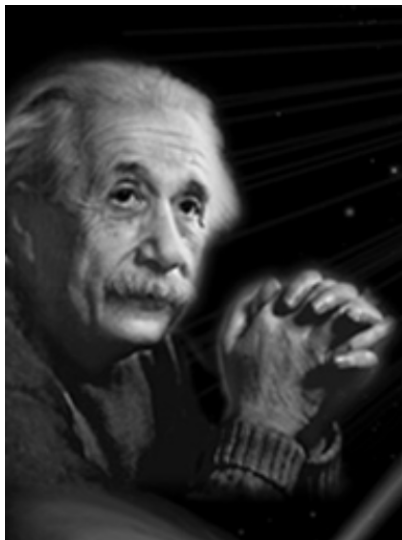


Chapter 18

A Manner of Thinking: Mathematical Priority and Psychological Supremacy



**To survive we need
a new manner of
thinking.**

A. Einstein.

**To survive we need
to think.**

Juan Manuel
Miguez.

**Thinking is shared
by all. Think for
yourself.**

Heraclitus.

Abstract: This chapter sketches how creation theory could provide foundations for scientific methodology, everyday creative thinking, and a dynamic mathematical and psychological logic.

Medicine provides a manner of thinking. Just as the physician must depend on practical experience in order to settle questions of fact in medicine, so the philosopher must depend on the same indispensable source of knowledge in order to settle questions of fact in general. In other words, according to Locke, “the appropriate method of inquiry

required in philosophy is, implicitly, the very same method required in medicine *generalized*.¹ The standpoint of life should also be fundamental to scientific endeavors. Science, said Quine, continues common sense. Einstein pointed out “the critical thinking of the physicist cannot proceed without considering critically a more difficult problem, the problem of analyzing the nature of everyday thinking.” Common sense corresponds to the common man. Opposition to common sense, and reliance on experts, has always been the program of aristocratic parties from Plato to our times. Science is a human activity. Culture, ideologies, personal feelings and interests influence its march. Science has a psychodynamics and a sociodynamics. Facts have priority; psychological factors (including social and economic interests) determine their interpretation. For this reason, critical thinking is necessary. For the same reason, critique is not sufficient. Challenging assumptions, prejudices,² ignorance,³ carelessness,⁴ errors, and even dishonest distortions of data for profit, is at times crucial, but it often becomes unnecessary.⁵ It is, in any case, useless to oppose a view unless one can provide an alternative. We need creative thinking.

Creative thinking implies action, not just change, and it considers **past, present and future**; focusing on the present is a static manner of

¹ Romanell, P. (1984). *John Locke and Medicine*. New York: Prometheus Books. It is difficult to list the many physician-philosophers, from Imhotep to Empedocles to Avicenna, Averroes, Maimonides, Copernicus, and many others.

² A prejudice in favor of circular movement directed Ptolemy to design his cosmological model. It also impeded Copernicus to propose a simpler system, it delayed Kepler's discovery of the elliptical form of planetary orbits for almost twenty years?, and it prevented Galileo to accept Kepler's discovery! [Koyré, A. (1973). *Etudes d'histoire de la pensée scientifique*. Editions Gallimard]

³ One example should suffice. The founders of sociobiology claim that the female orgasm is a “human invention”; females of other species (including rabbits that only ovulate after coitus) do not experience orgasm (Wenegrat, B. 1984. *Sociobiology and Mental Disorder*. Menlo Park. CA. Addison-Wesley Publ.) These zoologists must have never had pets. In the early twentieth century, eminent psychologists, including G. Stanley Hall, claimed that advanced education would reduce women's reproductive capacity, so, to protect the species from extinction, women must be excluded from colleges and universities. Even today, psychiatrists, pharmacologists and governments employ concepts of race that sociologists regard as racist and biologists as ignorant.

⁴ Up to the time in which Watson and Crick discovery of its structure unchained the development of modern genetics, medical textbooks taught us that human cells contained 48 chromosomes, rather than the 46 that actually exists.

⁵ As time goes by, it becomes increasingly unnecessary to discuss psychoanalysis, Marxism, behaviorism, quantum mechanical speculations denying the existence of matter, and other theories taught as fact no long ago. Time is limited, pointed out my father, why waste it in polemics?

thinking.⁶ Second, focuses on bipolar opposition, not just conflict. The twentieth century spawned a most vast and radical historical process, the women's movement, which has made us take seriously not only the equality of the two halves of the human species but also of opposites in all areas of reality. A case in point is the coexistence of information and misinformation. Third, it regards **qualities as dimensions** that measure different aspects of an entity rather than as separate classes. For instance, we ask ourselves the intensity and domain of introversion (and of extroversion) in each individual persons, rather than classify persons as introversive or extroversive. We ask ourselves to what extent a country is monarchical and republican (in a Platonic fashion) rather than one or the other (in an Aristotelian classificatory mode).⁷ Fourth, it replaces determinism and probabilism with the notion of creative determination of the future by the present. Finally, creative thinking requires not only interdisciplinary integration, but also critical examination of the tenets of one science from the perspective of others.

