in any way reduce the scientific to the philosophical, or vice versa.

In other words, an introduction to the work of Henri Atlan is much like an introduction to complexity itself. It can offer potential directions for reading but cannot summarize Atlan's thought. This introduction, like the book as a whole, attempts to show how the different elements of this complexity allow for a picture that is irreducible to the sum of its parts, yet nevertheless reveal a trajectory in Atlan's work, one that cannot be reduced to a few keywords but rather links its interweaved elements. We start out here from a number of points, none of which can be granted strict priority: Atlan's approach to the theory of self-organization; his reading of Spinoza as at once mirroring self-organization's theory of nature and offering an understanding of the way determinism in nature organizes and allows for our sense of freedom and ethics; his writing on Judaism, on the ethics of an artificial alteration if not fabrication of the living, and on questions of ethics and freedom; his historicization and critique of biological concepts and practices.

Life and Thought

Henri Atlan was born into a Jewish family in Blida, a town in what was then French Algeria, in 1931. He studied biophysics and medicine in Paris and eventually in the United States. Among the figures who defined his studies and early research were Heinz von Foerster and Aharon Katchalsky, whom he met at Berkeley and cites as a decisive influence.[2] His first book, *L'organisation biologique et la théorie de l'information* (*Biological Organization and Information Theory*) appeared in 1972 and attempted to link the question of

2. For an autobiographical essay, see Atlan 2008.

organization in biology with the theoretical potential of computer programming. In 1979, Atlan published *Entre le Cristal et la Fumée: Essai sur l'organisation du vivant* (*Between Crystal and Smoke: An Essay on the Organization of the Living*), which elaborated his understanding of self-organization, while aiming for (and finding) a far wider audience.[3] In the 1980s, thanks in part to a careful study of Spinoza, Atlan moved to develop the philosophical consequences of his studies. In 1986, he published *À tort et à raison: Intercritique de la science et du mythe* (published in English as *Enlightenment to Enlightenment: Intercritique of Science and Myth*), in which he argues against scientists' tendencies to extrapolate metaphysical and philosophical principles from specialized kinds of research. Starting in 1983, Atlan served on the newly founded French Comité Consultatif National d'Éthique pour les Sciences de la Vie et de la Santé (National Advisory Committee on Ethics in Sciences of Life and Health)—a committee charged with drafting reports for the president of the French Republic on matters of new technologies and practices, their ethical import, feasibility, and desirability, the most famous of its concerns being cloning.

His balancing of scientific and philosophical research further led to *Tout, non, peut-être: Education et vérité* (*All, No, Perhaps: Education and Truth*, 1991), and, above all, his magnum opus, written from 1999 to 2003, the two-volume *Les etincelles de hasard* (*The Sparks of Randomness*). Several of the major strains in his thinking have appeared in short book form. Already in *Between Crystal and Smoke*, Atlan is critical of facile reductions of biology to the simple idea of a genetic program, an argument he elaborated on in *La fin du "tout génétique"?* (*The End of "Everthing Is Genetic"?*, 1999; translated in full as Chapters 9 and 24, below); similarly, *La science est-elle inhumaine? Essai sur la libre nécessité* (*Is Science Inhuman? An Essay on Free Necessity*, 2002; translated as Chapter 1, below) again addresses the status of science in modern human inquiry, while *L'utérus artificiel* (*The Artificial Uterus*, 2005) recalls the historical, philosophical, and cultural questions concerning the artificial creation of new beings, notably new human beings. Two books of interviews, *Questions de vie, entre le savoir et l'opinion* (*Questions of Life: Between Knowledge and Opinion*, 1994) and *Chemins qui mènent ailleurs* (*Paths That Lead Elsewhere*, 2005) also contributed to his influence by facilitating a broader understanding of his

3. As Douglas Morrey notes in his book on Godard's films, Godard repeatedly cites and quotes from *Entre le cristal et la fumée* (Atlan 1979) in his films *Sauve qui peut* (1980) and *JLG/JLG: Autoportrait de décembre* (1995). See Morrey 2005: 156–58.

positions. What distinguishes *The Sparks of Randomness* is its tremendous scope: in its pages Atlan moves freely from his studies on self-organization to work on Jewish thought, from Spinoza to the ethical import of scientific thought. Today, Atlan divides his time between France and Israel, where he is (respectively) a Director of Research at the École des Hautes Études en Sciences Sociales in Paris, and Professor Emeritus of Biophysics at the Universities of Paris VI and Jerusalem and Director of the Human Biology Research Center of the Hadassah University Hospital in Jerusalem.

Self-Organization, Emergence, Chance, and Randomness

In his classic and paradigm-defining study of the conceptual and experimental history of biology, *La logique du vivant* (1970; translated as *The Logic of Life*, 1993), François Jacob presents *life* and *memory* as the two major concerns of biology after the discovery of DNA. The barrier between life and the nonliving and the emergence and operation of an apparatus of storing experience were problems that defined the science of biology, problems that had to be addressed as much in everyday as in experimental terms. Although these problems were not new, Jacob explains how they came to be addressed together through the examination of DNA, whose discovery had drastically altered the landscape and utility of biology, establishing molecular biology, biophysics, and other subdisciplines as essential to the understanding (at once scientific and philosophical) of living and knowing.

Atlan began to develop his theory of self-organization shortly thereafter, during the turn into the 1970s, using the notion of *self-organization* to address the problems of *life* and *knowledge* (the latter of which, as we shall see, is for him grounded in memory). *Self-organizing processes* are processes in which a dynamic relation between different elements allows them to self-organize, without any sort of external aid or cause, raising them as a system to a level of higher complexity. At the level of the complex system emerge new properties that are not the result of any force transcendent to the system; at the same time, information contained within the system is rendered meaningful thanks to codes that pertain to the system itself rather than the different elements. "These models [of the self-organization of matter] show us how global properties of a complex system made of many simple elements are qualitatively different from the properties of these elements themselves" (Atlan 2003: 9). Self-organization and complexity theories exploded in the

1970s and 1980s, with various strands of research (by no means restricted to biology) involving such diverse and influential scientists as Stuart Kauffman, Ilya Prigogine, John Holland, Edward Lorenz, and Atlan himself. For some thinkers, like Jacques Monod, who had played a role in the earlier stages of the revolution of molecular biology, the theorization of self-organization and complexity in the 1970s came to offer a solution to major problems raised by the transcription of protein sequences from DNA; for others, like John von Neumann, it came to serve as the major question of the twentieth century.

Central to Atlan's approach was the utility of information theory, which complemented the birth of molecular biology, particularly in an effort to understand the role of noise and the transmission and correction of errors in a message. In his first book, *Biological Organization and Information Theory*, as well as his crucial essay "Noise as a Principle of Self-Organization" (Chapter 3, below), Atlan took up Heinz von Foerster's critique of Erwin Schrödinger's thinking that order derives necessarily from order. Demonstrating that this was neither necessary for nor capable of generating any sort of nonpreformed organization, Atlan raised the central question of how noise, randomly introduced by an organism's environment or thanks to errors in a system or a message (e.g., chance mutations in genes), affects the complexity of this system, adding variation, threatening the reliability of the "original" message, but at the same time making possible new information and new interpretations (see Atlan 1972, chaps. 3–4). For the principle of noise, Atlan relied on Claude Shannon's theory of probability, showing (contra Shannon, see Chapter 3) that in a channel of communication noise does not merely increase the ambiguity of an original message, distorting it, but also allows this message, thanks to the distortion, to augment in complexity. Noise's production of "errors" affects a system's (or organism's) relation to its environment by affecting its response:

> it depends on the subsequent reaction of the system in relation to which, a posteriori, these factors are recognized as either random or as part of the organizing process. A priori, they are in effect random, if one defines randomness as the intersection of two independent chains of causality: the causes of their occurrence have nothing to do with the chain of phenomena that has constituted the prior history of the system until then. It is thus that their occurrence and their encounter with the system can constitute noise from the viewpoint of the exchanges of information in the system, where these encounters are susceptible to producing only errors. But from the moment the system is capable of responding to these "errors,," not just so that it does not disappear, but rather so that the system uses

> them to modify itself in a way that benefits it or that at least ensures its subsequent survival—in other words, from the moment the system is capable of integrating these errors into its own organization—then these errors lose, a posteriori, a little of their character as error. (Chapter 3)

The systems at stake may be dynamic computer programs as much as evolving organisms, neural networks, the physics of disordered and complex systems, ecosystems, or immune networks (Atlan and Cohen 1989). The bridging of information theory and biology, a form of reductionism to which we will return, allows for the elaboration of self-organizing systems across a series of different realms of inquiry (though Atlan refuses any identity between such realms, as a problematic kind of reductionism; Atlan 1994a: 72). In any case, at the broadest level, if order can emerge from noise thanks to a dynamic it develops, then we can begin to approach how matter, in self-organizing, can make possible forms that would seem otherwise irreducible to it—forms such as life and thought.

