

MATTER'S MASTERMIND: THE MODEL-MAKING BRAIN

MODEL AS ANALOGY

Innovative understanding or explanation stems almost exclusively from analogical reasoning. Induction systematizes the familiar; deduction casts it into formal relationship. Reasoning by analogy brings to bear on the familiar a new perspective derived from another realm of inquiry.¹ Models are fruits from the tree of analogical knowledge.

The first models are the demythologized mechanical devices of the Greek astronomers in the 6th century B.C., but the term “model” is of later origin; it derives from *modulus*,² a diminutive of *modus* (the *Latin* “measure.”) The *modulus* relevant to Plato is a mathematical metaphor based on the 2:1 ratio of the musical octave. For possibly thousands of years before Plato, music provided a meaningful correspondence between number and tone in the readily observed-measured relation between string length—on Hindu-Sumerian Babylonian harps—and the tonal intervals of sounds. Halving a string length changes its pitch by an octave; hence the ratio 1:2 or the “modulus of doubles” was considered a measure of sensory experience.^{3, 4}

Until the second half of the 19th century models referred to either small scale reproductions of what was to be modeled, or alternatively (following Plato): the outside world was regarded as the model, image or icon (εἰκῶν) of a paradigm (παράδειγμα). Our present inclination to consider scientific concepts, theories and hypotheses as models of outside reality is of Platonic and Neoplatonic heritage.

But how do we know what is known? How does biologically preprogramed, genetically transmitted and embodied “knowing-how” become aware of its own consensually validated “knowing-with” (*con-scientia*) as the apparent content of consciousness? Is (ἐπιστήμη) or knowledge, a body-bound, empirical knowledge, as claimed by the adherents of Alkmaion of Kroton? Or is there another, a higher form of knowledge that is not bound to the body, as the disciples of Empedokles and Pythagoras asserted? For problem solving and explanation the empiricists devised technomorphic, i.e. material models, while the Pythagoreans resorted to ecstatic-cathartic or shamanistic, i.e. dematerialized models.⁵ It is fascinating that these two types of models analogically reflect the nature of “knowing” that is “contained” in the scripts and scenarios of the two extreme states of human consciousness: (a) the “I”-state of daily routine, i.e. the matter of fact, normaphrenic experience of all that which is *observed* as the *material*, outside world, and (b) a “Self”-state, i.e. our awareness of being an ecstatic (hyperaroused) or deeply meditative (hypoaroused) *dematerializing observer* whose world exists only in the mind.⁶

THE SELF-OBSERVING UNIVERSE

The magic process of *observation* or interaction between observer and observed is the *creation of reality*—on all levels from the subatomic realm to the visible world. No reality can be attributed to the external world but only to our (interactional) observation of it. The bitter reality of quinine, to give an example, exists only during our interaction with quinine, i.e. when it is being tasted. Hence the evolution of conscious organisms (or meta-structures) from ordinary sub-stance enables us (meta-structures)

Matter's Mastermind

to observe-register (or interact with sub-stance) and thus create (the super-structure of) reality. Matter evolves to the awareness of its own knowledge and becomes conscious of its self-interpretation. Matter harbors a twofold identity: it is not only itself but also a reflection—an image—of itself, a concept brought forward by John Damascenus and Theodorus Studita during the *εἰκόν*-dispute that led to the split between the Eastern and Western Church.⁷ Both Church Fathers asserted that an authentic *εἰκόν* (or icon) is also the real Christ, the real Mary, the real Saint. And in our days we reassert that claim by positing that images are reflections of the self-reflecting system man, who (literally) is in the picture. “I am in the picture” (in German: “Ich bin im Bilde”) means understanding of the (two-fold) nature of whatever matters.

It took, of course, quite a bit of *time* for matter to acquire this two-fold identity. The story of the evolution of “intelligent life” is the story of the evolution of self-reflective consciousness. The Bible’s Genesis alludes to this time lag: God creates matter first and only after—on the 6th day—is its self-reflective image maker, man, created “in His own image.” This may be interpreted as model making, and so is perception-cognition of the creation of superstructure (i.e. reality) in the sense that an *εἰκόν* is both an image as well as the “real thing.” Dicke postulates an “anthropic” requirement on the universe, that it should last long enough to be able to give rise to life.⁸ What possible sense would it make otherwise to speak of “the universe” unless there was someone around to be aware of it. The architecture of *knowing* is such that only through self-reflection and observation does the universe have a way to come into *being*. For Wheeler even the past, a five billion light years old galactic explosion, for example, has no existence except as recorded in the present.⁹ Hence the evolutionary history of the universe comes into existence only with the development of intelligent life on earth.

