

## Mind-Body Relationship



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The problem of the relationship between the mind and the body, is one that has always fascinated humanity across all cultures and in all times because of the many implications brought about by such an issue, not least the religious and existential ones. At present the issue is becoming more ample because of the progress of modern science and of its capacity to comprehend, with its methods, the psychical functions, their neural basis, their behavioural manifestations, and also the artificial reproducibility, at least partial, of such manifestations and, at least in perspective, the genetic modifiability of the neurophysiological basis of the same psychical functions. Faced with these questions, however, contemporary scholars are quite unprepared, because such progresses continually put into discussion the "territorial" division operated by René Descartes at the beginning of the Modern Age between the *res cogitans*, exclusive object of philosophical-theological investigation, and the *res extensa*, object of the physical-mathematical sciences. Starting from such a territorial division, the modern religious conscience has often found in dualism - that is in fact rooted in a tradition stemming from Plato to Augustine and to Descartes —an apparently safe and simple way to overcome the many failures emerging from the attempts to use science in order to explain human self-consciousness. This way has been especially followed by a number of scientists. However, the philosophical context of dualism leaves unsolved those difficulties,

that in the Middle Ages had already led the Magisterium of the Church to find the vision of St. Thomas Aquinas to be more congenial to the content of faith, a vision that we shall discuss here in this paper.

## I. Mind, Soul and Person: Some Epistemological Observations

*1. The Inadequacy of an Epistemological Reduction of the Problem.* Before dealing with the main metaphysical theories of the mind-body relationship that have followed on from each other throughout the course of the history of Western thought, a logic and terminological introduction, which involves profound theoretical problems, is necessary. When pre-modern thinkers were dealing with such a relationship, they generally would not refer to it with the expression "mind-body", but rather "soul-body." The distinction between "mind" and "soul," in these two uses, is essentially that which exists, in contemporary terms, between a "function" (*mind*) and the "structure" (*soul*) that exercises that function. Using the language of classical metaphysics, it is the distinction between a "faculty" — or "capacity to carry out (a) defined operation(s)" — and the "entity" or "being" that owns that faculty as an "essential" property, being typical or characteristic to it. In the Middle Ages, and especially for Scholastic philosophy, the *mens* represented the source and the common root of the two main faculties of the human rational [soul](#) [2]: intellect and will. In this sense, the problem of the mind-body relationship is presented in a double way: a) as a "psychological" problem of the relationship between the so-called "superior" functions of the human psyche (intelligence and free will) and the neurophysiological and physiological functions as such of the human body; b) as a "metaphysical" problem of the relationship between the subject of these superior faculties (the entity defined by classical thinking as the "soul") and the subject of the neurophysiological and physiological functions (the entity, evident to everyone, that we define "body"). Depending on whether these two entities become identified, or distinguished, and also depending on the way in which they are distinguished, we have varying metaphysical theories concerning the mind-body relationship. However, when the problem is dealt with in terms of the "mind-body" relationship, in many texts it is to be understood as being restricted to the first of the two problems above (that is, to the psychological one). Historically, this is due to the fact that, starting from David Hume's (1711-1776) *A Treatise of Human Nature* (1740), modern thought, in particular Anglo-Saxon authors, refer to the term *mind* as to the whole of the states and/or the conscious functions of the human being, as opposed to the Cartesian view of conscience as a substance in terms of a *res cogitans*, that is, an «individual thinking substance of immaterial nature». As we know from the history of philosophy, the notion of mind used by the English philosopher was totally devoid of any ontological foundation, as was in general any other notion of "substance," whether material or immaterial.

The legitimate, scientific motivation of such a [reduction](#) [3] is linked to the epistemological *posit* typical of modern science that, from Galilei (1564-1642) onwards, refuses to "try the essences" and, from Newton (1642-1727) onwards, concentrates exclusively on the "phenomenic", that is on the observable as "measurable." According to this epistemological vision, that limits itself to study the observable quantified and its laws, the reduction of our problem to the psycho-physiological dimension alone, i.e. the analysis of the relationship between the psychical and neurophysiological functions, is perfectly legitimate. This reduction should be at least declared, so that it is clear to those using such theories, and, above all, provided that other methods of investigation on the same subject are not excluded.

On the contrary a reduction that "in principle" excludes the metaphysical dimension of the problem has to be judged an a priori assessment. So does a vision that denies the mind-body relationship as a relationship between two distinct "entities" ("the mental" and "the physical"), reciprocally irreducible in such a way that the two disciplines (psychology and neurophysiology) that have these two entities as their own objects of study, are also seen as irreducible. When studying our problem, one of the major conquests

obtained in this century by logic and analytical philosophy, has been the demonstration of the logic-linguistic inconsistency of any epistemologically and linguistically reductionist approach to the mind-body relationship (cf. Quine, 1987, p. 133). The fundamental reason for the impossibility of this epistemological reduction has been clear since the end of the past century, thanks to the work of Franz Brentano (1838-1917). He rediscovered the irreducibly "intentional" nature of each psychical act as such, opposed to the Kantian formalism in the treatment of the states of conscience. The intrinsically "directed-to-a-content" character of each psychical act, as a conscious act, was rightly claimed against the Cartesian *cogito* and the subsequent Kantian *Ich denke überhaupt* ("I just think"), that both wanted to treat the conscious thought as "pure logic form" without any content. We do not "just think", but, rather, we always "think (perceive, want, etc.) *something*." The "subject-object" relationship, that is the relationship between a "subject who intends" and an "intended object," is an essential component of all conscious psychical acts, and for this reason it is defined as "intentional." The logical impossibility to identify "in principle" the "observational enunciations" of the neurophysiological science with the "subjective enunciations" of an individual, that describes our own psychical states associated with those events observed by the neurophysiologist (as in the classical experiments of psychophysiology), is due to the fact that these two languages follow "two different and incommensurable logics."

It is this incommensurability between physical and psychical states that makes the position of the so-called "theorists of identity" inconsistent (cf. Feigl, 1958, pp. 370-497; for a critical outline, cf. Basti, 1991, pp. 76-85 and Moravia, 1996, pp. 5-38). The theorists of identity hoped they could resolve the mind-body problem by proposing a presumed "synonymy" between the two modes, the "psychical" and the "neurophysiologic," to denote the same object (the neural event), that would imply the "substitutivity" of the one with the other. This substitutivity, based on the identity of the reference used (that is on the equivalence of the "extension" of the terms), is precisely what is forbidden in an "intentional" logic. As a matter of fact, the "axiom of extensionality," which is implicit to the reasoning of the theorists of identity, does not hold in the framework of an intentional logic. According to such an axiom, two classes (or in a weaker form, two collections) related to two distinct predicates that contain the same elements, in such a way to make equivalent the extensions of the relative predicates, represent the same class (or collection). From here it follows the reciprocal substitutivity of the corresponding predicates. Closely connected to the axiom of extensionality is the so-called "existential generalization", whose technical details we are not concerned with here. Such a procedure of generalization, however, is disastrous for the logic of those types of languages in which the axioms of "extensionality," "existential generalization," and "substitutivity for equivalence," clearly do not hold, as happens, for example, in the language of poetry, where the terms cannot be substituted with those of scientific language without compromising the meaning and the expressive value of our propositions. All the types of logic where the three axioms mentioned above do not hold, wholly or in part, are called "intentional logics." Synthetically, we could say that the languages satisfying the rules of intentional logics are those where the "ways" in which the terms describe (mean) their references —the extra-linguistic objects to which they refer— and not simply the rough fact of denoting them, become essential for the determination of the meaning of the propositions of that language. According to this, we could also say that a proposition constructed in an intentional form is characterised by a double content: a) it is "connotative" (the intended meaning) and, through this, b) it is "denotative" (the referring object).

*2. The Attempt of "Intensional" Logic: from the Mind-Body Relationship to the Person-Body Relationship.* All the empiricist approaches to the mind-body problem based on the epistemological reduction of the intentional description of a psychical type to the observational description of a neurophysiological type are therefore unproved, because they suppose the substitutability of the two descriptive genres, as if both followed an extensional logic. This groundlessness begins from the classic Humean and Kantian theory of sensation defined as "pure impression" (*raw feel*) in both systems,

considered as the psychical awareness of the mechanical modification of the sense organ, thus supposing an identity between the psychical modification of the mind and the mechanical modification of the sense organ. The only theories of identity which are today epistemologically acceptable - apart from their truthfulness, which is another problem - are those so-called "substitutive of identity" theories. Such theories are based on the assumption that, in order to build a really scientific psychology, and according to the level of progress reached by the neurophysiological and cognitive sciences in terms of supplying their descriptions and explanations of given psychophysical phenomena, it is allowed to operate, wherever possible, the following substitution. That is, to substitute an intentional "subjective" description about the psychical event with an "observational" description of the associated neurophysiological events and, at the most, with the "cognitive" description on the processing of information "implemented" in the aforesaid neurophysiological events. The lawfulness of such substitution would depend simply on the fact that each mathematical and experimental science, particularly according to its modern meaning, is based on extensional-type logics. The intensional logics, which are associated to the intentional reports of the psychical events, are, at most, those of the ordinary language when the latter deals with the mental events: those of a "*folk psychology*" and not of a "scientific psychology." This is Quine's position regarding the argument (cf. also Churchland, 1986; Churchland and Sejnowski, 1992).