We are exploring the development of creative thinking in two different contexts, as logic of science and as psychotherapy.⁸ These two issues are not independent. It is not only important to know how to perfect our thinking, but it is also important to understand why we, and others, fall into distorted ways of reasoning. Reason does not stand alone. It is always paired with irrationality. Recognizing the coexistence of these opposites indicates that **logic must be both mathematical and psychological**. We must not only design computers and algorithms but also choose what algorithms to design, and for what purpose. For instance, from the perspective of evolutionary science, a focus on invariance and universality to the exclusion of change is irrational. Yet

⁶ Consider the opposite attitudes fostered in the elderly by living in the past (as often happens), living in the present (as it is often advised) and living in process, aware of past, present and future. Likewise young persons develop healthier attitudes by being aware of all three perspectives.

⁷ The USA constitution combines republican concepts derived from the Iroquois and the Greek with strongly monarchical traits derived from the British system, and it also allowed for plus slavery.

⁸ Sabelli, H. *Mathematical Dialectics, Scientific Logic and the Psychoanalysis of Thinking*. In *Hegel and the Sciences*, Edited by R. S. Cohen and M. W. Wartofsky. New York: D. Reidel Publishing Co., 1984:349-359; Sabelli, H. *Non-linear dynamics as a dialectic logic*. *Proc. International Systems Society*, pp. 101- 112, 1995; Sabelli, H. and Carlson-Sabelli, L. (1996). *As simple as one, two, three. Arithmetic: a simple, powerful, natural and dynamic logic*. *Proc. International Systems Society*, pp. 543-554; Sabelli, H. *The Union of Opposites: from Taoism to Process Theory*. *Systems Research* 15: 429-441, 1998.

the entire edifice of standard logic is built on the assumption of permanent entities. This is useful in mathematics, but it contradicts evolutionary science. Standard logic is not independent from the static worldview that prevailed before. Logic is constructed with timeless sets and tenseless propositions, driving our attention away from change and evolution, and thereby from reality itself. $A=A$ is true in mathematics but misleading elsewhere.⁹ It is disingenuous to pretend that ideas have no consequences. Ideas guide actions. For this reason, it is cogent to attend to the implication of hypotheses, and to be particularly careful with those that have potentially harmful effects – such as those postulating conflict and selfishness as dominant factors in behavior. Prejudices in favor of static concepts still dominate scientific discourse. I must confess to an equal but opposite prejudice that makes me pursue dog headedly a world view in which nature and thought are actions, opposites are similar, processes are creative, and human actions are effective.

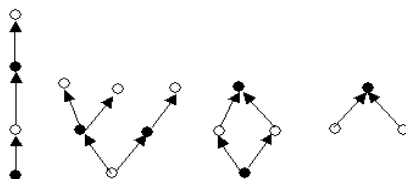


Fig. 18.1 Helicoids. Helicoids are sets with a relation \downarrow satisfying the following postulates: If $A\downarrow B$, then it is not true that $B\downarrow A$. If $A\downarrow B$, $B\downarrow C$ and $C\downarrow D$, then $A\downarrow D$. It follows that $A<C$. One may read $A\downarrow B$ as A is refuted by B , and $A<C$ as C confirms A .

Creation theory provides general guidelines for creative thinking (Table 8.1) that may possibly be firmed up as a biotic logic. A logic involves (1) identity and unidirectional implication, (2) two values (negation) and (3) operations that combine two elements to generate a third. Logical implication (if ... then) is a partial order and hence generates lattices. Dialectic refutation is at once a partial order and a negation, and hence generates two-colored lattices (helicoids). If A implies B and B is false, then A is false. These two types of inference are complementary. It is easier to walk on two feet than on one. Both types

⁹ Consider, for instance, the simple statement “Chinese are Chinese”. A few decades ago, sociologists wrote long essays discussing why the Chinese did not progress, and attributing it to culture and mentality. At this time, China is one of the fastest growing nations in the world.

of inference occur in helicoids (Fig. 18.1).¹⁰ The conceptual similarity between bios and helicoids would not escape the reader.

