PONTIFICIAE ACADEMIAE SCIENTIARVM SCRIPTA VARIA
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BRAIN RESEARCH AND THE MIND-BODY PROBLEM: EPISTEMOLOGICAL AND METAPHYSICAL ISSUES

Proceedings of a Round Table Discussion held at the Pontifical Academy of Science on 25 October 1988

Edited by:
GIUSEPPE DEL RE

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EX AEDIBVS ACADEMICIS IN CIVITATE VATICANA

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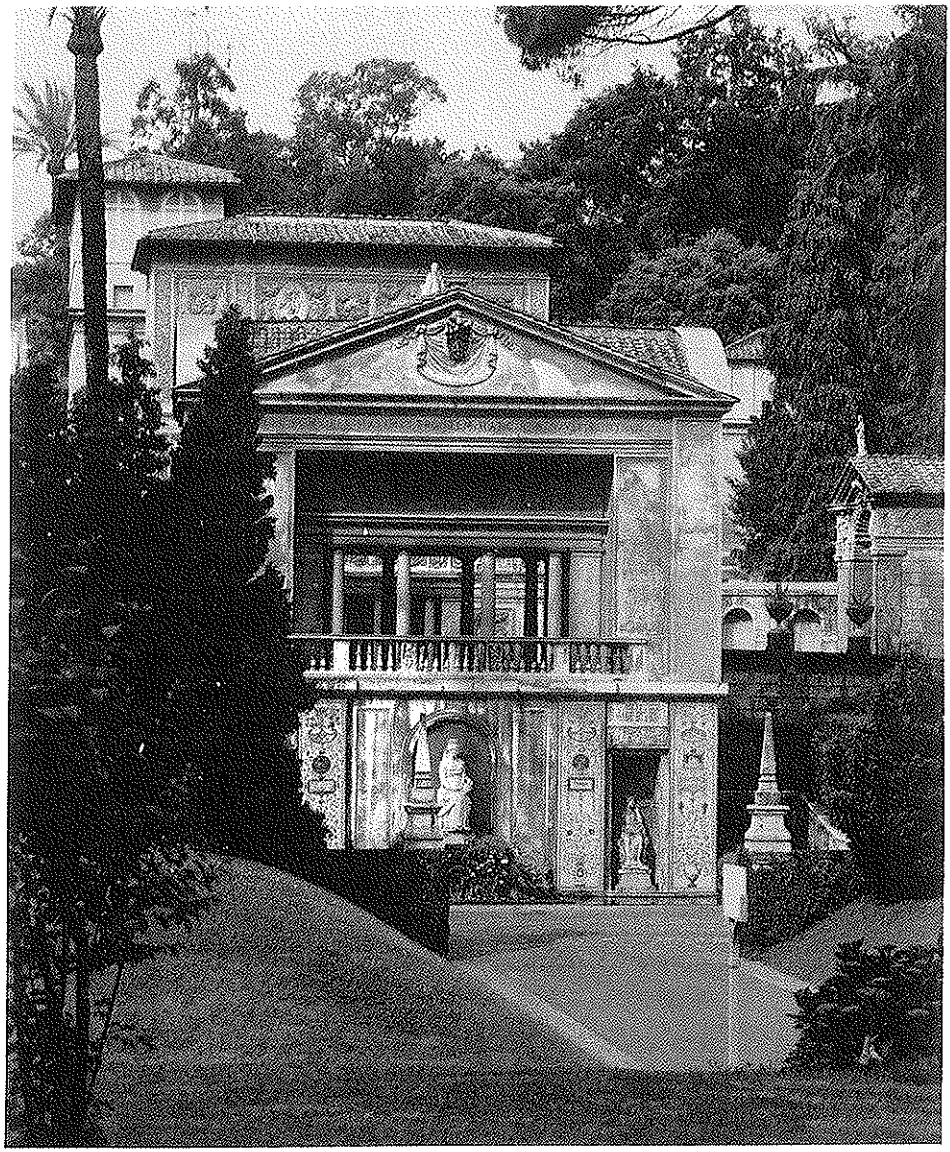

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Editorial commentaries and discussion reports:
Giuseppe Del Re

The opinions expressed with absolute freedom in the course of the Round Table Discussion, as well as the editor's commentaries, although published by the Academy, represent only the points of view of the participants and the editor, and not those of the Academy.