> Neural networks, and more generally automata networks, exhibit self-organizing properties of different types. In particular, large, random Boolean networks can be studied as models of functional self-organization in which both structure and function emerge without an explicit program. A network microstructure, together with its initial conditions, is set up randomly. Then, under some conditions of connectivity, network dynamics almost always lead to a robust attractor with a macroscopic spatiotemporal structure characterized by a division into subnets, some of which are stable, while others oscillate with a relatively short, nontrivial limit cycle. Furthermore, it can be shown that the network, after having reached its attractor, behaves like *a machine to recognize patterns on the basis of self-generated criteria*. After the network has been stabilized, it reacts to incoming temporal binary sequences by changing its state differently according to the temporal pattern of the sequence, thus defining a class of patterns that are "recognized." Therefore, what emerges from the dynamics of the network is not only a macroscopic structure but also some functions in the form of classification procedures capable of differentiating between classes of input sequences. This work shows that networks are able to organize themselves so that they *behave in a meaningful fashion*—at least to our eyes as human observers—*without having been programmed to do so.* This kind of functional self-organization can serve as a generic model to understand how the emergence of function and meaning can take place in nature without having to resort to planning that would involve some sort of conscious intentional design. This is what I have called . . . self-organization in a *strong* sense. Self-organization in a *weak* sense differs in that the origin of meaning, as a goal to

> be achieved, is set up from outside by a designer, as for learning machines. A third kind of self-organization, in an even stronger sense, can be called "intentional" if the emerging behavior not only appears to be a meaningful function to the observer's eyes but also is known to be so by the system itself, capable of self-observation.(Atlan 1994a: 71–72)

In other words, at stake in these self-organizing processes is not only an emergence of complex forms out of seemingly meaningless matter that does not postulate either a necessary *creatio ex nihilo*, a *creatio continua*, or even an external impulse and movement to aid matter in its organization; at stake is (perhaps above all) the creation of *meaning* and *intentionality*. In his later work, finding Shannon's probabilistic information theory insufficient to address the problem of meaning, Atlan would turn toward the approach and language of Boolean networks. For him, central to the development of an adequate theory of self-organization was the question of how complex systems offer evidence not merely of complexification but of the development of certain sorts of internal discernment and agency. Meaning would emerge thanks to nature itself: not because of any animal or human agency, but because the emergence of complex systems out of simple elements would of itself necessitate the systems' "choices" between, say, useful and useless changes occurring within them (not only in the case of *intentional* self-organization, but also in that of *strong* self-organization, where the system would not be consciously choosing but would do so nonetheless).

Atlan emphasizes these questions of meaning and intentionality. In his essay "The Self-Creation of Meaning," he writes:

> The creation of meaning in natural systems is one of the most difficult problems both in linguistics and in biology. It is at the root of the known difficulties in simulating natural languages, where apparently an unlimited number of new meanings can be created and understood, although no syntactic structures are sufficient to program their appearance in a predictable way. In biology, meaning is not experienced from within, as in our process of understanding human natural languages. However, biological information has a meaning that is manifest in physiological functions: for example, the meaning of genetic information is to be looked for (and sometimes found) in phenotypic features, both morphological and functional. (Atlan 1987a: 563)

Indeed, throughout much of his career Atlan has sought to offer models for this self-creation of meaning as well as approaches to the problem of intentionality. (His arguments about natural language and frequent discussions of

Wittgenstein also seek to address this problem, though from a specifically philosophical perspective). Because "the appreciation of meaning and intentionality takes place at the interface between a self-organizing system and its environment," Atlan's emphasis on the presence of self-organizing behavior both in evolution and in cognition aims precisely to understand the conditions of possibility for subjectivity and meaning. The problem of intentionality—Atlan divides self-organizing systems between weak (i.e., receiving external support), strong, and intentional (i.e., not just strong and thus unsupported from the outside but capable of intentionality)—quickly comes to concern networks capable of self-observation (Chapter 7).

Central to self-observation are the chances of *memory* and the subject's perception and subsumption of them. Atlan notes that "memory devices keeping record of previous histories of such interactions are essential ingredients for models of what appears to us as both conscious and unconscious intentional behavior" (Chapter 2). In other words, memory is a, if not *the*, fundamental determinant of consciousness and intentionality:

> Conscious will and intentionality should be analyzed as secondary to the interaction between two different primary processes: consciousness as memory of the past on the one hand, and unconscious self-organizing processes on the other. Basically, consciousness would be mere recording, storage, and retrieving of past events, whereas innovation and adaptation to newness with the creation of new structures and functions would be produced by unconscious self-organizing processes. On top of these two basic primary processes, and secondary to their interactions, conscious will and creative intentionality would be interpretations of memorized products of previous self-organization, in such a way that previous unplanned consequences of actions are transformed into possible causes for the repetition of similar—though not necessarily identical—sequences of actions. (Atlan 2000: 135–36)

To the extent that the problem of consciousness and the biological function of un- or nonconscious self-organizing processes that occur in the body with growth and learning (i.e., with adaptation to, and efforts toward the mastery of, the external milieu), memory comes to serve as the biological grounding of consciousness. This is not a static ground, however: self-organization guarantees that consciousness retains a dynamic character that relates this ground to the world it needs to adapt to and aims to control—in other words, its *intentionality*. Memory becomes the ground of a being's sense of its world and its ties to the world.

Concepts of Modern Biology and Their Philosophical Implications

Atlan's writings are filled with references to the history of physics, chemistry, and the life sciences, and it would not be an exaggeration to claim that, in his thought, self-organization has its own conceptual history, a history with direct implications for the philosophical claims made for it. Atlan's critical treatment of DNA, complexity, and biotechnology is firmly grounded in a theoretical understanding of their conceptual and cultural history and is pertinent in part thanks to the remarkable extent to which that history is tied to the historical rise of the major concepts and problems of biology. His critique of the genetic paradigm—the *tout génétique*, or "all is genetic"—attempts both to interpret biology's development in the last fifty years and to rethink more traditional and long-term problems of *mechanism* (since Descartes), *finalism* (particularly in Kant), and *vitalism*, as well as their historical and contemporary stakes. His discussion of the artificial womb and cloning similarly speaks not only to contemporary biotechnological possibilities but also to the conceptual and cultural traditions surrounding (and, for better or for worse, frequently framing) these possibilities. The very term *self-organization* reaches back to questions of the organization of the living (back to Cuvier, if not to Aristotle), of evolution and mutation, not to mention the question of *who* does the organizing. Similarly, Atlan's thoughts about the traditions of empiricism and determinism motivate a thinking of the links between the theory of science and its history, as well as his approach to reductionism and the "underdetermination of theories by facts." In these we begin to glimpse a theory not only of modernity but also of humans' relations to their own being and world, amid the efforts of human scientific inquiry.