Indeed, the creation of the universe itself may depend on the existence of self-reflective observers who will evolve from that creation. For them, by them the world is made: “O Mohammed, God said, ‘hadst thou not been, I would not have created the sky’”.¹⁰

What a magnificent drama and what a circular, self-reflective plot! In the natural history of the living human: *being* (ontology) and *knowing* (epistemology), cannot be separated. Self-reflection and observation coalesce in the identity of knowing and being, which is *self-observation*. Hence to be conscious of one's own being is not absolutely logical but due to our partially pre-programmed nature only ana-logical.

REALITY AS A MODEL OF BEING-AND-KNOWING

The self-observing and thus paradoxical nature of consciousness is seemingly contained in the simple statement, "I am conscious." The paradox is simultaneously a statement in an object language (about "I") and a statement in meta language (about "I am conscious"). It is, therefore, a self-referring statement which judges its own validity and hence has no signification in ordinary (Aristotelean) logic (where propositions of more than one dimension are not permitted). It is not only a violation of logical typing, but also a violation of semantic convention since both the subject "I" of the proposition "I am conscious" and the system that proposes to be conscious are identical.¹¹

Due to the self-observing nature of consciousness the structure of the universe appears to us isomorphic with (or corresponding to) the structure of its self-reflected image (Fig. 1). The universe, as we are able to know it, is not the "real thing" but a model to begin with, i.e. a structure that is isomorphic with the structure of that which it represents. Hence "being-knowing" is primordial model-making and what we commonly call "reality" is but a web of models. The first part of the third Commandment rightly forbids the making of (second order) models: "Thou shalt not make unto thee any graven image, or any likeness of anything that is in the heaven above, or that is in the earth beneath, or that is in the water under the earth..."

The divine logic (of divine consciousness) is single valued. Mundane values of positive and negative, true and false, good and bad collapse in the absolute and thus bridge the infinite gap between man and the wishfully unthinkable, God. In our two-valued Aristotelean logic, the second value (negation) is the

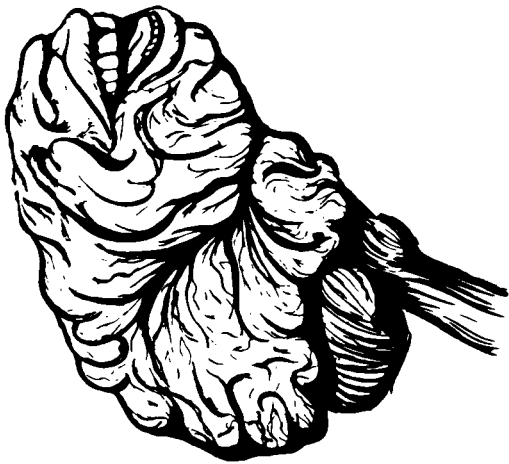
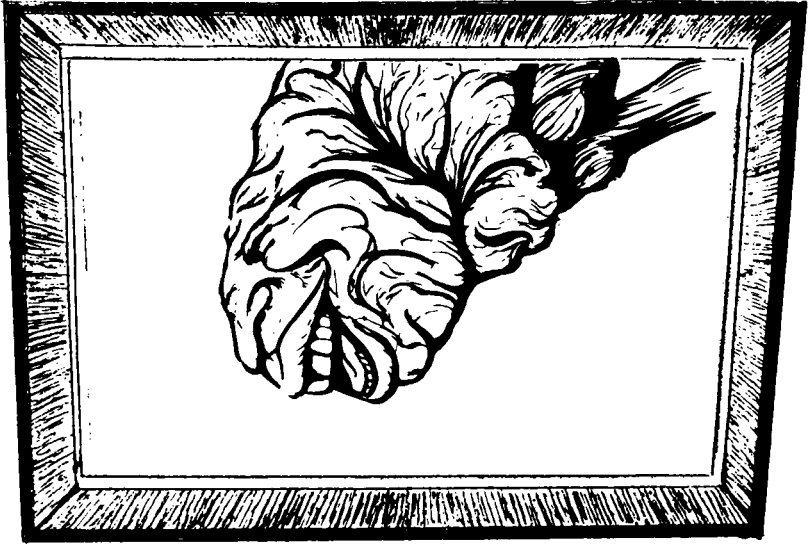