18.1 Action

Ideas are actions. Action calls for spontaneity, integration, and practice. Act, do not react. Take the initiative.¹¹ Practice measures ideas, as illustrated by health measures of democracy (Fig. 16.2). Action implies order and organization. We thus assume that natural processes are patterned rather than random. When a difference between data and random models is not detected, we strive to develop methods that will demonstrate it before abandoning the apparent (a.k.a. evident) pattern as having been definitely demonstrated to be fortuitous.

If ideas are actions, logic must become dynamic. Dialectics has been proposed as a dynamic logic¹² but it remained purely philosophical. This allowed for political distortions that led many to regard dialectics as the last resort of the scoundrel. The only possible solution, I concluded, is a mathematical formulation. Certainly in our times of mechanical computation, dialectics must become mathematical. Several attempts have been made,¹³ including group¹⁴ and catastrophe¹⁵ models.

¹⁰ Sabelli, H. C. An Attempt to Formalize Some Aspects of Dialectic Logic. *Hegel-Jahrbuch 1970*. H.v. Wilhelm R. Beyer, Verlag Anton Hain. Meisenheim am Glan, 1971, pp. 211-213. I have used helicoids as models to locate the site of action of drugs on neural nets [A Pharmacological Strategy for the Study of Central Modulator Linkages. In *Recent Advances in Biological Psychiatry*, Edited by J. Wortis. New York: Plenum Press, 1964:6:145-82; Sabelli H. A Pharmacological Approach for Modeling Neuronal Nets. In *Biocybernetics*, Edited by H. Drischeland P. Dattmar. Jena, Germany: Veb Gustav Fischer Verlag, 1972: IV: 1-9].

¹¹ Nobelist Bernardo Houssay, my mother's mentor, advised me (and probably many others) to study something new rather than following the mainstream. ("They" have the economic resources, and can publish faster. Create anew, set the trail. Let them read your work and follow you.)

¹² Lefèvre, H. *Logique formelle et logique dialectique*. Paris, 1947.

¹³ I am not familiar with work from scientists from the Eastern Europe, so I may have missed much of importance. I refer the reader to *Theoretical Dialectical Journal: Physics-Mathematics-Logic-Philosophy*, <http://www.tedial.narod.ru/eni01.htm>. Concerning the relationship between dialectics and formal logic, the official Soviet position until the 1960s was that there were two logics, formal logic dealing with simple, abstract relations and dialectical logic devoted to concrete and complex relations. In the hands of political dictators, dialectic contradiction became a justification for inhumane behavior. Later on Soviet Marxists treated dialectics as an epistemology rather than as a logic per se. In other words, these authors abandoned dialectic logic.

¹⁴ Günther, G. (1967). Time, Timeless Logic and Self-Referential Systems. In *Annals of the New York Academy of Sciences*. Edward M. Weyer. pp: 396-406; Sabelli, H. C. (1970). An attempt to formalize some aspects of dialectic logic. In *Hegel-Jahrbuch*. pp: 211-213; Gauthier, Y. (1984).

Table 18.1 Three Forms of Reason

	Logic	Dialectic	Biotic
Identity	Static $A=A$	Dynamic	Dynamic $A_t < A_{t+1}$
Opposition	Linear (categorical or quantitative) Two values No-contradiction	Complementary (orthogonal) Two values Coexisting opposites (contradiction)	Autonomous (planar) 2^N values. Quantum superposition, local no contradiction and global co-existence
Implication	Formal (if then) of cause by consequence	Mutual implication of opposites (ambiguous definition)	Formal and material (of consequence by cause)
Materiality	Extension portrays intension: properties are defined by sets	Opposite properties coexist in each entity	Lattices of classes. Qualities as dimensions. Groups of qualities.
Creation	No model	Synthesis	Bifurcation and synthesis
Psychobiological bases	None	None	Cognitive structures, neurophysiology
Mathematical model	Boolean	None	Nonlinear dynamics
Technological realization	Standard computation	None	None. Quantum computation?

Logic traditionally is formal and extensional (i.e. material).¹⁶ Both traits indicate a static bias. A process logic must define an **evolving identity** $A_{t+1} > A_t$ that implies continuity and similarity, but not equality. Extension and intention do not show one-to-one correspondence: opposite properties coexist in each entity, in a dialectic fashion, so one must describe them separately. Sign does not determine boundaries. Finally, formal implication of the cause by the demonstration of its

Hegel's Logic from a Logical Point of View. In *Boston Studies in the Philosophy of Science*. Robert S. Cohen and Marx W. Wartofsky. 64: 303-310; Kosok, M. (1984). The Dynamics of Hegelian Dialectics, and Non-Linearity in the Sciences. In *Boston Studies in the Philosophy of Science*. Robert S. Cohen and Marx W. Wartofsky. vol. 64: 311-348.