Atlan's understanding of modern science is organized around the notion that two scientific revolutions determine modernity: the first, in the seventeenth century, concerns physics, and the second, which has dominated the last half-century or so, concerns biology (Atlan 2003: 18). Concerning the former, Atlan highlights the relationship between physics and biology: either the objects of the latter were reducible to those of the former or they were so patently superior in their complexity as to suggest a rigid and absolute divide between the two sciences. This led to the rise of two competing attitudes concerning living organisms: *mechanism*, which postulated that organisms were merely complex machines whose exact laws would eventually be discovered by physics and mechanics, and *vitalism*, which postulated a vital

principle or impetus thanks to which living beings differed from matter. In Atlan's genealogy, what granted vitalism force was its alliance with *finalism* (Chapter 7), the belief that nature has particular purposes and goals, that organs function to serve particular goals, and that organisms not only exhibit this existence of purposes and goals but carry in themselves internal purposes. All of these attitudes pose problems. Atlan objects to classical mechanism's crudeness, and he rejects both vitalism (roundly discredited by biology since the discovery of DNA) and finalism, finding in them some of the major dangers and misunderstandings of modern biological thought.[4] He premises his approach to self-organizing systems both on the lack of goals within nature and on the lack of external forces guaranteeing the direction or reliability of evolution and organismic functions:

> Most of the researchers who were Kant's contemporaries held that biology obeyed vitalist presuppositions, principles, or theories. Living beings could ontologically, or at least epistemologically, be distinguished from nonliving beings. Thus Kant could think living organisms through the internal purposiveness that they display and contrast them with others determined by causal mechanisms alone. This a priori purposiveness has practically disappeared from the discourse of contemporary biology. Vitalism is finished, and so is what so solidly grounded the difference between living beings and others. Every day, molecular biology shows us that organisms, far from obeying an internal purpose, are regulated by physicochemical mechanisms. Today, biology and the neurosciences reveal a continuity between the nonliving and the living, between the world without consciousness and the world of human consciousness. We have definitively left behind a period that could be described as "prebiological," when the existence of the soul cut the world in two, distinguishing animate beings from inanimate beings and man from every other living being. Now, the soul exists only for philosophers and poets. All previous visions, from Plato to Descartes, of the soul governing the body like a charioteer his chariot have collapsed. (Chapter 1)

By contrast, the second scientific revolution of the twentieth century—or rather, the two revolutions, in molecular biology in the 1960s and postgenomics, synthetic biology, and biocomplexity in the 1990s—sets up a decidedly *biological* period and forces a conceptual and philosophical reorientation on the grounds that biology can be reconciled with mechanics in a particular way. In "Noise as a Principle of Self-Organization," Atlan endorses the cybernetic revolution, as well as W. R. Ashby's claim that computers have

4. See also the account of mechanism in Atlan 1999b: 126–33.

allowed us to understand medium-complexity machines that approximate between organisms and basic machines (Chapter 3). Elsewhere, Atlan expresses his stance more precisely: what matters is not an adoption of modern mechanism tout court, but to recognize that the living, natural machine transforms itself in a fashion that is not available to artificial machines (Chapter 3). That is to say, Atlan objects to the strict and overly reductive mechanism that would identify the genetic code (DNA) with a *program* that is merely played out in the organism. By contrast, the alternative he favors is premised on self-organization, which allows for internal dynamism. He sees the mechanistic approach as out of date and tainted by scientific faults, both of which have gradually undermined its status as (according to Atlan) the central dogma of biology since the 1960s. Moreover, for him, it suffers from a conceptual muddle because it depends on a dated notion of the computer program and thereby reconstructs a kind of preformationism (the eighteenth-century theory that saw an organism as being wholly contained in the genetic material from which it emerged; Chapter 24) and is also bound to a neo-finalism of "mechanistic purposefulness" (Chapter 5). By contrast, Atlan works from the perspective of a new sort of epigenetics, which articulates DNA as a mixture of program and data,[5] which deploys itself both on its own and in response to environment.

Importantly, at stake here is not only the conceptual development of modern biology but also the kind of mechanism and relation to information theory that it will develop. In his largely epistemological argument, Atlan fashions a history of biology that is divided between the central dogma of genetics (based on the hypothesis "one gene—one enzyme—one function or characteristic" and a univectoral flow of determination from the first to the last) and a more complex model, one that sees the organism as influenced by its environment and is unwilling to equate code with program.[6] In his early work, Atlan already utilized self-organization to object to theories that treat the genome as a preestablished program:

> where the evolution of species is concerned, no mechanism is conceivable outside of those suggested by theories in which random events (chance mutations) are responsible for evolution toward greater complexity and greater richness of organization. Where the development and maturation of individuals is concerned, it is

5. See Chapter 5 and, for the rising public awareness of epigenetics and recent engagements with it, see Stephen S. Hall, "Beyond the Book of Life," in *Newsweek* (July 13, 2009).

6. Atlan already considers the problem of genetic coding in 1972: 74–79.

> strongly possible that these mechanisms also play a non-negligible role, especially if one includes the phenomena of nondirected adaptive learning, where the individual adapts to a radically new situation for which is it difficult to call upon a preestablished program. In any case, applying the notion of a preestablished program to organisms is a debatable move, insofar as this concerns programs of "internal origin," created by the organisms themselves and modified in the course of their development. To the extent that the genome is produced from the outside (by its parents), one often compares it to a computer program, but this comparison seems to us to be totally abusive. If a cybernetic metaphor can be used to describe the role of the genome, that of data stored in memory [*memoire*] seems to us more adequate than that of program, since the latter implies mechanisms of regulation that are not present in the genome itself. Otherwise, one cannot avoid the paradox of a program that needs the products of its own execution in order to be read and executed in the first place. By contrast, theories of self-organization permit us to understand the logical nature of systems in which what fills the role of program modifies itself unceasingly, in ways that are not preestablished, as a result of "random" factors in the environment, which produce "errors" in the system. (Chapter 3)

The model of DNA as program is mechanistic in a traditional sense—it reduces the living organism to a prefabricated machine whose essence is contained in the gene (hence the accusation of preformationism Atlan levels at it). It is not, however, mechanistic in a sense that would allow for an immanent dynamism, or more specifically, it precludes any real self-organization.[7] In more recent work, Atlan has similarly emphasized how techniques in cloning, advances in epigenetics, and the utilization of embryonic stem cells have demonstrated the insufficiency of the "genetic paradigm." Phenomena of epigenetic heredity—including the three-dimensional structures of proteins (Chapter 5), how cell nuclei function in a growing embryo, and how adult cell genomes can be used for cloning (as in the case of Dolly the sheep; Chapter 22), and techniques of reverse transcription and RNA splicing in human virology (Chapter 5)—demonstrate that the genetic paradigm is insufficient to account for the uniqueness of individual organisms, and thus to theorize the overall role of DNA. For Atlan, an emphasis on epigenetics—or rather, a rejection of the self-sufficiency of genetic code—is not vitalism ("life" exists neither in DNA nor outside of it; Chapters 1 and 24). Because mechanism and determinism act in relation to one another, epigenetics discredits the "program"-based mechanism Atlan sees as dominant and

7. In this regard, see Atlan's reference to Richard Lewontin in Chapter 24.

lays the ground for a research program at once biological, epistemological, and ontological.