Fig. 1 A structure that is isomorphic with the structure of its self-reflected image, or an answer to the question: Who is who in the universe? (The left half of the Figure is taken from *Psychiatry and Social Science Review* 3, (2) 1969, page 14, with the kind permission of the artist, Alan Ginsberg, New York).

marking of the distinction and distance of human consciousness from its divine origin. Due to this distance God can speak to man only through His program,¹² and analogously we are able to speak to computers through our program.¹³

“WHAT’S IN THE BRAIN THAT INK MAY CHARACTER?”

(108th sonnet of Shakespeare)

The evolution of matter to its own awareness is the history of life. Rothstein believes that a well-informed heat engine could never discover its own origin except in a restricted sense—e.g. tracing its evolution, in part, by examining a junk pile of scrapped preliminary models.¹⁴ Be that as it may be, all life seems to display self-awareness but some life forms, of course, are more conscious than others. If we assume that *Homo sapiens*¹⁵ is conscious of more matter(s) in the universe than any other life form on earth, then we may wonder about the possibility of any unique neural feature that may distinguish our brains from those of other mammals. The fact of matter is, however, that there are no distinctive qualitative differences. Pieces of the bovine and human cortex, for instance, are very difficult to distinguish even for anatomists, and the “wiring” of the cortex is quite similar in the so-called motor, sensory and associational regions.¹⁶ The only feature known at present to distinguish human brains from those of other mammals is relatively large size, about 3 to 3.5 times greater than would be expected in a higher primate of the same body weight.¹⁷

The question, therefore, “who is human?” turns out to be an uncanny question. Master Eckhart, the German mystic (born 1260), had no doubts about the nature of some, but mainly his own, humanity. Master Eckhart wrote: “The eye through which I see God is the same eye through which God sees me.” Contrast this with David Premack’s statement that his motivation in studying cognitive capacities in chimpanzees is to obtain a description of human capacities, as seen by another species.¹⁸

Between the two extreme positions of seeing man through the eyes of God and seeing him through those of chimpanzees, is centered the idea of modeling the human brain in the image of

Matter's Mastermind

machines that it is able to devise. If we wish to consider the origin, function and evolution of complex machines that now exist, then the brain of man must be recognized as part of the complex system, thus contends Pattee.¹⁹ The reverse of this statement, however, is also true. If we consider the origin, function and evolution of the brain, then machines—designed and constructed by that brain—must be recognized as part of the complex system.

If machines are part of the man-machine system, then machines should reflect and hence serve as models of brain function. But brains can create both machines as well as delusions; bizarre as it seems, scientists and paranoid schizophrenics are the two main categories of people who employ machines to account for the functioning of their brains, and they model brain function with the most recent technical discovery of the day.^{20, 21} The trend to do so started after Newton had concluded in *Principia* the mechanization of the world picture; the universe is transformed to a construct of our brain, and brain mechanisms are to be modeled according to the most recent mechanical discovery of a particular period; clockworks, hydraulic engines (Descartes), Voltaic piles, switching mechanisms (inspired by railroading), telegraphy (relay stations and code), the telephone (circuitry), servomechanisms (feedback) and computers (programming) represent the creative structures into which universal meaning is to be projected.