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FOREWORD

This volume is a report of the work of the Round Table Discussion on the mind-body problem held at the Pontifical Academy of Sciences on October 25, 1988, with the participation of President Carlos Chagas as chairman, of Academicians Sir John C. Eccles, J. Szentágothai, J. Lejeune, E. di Rovasenda, and of several other distinguished scientists, philosophers, and theologians.

The special interest of the Discussion reported here is that it was a significant opportunity for the Academy to discuss explicitly the philosophical presuppositions and implications of science in a domain which is becoming of greater and greater actuality — suffice it to recall that the Congress of the USA has declared the years 1990-2000 "the decade of the brain". As the Introductory Message explains, the Holy Father's indications are strongly in favour of a return to the integration of science within the greater body of culture. It is hoped that the work done at the Round Table of October 1988 will be a contribution towards that goal.

The numerous remarks and questions could not be reported without any editorial comment, because the variety of topics covered in the little time available caused the remarks to be extremely short and fragmentary and not ordered by subjects. A bare transcription of the interventions would not have done justice to the high level of the study carried out. The formula used in order to obviate these difficulties has been to provide an editorial report giving the necessary additional information and cross references to the main interventions. The actual time order of the interventions has been only partly respected, but some gain in logical sequence of arguments has hopefully been achieved.

More extensive covering of specialistic aspects of the neurosciences is to be found in the Proceedings of the Study Week on the Principles of Design and Operation of the Brain, which immediately preceded the Round Table Discussion. Topics which, in the Editor's opinion, required ad hoc *reviews have been covered in the two appendices. The Article by P.A. Rossi gives the* status quaestionis *on the delicate problem of artificial*

intelligence; the Article by F. Calvo, which is a revised version of a paper published in the Proceedings of the 1983 Study Week on Pattern Recognition Mechanisms (Pont. Acad. Sci. 1985), provides a critical analysis of the epistemology of K. R. Popper. This is important because, although Sir John Eccles and Sir Karl Popper seem to agree on many points, on reading their joint book The Self and its Brain *it appears that they have divergent views on such central topics as the nature of truth and the immortality of the soul. The reader may find it useful to know more about this question and related matters by reading Calvo's critical review of Popper's thought.*

THE EDITOR

INTRODUCTORY MESSAGE*

In his address to the Pontifical Academy of Sciences of September 26, 1986, His Holiness Pope John Paul II made a number of very important statements on the role of scientific research in the promotion of the human person. Three of them will suffice to explain the spirit in which this Round Table Discussion has been conceived, the goals it is expected to achieve, the precedent it is supposed to constitute.

"The free search for truth for its own sake is one of the noblest prerogatives of man. Science goes astray if it ceases to pursue its ultimate end, which is the service of culture and hence of man; it experiences a crisis when it is reduced to a purely utilitarian model; it is corrupted when it becomes a technical instrument of domination or manipulation for economic or political goals".

"There is then what one can call a crisis of the legitimation of science, and it is therefore urgent to defend authentic science that is open to the question of the meaning of man and to the search for the whole truth, a free science that is only dependent on the truth". (...) "The man of science is called in a new way to openness. With all respect for the methodological requirements of abstractions and specialized analysis, one may never forget the fundamental questions concerning its role and its goal; it cannot close itself to the universal, nor to the knowledge of things as a whole, nor to the Absolute, even if it is unable by itself to answer the question of meaning".

"Is there not a need to explore some common projects, in which the link between science and culture would be manifested?".

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* Distributed by the Academy to the participants before the opening of the Round Table

Considerations by E. Agazzi (in: *Le mental et le corporel*, Bruxelles 1982) summarize the general problem of the Round Table:

"In the case of the sciences, the consciousness of the partiality of their respective approaches has today become quite clear, not only with regard to each single science, but also with regard to science as a whole; and this leads to the conclusion that a full comprehension of man obliges one to overstep the limitations of science. But the question must also be seen the other way around: a full comprehension of man cannot be obtained within a purely poetic or artistic experience either, nor can it be obtained solely through abstract philosophical speculation, or by means of an exclusively religious approach. A harmonized convergence of all these ways of understanding is needed; and in addition all the information on man provided by the sciences must enter the unitary image of man we are seeking".