Atlan's outline of a conceptual history of biology, hinging on the birth of molecular biology, the discovery of DNA, and the association with information theory, allows him to address a number of further problems. One concerns scientific reductionism, and another concerns what Atlan calls the *underdetermination of theories by facts*. The question of reductionism has been crucial to the philosophy of science since the rise of positivism in the nineteenth century. Traditionally, reductionism has been used to account for analogies drawn from one domain of inquiry and applied to another that amount to a transcription of the former onto the latter—analogies that explain psychology by reducing it to biology, for example, or—as in the early mechanist example—that reduce biology to physics. For Atlan, the stakes involved in reductionism are substantial. They concern the metaphysical premises of scientific experimentation, the disunity of scientific knowledge, and the status of reason (or, rather, of reasons; see Chapter 9 and, more generally, Atlan 1986, chap. 2). Atlan opposes the classical kind of reductionism, which imposes a materialist metaphysics that reduces biology and chemistry to physics, and celebrates the failure of new "strong" reductionisms (see the appendix to Chapter 9). Following the advent of double-helix biology, this problem has been transformed, largely because the new kind of reduction of biology to physics involves a profound transformation of physics by biology, particularly a transformation in the meanings of the terms (*program*, *code*, etc.) used by biology.[8] Atlan's work on self-organization, by contrast, concerns the emergence of systems more complex than the elements on which they are based without allowing a classical reduction of these systems to those elements. However, his understanding of emergence is mechanistic and in some sense even more reductionist than classical reductionism, since it is based on mechanisms of self-organization and not on properties of life, as was done by vitalist emergentism in the nineteenth century.

He proposes a distinction between weak and strong reductionism: weak reductionism is "indispensable to scientific practice," whereas strong is "the result of the belief in this axiom" (Atlan 1993: 44). That is to say, reduction is inescapable, indeed, a necessary tool in the movement between different scientific languages and methods (e.g., cybernetics and biology in Atlan's own

8. Jean-Pierre Dupuy, in Kritzman 2007: 394.

work). Denying all reductionism would amount to negating "the unity of an organism," he writes (ibid. 38); however, the practice of systematizing reductionism quickly amounts to a "metascientific philosophy" that envisions a rigid materialism and denies whatever it cannot reduce (in other words, that denies the very possibility of complexity; ibid. 43). Though one must not systematize reductionism, weak reductionism is of considerable importance:

> this pragmatic reductionism circumscribes science's domain of legitimacy; it indicates the limits of the scientific process, which can progress only by *forcing itself* to be reductionist, only by "playing the reductionist game," whereas "believing in it" would be evidence of great naiveté—the naïveté of believing in the objective truth, in some fashion or other, of the "fact" of the reducibility of the real to some unique (ultimate) reality, whether material or not, on the basis of scientific theories. (Chapter 9)

In other words, weak reductionism guards against the overreach of a scientific rationality convinced of its self-sufficiency and autonomy. Despite, or rather because, it paradoxically demands that science play a game without believing in it, it allows for the possibility of research that is not premised on restrictive and overly defined reductionist theoretical postulates. Most importantly (and to this problem we will return), it guards against a mystification of scientific reasoning.

"Underdetermination of theories by facts" concerns the relation experimental findings or observations and the theoretical models that aim to explain them. Atlan's question here is epistemological: What do we do when we have findings that can be explained by very different models? On what basis is it possible to judge between such alternatives—and to what degree is it possible to be satisfied with a theory that cannot determine or predict, strictly and with far higher success than do its alternatives? Atlan here addresses much of twentieth-century philosophy of science. Versions of the problem of underdetermination have been present in analytic philosophy since Willard V. O. Quine's work in the 1950s, including his use of Pierre Duhem's 1906 *The Aim and Structure of Physical Theory* (Duhem 1914),[9] and in France since Duhem and especially in the wake of the epistemological thinking of Gaston Bachelard, Alexandre Koyré, and Georges Canguilhem, who influenced thinkers as different as Thomas Kuhn, François Jacob, and Michel Foucault. Bachelard's studies of a "scientific unconscious" that influences interpretations of experimental results, Canguilhem's discussion of the

9. See Quine 1960, and Duhem 1914.

relations between concept and life, and Koyré's efforts to show the dependence of early modern experimental results on metaphysical premises broadened the problem beyond Duhem's critique of positivism by asking where theories acquire their explanatory value and how the facts they establish or the observations they make interplay with nonscientific presuppositions to give theories their particular character and aim.[10] Atlan approaches the problem from a somewhat different perspective, noting that, in discussions of automata and neural networks, the complexity of the interpretive models required to explain observations can lead to their vastly outnumbering the basic elements being studied, and that a certain indetermination or apparent redundancy is inescapable. Thus Atlan argues that in such networks only a limited application of Ockham's razor is reasonable or useful, that "*an underdetermination of theories by facts does not necessarily imply a useless redundancy in the theory itself*" (Chapter 6). Put affirmatively: "The more complex and singular a phenomenon is, the more underdetermined any theory giving some account of this phenomenon will be" (Chapter 25). Such an affirmation comes to concern not only the capacity to engender adequate models but the very complexity of complexity, the possibility and meaning of norms, the limits of theoretical activity, and the production of scientific objects. Underdetermination further points toward an image of the status and goals of philosophy:

> Thus, contrary to the ideal of the neo-positivist philosophies that tried to imitate the logical-mathematical shape of physics, the role of philosophy is to speak of what cannot be formalized, to use a natural language with its metaphors, analogies, and all the vagueness that comes with them, yet without giving up rationality. This means not giving up on distinguishing good analogies from bad ones, enriching metaphors from misleading ones, the vagueness [*le vague en moins*] that conceals what should be said from the vagueness [*du vague en plus*] that stands for the potential of creation. For the sake of this new ideal of philosophy, one must envision how this philosophy based on natural language—nonformalized, but rational and rigorous nonetheless—distinguishes itself from scientific language, and does so without confounding itself with either mythology or ideology.(Chapter 25)

This joining of philosophy, biological research, and the history of science from the angle offered by self-organization further suggests that concepts cannot be understood in static or essentialist terms. Because one cannot

10. Atlan discusses Canguilhem in 1999b: 41–42.

appeal to science in general (or to particular scientific discoveries more specifically) in order to offer a single unifying interpretation or model of facts or observations, because definitions need to be flexible enough to operate across fields, and because self-organization undermines a sense that what is given is produced as such, it is in general impossible to offer concepts based on self-identity. Writing of the embryo, for example, in relation to advances in potential therapeutic applications of uses of stem cells, Atlan says:

> We are forced to consider new discoveries in biology that modify traditionally accepted definitions of life and human nature, along with the representations associated with them. Essentialist definitions must be abandoned and replaced by evolving definitions: what is not alive, for example, molecules, can be alive at some degree of organization; what was not human life has become human life in the process of evolution; what is not conscious can become conscious in the process of development, etc. (Atlan 2007: 3)

This is thus one way in which issues of reductionism and underdetermination direct Atlan toward one of the crucial openings in his scientific writing: not just to questions of the humanities but also to matters of mythology, religion, ethics, and Judaism. Understanding the reductionism that Atlan endorses allow us to grasp how central tenets of his thinking (e.g., determinism) are carefully joined to a forceful refusal of scientistic tendencies toward all-encompassing and thus mystical theories, yet also to a willingness to identify affinities and analogies between his own postulates and philosophical and religious approaches to similar problems. As he argues in "Mysticism and Rationality" (Chapter 16) and, more generally, in *Enlightenment to Enlightenment*, claims to reason and scientific rationality have often been linked to concepts of reason that do not much differ from mythology—both because of myth's inherent rationalities but also because of reason's own tendency to determine a whole world. At stake is the possibility of balancing different rationalities, with the goal of usefully linking—through differences rather than through analogies—recent neurobiological languages with philosophical and religious ones. Chief among these, in Atlan's work since 1980, is the thought of Baruch de Spinoza.