“SHALL I COMPARE THEE TO A” HOLOGRAM

“Ich selbst muss Sonne seyn, ich muss mit meinen Strahlen
Das farbenlose Meer der ganzen Gottheit mahlen”

(Angelus Silesius)

In a pseudohermetic manuscript of the 12th century, *The Book of the Twenty-four Philosophers*, the second of twenty-four definitions of God, a definition that has played an important part—not only in the thought of theologians and philosophers—but also in the imagination of poets, reads: “God is a sphere of which the center is everywhere and the circumference nowhere.”²² And around 1650 A.D. Angelus Silesius exclaims: “God

is my centre when I close him in, and my circumference when I melt in him.”²³

This theme became the basis of the philosophy of Nicolas de Cusa and it had an immense influence on Leonardo Da Vinci, Giordano Bruno, Pascal and Leibniz.²⁴ Leonardo already transfigured the meaning of the infinite sphere as a symbol of God to that of the universe²⁵ and the concept became gradually transformed into a symbol of human consciousness. Thomas Traherne (1636-1674) finally could proclaim: “My soul is an infinite sphere in a centre.”²²

In the present day the optical hologram, so far the most transcendental model of brain function, may be but the scientific re-definition of God’s essence as “... the Fourier transformation of an image, where every point in the transformation carries information about the phase and amplitude of every point in the initial image.” Today God does not reside anymore in the “far out” reaches of the universe but in n-dimensional space, and we model Him in the holographic image of our personal, individual consciousness.

It is tempting to use the latest scientific discovery as a model of brain function. I too was tempted years ago, when we asked volunteers to read texts in which up to 74% of the upper part of each line was deleted.²⁶ Four of our 17 subjects were able to read more than a third of these topless texts, but only when under the influence of the hallucinogenic drug psilocybin (see Fig. 2). During the subsequent years I have found, and can repeatedly verify, that 2 out of about 800 second-year medical students read topless texts even without any drug. Eidetic ability could be excluded,²⁷ and the most surprising result was that only through the use of psilocybin and the topless texts were we able to identify a category of subjects who read the largest percent of correct words within the shortest time.

Four subjects—the most articulate ones—spontaneously reported “actually” seeing the missing tops of the letters at the peak of the hallucinogenic drug experience. Two of them specifically stated that the upper part of the printed words appeared in *lighter gray* than the rest and they were convinced that the photographer had not deleted them properly. Since it is known that each part of the hologram can reproduce the entire image,

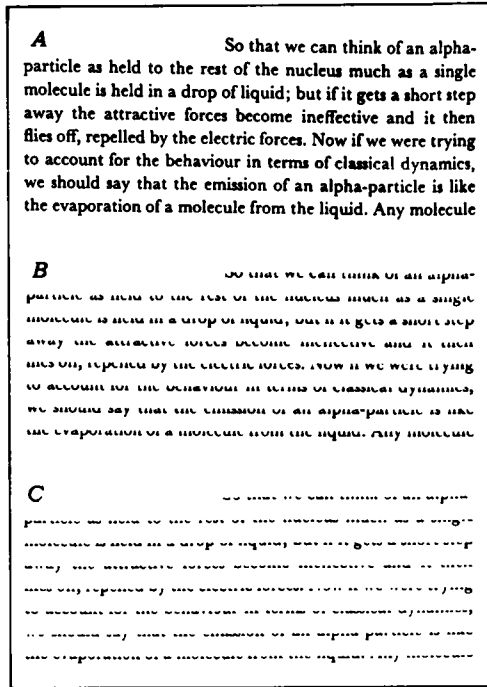


Fig. 2 (A) An 8 line sample of one of the undeleted 184-word control texts (4/5 of original size). (B) The same as above but with 43% of each line vertically deleted. (C) The same text with 74% vertically deleted. (From R. Fischer and M.A. Rockey, *Experientia* 23, 150-153 (1967) with the kind permission of Experientia and Birkhäuser Verlag, Basel, Switzerland.

and as the pieces become smaller, resolution is gradually lost, we argued that a holographic pattern recognition model could “explain” the hallucinated remembering of the deleted parts. Subsequently and independently Pribram, with persuasive brilliance, has elaborated in a series of publications on the holographic model of memory (see e.g. Ref. 28). There are pros and cons for such an interference pattern mechanism. Arbib²⁹ believes that neural holography should provide a useful metaphor if we avoid the temptation to use it literally (e.g., recreating visual input) but instead exploit the idea of portions of a wave

activity to help recreate the whole wave front, with different cuing waves that allow multiple storage in a region of brain tissue.