Obviously, there is no objection to the fact that extensional and not intensional-type logics should be used in science. However, could the extensional logics of science be considered apart from the intensional component of each language, and in particular of the natural languages? And, above all, to what extent can they do this at the level of their foundations, particularly to formally resolve their semantic problems, first of all that of reference and that of the necessity-universality of their assertions? Were it impossible to think of an absolute independence of the extensional logics from the intensional contents, as in fact it appears to be, it becomes quite unlikely that where we talk about "mind," the producer of all languages and of their logics, we could imagine a complete substitution, in the name of the extensionality of scientific languages, the contents and the constructs of intensional languages. On the other hand, we comprehend how this irreducibility between the two reports of the subject agent/perceiver that describes his or her own irreducibly "private" psychical events - never to become completely objective even to the subject that perceives them — and the external observer describing the neurophysiological and informational (which are assumed to be) associated in some way to those psychical states, would be justifying a further epistemological approach to the mind-body relationship. Here we refer to the approach of many authors, who declare that we should not literally talk about the mind-body relationship, but rather of the "subject-body" or even of the "person-body" one.

This position has acquired importance thanks to the analysis of one of the best known representatives of analytical philosophy, Peter F. Strawson (b. 1919), who, moving against Descartes' position, and in full harmony with the epistemology of Scholastic philosophy, considered the "person" and not the "mind" as the characteristic subject of intentional language. Moreover — and in accordance with the Scholastic philosophy — Strawson considered the "person" as a primary notion, no further reducible to any other notion (cf. Strawson, 1959; similar positions, though with minor differences, more or less emphasized, were also put forward by Wilkerson, 1974; Greene, 1976, pp. 113-129; Margolis, 1978; Nagel, 1979; Dreyfus and Hall, 1982; for a review on these approaches to the mind-body problem cf. Moravia, 1996, pp. 233-266). From a logical and epistemological standpoint, to establish that the problem we are dealing with is not "mind-body," but more properly "person-body," is not a trivial assertion, considering not only what we have already said regarding the point of view of the subject of the intentional acts and of his or her absolute individuality, but also considering the complementary point of view given by the analysis of his or her corporeal properties, as it had been already noticed by Moritz Schlick (1882-1936). The "own" body as seen from the subject — "*my* body" — never coincides with the body observed by an external observer, given that the "own" body is the body that by definition can never become completely objective



to the personal subject that owns it (cf. M. Schlick, *Meaning and verification* in "Tra realismo e neopositivismo", edited by L. Geymonat, Bologna 1974, pp. 187-218).

3. *Epistemological Characteristics of a Dual, Non-Dualistic Metaphysical Approach.* To conclude this section, we observe that all of the cited authors -and I include also myself together with them- invite us not to metaphysically overrate the logical-epistemological approach of the anti-reductionistic type as it is here put forward. The "duality" of "mental" and "physical" languages, and the irreducibility of their references, do not imply the "dualism" of the substances of "mind" and "body". It is not by chance that none of these authors agrees with a "dualistic" Cartesian solution to the metaphysical problem that emerges from this analysis. On the other hand, we do not agree with those authors, such as Quine, who state that the mind-body problem, if correctly set upon these non-reductionist epistemological bases, should be exclusively a logical-epistemological one, and not also a metaphysical problem. Such a position implies a wrong epistemological conception of metaphysics, one typical of the Modern Age. In a few words, to state that metaphysics is the "science of the being ( *ens* ) as such", does not mean that metaphysics is the "science of the being ( *ens* ) as existent ( *existens* )". The fact of reducing being to the dimension of existing alone and of its factuality is, once again, the result of an "extensionalist" reduction of the notion of being, brought into modern metaphysics by the "competition" between modern physical-mathematical sciences and their extensional languages. The "being" described in metaphysics is not only the "extensivity of being" ( *existentia* ), the "being" of the referent of a true affirmative proposition, or of the "non-being" of the referent of a true negative proposition. The being of metaphysics is also the "intensity of the entity" ( *entitas* ), of the "being as" ("as a horse," "as a man," "as a number," "as an atom," "as a substance," "as an accident," etc.), respect to certain properties, which are "essential" for an adequate description of a referent in a given and limited context, and without which it would make it impossible to build any positive proposition on it.

It was thanks to Thomas Aquinas (1225-1274) and to the contemporary reading of his doctrine of the "being as act," as an "intensive" *esse*, worked out by Cornelio Fabro (1911-1996), that this issue was given particular attention in the neo-Scholastic philosophy of the 20th century (cf. C. Fabro, *Partecipazione e causalità*, Torino: S.E.I., 1961). In other words, when we say about a certain being *x* that "it is an entity," or "it has *being*," we are not merely saying that "it exists." Rather, we cannot satisfactorily answer the question "does it exist?" if in first place we have not sufficiently answered the question "what is that being that should exist?". The term "being" which is next to the term "is" (Lat. *copula*) in the scheme "*x* is a being" does not primarily indicate the existence of that being, but rather the entity of that being, that set of properties which are necessary, though never sufficient, to determine that being. When captured in a (always) partial manner by a defining-type proposition that refers to a subject as a general term denoting a collection of beings, such "essential" properties endow that same proposition with a subject-predicate reversibility (i.e., "man is a rational animal" as an equivalent to "the rational animal is man") that grounds its analyticity of non tautological nature in a given linguistic context, and grounds as well the logical necessity of that proposition and of the propositions correctly deducible from it. That is why we were not, and neither we intend to be, dualistic when, according to the initial linguistic analysis, we stated that it was correct to talk about the "mental" and the "physical" as two distinct entities, without at all implying that through this statement we were admitting (or denying) the existence of two distinct beings relatively to these "entities" and to their semantic fields. These "two" distinct and irreducible entities figured as a closed polygonal line and the surface that it includes, can be very well two components of a unique "existing" psycho-physical being, the human person. This is logical-epistemological nucleus of the "dual" metaphysical theories — neither "monistic," nor "dualistic" — of the mind-body relationship. We hold that these are the theories that provide the most adequate (true) metaphysical solution to our problem, besides representing the solution that is most consistent with the Christian faith on the (temporary) immortality of the soul, and on the (definitive)

immortality of our person [risen from the dead](#) [4], reconstituted in its psychophysical unity.

## II. Metaphysical Theories of a Dualistic View

The mind-body problem was first introduced by Plato (427-347 B.C.), the principal representative of the dualistic theory. According to his theory the soul and the body constituted two separate substances that interacted causally, and the soul represented the "driving force of the body." The soul moves itself, and at the same time it moves the body that is seen in this way as a "tool" of the soul, according to the famous metaphor of the helmsman and of the ship (cf. *Republic*, IV, 438d-440a; *Timaeus*, 42e-44e; 69c-77c; 89d-90d; *Laws*, X, 894e-898d; however, this metaphor precedes Plato). In the Modern Age the dualistic theory was once again put forward in the 17th century by Descartes, and in the 20th century by Eccles.