Spinoza

In "Is Science Inhuman?" (Chapter 1), Atlan presents his turn to Spinoza in terms of a discovery that finally made possible a reconciliation between the

determinism he saw as ineluctable in scientific inquiry and the moral, political, and metaphysical concepts of freedom and agency that one experiences every day:

> My scientific experience led me to defend in theory the position of absolute determinism. The sheer fact of searching for causes implied positing determinism as a postulate. But at the very same time as I upheld this position, I fought to obtain concrete things, made certain decisions, chose one strategy over another. . . . A determinist position changed nothing in my everyday life, in the relationships I formed, including within my laboratory. In sum, I lived fully the contradiction between theory and experience. It was in this uncomfortable position that I discovered the philosophies of absolute determinism: first the Stoics, then Spinoza. It thus became possible to reconcile these two experiences . . . (Chapter 1)

Out of all the philosophers with whom Atlan engages, Spinoza has certainly exercised the greatest influence on his thought—indeed, Spinoza's *Ethics* offers a conceptual system that addresses not only the paradox of freedom within determination but, just as importantly, the status of nature and the mind.[11] In him can be found the philosophical terms of Atlan's refusal of finalism and also of his support for a new and different kind of "mechanism," opposed to the paradigm of the genetic program and open to continual and disordered self-transformation.

Atlan works with Spinoza in two main areas of his writing. The first involves his ideas of complexity and emergence in self-organization, which parallel Spinoza's rendition of nature as at once *natura naturans* ("naturing nature") and *natura naturata* ("natured nature"). The main question here for Atlan is the capacity of nature to operate without either external impetus or internal purpose: "From a philosophical point of view, [the mechanistic experience of emergence] is more akin to the Spinozist notion of *causa sui*, cause of itself, used to describe the power of Nature under its two aspects of *Natura naturans* and *Natura naturata*, producing in itself an infinite multiplicity of forms and beings" (Atlan 2003: 19). The dual character of Spinoza's Nature mirrors self-organization's postulation of nature as at once ordered and dynamic; his monism erases the need for an impetus or force that would be external to matter and would organize it from without. Atlan is concerned to identify self-organization with a specific sort of mechanism: Spinoza, he

11. Atlan is careful not to grant either Spinoza's thought or his own scientific interests priority over one another. While he seeks support in each for interpretations involving the other, he does not suggest that either has explicative force for the other.

writes, cannot be understood as a vitalist, because there is no external motivation for nature's actions, and he eludes the finalist problem by allowing for a dynamism and, more importantly an *internal causality* in nature that is unbound by the ordered states we usually experience. *Natura naturans* can thus be understood as nature in the process of self-organization; *natura naturata*, "natured nature," reflects these ordered states. The mechanist experience of emergence thus allows the subject to perceive nature as in some way ordered, even while preventing this very subject from claiming any sort of control or complete understanding of nature, or from pretending that the order experienced is in any sense static or given:

> [Spinoza's] cause of itself, *causa sui*, which pertains to substance, is distributed in the modes through their essences or *conatus*, although the modes are produced by one another, come into existence, and are destroyed in their infinite chain of efficient causes. Given such a notion of immanent causality, evolution can be seen as the unfolding of a dynamic system or a process of complexification and self-organization of matter, produced as a necessary outcome of the laws of physics and chemistry. In this process, new species come into existence one after the other as effects of mutations with stabilizing conditions working as their efficient causes, whereas their particular organizations are instances of the whole process. This view of evolution is compatible with the idea of a dynamic evolutionary landscape with peaks of local stability. (Chapter 11)

The *conatus* here implies a "presence of self-transforming infinite power in every finite thing"—the possibility and presence of self-organization across different organisms and at different levels of organization in nature.

The second subsumption of Spinoza occurs when Atlan brings together neurophysiology and the mind/body problem, and involves the reliability of our notions of freedom and agency. Atlan refers to Spinoza's understanding of the mind as the *idea* of the body, as nothing external to it, merely a different attribute. Here he finds a central parallel to his writing on self-organization as a process that determines living and knowing, a dynamic immanence capable of accounting for the difference between mind and body without at all separating the two. He frequently quotes the second proposition of part 3 of the *Ethics*: "The body cannot determine the mind to think, nor can the mind determine the body to motion or rest, or to anything else (if there is anything else)" (pt. 3, prop. 2; 2002a: 279), arguing that Spinoza's mind/body monism is essential for an understanding of body and consciousness through and thanks to memory, as well as for the establishment of meaning and intentionality in a

biological system that is self-generated and self-generating without any external spark or force (Chapter 12). At stake here is at once the grounding of consciousness in memory and desire, the establishment of mental and bodily events as identical and expressed in different aspects of human being, and the very possibility of meaning and decision: How can decisions and free will appear if their author is matter? If they do so through self-organization, how can we explain away the presumed independence of thought? What meaning could they, and their freedom, have?

In this argument, Atlan's main targets in his turn to and citation of Spinoza are Kant and, in a less direct sense, Edmund Husserl. He aims three critiques at Kant. First, because he understands thought to be a self-organizing process founded on memory, Atlan criticizes and rejects Kant's dependence on a mind/body dualism that can be read as a relationship in which the mind influences or commands the body's movements: "Today, it is in relation to biological discoveries that Kant's philosophy has been thrown off balance" (Chapter 1). Second, Atlan targets Kant's understanding of nature—especially his finalism, which imbues nature with an internal purposiveness (see Chapters 1 and 16).[12] And third, Kant's understanding of free will is incommensurate with the determinism—the absolute determinism—that emerges from physical biology and information theory.

As for Husserl, Atlan refuses his pure ego and prioritization of consciousness and intentionality over the natural sciences as basic to our horizon of apprehension and our understanding of nature. As a result of his immanent approach, Atlan finds no place for such a separate consciousness or an intention that stands on its own apart from the world of matter and life, and only then engages with it. Atlan writes of phenomenology:

> Husserlian and post-Husserlian phenomenology constitutes a powerful attempt to understand what it is to understand and think, based on analysis of the flows of our consciousness as the origin of all meanings. However, even for Husserl, the ascendancy of vitalism made the idea of physical biology impossible, whereas, this is precisely the type of biology that we practice today. That is why we must consider a symmetrical relationship between *two kinds* of reductionism. On the one hand, the *phenomenological reduction*, Husserl's famous *epochē*, brackets the "naturalistic attitude," that is, puts aside the natural sciences, to be explained and founded later by transcendental phenomenology (Husserl 1947, 1950). On the other hand, the *physico-chemical*, *materialist reduction* brackets consciousness, to be explained later by the natural sciences. (Chapter 2)

12. See Kant 2007, §§5–8 of the introduction.

For Atlan, phenomenology's postulate of a pure ego is neither necessary nor helpful in understanding the operations of consciousness and indeed disregards the very possibility of thought's emergence in evolution. The problem with the transcendental reduction is that it relies on a separation between the biological conditions for consciousness and the operation of consciousness and its perception of the world. This grants consciousness autonomy and gives an inferior epistemological status to biological processes, thus raising the twin specters of a vitalist interpretation of the mind (targeting the body and the physical world) and a subjectivist interpretation and reduction of the reach and meaning of biology.

To these thinkers, Spinoza offers a striking counter, a conception of nature and freedom that surprises us by its modernity and its compatibility with biological research. Atlan's turn to Spinoza echoes the renewed attention paid to him in both analytic and continental thought in recent years. Atlan converses chiefly with the analytic and postanalytic tradition, in whose discussions of language and mind he is particularly well versed; he cites Hilary Putnam, Jerry Fodor, and G. E. N. Anscombe (Chapter 12) and takes on Donald Davidson for his rapprochement between Spinoza and Kant (Chapter 11). But he does so from a somewhat more complex perspective than that offered by analytic philosophy and in some respects engages in bridging between it and concerns in European thought. This is evident less in his occasional alliance with Antonio Damasio than in his echoing of postwar French philosophy's resolute suspicion of Kantianism. Though Atlan is far from allied with the readings and uses of Spinoza by Gilles Deleuze or by Michael Hardt and Antonio Negri, through Spinoza Atlan engages with priorities of late-twentieth-century continental thought.[13] Specifically, Spinoza allows Atlan to argue for a decided antianthropocentrism and antisubjectivism, which would deny human authorship of actions while admitting that an illusion of free will exists in our experience of them (Chapter 1). Here we find the reasons behind his engagement with Foucault (Chapter 28) concerning the transformation of man, as well as questions concerning the status of freedom.