A more specific question can be formulated as follows: Supposing we knew everything about the design and operation of the brain, would we know what thought and self-consciousness are?

It is well known that Sir John Eccles, one of the greatest experts on the brain, emphatically answers 'No!' But could the philosophers and the scientists first of all specify what they mean by thought, consciousness, and so on?

Apart from these indications, the subject of the Round Table will probably take clear shape only after the first round of discussion statements. A detailed programme of what is intended as an exploratory meeting has of course been impossible. Indeed, since the mind-body problem is one of those where collaboration of science, philosophy, and theology is most important, a one-day discussion can only scratch its surface. What we hope is that it will suffice to point to the direction in which further interdisciplinary work should evolve. We hope that all participants will provide comments and suggestions.

LIST OF PARTICIPANTS

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PART ONE

SCIENCE AND THE MIND

CHAPTER ONE

THE BRAIN-MIND PROBLEM IN THE INTERACTIONIST APPROACH

1. THE BRAIN-MIND PROBLEM AND BRAIN RESEARCH: SCIENCE OPENS TO PHILOSOPHY.

The Round Table Discussion on the Mind-Body Problem of October 1988 took place at the Pontifical Academy of Sciences after the Study Week on the Principles of Design and Operation of the Brain, in which many of the most reputed brain scientists of the world participated under the direction of Sir John C. Eccles. The Proceedings of that Study Week are contained in a separate volume, but its spirit is important for a better assessment of the motivation of the Round Table Discussion to which this report is devoted. It has been summarized by Sir J. C. Eccles as follows. "The Study Week was designed to provide a more holistic understanding of the human brain; 25 participants from 12 different countries met for 10 half-day sessions in which experimental and clinical

studies were the bases of discussion concerning hypotheses of scientific and philosophical ideas. The Study Week was oriented to a systems approach to higher cerebral functions and not to an analytic study of molecular neurobiology. At the outset were presented the evolutionary building of the human brain, and the embryological development of the human neocortex. Following this introduction the Study Week was directed to the human brain in a diversity of activities: visual perception and consciousness, volitional movements, learning and memory. At the culmination of the Study Week attention was directed to the higher functions of the human brain: cognition, behaviour, language, cognitive functions, and the theories of the mind-brain interaction. So the conference developed into a consideration of the spiritual values of human life and destiny."

The above summary concisely confirms, if need be, that Eccles is a scientist who fully realizes that science must be open to existential and philosophical values. He has expressed these ideas not only in scientific papers, but in several well-known books (Eccles 1966, 1970, 1973, 1977, 1979, 1984, 1989.) Eccles is the best known representative of a point of view on the problem of the human mind which goes back to Plato and Descartes through St. Augustine, Doctor of the Church, although it has become easier to reconcile with the notion of the unity of man in its modern version, in as much as it assigns an ontological distinction to mind and body only in the same sense as such a distinction is assigned to two essential organs of the body. Before reading Sir John's introduction to the Round Table Discussion, it will be useful to trace his ideas back to their earlier stages, because this is a good way to gain insight into the process by which purely scientific work combined with a sincere interest in understanding the world will lead a scientist to the borderline between science and metaphysics. Several significant statements can be found in the Proceedings of the 1964 Study Week of the Pontifical Academy of Sciences on Brain and Conscious Experience (henceforth called BCE; Salviucci 1984.) The weight of those statements for an assessment of the relations between science and other approaches to reality is very great, because the unquestionable scientific authority of Eccles immediately disposes of the notion that only bad scientists are interested in philosophy.

In 1964 Eccles said:

"I am prepared to say that as neuro-physiologists we simply have no use for consciousness in our attempts to explain how the nervous system works; that is one side of our problem. But then on the other side, as a person who is a neuro-physiologist as I am, the ultimate reality for me is my conscious experiences, including perceptions, memories, dreams; and there is the secondary or derivative reality of the world, which is a construct from our own perceptions. I want to ask people who doubt the existence of consciousness in its own right: what about the world of colours and sound and smells? Where does that belong except as conscious experiences? It does not exist otherwise." (BCE p. 371.)