*1. The Cartesian Theory.* Unlike Plato, René Descartes (1569-1650) considers the organic body of living organisms, including the human body, as an "automaton" of inertial type. It is an automaton in the sense that it does not need any [finalistic principle](#) [5] for the explanation of its functioning; it is "inertial" because it is based on the determinism of the principle of inertia. The two most fundamental dilemmas of the Cartesian dualistic theory are the "logical-metaphysical" and the "physical-mathematical" problems.

a) From the "logical-metaphysical" point of view Descartes demonstrates the existence of an individual spiritual substance based on the *cogito*, using the ancient Augustinian proof the wrong way. The French philosopher claimed that from such a demonstration he would derive self-evident information not only on the "existence" of a conscience, but also on its "nature". As already noticed by his contemporary Gassendi, and after him by Kant, Hegel and Husserl, the Cartesian claim of saying that «I think therefore I am, such that there is a thinking object (*res cogitans*)» is equivalent to saying that «I think therefore I am, i.e. there is a "thinking individual spiritual substance"» has absolutely no foundation. The *cogito* proves up to a certain extent the existence of a conscience although the nature of this conscience, whether material or spiritual, individual or meta-individual, is another issue. In relation to this, Aquinas, commenting upon Augustine, stated that the introspection given by the *cogito* only proves the existence of a psychical life within us. However in order to decide which nature this psychical life is, whether it be material or spiritual, individual or meta-individual, a *subtilis et difficillima inquisitio* is required — as the Averroistic Aristotelians declared at the time of Aquinas (cf. Thomas Aquinas, *De Veritate*, q. 10, a. 8, where this «"subtle and extremely difficult research" is brought forward in a synthetic form and with exceptional clarity and depth).

b) From the "physical-mathematical" point of view, the establishment at the time of Plato of an interactionist doctrine that viewed the soul as the subject of a special action on the vapor particles (air + water + heat) of the so-called "corporeal spirits" of ancient neurophysiology, found no problem. From ancient Egypt and from the book of *Genesis* up to the time of Luigi Galvani (1737-1798), the interactionist doctrine attributed the transmission of the nervous impulse (whose electric nature was discovered by Galvani) to a sort of fluid along the nerves, reduced to microscopic capillaries. This, however, could not hold for the physical-mathematical explanation of inertial type, which Descartes proposed in his physiology for the action of corporeal spirits. The idea that the spiritual soul would shift the direction of motion of a flow of "spirits" in the pineal gland (epiphysis) of the brain, in such a way to set off a "voluntary" movement of the human body, was against a fundamental principle of conservation in mechanics, directly derived from that of inertia, known as the "principle of conservation of momentum." Therefore, a non-extensive substance such as the Cartesian *res cogitans* cannot minimally deviate the motion of anything endowed with a mass, no matter how little it is. In any case, moving beyond any specific criticism to the Cartesian mechanism, every dualist-interactionist theory between

spiritual minds and material bodies implies a violation of some kind of principle of energy conservation. In this way, such a criticism completes from a modern scientific point of view the criticism that in the Middle Ages St. Thomas had already made against Platonic interactionism in metaphysical and theological terms. As a matter of fact, while criticizing Platonic dualism, Thomas Aquinas affirmed that if the spiritual soul is in a causal relationship with the body through the influence on the action of the corporeal spirits, then the principle of the substantial unity of the person is lost, and it becomes difficult to explain the individuality of the soul, which according to Plato can reincarnate in different bodies, a hypothesis which is considered absurd by Christian theology (cf. Thomas Aquinas, *Summa Theologiae*, I, q. 75, a. 7, ad 2<sup>um</sup>; q. 76, a. 7 corpus and ad 2<sup>um</sup>).

2. *The Theory proposed by John C. Eccles.* The most fundamental contribution that John Eccles (1903-1997) made was the attempt to provide a new solution to the physical-mathematical problem of the violation of the conservation principles that emerges in all interactionist approaches; like many other modern authors, he was convinced that the only way to support the right ethical and religious reasons for the existence of a spiritual soul was to adhere to a dualist-interactionist metaphysical vision of a Platonic-Cartesian type (cf. Eccles and Popper, 1977; Eccles and Robinson, 1984). Eccles believed to have found such a solution through the reference to the principles of [quantum mechanics](#) [6], necessarily involved in the chemical-electrical mechanism of synapse communication. In fact, according to the principle of indetermination, we could think of an extra-physical action exerted by the mind on the synapses of the various cortical neuronal populations, without the violation of any principle of energy conservation. There are two main objections that can be moved towards this solution, one of a biological type, and the other, more substantial, of a physical type, they both having immediate metaphysical implications.

a) From a biological point of view the fact of claiming that the characteristic level of the psycho-physiological phenomena corresponds to the microscopic scale of the quantum interactions between the molecular components (proteins) of the nervous cells, makes Eccles' theory subject to a physicalist [reductionism](#) [3]. Generally speaking, most biologists agree in saying that the characteristic physical level where the vital phenomena emerge in their irreducible specificity is that of the macroscopic scale, where the organization and possibly the self-organization of complex molecular structures (proteins) occur, which are stable out of the thermodynamic equilibrium. They are "dissipative structures" that self-organize and continually exchange matter-energy with the external environment, internally and externally to the body (cf. I. Prigogine, *From Being to Becoming. Time and Complexity in the Physical Sciences*, San Francisco 1980; I. Prigogine and I. Stengers, *Order Out of Chaos. Man's new Dialogue with Nature*, London 1984; I. Prigogine, *Exploring Complexity. An Introduction*, New York 1989). Yet, here we are faced with an important metaphysical consequence. If we accept that the biological and - in our case - the neurophysiological level is that of the microscopic quantum scale, given that such a level and its related uncertainty are universal for all the material structures of organic and non-organic nature, why then not brush up again the Gnostic and Neo-Platonic theories of the *anima mundi* type? Then, why would not all matter be animated? This is what, in fact, was suggested in the years 1960-1970 by a few theosophical movements — some very prestigious due to the known scientific personalities involved, such as the so-called "Gnosis of Princeton" — that were actually based on such principles.

b) Much more substantial is the "physical" objection against interactionism, which is supported by authors like Roger Penrose who, although coming from a non-dualistic standpoint, is among the supporters of the role of quantum phenomena in the study of the physical basis of conscience. His objection is that it is unfounded to endorse the suspension of the causal physical [determinism](#) [7] on the account of the quantum uncertainty. The quantum phenomena only show uncertainty when faced with the problem of "reduction of wave function" and to the problem of the amplified "reading" of quantum event,

on a macroscopic scale, in terms of the mathematical formalism of classical mechanics (that is, in terms of the functions that define one-dimensional trajectories; cf. Penrose, 1995, p. 349). On the other hand, the description of quantum phenomena (in the microscopic terms of the appropriate mathematical formalism of the wave function) is supported by experimental measures which agree with the theoretical predictions, and show no uncertainty at all, despite the temporary state of quantum electrodynamics which provides such predictions (cf. R. Feynman, *QED. The Strange Theory of Light and Matter*, Princeton: Princeton University Press, 1985). Therefore, it is not at the quantum level that we can hope to solve the scientific groundlessness found by modern authors in the dualist interactionist explanation.

### III. Theories of a Monistic View

Theories of a monistic view are "metaphysically reductionist," and they still are even at present time, when they are forced to be "epistemologically non-reductionist" by logical evidence (see above , I). These are metaphysically reductionist since they reduce one of the two terms to the "product" of a function (or many functions) of the other. The history of philosophy of the second millennium brings to us two distinct types of monistic theories, spiritualist and materialist. The former can be essentially reduced to a single theory of this type, that Leibniz (1646-1716) presented in his *Monadology*. According to this theory, the body results as a "representation" of the [spirit](#) [8]. This philosophy of nature considers the material particle in terms of an "non-extensive singularity," hence immaterial, of a "monad," in such a way that each physical body results as an aggregate of immaterial monads, all which are in the end "internal" representations of the Absolute Monad. This theory, that was judged by Hegel as a "metaphysical novel," for us it is merely of academic interest. Here we shall dedicate more attention to the theories of materialist nature.

*1. Materialistic Monistic Theories.* The materialistic monism consists in the reduction of human psychical life to the product of the neurophysiological functions of the body, considered a sort of "secretion" of the neurons. As main representatives of this anthropological teaching we can consider all the major empiricist philosophers of the Modern Age, from Hume to the contemporary positivists and neo-positivists. In the 20th century, this way of proceeding is presented in different versions.

A first version is that of the "theories of identity," already presented in Section I and which we do not need to recall again. A second version is represented by the "emergentist theories." The emergentism is highly popular amongst the neurophysiologists and those who have a background education in the natural sciences, such as physics, chemistry or biology (cf. Bunge, 1980). The term "emergence" is to be understood at a level of organization of matter that, maintaining the validity of the laws at the lower level, needs for its scientific characterisation the formulation of new laws. For example, it is evident that the laws of thermodynamics apply to all chemical systems, however it is not possible to simply derive from the laws of thermodynamics all of the chemical properties of the molecular compounds, although it is clear that in both cases the referent is always the same aggregate of molecules. With the same type of reasoning the theory attempts to explain the emergence of the psychological facts and their laws as the emergence of a new, higher level of organization of the same physical substratum. Here, we are not far from a theory of identity: moreover, there are always emergentist signs in all theories of identity, from that of Feigl to that, more recent, of Patricia Smith Churchland. The limits of the identity theories already discussed, are the same as those of the emergentist theories.