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13. Recent debates on Spinoza have raged along a series of axes. For a few of them, see: on Spinozism and the history of the Enlightenment, Israel 2001, 2009, critiqued by Moyn 2010 and Lilti 2009; for contemporary political appropriations of Spinoza, Hardt and Negri 2000, and also Connolly 2002; for a Spinozist neurology, Damasio 2003. For an excellent account of the importance of Spinoza in twentieth-century French thought, including his paramount influence on the oeuvres of Gilles Deleuze and Louis Althusser, see Peden 2009.

The problem of freedom thus poses the third and crucial question where Spinoza offers Atlan a philosophical hand. Atlan cites Spinoza's definition 7 of part 1 of the *Ethics*: "That thing is said to be free which exists solely from the necessity of its own nature, and is determined to action by itself alone" (2002a: 217). Atlan appeals to determinism as defining human experience, when he writes that:

> We must begin by accepting what we encounter every day in our science of determinisms: that is, that our subjective consciousness of free choice is increasingly refuted by our objective knowledge of causes and of the impersonal laws that determine these choices and show that they are not free as we believe. Instead of first positing our daily and affective experience of free will and then trying to accommodate it to our cognitive experience—that is, to our wider and wider understandings of mechanisms—let us do the opposite. Let us forget our experiences of free will for a moment and start from the postulate that today we know only part of an infinity of determinisms, and let us postulate a totally determined world. In other words, let us stop debating the gaps in determinism and assume that there no longer are any. (Chapter 1)

He appeals to determinism precisely in the sense allowed by Spinoza—one that does not contrast determinism and freedom, indeed that interprets classical free will as an illusion, given that the subject experiencing it ignores the reasons behind it. At stake then, as per Spinoza's definition 7, is the freedom that Atlan calls "not being determined by anything other than one's own law" (Chapter 1), a freedom that thoroughly depends on knowledge of causes or determinisms, a freedom to which one aspires without ever being able to achieve it:

> Our subjective experience of voluntary acts—what Spinoza designates as what *we* call the decree of free will from the viewpoint of the attribute of thinking—is not more illusory than our objective experience of the physiological mechanisms that we discover in these acts. It is a consequence of our ignorance of a part—a very large part—of their determinations. And we have no means *of acting as if* this ignorance did not exist; *we have no means of knowing what our behavior would be like if we had a total knowledge of the determinisms in nature*. (Chapter 25)

Ignorance plays an important part in this theory of freedom. While it demonstrates a profound lack of freedom and allows the persistence of a grand delusion of free will, it also buttresses against the interpolation of grand schemes arising from specific scientific results—a tendency Atlan identifies among scientists as much as among laymen and that he targets as mystical in a pejorative sense:

> Every scientific system rests on the postulate or faith in the ability of reason to disclose an order beneath the complexity and apparent chaos of our experience of the world. From this point of view, symbolic and interpretive thought goes as far as possible down the path of faith in the possibilities of reason: nothing is accepted as being devoid of meaning. Every phenomenon, even the most fortuitous and confused, every myth, even the strangest and most enigmatic, finds an explanation that renders it rational by means of a change of level—the symbolic explanation—in which reason appears not only in what is said overtly but also symbolically, "between quotation marks." (Chapter 16)

It is when reason is charged with seeking to offer complete explanations of the complexity and chaos confronting science (and because mystical systems of thought also convey a strong sense of rationality and are thus by no means simply opposed to reason) that one must emphasize the limits of the human capacity to know and believe. Spinoza offers not only a philosophical way of understanding the possibility and hopes of freedom (setting up a crucial link between freedom and happiness), but a way of guarding against easy pretenses to having achieved it (Atlan 2003: 23).

This understanding of freedom as tied to perfect knowledge yet also bound up with our ignorance of total determination offers three further openings into Atlan's ethical and anthropological thought: his treatment of traditions of Judaism and its continuing importance and pertinence; his understanding of ethics, especially an ethics of life; and his treatment of the motif of the creation of life, in both historical and biotechnological terms.

On Judaism, Mysticism, and Mythology

Atlan's approach to self-organization is not scientistic; he does not seek to ground in biological premises the study of cultural, philosophical, and religious traditions. Nonetheless, he does not hesitate to offer arguments concerning the autonomy and legitimacy of philosophical and ethical inquiry, as well as the independence of different kinds of rationality. The biological antianthropocentrism of self-organization does not make totalizing claims about the forms and possibilities of culture—rather, it allows for their difference and their own forms of order and rationality. This openness is clear in Atlan's frequent engagement with Wittgenstein's thought (particularly about natural language, intentional descriptions, and the role of philosophy). A far more complex case involves Atlan's extensive studies of Judaism and the

rationalities of myth: Judaism allows Atlan a space in which to extend principal concerns of his scientific research into a humanistic arena, a space whose legends and problems can be brought into conversation with those of a particular scientific inquiry he undertakes, while remaining a different realm of human inquiry.

Before tackling Atlan's approach to the Kabbalah, it is useful to recall his understanding of mysticism, which has two central elements. First is his frequent critique, in *Enlightenment to Enlightenment*, of totalizing and mystical trends in scientific thought—notably the trend, born of "strong reductionism," to attempt a complete explanation of life while ignoring metaphysical elements of the concept or mistakenly identifying them with experimental results that favor the reductionist's own position. Second is his attention to Jewish mystical thought and its particular rationality, one that need be neither at odds nor in agreement with modern scientific thought. Mystical traditions "do not stop at the ecstatic experience of the ineffable but call on the intellect and on discursive reason,. They did not wait for the development of Western science and philosophy to make use of the human rational faculties, which were nourished by them and which carried them forward and renewed them over the centuries" (Chapter 16). As he writes in *Enlightenment to Enlightenment*—in passages that could retrospectively be read in conversation with post–World War II thinkers such as Adorno, Foucault, and Cavell—this two-sided relationship between rationality and mysticism is essential to an understanding of either concept. The persistence of similar questions across different mystical traditions—questions concerning reality, finitude, individuality, and so on—as well as the effort made in each of them to divulge an order of the world that can be commensurate with sense (Chapter 16). Among these traditions, Atlan works in particular on Jewish myth, the Kabbalah coming to serve as a realm that can be approached in a naturalist and rational fashion, not as a spiritualist tradition valuable for its extra-rational character.

In his autobiographical essay "From French Algeria to Jerusalem," Atlan writes that his early upbringing was secular and indeed involved little reference to Judaism; it was the 1940 anti-Semitic laws barring Jewish children from school in Vichy France and its possessions that made of him "a perfect illustration of Jean-Paul Sartre's thesis that 'the anti-Semite is the one who produces the Jew' " (Atlan 2008: 340). Following the liberation, Atlan studied

for a year at the École Gilbert Bloch in Orsay (a school founded by Robert Gamzon for the purpose of giving Jewish adolescents a space to consider their identity and heritage, as well as their status as Jews, after the experience of occupation and the Shoah). There he began a life-long engagement with the Hebrew Bible. Atlan writes that it was thanks to his studies at the École Gilbert Bloch that he began to work on the rationality of Jewish mysticism:

> I realized that, if we study these texts not as mere expressions of more or less dogmatic religious beliefs based on articles of faith, then we can find in them a kind of formal rationality associated with their mythical contents. Thus, in the end, these teachings appeared to us, in the light of our twentieth-century critical experience of reason, more rational than most texts of Jewish philosophy and theology, including Maimonidian ones, classically supposed to express the rational path in Judaism, as opposed to so-called Jewish mysticism. . . . Rather than an opposition between rational and irrational trends in Judaism, we are dealing here with an opposition between Jewish Aristotelian theology and other philosophical schools more related to the Stoics and Neoplatonists. (Ibid., 342)