This statement illustrates the mechanism by which science becomes open to philosophical issues. A routine neuro-physiologist, essentially interested in collecting information or in curing patients, would be content with his technical success; but a man primarily interested in knowledge, in understanding, realizes that in neuro-physiology he is dealing with just one aspect of that complex reality that is man. So the question arises: what can our (the neuro-physiologists') research tell about man?

A pure philosopher of the traditional school (including well-known materialists such as Louis Althusser) would answer that scientists should not go out of their science, and should leave philosophy to philosophers. There is a measure of professional bias in this; everybody would agree that a final acceptable formulation of philosophical points requires a professional background different from that of scientists; but to raise points and questions, and to formulate hypotheses is a right of the scientist. Moreover, the primary preoccupation of Eccles is partly due to the fact that in his specialty the boundaries of science and metaphysics are by no means clear.

On his path towards interactionism Sir John Eccles was not alone. In the 1964 *Study Week* (BCE), in a paper significantly titled *Neuro-physiological correlates of mental unity*, F. Bremer said: "The neuro-physiological problem raised by the behavioural singleness of all goal-seeking creatures had until recently attracted little attention from the studies of nervous mechanisms. The reason for this apparent lack of interest is perhaps to be found in the fact that behavioural singleness be-

comes mental unity in man and that physiologists feared to incur in the reproach of adhering to a unifying concept recalling the Cartesian description of 'la petite glande qui se trouve environ vers le milieu des concavités du cerveau et est proprement le siège du sens commun'. The body-mind relationship remained as a metaphysical problem, not as a scientific one. Yet, one may wonder whether it is not time for abandoning this attitude of resignation." (BCE 419.)

Thus, in contrast to the positivists' contempt for metaphysics and metaphysicians, the neurophysiologists ask themselves once again the old question of Descartes: is there anything like a "protocol converter", a "transducer" between some kind of non-material world and that tool that is the brain? There is no doubt that the arguments and suggestions of Descartes sounded untenable, indeed ridiculous, in the context of the simplistic notions of the structure of the brain and of a machine of the 17th century. Would it not be wise, given the revolution in the knowledge of brain and in the concept of machine, to take them as working *scientific* hypotheses once again, and see whether they can be made respectable ingredients of a consistent scientific explanation of brain activity?

As will appear from the opinions expressed by philosophers during the Conference, the dualistic (or rather interactionistic) picture underlying the above statements can be questioned — though not by referring to such a primitive notion of machine as underlies many critiques of interactionism. However, the significance of the above considerations lies elsewhere. They convey a message of comfort to those who still believe in the unity of the human person: biology, and in particular neurophysiology, has become a chapter of natural philosophy, meaning by this term not an old-fashioned "cosmology", but science trying to give her contribution to the construction of a consistent conception of man and the world. A statement by Eccles echoes even in style the great scientist-philosophers of the past: "... When I re-examine the nature of my sensory perceptions, it is evident that these give me the so-called facts of immediate experience and that the so-called external world or "objective world" is a derivative or representation of certain types of this private and direct experience. But this "representative theory of perception" must not be confused with idealist monism, for the implication is that my perceptual

world is my symbolic picture of the "objective world" and thus resembles a map. This map or symbolic picture is essential so that I can act appropriately within this "objective world"; and, as we have seen, it is synthetized from sensory data so as to be effective for this very purpose. It is built upon spatial relations, but also given symbolic information in terms of secondary qualities. For example, colours, sounds, smells, heat and cold as such belong only to the perceptual world. Furthermore, it is part of my interpretation of my perceptual experience that my "self" is associated with a body that is in the "objective world"; and I find innumerable other bodies that appear to be of like nature. I can exchange communications with them by bodily movements that give rise to perceptual changes in the observer, for example by gestures or at the more sophisticated level of language, and thus discover by reciprocal communication that they too have conscious experiences resembling mine. Solipsism becomes for me no longer a tenable belief. There is a world of selves each with the experience of being associated with a body that is in an "objective world" comprising innumerable bodies of like nature and a tremendous variety of other living forms and an immensity of apparently non-living matter. (...) How can some specific spatio-temporal pattern of neuronal activity in the cerebral cortex evoke a particular sensory experience? We can dimly perceive a relationship between brain states and consciousness when we consider the neuronal activity of cortex in states of unconsciousness, i.e., when stimulation of sense organs fails to evoke a sensory experience. (...) I would suggest that the transcendent performance of the central nervous system is a consequence of its amazing complexity, not only structural, but also dynamic, which is of a much higher order than any other organized system in the universe.