A third version of materialistic monism is represented by the "behaviorist theories." Behaviorism started off in the 1930's as a particular school of empirical psychology, with the works of John B. Watson (1878-1958), and considered each reference to the 18th century psychology of conscience as



non-scientific, in particular that of phenomenological nature. Then the behaviorist theory acquired philosophic dignity in the 1950's, thanks to a fundamental work by Gilbert Ryle (1900-1976), *The Concept of Mind* (1949). The leading idea of this theory is the non-objectivable character of the conscious "self", intended as the "presence to my self" (what I am able to render as an object to myself is only "me," however always relatively to its past states or acts) and its systematic elusivity, like the present temporal moment, the "now," the *nunc*. From that it derives its criticism to the "Cartesian self", intended in an objectivistic way as a "spiritual thing," and the proposal of a "dispositional behaviourism" as the characteristic object of a really scientific psychology. In other words, because of the systematic elusivity of the temporal moment, what is objectivable of behaviour is not the physiological event as such (for ex. the modification of the physical state of a population of neurons), but rather the modification of the "disposition to act" of a number of organs (for ex. the modification of the electrical action potential of an aggregate of interconnected neurons). This approach has resulted particularly prolific in scientific terms because it created on a theoretical scale a link between the old type of behaviourism belonging to the associationistic psychology of Pavlov and Watson and the computational approach typical of functionalism, and this because the notion of a "disposition to act" correspond immediately to the matrix calculus of statistical mechanics applied to the study of the cerebral dynamics. In fact, a status that shows disposition to act can find its immediate operational equivalent in a matrix of transition probabilities, which is, in statistical mechanics, a classic algebraic instrument of calculus. Such a matrix of  $n \times n$  elements, for each time  $t_k$ , defines for each element the probability of transition from one to any other of its possible states (for ex. the probability for each neuron in a network of interconnected neurons to jump from an active to a non-active state, and vice-versa) in a manner that is conditioned by the state of the other elements in the matrix. On a formal scale the "neural networks" are nothing more than very evolved, and sometimes very complex, versions of this basic idea.

2. *A Special Kind of Materialistic Monism: the Functionalist Theories.* At the beginning of the 1960's Hilary Putnam (born in 1926), with his famous work *Minds and Machines* (1960), launched the research program of "functionalism," having the intention to solve the mind-body problem in terms of the *software-hardware* relationship of a *computer*. Such an approach, which is today completely repudiated by its initiator, had the intention to re-propose on a new basis the classical rationalist theory of the mind. Putnam did so in the light of the notion of "cognitive unconscious" taken from the psychology of intelligence elaborated by the Swiss psychologist Jean Piaget (1896-1980), who identified the intelligence with the development of logical-formal operational schemes and their unconscious use by the subject (cf. J. Piaget, *Logic and Psychology*, 1930; J. Piaget and B. Inhelder, *The Early Growth of Logic in the Child*, 1960). Putnam's second pillar was the development of a theory of computability starting from the mathematical interpretation of formal logic and the notion of propositional function operated by Gottlob Frege (1848-1925), which had experienced two further steps. First of all, between the 1920 and the 1930, we had the invention and the development of the *lambda*-calculus, through which the great American logical-mathematician Alonzo Church (1903-1995) demonstrated that all computable functions of the logic and/or mathematical calculus are also algorithmically computable through "recursive" functions. Secondly, the English mathematician Alan Mathison Turing (1912-1954), who is the father of modern computers, discovered in 1937 an elementary scheme for an algorithmic machine, the "Turing Machine" (TM), which was able to calculate any recursive function and/or to simulate the calculations performed by another TM, until the construction of the "Universal Turing Machine" (UTM), able to simulate the calculations of any other TM. Therefore, the UTM constitutes the logical scheme of a modern multi-programmable calculator. The link with the field of behaviourism was derived by a further demonstration obtained by W.S. McCulloch and W. Pitt in 1943, that guaranteed the equivalence between the algebraic matrix calculation of a simply interconnected network of neurons and the calculations which were executable by a TM. From here followed, in the 1950's, the development of the two main features of functionalism, that ultimately led to the so-called "strong version" of the research programme of [Artificial](#)

[Intelligence](#) [9] (AI): the idea of artificially simulating the intelligent human behaviour, and the idea of an essential isomorphism (biunivocal correspondence) that must formally exist between a logical calculation performed by the brain of a human being that is performing a certain intelligent behaviour and the *software* that "runs" (that is, the formal calculation executed on symbols) on a *computer* that is able to simulate that behaviour (cf. Turing, 1950, pp. 433-460).

In spite of the extreme theoretical interest and its scientific inventiveness -that made possible the birth from a functionalist research program of a new discipline linking together psychology and neurophysiology in the new field of "cognitive sciences" — the most fundamental limit of this approach is the purely formal, exclusively extensional, character of the logical calculations which can be simulated by a TM. It appears therefore totally insufficient in accounting for the intentionality and the intensional logic referring to the "contents" (cf. Searle, 1980, pp. 128-135 and Searle, 1983), and results also deprived of the fundamental "Socratic" property of human intelligence, that of the "knowing of not knowing," and thus of the ability to judge the truth and the consistency of those theories and ideas which are produced by it. An incapacity which is formally linked to the theorems of incompleteness of Kurt Gödel (1906-1978) on the limits of a purely formal metalogic and that is usually identified by the AI theorists with the systematic incapacity where the machine is concerned, unlike the mind, to "take the distances" from the task being executed in order to judge it "from the outside". For this reason, in the functionalist approach of "strong" AI, it is necessary to rely on an "oracle", according to the expression coined by Turing himself, a figure of unquestionable universal intelligence that is able to produce its responses of truth and coherence without conceding any possible control on its action. Hofstadter (1979) comes to this conclusion and ascribes in a neo-Spinozian way the metalogic function of "universal intelligence," of "oracle," to the non-computable determinism of the matter as a whole, matter of which also the brain of a single individual is part of, a determinism that appears "inviolable" towards the necessarily partial self-referentiality of the cerebral computations of a single brain. In such a way, functionalism reveals its "double monist" nature for a theory of mind-body relationship. It is monist not only because it denies the "immaterial" dimension of intelligence, but also, and above all, because it denies the existence of "individual" intelligences which produce thoughts and are capable to act freely. That is, it denies the metaphysical foundations of the notion of person. From a metaphysical point of view, functionalism appears as a re-proposal of the rationalist theories of the mind that deny to the single individual the capacity to think "with his or her own head," as was proposed already in the Middle Ages by the theories of the Arabian rationalist aristotelism of Avicenna and Averroes, in the Modern Age by the theories of Spinoza and Hegel, and in the contemporary ages by the doctrine of Husserl and his meta-individual "phenomenologic Self."

*3. Intrinsic Limitations of the Functionalist Approach* . On the other hand the approach of the cognitive sciences to the study of the mind and of the mind-body relationship can also be interpreted according to a "dual" type of metaphysical scheme, provided a renunciation of its original functionalist character. However, before examining the dual theories, it is necessary to make a brief consideration about the intrinsic limitations of the functionalist approach, or theory of the "strong" AI, that leads its authors to the "oracle solution" and brings them to the above mentioned twofold monist outcome. It is clear that in the functionalist approach each human mind corresponds to a UTM, given the capacity the human mind has for a universal thought. Now, the incapacity of a UTM "to have the knowledge of not knowing" depends upon the famous theorem of limitation which is intrinsic to the Universal Turing Machine computations. This machine has the capacity to simulate the calculations of all the single TM, in such a way to confer universality to their computations, but has the limitation of not being able to decide when its calculations have reached a satisfactory outcome and have to stop consequently. In particular, the UTM cannot find a decisive computational procedure, through which "to assert" in its (arithmetic) meta-language that a certain datum expressed in its (arithmetic) language is "false." For this reason, it is said metaphorically

that the UTM "cannot have the knowledge of not knowing." Yet, this is exactly where human intelligence begins. Human intelligence is capable of correcting itself, of progress and development, unlike animal intelligence, precisely because of its ability to notice its own errors. The incapacity of a formal calculation to decide upon its own falsity depends upon the theorems of incompleteness of Gödel regarding axiomatic arithmetics, and particularly upon the second theorem of incompleteness, that excludes the possibility of formal arithmetics being its own meta-language (on the theories of limitation of the UTM, see the introduction by Penrose, 1995, ch. 3; for the interpretation of the limits of the UTM as a denial of the Socratic roots of human intelligence, cf. Basti and Perrone, 1999, pp. 553-566). From a point of view that takes into account the history of logic, to overcome the mentioned limits of the formal calculus would mean, at the same time, overcoming the limits of the axiomatic method itself, as if it were the "only" method in modern logic, and to recover the richness of the pre-modern analytical method, characteristic of Platonic, Aristotelian and Scholastic logic: the logic of induction, abstraction and [analogy](#) [10]. In a word, to perform these operations would mean to render scientific dignity to the "logic of discovery" against the modern absolutism of the "logic of proof" and of its axiomatic method (cf. Cellucci, 1998).

## IV. Dual Theories of interpreting the Mind-Body Relationship

When speaking of "dual" theories we mean all those theories of the mind-body relationship that:

a) against materialistic monism, and like the dualist theories, admit a reciprocal irreducibility of the "mental" as a product of a function, or an ensemble of functions, of the body; b) against dualism, they support the psychophysical unity of the living organism and, in our case, of the human being.