One objection to the holographic model, that of Bogen,³⁰ contends that presently available holograms are homogenous, whereas, in the brain, although everything is represented everywhere, some functions are represented at certain points more than at others. Another objection is that signals propagate in the nervous system at non-uniform speed, as opposed to the uniform speed of light within the holographic system. Lastly, I would argue that perception is neither a photographic nor a holographic copy of outer reality but a brand-new interactional creation between the brain and what we call—*ex post facto*—the outside world. The “outside world,” of course, is a model to begin with, irrespective of being called “reality” or “appearance.” How else could a perceptual pattern be recognized without a representational process or model that allows for comparative matching of present impressions with past ones? The mind is a system of models, and being self-referential, must also have a model of itself; that model must have “matching consciousness” for “Self”-identification. Thus mind or the self-aware brain is a system of systems or a model of models that includes “the referee in the reference, the observer in the description and the axioms in the explanation.”³¹

A SOCIO-BIOLOGICAL MODEL

A proof within himself he feels
That all mankind is mov'd by wheels;
Their chains and strings and hidden springs,
And twenty other curious things...³²

Why follow endlessly the physical-technological tradition in modeling brain function? Why can't we study the “mind,” that is, consciousness, thinking, and attention through socio-biological models? Such models have the advantage that they need not be constructed, “they are already there.”

I propose that the social behavior of insect and, particularly, ant colonies may be viewed as a general model of brain function. An ant colony embodies a set of principles that account for

analogous performance in the domain of brain function. An ant colony follows both the *law of mass action* and the law of *equipotentiality*; and moreover, the colony is able to perform *parallel* operations just as the human brain does.

Karl Lashley³³ first reported that impairment in maze-running-behavior does not seem to depend on what part of the rat cortex is removed but only on how much is removed. Hence the “law of mass action” states that behavioral deficit depends upon the amount of tissue removed. The “law of equipotentiality” states that each part of the brain can make the same contribution to problem solving. The two laws are reconciled within the concept of parallel processing, i.e. the notion of computation involving the cooperation of many subroutines that work simultaneously in parallel.

A deficit in the functioning of an ant's nest or colony depends on how many ants are removed. And every part of the nest is able to make the same contribution, particularly in our specific model, the desert ant: *Cataglyphis bicolor*. This ant has a behavioral pattern comparable to that of the bee, but much easier to study.³⁴ The adult workers of almost every kind of social insect change roles as they grow older, ordinarily progressing from nurse to forager. The behavioral change is accompanied by patterned shifts in the activity of exocrine glands. In *Cataglyphis* each of the ants is undergoing a transformation process,³⁵ starting with “inside-service” behavior and then shifting to roles of the “outside-service.” Accordingly, there are ants which are “carried” by special carriers and who introduce them to outside-service; there are “diggers” and “hunters” and “carriers” of the outside-service. The ants change size and certain physiological parameters when passing through these functional states or temporal castes (as against physical or fixed castes in other species). In analogy to the cells of a particular human brain tissue, ants of a temporal caste do not recognize each other either as individuals.

The reliability of a system such as an ant's nest or a human brain depends on the ability to operate in parallel. The reliability of such a system is a function of the reliability and redundancy of its components. Speaking of the redundancy of components is tantamount to speaking of the operation of the law of mass action. The singular efficiency and optimized performance of the

human brain is regarded by many as a unique and most improbable event in evolution. But eusociality in hymenopterous and termite species, i.e. co-operative division of labor among workers who pass through well defined life stages across which their labor roles systematically change, is known to have originated independently and not more than thirteen times in evolution while the vast majority of the hundreds of thousands of insects and other arthropods are entirely solitary.³⁶

In 1964 W.D. Hamilton opened a new chapter in sociobiological theory by noting that the haplodiploid mode of sex determination in the Hymenoptera causes sisters to be more closely related than are mothers to their daughters. He viewed this circumstance as favoring the formation of a sterile worker-caste devoted to the care of sisters instead of daughters and hence a major factor in the origin of eusociality.¹⁹