"On the basis of this concept we can face up anew to the extraordinary problems inherent in a strong dualism. Interaction of brain and conscious mind, brain receiving from conscious mind in a willed action and in turn transmitting to mind in a conscious experience. But let us be quite clear that for each of us the primary reality is our consciousness — everything else is derivative and has a second-order reality. We have tremendous intellectual tasks in our efforts to understand baffling problems that lie right at the centre of our being; but as Eugene Wigner asks: 'Have we any right to expect

a solution to such fundamental problems when the efforts made have been trivial relative to the extreme nature of the problem?' " (BCE 484-487)

2. BRAIN RESEARCH AND THE BODY-MIND PROBLEM. EPISTEMOLOGICAL AND METAPHYSICAL ISSUES.

Sir John C. Eccles
Nobel Laureate for Medicine
Pontifical Academician

2.1. A list of problems

The mind-brain problem has been with me all my life. In this introduction I shall first list some general points, which in my opinion make up most of the mind-brain problem, and then pause on some of them, in particular those where brain research has some direct contribution to give. By the way, it is called "body-mind problem" in the title of this Round Table, following tradition. But that is a mistake. There is no body-mind problem; you have to go from the body through the brain to the mind; so brain-mind is what we should talk about.

Let me start from the conception of the three worlds, which I shall later illustrate in more detail. This is a philosophical view of reality Popper and I have adopted, which has of course many roots in the past in philosophy. World 1 is the matter-energy world, including the human brain. World 2 is the world of the states of consciousness. Many people do not realize that these have an ontology that is quite different. The world of mental states and consciousness is as real as the world of material objects; in fact, we should not know the world of material objects if it was not that we perceive it in the states of consciousness.

These are the two basic factors in the philosophy of the brain-mind problem. In the world of the states of consciousness we put all the experiences of perceiving, thinking, emotions, disposition, intentions, memories, dreams, creative imagination and so on. You could make a big list. This is the

whole of the mental world including the whole of our religious beliefs and feelings, in short everything that is consciously experienced. Finally, there is World 3, which is the world of culture.

Our next problem is the relationship between World 2 and World 1: how can we get across the interface between them? There are many materialist theories for this, and a consideration of them will be basic to our discussions, which will require examination of all the various theories of the mind-brain problem.

Of course, the materialists want to stay in the material world and explain the mind in some strange manner as being just an offshoot of the brain. Radical materialism even denies the whole mental world. Then there is parallelism with its panpsychist complement.

Identity theory is the most widely accepted one. It just says that certain states in the brain give you conscious experiences; it never says how they do it. It is just believed dogmatically.

Finally, dualist interactionism is the belief that Popper and I have developed, and, as I have explained above, it proposes that there are two orders of existence, World 1 and World 2, and that they do interact in the brain. That is the problem confronting us today. Is this a reality? Are there really in the brain the World 2 operations of the mind, and how can that give rise to the whole mental experience, the subjective world that relates to the brain?

In the second part I shall pause a little longer on neuro-physiological evidence. Here I only point out that the whole of brain operation (as far as we are concerned here) occurs in special regions of the brain. Take perception, for instance. When certain events take place in your brain, you can *feel* a touch or you can *hear* a sound or *see* light and so on. That is the great mystery. How can you get across the barrier between the material world and the mental world? That is what the *Study Week* has been partly about. I have put up a theory in terms of quantum mechanics about how this can happen without breaking the conservation laws: how for example happenings in the brain can give us a feeling of touch and sight.

Consider again the inner senses with thoughts, feelings, memories, dreams, imaginings. All of this is in the mind. This is the mental world we live with. Now I put the central core of

our mind as what you may call the psyche, self or soul, depending on whether you are a psychologist or a philosopher, or a theologian. They stand for the same thing. So at the core of our being, central to our being, there is the soul.