In such way the mind-body relationship is interpreted according to the Aristotelian "hylomorphic" metaphysical scheme of the form-matter relationship (Gr. *hyle*, matter, and *morphé*, form. According to the version given by Scholastic anthropology, the spiritual soul is the form of matter, and "form" and "matter", substantially united, constitute the living human body, the only personal substance of a human being and of that "unique" human being, capable of vital vegetative operations (metabolism, growth, reproduction), and of sensory-motor and intellectual functions (for a review on the principles of the Aristotelian-Thomistic biology, cf. Basti, 1995, pp. 131f). With respect to the monist and dualist theories, the "dual" theories have three main characteristics: the first one regards the "localization" of the mind with respect to the body; the second regards the "non-representational epistemology" associated with it; finally, the third one regards an original solution put forward for the problem of "immateriality" and of *post-mortem* "subsistence" of the soul separated from matter. These characteristics (especially the third) are strongly present in the medieval thought of Thomas Aquinas, who made the choice to re-evaluate the Aristotelian hylomorphic approach in anthropology -not without operating a profound revision of its metaphysical basis. He noticed that, besides an intrinsic superior coherence, such an approach could grant a great consistency with the principles of Christian anthropology, more than that shown by the Platonic dualist approach, especially for what concerned the person, its irreducible individuality and its intrinsic psychophysical unity. Many contemporary authors who operate today in the field of cognitive sciences intend to refer to a dual-type, and not to a monist-type metaphysical paradigm, even though only a few of them, in the recent past, were clearly aware that such metaphysical paradigm was not compatible with the functionalist approach of the cognitive sciences (cf. for ex., Fodor, 1981, see below , V).

*1. The localization of the Mind.* The mind (or, in the Scholastic, Greek-Platonic terminology, the "soul") is indeed a non-material "thing," as Descartes would have liked, however it is not a "substance" that is complete in its being in the way it is stated by the dualist theories. It is the formal principle of unity of a stratified whole of material parts (today we would say: atoms, molecules, proteins, cells, tissues, organs) such as the living human body, a principle that enables this whole capable of performing certain

operations, at the most those voluntary and intellectual of a personal human subject. It is rather a non-material or "formal" component of a substance made of material parts that experience constant modification. Where the notion of "form" is understood according to the Aristotelian philosophy of nature, as a constantly adapting plastic whole of relationships of disposition of dynamic material parts, continually modifying and interacting among themselves and with the external world. An example of it, is given, at the cellular level, by the metabolic physical-chemical activity of the cell itself. In this context the "mind," according to the dual theories, has a unique location with respect to the body, which the mind itself organizes. Instead of being located "in the body" and at the most "in the head", as in all of the dualist theories (Plato assigned its location to the attachment point of the neural cord with the cerebellum, Descartes in the "pineal gland" (epiphysis), Eccles in the synapses of the populations of neurons in the cerebral cortex), and in the ancient and modern monist theories, an illustrative solution that M. Schlick defined "principle of introjection", the dual theories rather affirm that "it is the mind that *contains* the body." The mind is in fact considered as a formal whole of relationships of organization (communication and control) between material parts undergoing a process, in constant physical-chemical interaction, that grants to such a dynamic whole a unity, identity and specificity in time, which are themselves also plastic, dynamic, in constant modification of adaptation to an environment that changes. In a book which is strongly and justly critical towards the functionalist approach to the cognitive sciences, Penrose expresses himself on the matter: "Most of the material of our bodies and brains, after all, is being continuously replaced, and it is just its *pattern* that persists [...]. It is not all unreasonable to suppose that the persistence of the 'self' might have more to do with the preservation of *patterns* than of actual material particles" (Penrose, 1995, pp. 13-14). Here is instead what was stated on the same argument by Donald M. MacKay (1910-1986), one of the founders of the non-functionalistic approach to the cognitive sciences, to whom, amongst other things, we must acknowledge the definition of "dual theories" applied to this particular type of theories of the mind: "In the first place, it meant that although looking for 'the seat of the mind' was not meaningless, it was not something to be achieved by analysis of the brain into components and looking for 'action of the mind' on individual parts. Mental activity would be meaningfully locatable (in principle) in specific flow-structures of the information-diagram; but this meant that the relevant flow-lines would in general extend beyond the confines of any one component structure, and during conscious action might even run out-and-back through the environment. Mentality, as a system-property, could be rendered invisible or destroyed by attempts to localize its action to any subsystem of the total information-flow pattern in which it was currently embodied" (MacKay, 1980, p. 1389). More recently, the same idea that the mind is embodied within the informational flow schemes, internal and external to the body, received support from A. Clark (1997). It stands as the new post-functionalist paradigm in the cognitive sciences, one that tries to unite different elements, albeit not without some confusion. Among them are: the traits of the phenomenology of corporeal qualities of Heidegger and Merleau-Ponty; the non-representational theories of the mental activities which are typical of robotics, of the connectionist approach to the neural networks and of the "ecological" approach to perception of J.J. Gibson; the theories of complexity used in the study of the non-linear dynamical systems.

Regarding the localization of the mind or of the "rational soul" of the human being with respect to its body, in the Middle Ages, Thomas Aquinas held a position that was very similar to that of the modern supporters of the dual theory. He said precisely that non-material entities, such as the soul, can be localized with respect to the matter that they control and organize, not through a relationship of contact between the external surfaces of a body "that contains" and those of one that is "contained," as it takes place between material entities. Non-material entities, rather, must be localized through "the extension of the capacity to control and organize (Lat. *gubernare et regere*) matter» that, thanks to this global control and organization, constitute a living body, an "organism" with specific faculties. For Aquinas the attempt to localize the soul and its action in specific parts of the brain, such as that brought forward at his times



by the interactionism of the Platonists, is totally wrong and misleading (cf. *Summa Theologiae*, I, q. 52, a. 1; q. 76, a. 8). Resorting to this same principle, he justified the omnipresence of God in the universe, for His actual capacity to govern everything (and not just a body as in the case of the human soul in each one of us). According to St. Thomas, only in this way does it make sense to say that the whole universe «is in God», as it is stated by the Holy Scriptures and theology (for an historical overview, cf. Basti, 1991, pp. 266 ff ).

*2. Intentional Theory of Knowledge.* A second characteristic of the dual metaphysical theory of the mind, immediately linked to the original localization of the mind with respect to the body in the theory itself, is that it appears connected to an "intentional" theory of knowledge, as much as the other two types of theories are, at least in modern times, dependent upon an exclusively "representational" theory (representationism) of knowledge. How the history of modern philosophy teaches us, the emergence of a representational theory of knowledge is nothing more than the epistemological counterpart of the progressive establishment of the absolutization of the axiomatic method in modern mathematics and logic, that identifies in the theory of demonstration and proof the only object of logic as science and as *organon* of the mathematical and natural sciences. So much the questioning about the truth and the foundation of axioms is well far beyond the interest and the capacity of the axiomatic method, how much, in a similar way, does the questioning about the "thinking thought" (the *intellectus* for the thinkers of the medieval period) that formulates ideas and produces logical symbols in a truthful relationship with the object, with respect to the representational theory of knowledge. A questioning, that on the thinking thought, which limits itself just to the analysis of the "thought which is thought," the thought that manipulates symbols which are already constituted according to logical and formal rules (the *ratio* in medieval terms). This got to a point in the 19th century when a project was conceived to reduce epistemology and logic to a unique "universal algebra" of thought, reduced to a pure syntactic formalism occupied with the manipulation of graphical "signs", no longer without a symbolic (semantic) value. The building of a TM is probably the higher expression of the formalist approach to logic and epistemology, but for this very reason it indicates, at the same time, the beginning of an unstoppable decline. The intrinsic limitations of the UTM (see above, III.3) have revealed the relevance of the logical-foundational questions over the calculus and its automation, the latter being the major contribution given by the modern scientific revolution from Newton and Leibniz onwards. It is certainly not due to mere chance that the principle of intentionality came to acquire an ever greater relevance in the contemporary epistemological and logical-foundational debate, as it became increasingly evident that there was on the one hand a failure in the formalist approach to the foundations of logics and mathematics, and, on the other, the insufficiency of the functionalist interpretation in the cognitive sciences.