Atlan deploys his reading of Hebrew texts, notably of the speculative ("rationalist") Kabbalah, throughout his work. "Israel in Question," for example, Chapter 18 of the present volume, is an account of Israel following the destruction of the Temple. It dates to his 1979 *Between Crystal and Smoke*, from which we also take Chapter 3, "Noise as a Principle of Self-Organization." This aspect of his work culminates in *The Sparks of Randomness*, an interdisciplinary reading of Jewish myth and law in which he brings these constantly into conversation with biological theory and contemporary biotechnological and ethical debates. At the core of this work is the notion of a seminal reason or "spermatic knowledge," which suggests a rethinking of the relations between life and knowledge. It refers to the Jewish legend that Adam and Eve were separated for 130 years between the birth of Cain and Seth's birth (Genesis 4:25, 5:3). During that time, according to legend, Adam emitted drops of semen, whether thanks to commerce with demons or whether due to his involuntary nightly torment, that became demons or spirits. These drops were called *nitsoutsot keri*, translated literally as "sparks of randomness." Atlan treats this legend

> not as a story with a moral, but as an album of images of various and contrasting aspects of the human condition, associated in particular with the protracted period of childhood and maturation that follows birth and with the long interval between sexual maturity and intellectual and emotional maturity: the Tree of Knowledge is

> assimilated before the Tree of Life (although we can easily imagine how the inverse chronology might have had better consequences). (Chapter 14)

He invokes the "ambivalence" of the "sparks of randomness" legend to discuss the novelty and chance involved in birth and in the creation of a new being, showing that the radical determinism he advocates in biology, in his reading of Spinoza, and, as we shall see, in his reading of the Kabbalah (which he calls "expanded Spinozism"; Atlan 1999b: 335–46) does not simply deny individuality or hopes for autonomy. Seth is born in Adam's likeness, in his image (Genesis 5:3), a status that rabbinical commentaries accord neither to Cain nor to Abel (let alone the demons born of Adam's semen drops; ibid. 50). Atlan extrapolates from this the chance element involved in conception and birth, and expands further into a broader interpretation of the ethical considerations surrounding the episode. In Atlan's retelling, Seth comes to hold a privileged status: while his birth in Adam's likeness does not mean that he recaptures the unity and transparency lost with the fall, he reopens humanity to the possibility of such a recapturing. At the same time, he denotes the expulsion of the serpent's influence—and therefore the potential of a human innocence separated from an external reality dominated by the demons similarly expelled or generated from Adam's drops of semen (Atlan 1999b: 107–8).

This subject/world contrast marks the construction of a flawed subjective interiority distinct from the "animal knowledge of the serpent," a knowledge increasingly separate from life and eventually related to it (and to its possible redemption) only through the five books of the Torah (Atlan 1999b: 54).

Why emphasize this legend, though, and this particular reading? Atlan has two further interrelated problems in mind: first, that of chance or randomness; second, that of the motif of the creation, manufacture, or fabrication of life. Through these he deploys not a classical narrative of damnation and redemption (the narrative that he traces across the traditions he examines) but an anthropological questioning concerning man's sense of his world as hostile to, and constantly overwhelming, his efforts to control it. By the same token, the legend points to man's perseverance in this world and his efforts at control: "What is the status of the randomness of birth, chance, and the ignorance of causes that we call 'destiny' in a world that we are increasingly able to control, where uncertainty itself seems to be programmed by probabilistic estimates of risk?" (Chapter 16).

Atlan is particularly concerned with the role granted to chance, especially in traditions attentive to deterministic explanations. (The French *hasard*

encompasses both "chance" and "randomness.") The legend of the sparks of randomness leads to the question of possibility and determination in that it balances the figure of Seth, an offspring who successfully bears Adam's likeness, against the demons begotten of Adam's nocturnal emissions (Atlan 1999a: 107). As in his biological writings, chance and determinism are not contradictory alternatives. Atlan sides with traditions of rabbinical and philosophical commentary that emphasize determinism and the lack of control over human action.[14] Somewhat like the effects of noise in mediating or mobilizing a self-organizing process, chance mediates for humans the ineluctable order of the world set forth by God/nature, which is unintelligible to them. In "The Mother Machine" (Chapter 21), for example, an essay on "divine intrigues" or *'alilot* , Atlan rereads classical references of rabbinical and philosophical commentary that are tied closely to the question of free agency. To Maimonidean resolution, which highlights the possibility of free will (a resolution that Atlan believes can lead to refusing the possibility of a kind of reason offered by kabbalist mysticism), Atlan contrasts other schools of rabbinical interpretation, notably those of the Saragossa philosopher and rabbi Hasdai Crescas, who lived at the turn of the fifteenth century and is best known for his book *Or Adonai* (*The Light of the Lord*; Chapter 1), and Shlomo Eliaschow (Chapter 15). In a reading of the claim of *Pirkei Avot* (*Ethics of the Fathers*) "Everything is foreseen and the possibility of choice is granted" (3.15), Atlan, with Crescas and Eliaschow, highlights the deterministic first part of this sentence, which focuses on the "conduct of the world, which seems to play with men, who must believe that they are guilty of their crimes, even though all their doings are the results of an eternal decision from the Infinite" (Atlan 2008: 351). Free will then becomes an illusory, subjective experience and a trick or intrigue that the world's forces play with humans in cunning demonstrations of their responsibility for the good and bad they are determined to do (Chapter 15).

The second element Atlan evokes in his reading of the Adamic myth concerns creation—the role played by (or granted to) human beings in the creation of life, the discourses involved in understanding such creation, and the kind of control over the future and over nature that creation promises. Atlan here

14. Significantly, these traditions at once locate Spinoza's thought in a broader context and open out from Spinoza's reading of the Torah in the *Theologico-Political Treatise* toward a broader tradition of commentary that similarly emphasizes the idea of human choices as foreordained. For Atlan's reading of Spinoza's treatment of philosophical versus religious texts, see Atlan 1999b: 26.

addresses two principal elements: the relation between soul and body in the creation of man in Genesis (Chapter 17) and the tradition of the Golem. In the first, he seeks to emphasize that "the soul was not always 'spiritual' in the sense of incorporeal" (Chapter 15), that it can be understood instead as enveloping the body and not, in a Neoplatonist sense, as opposed to it (Chapter 17). Here, Atlan explicitly links readings of Genesis with his blending of neurobiological insights and Spinoza, both to demonstrate the noncontradiction between these realms of inquiry and to open a discussion of the potential stakes and openness to interpretation of seemingly internalist and "dated" systems of thought.

Atlan's treatment of the figure of the Golem opens his study of Judaism to bioethical concerns that have arisen with the development of technologies for cloning, stem-cell research, and control over conception and procreation—of biotechnology more generally. As Atlan notes, biotechnology has frequently led bioethicists to engage with traditions of creation (Chapter 26): "Here we propose . . . to analyze origin myths, whose anachronistic juxtaposition with the new situations created by these technologies can yield new insights. These make it possible to project diverse (and perhaps contradictory) meanings onto the moral and legal positions we are tempted to take in a given situation" (Chapter 20). For Atlan, the Golem poses a particularly forceful reference (in comparison with other literatures of a new man or a man-playing-God—most famously that of Faust) because its creation, regardless of the Golem's destructive consequences, does not result in summary judgments about the futility or destructiveness of human creativity. On the contrary, "the creation of a golem, far from being sacrilegious, was seen as the fulfillment, by means of the secrets of the Torah, of a long and difficult ascent toward wisdom and holiness" (Chapter 20), thus confirming for commentators both the capacity of the Torah to raise human knowledge and consciousness and the human failure to perfect and fully control knowledge and its promise. The very ambiguity of the Golem, Atlan notes, continues to haunt ethical debates today—in matters of gender roles (Chapters 21 and 26), in confusion and worry about the kind of "construct" that a new man created by man alone would be (Chapter 22), and in the very status of the human (Chapters 22 and 23).