¹⁵ Thom, R. (1970). Topologie et linguistique, in A. Haefliger and R. Narasimhan, eds., *Essays on Topology and Related Topics*, Springer-Verlag, New York. René, T. (1972). *Stabilité Structurale et Morphogénèse*, W. A. Benjamin, Inc., Reading, Massachusetts.

¹⁶ There are of course a number of other logics. A temporal logic has been developed by Rescher and Urquhart, [Rescher, N. and Urquhart, A. (1971). *Temporal Logic*. Ed. Bunge, M. Springer-Verlag. New York.]. It should be noted that Rescher [Rescher, N. (1996). *Process Metaphysics*. State University of New York Press] regards process philosophy as a twentieth century, primarily American (meaning USA) creation, and that he does not include in it coexisting opposites.

consequence must be complemented by the implication of the consequence by the process that creates it. For instance, period 3 implies its antecedents such as bifurcation cascades (Sarkovskii's theorem) because bifurcation cascades generate period 3. From a process perspective, bifurcation cascades imply period 3.

18.2 Opposition

Oppositions are so widespread that it is not possible or rational to ignore them whatever issue we consider. Purely quantitative approaches are, in a sense, blind to a fundamental aspect of reality. On the other hand, focusing on opposites also blinds us from seeing similarities and third alternatives. The coexistence of multiple oppositions is also confusing; hence oversimplifying thesis like being with me or against me. It is essential to establish a hierarchy of importance if one is going to fight.¹⁷ To gain insight, to create, it is more important to develop a new way of looking at reality, to conceive a new partition, which runs “diagonal” to the existing one. An insight, an “aha”, is always a new distinction, a new opposition. Likewise, to create peace and prosperity, it is often to create a “**cross partition**” that unites the humanists present on both opposing sides of a conflict, and separates them from others on “their” side.¹⁸ This is not a call for “harmony” between two good sides that are misrepresented as enemies by prejudice, but a denunciation of both belligerents.

Standard logics regard opposites as linear, either two values or poles of a continuum. Corresponding to matter and void, the two components of mechanism, standard logic offers two values, 1 and 0 (existence and absence). Process theories postulate real opposition, and therefore the fundamental values are 1 and -1 . Dialectic complementarity involves synergy and antagonism, so opposites are orthogonal to each other (1 and i). In the biotic model, opposites are planar, including all possible

¹⁷ Mao Zedong advanced the famous notion of “main contradiction”. An extensive critique of this viewpoint is developed in *Union of Opposites*, and a Taoist alternative is developed in Sabelli, H. (1998). The Union of Opposites: from Taoism to Process Theory. *Systems Research* 15: 429-441.

¹⁸ Consider, for instance, the religious wars between Catholic and Protestant Christians that bloodied Europe in the “little Middle Ages” contemporaneous with the birth of science and modernity.

manners of relating to each other, including linear diametric opposites (1 and -1) and orthogonal complementary opposites (1 and i). In the same manner, the outcome of the combination of two entities may be orthogonal to them, creating a tridimensional structure. Thom's catastrophe theory is the foundation of a mathematical dialectics because it involves opposites (rather than existence and absence) and further, it relates them in a nonlinear fashion. Bios theory also includes a multiplicity of opposites and of relations between them.

Bios data analysis of empirical data and of mathematical bios shows that opposites vary autonomously (lack of linear correlation, Section 4.5) but not independently, in contrast to the linear opposition postulated by logic and the complementary opposition conceived by dialectics. Thus the principle of no contradiction cannot be taken for granted. Nor can we assume a gradient from true to false as in probabilistic or fuzzy logic. There are multiple ways in which partial truth coexists with partial error.

Both positive and negative interactions contribute to the creation of novelty and complexity. Confirmation plays a major role in science,¹⁹ and so does proof in mathematics. The accepted structure of logical reasoning is a lattice of implications, starting with axioms. This view permeates mathematics from Euclid to Hilbert, Frege and Russell. By considering only deductive certainty, such view fails to portray the exploratory nature and creativity of rational thinking. In reality, the scientific community carries on a continuous dialectic in which refutations are as important as proofs.