*3. The Mind is Immaterial and subsists "Post-Mortem".* In the 13th century, when Thomas Aquinas had to face these problems as a philosopher and a theologian, he was in a very similar situation to ours. On the one hand, he had a traditionalist theology and philosophy of Platonic kind, which were linked to a fading spiritualism; on the other hand, he had the Aristotelian philosophy, which was linked to the culture of the new universities, and whose theory of the soul as a form of the body made the justification of the immortality of the soul problematic, especially when intended as immortality of the individual being. In a particular way, in the last part of his life, Aquinas, in Paris, had to face up to that "lay" interpretation of the Latin Averroism of Siger of Brabant (1235 ca. -1282) who, on the one hand interpreted in a materialistic sense the mind of the single individual, and on the other hand supported the theory of a single "universal intellect," meta-individual, with the purpose of assuring a universality to the products of the logical thinking. As an answer to these theories Aquinas proposed his own interpretation of the Aristotelian rational soul as form of the body. In so doing, he wished to obtain two main results: a) to assure spirituality or immateriality to the rational faculties of the mind, in order to justify the capacity of

universal thought of the single individual, and its freedom of action (in such a way, though, to explain that a cerebral accident could totally or partially prevent the practice of these faculties); b) to solve the apparent antinomy of a soul that on a metaphysical scale is a form of the matter of a body, hence which determines the "single substance" of the human person, and at the same time must be able to subsist on its own as an individual (and not as a group entity) after death, being in some way "itself a substance."

## V. Dual Theory of the Mind and Spirituality of the Soul

*1. Immaterial Intellect and the Brain.* As far as the first problem is concerned, that is how to ensure the immateriality of the intellectual faculties, the solution proposed by Aquinas is similar to that which is proposed today by the functionalist theory. The latter, in order to justify why the human being has the capacity of rational thought, particularly the "creative" capacities, hypothesize the existence, "outside" of the system, of a "closure" of the hierarchy of partially self-referential controls that characterizes the living body. However, instead of identifying such "closure" with the "unique" intellect of the Averroists -and/or with the "oracle" of the non-computable determinism of matter that comprehends also the single human body, as modern functionalists did- Thomas Aquinas identifies it with the individual intellectual faculty of each human being; and especially with that area which produces concepts, that is, with the "thinking thought" or the "agent intellect" as traditional Aristotelian language would put it. The function of the agent intellect is precisely that of producing a "universal" logical thinking in real time (abstraction), "correcting its own errors"; a function that cannot be performed by Turing's oracle or by Hofstadter's universal intelligence, but can be always executed by the intentional intelligence of the individual human being: *hic homo intelligit*, Aquinas said.

Thomas Aquinas interprets the active component of human intelligence ("agent" intellect) as a capacity to constantly re-define the context of the problem ("possible" intellect) in order to adapt it to the single present datum ( *adaequatio intellectus ad rem* ). In this way, the passive component of the intellect - its capacity to comprehend in a conscious way, because it is controlled by its active counterpart- can be considered as a *tabula rasa*, according to a famous Aristotelian expression. However, the passive intellect is not a *tabula rasa* (absolute absence of any data) in itself, but rather in respect to each new datum that the neurophysiological and cerebral activity presents to the intellect. Aquinas' position differs from what was pursued by the myths of absolute innatism, as meant by John Locke (1632-1704) or by the modern Empiricists up to Popper (1902-1994), deceiving Aristotle and the Scholastics. In fact, rather than speaking of a *tabula rasa*, we should speak of a *tabula* which is constantly swept (*rasata*). Due to its capacity to generalize (abstraction) with respect to all conditioned and singular datum, human knowledge can be applied to, or focus on an infinity of similar cases, becoming in such a way an "a priori" of the mind. When it results inadequate for a new set of data ("knowing of not knowing"), the procedure of adaptation can repeat itself indefinitely. It is evident that, in order to avoid an infinite regression and to allow such a type of abstraction —the other animals, which lack such abstraction, have no progress of knowledge — a transcendent "closure" of the finite hierarchy of inner and external senses is needed. Such a closure is nothing but a self-consciousness of non-organic nature, hence not materially conditioned by the past, what the Ancients used to call *intellectus*, having the capacity to act immediately on itself (distinction between the "agent" and the "possible" components of the intellect), and therefore capable of *intelligere se intelligere* (to know that it is knowing). This way of solving the problem of the relationship between the spiritual and the material component of the human psyche has two main consequences.

a) Being a "formal closure" of a hierarchy of partially self-referential controls, as they are embedded in certain physical structures (i.e. cerebral structures) the faculty of being subject of rational thought must result of "non-material" type. It is a sort of closure on itself of the informational flux, a "black hole", a

"singularity" on the informational space that closes on itself. Moreover, it can be partially or totally prevented by the wrong functioning of some of its material sub-structures which control our cerebral activity and that are informed by it, thus creating the illusion, accepted to be the truth by some thinkers, that these cerebral structures would be the "subjects" of human rational operations. A text by St. Thomas in his *Commentary* on Aristotle's *De Anima*, is of striking relevance for our subject matter, even today (cf. *In De Anima*, I, lec. II, nn. 46-81). Here, he distinguishes between sensory cognitive operations, which have the body as both an object and a means of the operation itself, and which can therefore be only partially self-referential, and intellectual cognitive operations, which have the body only as an object, and which can therefore be completely self-referential (*intellectus intelligit se intelligere*).

b) Given that we are dealing with the exchange of [information](#) [11] between structures which control and are controlled, there is no need to suppose any physical causality with exchange of energy and/or matter between the spiritual mind and the cerebral structures, contrary to the interactionism of the Platonic and Cartesian dualism. We just need the "exchange of information" without any violation of the physical principle of energy conservation, as we would say today. Within the context of the ancient physiology of the "corporeal spirits", all of this is explicitly stated by Aquinas of the "pneumatic" (non-electric) principle of the transmission through a distance of the nervous impulse, before the discoveries of the Italian physiologist Galvani. In another text of the same *Commentary* on Aristotle's *De Anima*, it is explicitly stated that the intellectual operation does not imply any physical modification (*immutatio naturalis*) during the flux of the corporeal spirits in the brain, which is the material organ of the internal senses, but only a formal modification (*immutatio spiritualis*) on the flux of controls of the dispositional states of the involved organs (cf. *In De Anima*, I, lec. 10, nn. 201-208). In order to be able to talk today in similar terms, the only physical condition we need is that the physical system we are dealing with, that is, the brain, possess a sufficient level of complexity and a sufficient dynamical instability, derived from its nature which is strongly and irreducibly non-linear (unpredictability on the medium-long range behaviour, as occurs in chaotic systems). This immediately implies that energetic and informational fluxes cannot be superimposed to each other in such systems, unlike what happens in the stochastic systems studied by statistical mechanics and linear thermodynamics. In fact, what characterizes chaotic dynamics that dissipates (all living systems are "dissipative systems" and "feed" upon free energy subtracted from the environment) is that there is a generation of information within them, that proceeds from the microstate to the macrostate, exactly in the opposite direction, from the macrostate to the microstate, through which the system dissipates energy. (The system behaves in an unpredictable way with respect to what we knew about it from the initial conditions) Although each individual quasi-periodical trajectory within the space of the states of the system is predictable step by step, it is a characteristic of the system to "jump" in a way that is absolutely unpredictable from one trajectory to another. The unpredictability of the macrostate is therefore generated from the microstate of the trajectories of particles that compose the system. In a classic thermodynamic system, the two energetic and informational fluxes proceed instead in the same direction from the macrostate to the microstate, meaning that as soon as the system is described in terms of its microstate, its behaviour becomes perfectly predictable (cf. the pioneering work by R. Shaw, "Strange Attractors, Chaotic Behavior and Information Flow," in *Zeitschrift für Naturforschung*, 36a [1981], pp. 80-112).

2. *The Soul as a Spiritual Substance that survives after Death.* In the first article of the *Quaestio Disputata "De Anima"*, Thomas Aquinas deals with the problem of the soul. On the one hand, being of spiritual nature, it can be considered capable of autonomous subsistence and must be therefore in some way a "substance," as it was intended by the Platonic dualist. On the other hand, according to the principles of Christian anthropology regarding the person, it must be considered a component, and therefore "part" of a unique psychophysical substance, that is the person. At this point it is clear that if we do not want to fall into contradiction, the soul must be considered as "substance", but in a way different

from what is intended for the person in its completeness. St. Thomas solves the question by referring to the general Aristotelian doctrine on the category of "substance", as discussed by the Stagirite in Book V of the *Categories*.