Which aspects of brain function are modeled by eusociality and the behavioral roles of temporal castes in *Cataglyphis*? Hughlings Jackson's concept, the "heterogram," implies that in any arbitrary piece of the human cortex the face, hand and leg are represented unequally. If the lesion, or a small tumor, were located in an area where the representation of the hand is greater than in the other parts, malfunctioning would start in the hand. But if the same area were ablated, no paralysis of the hand would ensue, since the hand is also represented in other places of the cortex.³⁰ Although eusociality in *Cataglyphis* is represented throughout the ant colony, some functions, such as hunting, digging and carrying, are represented "at certain points." Hence, the varieties and distribution of co-operative social behavior, i.e. eusociality, in *Cataglyphis* represent a reasonable living model of human brain function in general and the heterogram of Hughlings Jackson in particular.³⁷

An ant colony is also able to model the plasticity of the young human brain. Despite extensive brain damage, including removal of the entire left hemisphere, a young child is likely to speak normally again and in the near future. This reflects the well-known plasticity and widespread representation of skills in the brain of the growing child. Perhaps the child has learned to speak using both hemispheres and whichever one is spared merely *takes over* the helm of language. The older the person, the more

likely it is that a circumscribed lesion will give rise to a limited deficit—with the greater probability that this deficit will be permanent.³⁸

Plasticity of behavior in honey bees has been repeatedly established with the same observation being extended to the temporal castes of social insects. To cite one of the best documented cases: when the number of wax-producing bees is reduced in a hive, some of the older workers reactivate their wax glands and recommence comb building. Similarly, if all younger bees are removed, including those functioning as nurses, many of the older forager bees regenerate their hypopharyngeal glands and resume care of the larvae.³⁶

The existence of plasticity raises a semantic problem: why refer to age groups as castes if their labor roles can be altered according to the needs of the colony? Or why refer to specific brain tissues as related to a particular behavior if behavior can be *taken over* by another “specific” brain tissue, according to the need of the whole brain? Oster and Wilson³⁶ argue (in relation to social insects) that probably each age group has a greater or lesser capability than others of changing in certain directions. Hence a temporal caste is to be defined, not just in terms of its labor profile within a normally constituted colony, but also by its pattern of labor change—that is plasticity—when the age profile of the colony is altered.

A CYBERNETIC MANAGEMENT MODEL

Beer³⁹ recently proposed management systems or corporations as models of the organization and functioning of the human brain. The highest managerial echelon of a firm is modeled not as it is depicted on a typical organization chart but with a diagram of “System Five” that could serve to illustrate the neuroanatomy of the human neocortex. In Beer’s “multinode” System Five is the hierarchy of systems he undertook to consider. Each system is embedded in a higher-order meta-system, which alone is competent to handle the structure of the lower-order system. It is understood that the formal language in which we define any system is likely to be incomplete: it will result in undecidable

propositions which can be answered only in the metalanguage appropriate to a higher-order system.⁴⁰ In logic we are committed to an infinite regression of languages and systems, but in physiology and management we are limited by a finite anatomy. "The brain and the firm must, therefore, expect to be confronted by undecidable propositions at the point where they run out of metalanguages in which to understand them." The ultimate criterion of where to stop asking questions is the capability for survival. This is, of course, a physiological-ecological and not a logical criterion.

SORCERER'S APPRENTICE: A COMPUTERIZED MODEL OF PLATO'S CAVE ALLEGORY

Sorcerer's Apprentice is an interactive computer graphics system utilizing a head-mounted display (or helmet) and a three-dimensional wand. The system allows three-dimensional interaction with line drawings which are displayed in real time, that is about 20 frames per second. The display, worn like a pair of eyeglasses, gives an illusion to the observer that he is surrounded by three-dimensional, computer-generated objects which he sees in addition to the features of his surroundings. These synthetic objects exhibit the size, perspective, and stability characteristics of real objects as the observer freely walks among them. Like real objects they are seen only when the observer is facing them; as he turns or walks past them, they leave his field of view.⁴¹

A small wand with several buttons on it enables an observer to interact with the synthetic objects by reaching out and "touching" them. As an aid to reaching and "touching," the wand as seen through the head-mounted display is marked by a spot of light, a cursor, which normally moves as though attached to the wand. Lines drawn using the wand appear as glowing wires and form "wire-frame" drawings. These lines do not fade in time but appear to be stationary in space. With the wand the lines can be joined to form objects which can then be moved, modified, and stored in magnetic tape from which they can be re-entered at a later date for further modification.