Practices, Possibilities, and Ethics

As they define a questioning of the new man, the problems of knowledge and possibility become crucial for Atlan's thinking of the intricate and ever-changing relationship forged between human biology, scientific knowledge

(and practice), and everyday life. The continual reworking of this relationship brings us to the final section of our introduction and to an important conceptual domain—not to mention popular moniker—for moral philosophical concerns that reside within science and human experience: bioethics. Over the past several decades, the term *bioethics* has come to signify a seemingly novel set of disciplinary practices involving biology, philosophy, psychology, theology, and jurisprudence—and with this new discipline comes the assumption that equally new ethical concerns (as well as phantasms of thought; Chapter 8) have arisen out of and in the face of scientific advancement (see Bosk 1999). As a number of historians of science and medicine have suggested, what remains puzzling about this apparent renaissance of ethics as a means to gauge scientific value is the recognition that technical advancement brings with it increasingly difficult dilemmas, and thus bioethics as a discipline is hard put to extricate itself from the aura of future threat and the figure of crisis (Rosenberg 1999; see also Fox 1999). (As Alasdair MacIntyre has suggested, the problems and concerns that arise in bioethical debate seem always just beyond the reach of an answer.[15]) Atlan does not take lightly questions such as "Where do bioethical problems come from?" and "Where do they lead?" (Chapter 22). In his writings, however, whether or not moral philosophical challenges arise from (or run alongside) scientific and technological advancement, how biological theory is transmitted and taken up within social, political, and economic domains is an entirely human endeavor, science itself. Therefore, it is often hard to understand *bio-* in the term *bioethics*. Atlan states:

> [Bioethics] implies the existence of a new discipline derived from biology, rather like biophysics or biochemistry, and suggests that via bioethics it may be possible to find, within biology itself, the answers to the ethical problems posed by biology. But this is not at all the case. Biology poses problems of an ethical nature, but it does not solve them, even if it is clear that we cannot begin to tackle them without an understanding of their biological roots. Solutions will result from different ethical approaches that vary from person to person and culture to culture. These problems are so new that people belonging to the same tradition often respond spontaneously to them in totally different ways.[16]

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15. See MacIntyre 1975, cited by Jean-Francois Braunstein in his unpublished "*Bioéthique* ou philosophie de la médecine?" based on a paper given at the conference Vie, Concepts, Institutions at the Centre d'Études du Vivant–Collège international de philosophie, May 2004.

16. Interview with Atlan, conducted by Geraldine Schimmel, in the *UNESCO Courier* (Schimmel and Atlan 1996).

Atlan refuses to assert a scientific morality, that is to say, an ethics that would rest entirely within science itself. He states: "In this field the progress of science and technology has created problems—of legitimacy, of good and evil, of what is permitted and what is not—that did not exist before and that neither biology nor medicine alone can solve."[17] Nowhere do we see this more clearly than in the polemical debates about reproductive cloning, and more specifically ectogenesis—birth following artificial and not human gestation.

Ectogenesis, as it applies to the human production and reproduction of life outside the uterus, and reproductive cloning through somatic cell nuclear transfer (the implantation of the nucleus of a somatic cell into an enucleated egg cell, which then multiplies, replicating the implanted rather than its own nucleus) are two technologies in which biological possibility has become (or is at present) socially untenable (Chapter 26). Even technologies that seek to "correct" certain conditions (i.e., infertility and dangerous pregnancy) have incurred societal wrath because they are imagined to denature life (see the discussion of the 1992 Clothier report in Chapter 24). Atlan writes:

> each of these two techniques constitutes the crossing of a qualitative threshold in the denaturalization of reproduction. Debates about the acceptability of crossing the threshold of asexual reproduction, seen in relation to techniques of medically assisted procreation already employed, will very probably change their nature in societies the other threshold, that of ectogenesis, has already been crossed. Once ectogenesis were to become a normal mode of gestation that would make it possible to do without a mother's uterus in giving birth to a child, the question of what an embryo is and of its legal status would be posed in a new way, even more dramatically. (Chapter 8)

The problem here is that the nature of reproduction is seen as reflecting the nature of life as such. So long as the genome is treated as containing the "essence of life," manipulating it means destroying life and its supposed sacredness. The opposition to these technologies derives from what Atlan has described as a "fetishism of the gene" (Chapter 8), asserting that the genome contains all the instructions for the development and growth of the organism, now and in the future. Here, the diffusion of biological theory into a social (and ethical?) critique comes to absorb issues such as a woman's right to make choices about her own body and possible new models of kinship, as well as the value of biological life and how that value is determined. Atlan's own

17. Ibid.

approach is more careful. On the one hand, he emphasizes the problems involved in speaking of "life" in an essentialist fashion. He repeatedly quotes Albert Szent-Györgyi's claim that "Life as such does not exist" (Chapters 1, 14, and 24), interpreting it to mean that "life does not exist as an explicative notion of organic properties . . . life does not exist as an object of biological research" (Chapter 1). This is also to say, in the context of bioethics, that any thinking of the living cannot maintain its rigor if it postulates life as an essentialist notion. On the other hand, he emphasizes the need (regardless of Szent-Györgyi's "good news") for localized and precise responses to problems of biomedical ethics: "This is why, if one is preoccupied with questions in biomedical ethics and, as we are here, with the precautions to be taken in this domain, it is necessary to try to define these precautions in a pragmatic fashion, to analyze each situation in its particularity—that is, for each disease, each technique, and so on to analyze the specific potentially dangerous or undesirable effects, without launching into notions as woolly as 'the essence of life'" (Chapter 24). Thus Atlan suggests that human ectogenesis poses ethical, social, and political problems very different from those of reproductive cloning (Chapter 8): the technology actualizes biological concerns in a way that involves much wider social issues.[18] Similarly, the essay on cloning included here (Chapter 22) centers on an elaboration of different practices and techniques that commonly fall under the moniker "cloning" and supporting the Comité Consultatif's negative response to reproductive cloning of human beings (to be distinguished from the nonreproductive cloning of cells) as a biotechnological possibility on the grounds of an ethics of anticipation, claiming the problems of kinship and moral confusion that would result render cloning socially impossible at present.

An "ethics of anticipation": we use this term heuristically, in part to complement Atlan's explicit attention to ethics and moral judgment—an attention that begins with Spinoza's thought concerning pain and pleasure as the first and subjectively determinant level of ethics and extends to normative and meta-ethical concerns (Chapter 29). As Atlan repeatedly notes, what has come to dominate ethical questions is *possibility*: "what is not an embryo can become an embryo, what is not a human person can, under certain conditions, become a human person. The ethical debate . . . shifts to the conditions of such becomings" (Chapter 1). The ambiguity of biomedical ethics at present, for Atlan, concerns the question of addressing the relationship between

18. See esp. Atlan's recent (2007) work with Mylène Botbol-Baum.

things that are not (but might come to be) and things as they ought to be: in other words, not only the relation between things that are and things that are not, nor only that between things that are and those that ought to be. Rather, the effort to think and organize becomings, potentialities (Chapters 8, 23, and 28)—the effort to think the future—becomes pedagogically, scientifically, and ethically the basis of a persistent self-questioning grounded in a quasi-subjective experience and thought. Thanks to these ethical emphases, in his work Atlan is able to expose the analytical problems we face when solutions to moral philosophical systems fail to take hold in the everyday realities of individuals' lives.

In conclusion, let us return to the practical aspects of organizing a volume that encompasses such a far-reaching body of work. The chapters of this book are arranged to cohere around substantive aspects of Atlan's work. It goes without saying that there remain topics and concerns beyond the scope of a single volume. This book should not be mistaken for a reductive or single theoretical perspective (or suggest a single norm). Writing about the different levels of ethics, Atlan states: "In particular, if a norm must be erected, rightly or wrongly, on the basis of a theory (either by deduction and predictive projection of what must be on the basis of what is or merely by indicating the constraints that limit the possibilities), then each theory will permit us to erect very different norms" (Chapter 25). In this volume, we hope readers will find not the limit but the opening of possibility.

Selected Writings

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