According to this doctrine, "substance" can be intended in three main ways. In the first way, as a being that is defined and complete in its nature and that exists *as an* individual ("first" substance): in this sense substance is only referred to the person, otherwise we would risk to fall into dualism. In the second way, the substance can be intended as a defined and complete being that exists only *in the* individuals, understood as "parts of them" ("second" substance): this is the way in which the soul was understood as substance by the Averroists, unacceptable by Aquinas. An analogy for the notion of substance as intended in this second sense can be found in logic, in the notion of property that defines an "ordinary class" of elements, a class that does not belong to itself because it is determined by a non "autologic" predicate, that does not apply to itself. In such a way "humanity", intended as a property that defines all human beings and only human beings, "is not itself a human being," as Aristotle would say. Though ordinary classes are not the most important ones in logic and mathematics, they are known because they generate antinomies. In fact, as Russell discovered, if we consider the notion of "total class of all the ordinary classes," the class of *all* the classes that *do not* belong to themselves, whenever we ask ourselves if such a class does or does not belong to itself, we soon find an antinomy. Finally, there is a third way of speaking of substance. A substance can be considered as a being that is defined, but non complete in its nature, and that exists in the individuals as "part of them", a part that, however, determines the totality to which it belongs ("third" substance or "substantial form"). An analogy to the notion of substance as intended in this third meaning can be found again in logic, in the notion of property that determines a "non-ordinary class" of elements, a class that belongs to itself because it is determined by an autologic predicate, that can be applied to itself. For example, "polysyllabic," intended as a property that determines all the polysyllabic words, is itself a polysyllabic word, and therefore belongs to the class that it defines. Regarding this matter Aristotle used the physical, indeed biological, example of the "feet," that although being part of the totality of an animal individual, nonetheless they are a part that can define the totality to which they belong. In fact, an animal can be defined as "biped" or "quadruped."

Returning to our own discussion, Aquinas stated that the rational soul can be called "substance" according to this third and last meaning, that of a determined part that defines the totality to which it belongs. The soul is the form of a first, individual substance, that is the person, thus it is part of that, which is however specified by this part. Person means in fact "individual substance of a rational nature," according to the classic definition given by Boethius. The problem of the survival of the rational soul after death still remains unsolved. According to the previous proof, the soul has its own operations that it "must" execute independently from the organs of the body. Thus, as Aquinas states, if it has the capability *to act* by itself (*per se*), then it must also have the capability *to be* by itself (cf. *Quaestio De Anima*, a. 14). However, it does not have the being by itself as a "first" substance, but rather as a "third" substance, as a part of that totality that is specified by it. In other terms, in order to continue with the Aristotelian example of the hand and the body, and of how the hand cannot survive if separated from the body, with which the former constantly exchanges matter and energy for its vital operations of metabolic nature, analogously the mind, in order to perform its cognitive operations, needs to continually exchange information with the body, and through it with the rest of the world. In other words, a living organism can be defined as such if it is able to exert its characteristic vital operations. Nowadays, it is possible to put an explanted organ in a compatible chemical environment and maintain it for a short time in order to allow it to carry out its main metabolic operations up until the moment when it is transplanted in a new organism. The characteristic vital operations of the human mind are not, however, of chemical-metabolic type, but rather of the "informational" type. Therefore, how Thomas Aquinas already stated, the human mind can continue to carry out its vital operations hence to "live" after death provided that it receives from a source other than



the body the pieces of information (*species*) on which to operate. The question posed by the philosopher Thomas, *doctor humanitatis*, was answered by the theologian Thomas, *doctor angelicus*. The human soul can continue to survive temporarily in the after life, provided that it receives "through illumination" by God, as the angels, the "information" that can enable it to carry out its characteristic vital functions which are of the cognitive type. The souls of the dead can continue to see the world and be in communion with us "through God," just as the angels which do not have a body... This until the moment when each soul will be "transplanted" in a matter similar to the present one that the soul will reorganize as the body of a defined individual, that is to fully carry out once again its function of substantial form or "third substance" of a complete human person, "first substance", in agreement with the biblical dogma of the final resurrection of the bodies (cf. *Quaestio De Anima*, a. 15).

Apart from theology, much more nowadays than in the Middle Ages, the "dual" approach to the mind-body relationship offers to metaphysics and anthropology new ways to indicate unexpected solutions to the eternal problem of the survival of the mind after death. P. Johnson-Laird at Princeton University, one of the first "critics" of the absolutism of the functionalist paradigm in the cognitive sciences, writes at the end of his manual of cognitive psychology: "Cognitive computation raises many philosophical problems. It suggests an alternative to the traditional philosophies of mind: mental processes are the computations of the brain. This thesis is incompatible with the Dualistic philosophy that holds mind and matter to be independent domains. It is also incompatible with both Materialism and Idealism - the traditional attempts to abandon one domain or the other. It implies that certain organizations of matter enable processes to occur that represent events elsewhere in the world. It also implies that the fabric of a computer does not matter. The way in which it realizes its computations is — almost in both senses of the word- immaterial. What matters is the organization of these processes. This philosophy replaces the concept of the immortal soul with an alternative form of immortality. There is a remote possibility that the computations of a human mind might be captured within a medium other than a brain. A facsimile of a human personality could be preserved within a computer program. All living things pass on to their offspring a self-reproducing program in their genes. Human beings, in addition, can leave behind them some traces of their personalities in books, in pictures, in theories, and in other cultural artefacts. We are familiar with the idea of interacting with such artefacts in order to glean some understanding of a long-dead person. The concept of interacting with a dynamic representation of an individual's intellect and personality is sufficiently novel to be disturbing. It raises moral, metaphysical and scientific issues of its own" (Johnson-Laird, 1988, pp. 391-392).

## **VI. Cognitive Sciences and Dual Theory: Perspectives to understand the Mind-Body Relationship**

As we have seen, the debate on the so called "Mind-Body Problem" is very present and open, especially in the field of the so-called "cognitive sciences," the last to be born inside the encyclopedia of the modern sciences (cf. Gardner, 1987; Thagard, 1996). In synthesis, we could say that the fundamental thesis of the cognitive sciences is that the objective correlate, accessible to the "external" scientific observation, of the states and/or the conscious operations, accessible only to the subject that is experiencing them, is not only the neurophysiologic modification of his mind (for ex., the modification of a defined configuration of neuronal electrical stimulations which are recorded in a electro-encephalographic trace), but also the "information processing" implemented and executed through such neurophysiological events. In practical terms, the states and the conscious operations, which have always been inviolable properties of the individual subjectivity, have a double objective correlate, accessible to the observation by other human subjects, and thus also accessible to a scientific type of theorization: a) the neurophysiological events; b) the information processing that takes place through these events.

So we observe in the field of cognitive sciences a transition from a functionalist paradigm, that has the character of a monist-type metaphysics, to a much more well-organized paradigm that is based upon the distinguishing features of the dual theories of mind. To summarize, these features are: the "localization of the mind," that we do not recognize in any defined region of the brain, but rather in the actual informational fluxes that connect the brain to the body and the surrounding environment; a "non-representational" theory of knowledge, or at least not exclusively representational; a real distinction between "energetic" and "informational processes" in their reciprocal interdependence, based on the complexity of the participating physical systems and on the intrinsic unpredictability of their temporal evolution, and linked to a basic causal determinism. This last point, on which the former two depend, emphasizes the difference between dual and functionalist paradigms. How it was stated earlier, the *software-hardware* distinction made by the functionalist paradigm has little to do with the distinction "informational flux"-"energetic flux" made by the dual paradigm. Unlike the second distinction, which is based on an intrinsic characteristic of the complex dynamical systems, the first one is substantially a distinction of the heuristic type. A sequence of formal recursive computations of the symbolic type (*software*) has an essential isomorphism with a finite sequence of absolutely predictable states of an elementary mechanical system such as the TM (*hardware*), which, in turn, is equivalent to a variety of implementations and realizations on different compatible physical platforms. We can count from one to ten either by going through the fingers of two hands, in touching the beads of a rosary, by listening to the water drops from a tap, by moving the balls of an abacus, etc.: here is the secret of a construction such as the TM and of its technologic inventiveness, the ground forces of the informatic revolution of the post-modern society! According to this essential equivalence between *software* and *hardware* we can always be absolutely sure that anything which "functions" in a *software* simulation in the *computer*, "shall function" also in its/their *hardware* implementation/s, in its actual physical realization among the many possible. Within the functionalist paradigm this equivalence is shattered only when facing the highly problematic construction of the "oracle" and of its interpretation in terms of a non-computable determinism of the *hardware*. On the other hand, the distinction between informational flux and energetic flux is an intrinsic property of all complex dynamical systems, and in particular of dissipative structures such as all the living organisms (see above, V.1). From here follows contemporary interest for the cognitive sciences, which advance along a post-functionalist paradigm according to three fundamental directions of research development in the present and in the immediate future, to which we devote the last three sub-sections of this essay.