Synthetic objects seen through the head-mounted display ap-

Matter's Mastermind

pear to remain stationary as the observer moves. This stationarity results from continually changing the projection of the objects in a manner which compensates for head motion. Thus, the head-mounted display system is not only capable of displaying a frame every 20th of a second, but also of changing the perspective of each successive frame according to the changing position of the observer's head.

I.E. Sutherland⁴² at the University of Utah, was the first to formulate the concept of the head-mounted display or helmet to provide the vision (or illusion) of a three-dimensional environment of computer generated objects which can be "touched" although they exist only as data in a computer.

Since verification by touch through the small wand is programmed into the very same central computer that generates the perceptual data, Sorcerer's Apprentice appropriately models the most subjective of brain functions: reality testing.

In Plato's cave allegory⁴³ reality—for the chained down (pre-programmed) prisoners—consists of "shadows of images" in the cave. Analogously, the wearing of the helmet enables the vision of computer generated images in addition to the features of the surrounding. Hence Sorcerer's Apprentice may be viewed as a computerized re-formulation of Plato's cave allegory, both representing awe-inspiring models of the human condition in general and brain function in particular.

AN AUTOPOIETIC (SELF-MAKING) SYSTEM

Aristotle already made a clear distinction between the body and the organization of that body, our soul. Maturana follows the Aristotelean tradition and distinguishes between the material components of living systems and their structure: the complementary yet distinct aspect of any biological explanation. For Maturana the nervous system operates as a *closed* system and generates only states of relative activity between its component neurons (and sensory and motor elements). The nervous system does not generate input and output relations. Input and output are defined from the vantage point of the outside observer who specifies a perspective when describing the operation of the

nervous system. Accordingly the sensory and motor domains that an observer sees in an organism are attributes of the observer of the system rather than of the system itself.⁴⁴ Organization is in the eye of the beholder.⁴⁵ Every change in activity in the motor domain of an organism, according to Maturana, triggers a change of activity in the sensory domain of the same organism and *vice versa*. The closure between the motor and sensory domains is realized through what the observer sees as the environment, yet this environment is only a means for closure. The observer stands in his descriptions in the very path of closure of the nervous system, between the sensory and the motor domains of the organism, and from that perspective the nervous system appears to him as an open neuronal network.

We are a closed system, comparable to a pilot in the cockpit whose instrument flight at zero visibility consists only in maintaining and adjusting certain dial-readings.⁴¹ Our life too consists of maintaining and adjusting dial-readings for flight or fight, food, sex and sleep, the dial-readings for repression, denial, sublimation and so forth. In no sense is there environmental “information” being “processed.” “For what takes place in the operation of the nervous system is always the same kind of process: distinction of relations of relative neuronal activities through relations of relative neuronal activities, and so on recursively.” The paradoxical nature of such systemic information tightness,⁴⁶ i.e. the double-blind, double-bind nature of what “I am observing” becomes evident when one considers that the “I” of the observation and the goal seeking observer that proposes it are self-reflecting.

AN EVOLUTIONARY MODEL

The evolution of knowing-being or the story of “intelligent life” is reflected in an evolutionary model of the human brain that retains its ancestors as a three-in-one pattern.⁴⁷ According to MacLean we are constrained to look at the world and ourselves with the mentality of the crocodile in us (our brain stem), the horse in us (our limbic brain) and the human in us (our neo-cortex). In MacLean’s triune model of the brain the reptilian,

Matter's Mastermind

paleomammalian and neomammalian patterns, which radically differ in structure and chemistry, have replaced Father, Son and the Holy Ghost.⁴⁸ The reptilian brain provides what “was in the beginning” the λόγος or “program;”⁴⁹ the limbic brain’s arousal system lends (emotional) significance to the scripts and plots of the program; while the neomammalian brain—with its evolutionary generation gap⁵⁰—cortically interprets both program and arousal in as many ways as there are authors. The variety and creativity of interpretations is comparable to the creative variation in style that may be observed in the archetypal themes and plots that are being re-written, re-painted, re-sculpted and re-composed for each generation. For structuralists, adherents of general systems theory, believers in the theory of evolution and worshippers of Jung alike, the triune brain model offers scientific support for Utopian optimism while at the same time it comforts us with an evolutionary history that accounts for the gradual transformation of (Kantian) *a prioris* to *a posterioris*. To those who look for more relief from the human condition, MacLean’s advice is to take up cerebral astronomy and study the three great galaxies of the triune brain.⁵⁰