Opposition is creative in two different ways. First, the most useful way to test a hypothesis is to attempt to refute it; thus the Australian neurophysiologist Sir John Eccles provided the best evidence for chemical synaptic transmission by attempting to refute this hypothesis. Conversely, following ideas to their ultimate consequences serves to

¹⁹ Generalizing from repeated observations into a general rule is a common, and common sense, mode of learning. Statistics develops induction into a scientific method. Just as to claim that induction is the one and only scientific method was an over-enthusiastic proclamation, motivated by a justified reaction against medieval philosophy, to deny that induction is a psychological fact of ordinary life as well as a scientific procedure [Popper, *Conjectures and refutations. The growth of scientific knowledge*] is vastly exaggerated. Even if repeated observations offer no proof, most of us would dismiss the hypothesis that the sun will not rise tomorrow, even as we understand that the sentence is now to be interpreted as planetary rotation.

refute them. Second, refutations play a creative role by bridging notions that cannot be readily connected linearly. This is the argument of reduction to the absurd that is so useful when the principle of no contradiction can be applied, as in mathematics.

The biotic model indicates that multiple opposites are required to create complexity. A biotic logic should then include a multiplicity of **informational (truth) values**. Just as cascades of bifurcations multiply the number of oppositions in mathematical recursions and in natural processes, the number of truth-values can be multiplied by iterating complementation (a set theoretic model for logical negation) as a process (iterated negation²⁰). Thus two-valued negation becomes 2^2 valued, beginning with four values: 00 (neither A nor no-A), 01 (no-A), 10 (A), and 11 (both A and no-A). Expanding two-valued Boolean algebra into a 2^N -valued logic accommodates coexisting opposites. The qubit includes four values, and in particular distinguishes between +/- and -/+; there are two intermediate values between positive and negative representing directions of change.

An application of the concept of multiple opposites is in the formulation of a research strategy. Instead of testing one hypothesis to attempt to confirm it (as it is common) or to refute it (as in Socrates' negative dialectics and in Popper's falsification strategy), or two opposing views (as Protagoras), it is often useful to contrast many, as discussed by Bacon, Chamberlain, and Platt.²¹

The negation of truth is false but the negation of the false can be false. Negation is asymmetric: there is only one truth, but there are many errors. The multiplicity of opposition ends with the paradoxes generated by two-valued logic. For instance, induction formalizes the common sense notion that given a hypothesis (e.g. "all ravens are black") is supported by finding a case which is true (e.g. a black raven). In two-valued logic, "No no-black entity is a raven" is the same as "all ravens are black", so finding a red herring supports this hypothesis (Hempel's

²⁰ Sabelli, H. (1984). *Mathematical Dialectics, Scientific Logic and the Psychoanalysis of Thinking*. In *Hegel and the Sciences*, Edited by R. S. Cohen and M. W. Wartofsky. New York: D. Reidel Publishing Co. pp. 349-359.

²¹ Platt, J. R. (1964). Strong Inference. *Science* 146: 347-53.

paradox²² that scientists may dismiss, but logicians take very seriously). To assert P is to make a particular statement; to assert no-P is to refer to an infinite set almost identical to the universe.

Inductionism defines confirmation as the finding of the case of a hypothesis. I defined a stronger form of **confirmation as the refutation of the refutation of the hypothesis**. This can be modeled by helicoids (Fig. 18.1).

Chaos theory (as Greek physiology, Taoism and dialectics) indicates to focus on triads. Beyond opposites, there is a third that complements and opposes both. This differs radically from Aristotle's golden middle, Marx struggle, and Thom's catastrophes. How does one generate such third? Quantitative logics postulate a third between opposites, a "center" that finds favor among vote-seeking politicians. Traditional dialectic regarded the third as the synthesis of opposites. There is of course a third in the undifferentiated state that precedes a distinction. But Aristotle suggested a more interesting third, the open value for the future. One may create a third alternative by considering what is common to both opposites and negating it (just as one primary color is the opposite of the secondary color generated by the combination of the other two primaries). This is the neither/nor case (Shaffer's stroke), a logical function that can by itself generate the entire Boolean logic. For instance, the theory of creative processes emerged from negating both determinism and indeterminism, both of which imply that nothing new and more complex emerges, and that humans have no control. Similarly, the concept of priority / supremacy is not a middle ground between materialism and idealism but a rejection of their shared unidirectional conception of causality.

Opposites are also diverse. A fundamental diversity relates to levels of organization; in Chapter 9 we discussed a principle of quantum superposition, local exclusion and global implication of opposites. How this applies to quantum computation is as yet to be explored. Regardless of quantum superposition and dialectic contradiction, the fact is that

²² Hempel, C. G. (1943). A Purely Syntactical Definition of Confirmation. *J. Symb. Logic* 8, 122-143. Hempel, C. G. (1946). A Note on the Paradoxes of Confirmation. *Mind* 55.