*1. Beyond the Darwinian Paradigm, and the Development of Non-Darwinian Theories in Biology.* In order to explain the evolution in the biological systems, the laws of unpredictability that are manifest within the complex dynamical systems and which are the basis of the energetic flux -informational flux distinction, can provide a different, and perhaps more efficient principle, than the simple selection by a random mutation (DARWIN, IV). Unlike the introduction of a simple aleatory variable implied by the Darwinian principle of random mutation, the deterministic character of this unpredictability can avoid the system spanning the whole phase space of possible mutations, but rather should allow it to consider only significant sub-domains of it, and with a memory mechanism that should stop it from passing over where it has already been. The transition to chaos and the choice of islands of structural stability through the control (and hopefully the self-control) on such transitions, should render these systems much more promising candidates than the stochastic systems for the study of the physical basis of biological [evolution](#) [12]. And this, although an exceptional physical and mathematical work in order to characterize them in an acceptable manner would be necessary. We have only begun climbing a mountain, the top of which we do not even see! Much more than the "blind watchmaker" of Darwinian memory is here available: here we are dealing with deterministic laws of the so-called self-organizing systems, laws that should guide evolution and its attempts, making it capable to benefit from past errors. Therefore, the

selection for random mutation would be left aside only to modulate little modifications and adaptations within the species (for an introduction, cf. S. Kauffman, *At home in the universe*, Oxford: Oxford University, 1995; similar positions, although limited to a mere criticism of Darwinism in G. Sermoni, *Dimenticare Darwin*, Milano 1999).

2. *The Development of Post-Functionalist Theories in the Cognitive Sciences*. As in the biological systems the complexity of such systems rules out the possibility that a single model can account for the whole path of evolution, this must also be true in cognitive systems, that occupy the peak of complexity in the biological scale. The epistemological limit of the functionalist approach is its "representationism". This aspect depends upon the identification of the "mental" with the formal calculations of a TM *software*. This leaves out the possibility that this approach can account for the fundamental capacity of the intentional human intelligence, the capacity of "symbolization", in other words to be able to constitute those logical symbols (the abstractive-constitutive act belonging to the judgement of the *intellectus* in the Thomasian Scholastic teaching) that should serve in a second moment to execute the typical operations of the representational thought, the inferential reasoning (the *ratio* of the Thomasian Scholastic). This is one of the fundamental theoretical reasons why H. Putnam repudiated that same functionalist approach which he somehow initiated (cf. Putnam, 1975 and 1988). Moreover, and for the same reason, the functionalism places the mind within that "methodological solipsism," that shows an incapacity to face what is real and to learn from it, a quality that Carnap had already highlighted as being the fate of all formalist approaches to the semantic problem (cf. Fodor, 1981). We understand, then, why the major impulses to exceed the functionalist representationism in the cognitive sciences derive from the field of robotics: a robot does not at all need to represent anything symbolically in a formal calculation of a TM, that assumes a static environment, perfectly captured by that symbolization. It does need, however, to produce adequate actions in a constant interaction with the changing environment. Before teaching machines to simulate intelligent human beings, we should teach them at least to be animals.

The development of an informational approach that is able to manipulate the semantic and not only the syntactic information as in the TM, encourages a close look at the complex dynamical systems which are of course generators of information and not simple manipulators of bits already constituted, as in the perfectly predictable determinism of the TM. Mathematically speaking, a *bit* is a typical function that defines whether or not a certain element belongs to a set which is already constituted (two-value logic: yes/no): it does not have any semantic value. The semantic information is rather what leads to a constant definition and re-definition of the bits and of the sets associated with them. A shy attempt along these lines is that of the *fuzzy* logic (many-value logic) that allow a limited "elasticity" of the dividing line between the different sets. We are, however, quite far from what we are asking today of the logic and mathematics of the near future. A neurological exemplification of what we are talking about here is given by the network of neurons in our brains that constantly redefine the topology of connections - and not only the statistical weights of their connections, as in the connectionist models —in order to maximize their capacity of parallel processing (cf. Perrone, *Verso una teoria dinamica della computazione*, in G. Basti e A.L. Perrone, 1996, pp. 255-332).

All of this makes the complex systems the most natural candidates for the study of the physical basis of the cognitive operations, and for all of those pre-symbolic and pre-representational operations characteristic of a *bottom-up* knowledge. Such a path would have its neurologic correlate in the redefinition of the topology of connections in the network of neurons, activated in a reciprocal manner, within the globality of the cerebral dynamics. According to this scheme, the symbolic aspect of the representational thought, with all of its logical-deductive operations and associated formal calculations, would constitute the *top-down* path. This would have its neurologic correlate in the operations performed by the network of fixed connections, where the calculations are known to be equivalent to those of a TM.

The representational-symbolic moment would thus constitute a moment that is posterior to the constitution of the logical symbol, in the same way that the intentional, pre-symbolic moment is anterior to it. The constitution of the symbol, in fact, needs a sort of "exit from the system", which is linked to the characteristic intellectual function of the mind. In this way, the pre-symbolic moment and then the moment of the constitution of the symbol would be in a more consequential relationship with the representational functions of the symbolic thought. A relationship where the Scholastic scheme *intellectus-ratio* could once again provide the working paradigm.

*3. Logic of Discovery vs Logic of Proof.* What has been said up to now points towards that same direction of discovery and development, in a contemporary language, of the ancient analytical method in the study of logic. The extraordinary development of the axiomatic method in mathematics and modern logic has obscured the problem of the logical study of the discovery procedures, known as the "analytical method" in the logical pre-Cartesian tradition, with a meaning different from that used in the modern era, which descends from a stoic and manualistic tradition of Pappus (4th century B.C.). Much of this oversight was based on the myth of the absolute demonstrative certainty that the deductive procedures supposedly had. In our present times, this vision has probably reached its summit with the Popperian statement about the absolutely irrational character of the formulation of new hypotheses, and hence of the constitution of new axioms, that he thought as independent of any logical procedures of investigation (cf. K. Popper, *The Logic of Scientific Discovering*, 1934). The logic of discovery is based upon procedures such as induction, abstraction, analogy that certainly cannot aspire to the absolute certainty -as it has been known since the times of Plato and Aristotle. We are thus facing the so-called "inference paradox". That is to say of the inversely proportional relationship that exists between the level of certainty and the quantity of information produced by an inference. In a deductive speech, all of the truth is implicit in the premises: there is no increase in knowledge, the quantity of information produced by deductive inference remains null (cf. Cellucci, 1998, pp. 71f and 380). After Gödel, the impossibility to guarantee absolute certainty in the deductive procedures, typical of the axiomatic method, has brought about the fall of the fundamental reason of the modern preclusion towards the analytical method as a method for the discovery of new axioms. The absolute certainty - which only about four centuries ago brought Spinoza to claim that the relationship between the diameter and its circumference corresponds to  $p$  also for God- does not exist, it is just a myth. Then, why persist in the statement of the superiority of the axiomatic method compared to other discovery methods? If it is true that neither one or the other produce absolute certainties, at least the second one produces useful inferences that increase the knowledge. This is the conclusion reached by Cellucci (1998) at the end of his essay, which attempts to take into account the various phases of development of the logical sciences of the past millennium. If we aim not to assign the logic and its rigorous formalism to the absolute uselessness (it does not increase knowledge nor does it give absolute certainties), leaving the scientific practice to the irrationalism of *ad hoc* models of more and more heuristic type, then we must rescue the role of a logical methodology in the definition of the rules of discovery. And this, even if the wide application of *ad hoc* models is a practice that today prevails in the field of research, since it allows a free exploitation of science. All of this means renunciation of the identification of logic with the axiomatic method alone and renunciation of confining the research of rules to simply the rules of the proof.

Therefore the effort of synthesis between "thought which is thinking" and "thought which is thought," between "pre-symbolic intentional thought", constitutive of logical symbols, and "symbolic representational thought", manipulator of already constituted symbols, that is characteristic of the research on intelligence in the cognitive sciences, is part of a more general research of a dynamical synthesis and of a "stability out of equilibrium." Life needs to be constantly reinvented, between the logics of discovery and the logics of proof, between the analytical method and the axiomatic method. As in the cognitive sciences the Scholastic theories of complementarity between *intellectus* and *ratio* can



constitute a model for the research of this synthesis, in a similar way in the logical sciences this model can be constituted by the Scholastic theories of complementarity between *logica maior* and *logica minor*. Perhaps today more than ever "the past is in front of us" and not just behind our back. Heidegger defined the Modern Age as the "age of the visions of the world," visions set against each other in a sterile way. Particularly, as the age of "enlightening" of the modern scientific reason set against the "obscurantism" of metaphysics and theology, typical of the Classical Age. Today more than ever, there is the need for dialogue and synthesis, both "synchronic" between the various theories and doctrines, and "diachronic" between modernity and tradition. And the need for this synthesis is not only required by the ethnic, social and cultural pluralism, but also by the novel applications of the sciences in fields never before explored, that add to the contributions from the cognitive, logic and foundational research. The dialogue and the synthesis represent an issue of survival for all, as well as for the scientific rigour itself. The "mind-body" relationship can be regarded as an example of this.

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