CODA

THE REAL AND ITS MODEL

The word “real” was coined in the XIIIth century to signify “having Properties,”⁵¹ whereas a “model” refers to an analogical representation the structure of which should correspond to the structure or properties of that which it represents. For Scudder the mind is a system of models and each mind develops different models. We all have a different reality in mind and so we live each in a slightly different world.⁵² Hence the real nature of the model and the model nature of reality are often indistinguishable. A snail, for example, when exposed to four tactile stimuli per second (with a rod on his belly) will be compelled to crawl upon that non-existing coherent spatial surface.⁵³ For the snail four tactile stimuli per second correspond to or are isomorphic with the structure of a spatial surface but it is impossible for

the snail to “know” which of the two structures is real.—Or consider the model psychoses. They can be induced in certain (so called “reactor”) subjects within an appropriate setting through the administration of psychodysleptic or psychotomimetic drugs, such as mescaline, D-lysergic acid diethylamide (LSD), and psilocybin, in the dose ranges of 500 milligram, 100 microgram, and 15 milligram, respectively. The resemblance between these acute, drug-induced model psychoses⁵⁴—a term I coined 35 years ago—and the hallucinatory psychotic states seen in the wards of mental hospitals is so striking that even an experienced psychiatrist, if asked to examine “blindly” subjects under the effect of these drugs, may well consider the possibility that these are cases of early schizophrenia.⁵⁵

Is our competence to discern properties—or to make distinctions—the form of knowledge? Perception of the sweetness of sugar is based on our interaction with a sub-structure that becomes sweet “super-structure” only when tasted. Without being tasted sugar is devoid of the property of taste, and hence is not “real.” Is sweetness ultimately (only) in the mind?

Does knowledge of the world exist within wisdom or is the way of knowing an illusory charm, the “appearance” of knowing? Don Quixote was confronted by a similar dilemma when asked by the Duquesa whether Dulcinea is real or only a model, i.e. a figment of his imagination. He replied: “These are not matters which lend themselves to unequivocal verification,”⁵⁶ or paraphrasing it in contemporary terms: “Is this really an important (a testable and falsifiable) question?”

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²⁰ The "influencing machine" is a successor of belief in *incubi* and *succubi*, devils which only priests were qualified to exorcise. The influencing machine of the paranoid schizophrenic is a machine of mystical nature. It consists of boxes, cranks, levers, wheels, buttons, wires, batteries, and the forces known to technology are utilized to explain the functioning of the apparatus. All the discoveries of mankind, however, are regarded as inadequate to explain the marvelous powers

of this machine, by which the patients feel themselves persecuted. The influencing machine produces motor phenomena in the body, erections and emissions, and this is accomplished either by means of suggestion or by electricity, magnetism, or X-rays. The machine serves to persecute the patient and is operated by enemies who are predominantly physicians by whom the patient has been treated. The connection with the patient is often established by means of invisible wires leading into his bed. V. Tausk, "On the origin of the "influencing machine" in schizophrenia", *The Psycho-analytic Quarterly* 2, 529-556 (1933); translation of the 1919 German original.

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Matter's Mastermind

³⁷ On the systemic level of the whole species—and in analogy to Hughling Jackson's heterogram—every "function" is represented everywhere but some functions are represented at certain points more than at others. The various "functions" correspond then to states of consciousness, states that are experienced "at certain points", i.e. in certain individuals more than in others. If we look at the human species as a giant brain then the localized functions at certain points are the "creative people", "psychotic patients", and "ecstatic mystics". Similar localizations are in fact "experimentally" produced during the tribal ceremonies of birth, initiation, marriage, installation, burial, and so forth. The ritual serves to transcend the life-experiences of individuals into transpersonal forms. During the ceremony of the ritual each person loses personal identity and becomes the archetypal warrior, bride, widow, priest, chieftain. The whole society is reflected in itself as an imperishable living (systemic) unit. In every archetypal function each individual discovers himself enhanced, supported, magnified and integrated.

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