My next point concerns the difference between man and other animals. Mammals, e.g. the chimpanzees, as was the case for our hominid ancestors, do not have this central core. Of course, they have consciousness, they have a mind, because they have feelings, thoughts, memories, etc. But they do not know; they have no self-knowledge. They do not know they exist, they do not have self-consciousness. That came in the evolutionary process, as I have discussed in a book now in press. How did we get to the human existence with the central core out of the evolutionary process?

How could we get there? A related answer is: we have all done this ourselves. When we were babies we did not have this central core. It was latent, shall we say, and only at about one and half years did we begin to have self-knowledge and did we develop this central core. So this is again an interesting problem. We have been through this whole stage, of not knowing that we know, just like the animals, having all the experiences, but not having the central core. We came from this to the central core. These are problems that we should discuss. How did this come about? It is really a great mystery.

2.2 Evidence and hints from brain research

Let me now come back to those questions that are more directly related to brain research. I already pointed out that it is good that the title of this Round Table starts with brain research, but unfortunately there follows the outmoded philosophical formulation of the *Body-Mind Problem*. Brain research has established that all interactions between body and mind involve the participation of the brain as the central factor. So body-mind interaction has to be resolved into body $\leftrightarrow$ brain interaction and brain $\leftrightarrow$ mind interaction. The first component is physiology and has no place in this discussion. Furthermore many regions of the central nervous system or brain have no interaction with the mind. Therefore I exclude

the spinal cord, the brain stem and the cerebellum. In fact the experimental evidence now makes it extremely likely that the mind or mental world is exclusively dependent on the cerebral cortex.

The left and right cerebral hemispheres are almost symmetrical anatomically, but in many functions are extremely asymmetrical. The left cerebral hemisphere is convoluted so that the covering layer of 3 mm thick *neocortex* has an area of about 1000 cm^2 for that hemisphere. It is subdivided into four lobes, Frontal, Parietal, Temporal and Occipital; an equivalent subdivision applies to the right side.

The primary motor and sensory areas are symmetrical, e.g. the motor transmitting area with the strip labelling of the muscle locations, and the sensory, auditory and visual transmitting areas with inputs from the skin, ears and eyes as indicated. The important asymmetrical areas are the two large speech areas named after their discoverers, Broca and Wernicke. In 95% of subjects these areas are on the left hemisphere. The equivalent areas on the other side are for visuospatial orientation and for music and subtle linguistic performances.

The left and right cerebral hemisphere are linked by the *corpus callosum* (severed) and the projection from the eyes by the optic nerves that partly decussate in the optic chiasma so that the left visual field goes to the right occipital lobe, and the right to the left occipital lobe. The important work of Sperry has shown that transection of the *corpus callosum* resulted in restriction of the subject's self-conscious experience to inputs from the linguistic left hemisphere with its input from the right visual field and the right hand with its action in writing by the right hand.

By contrast, the right hemisphere had a simple language comprehension but no linguistic performance. It had, however, good geometrical and spatial comprehension and nonverbal ideation.

These fundamental differences between the two hemispheres are a challenge to the philosophy of the mind-brain problem.

An elementary understanding of the neuronal structure and arrangement of the cerebral cortex is necessary in considering how the cerebral cortex relates to such mental happenings as

perceiving and acting. These are the simplest levels of mind-brain interaction.

A pyramidal nerve cell of the cerebral cortex is characterized by its soma, and the apical and other dendrites for receiving information from other nerve cells by the numerous spine synapses (actually there are about 10,000) and transmitting its output to other nerve cells by means of its axon that branches to end in synapses. Such a synapse has an axonal branch ending in a bouton with synaptic vesicles on a spine of a dendrite.

Figure 4 gives a greatly simplified diagram of the nerve cells of a small area of the cerebral cortex, showing four output lines by the axons of pyramidal cells and three input lines, one a cortical-cortical afferent from another cortical area and two specific afferent inputs from the great input nucleus, the thalamus, for sending information to the cerebral cortex. There are also many other nerve inputs that act synaptically in the cerebral cortex either to excite or to inhibit. Now consider a cortico-cortical column, which is the cortical unit for integration and transmission to other columns of the cortex on the ipsilateral or controlateral side by the *corpus callosum.* In the human cerebral cortex there are about ten thousand million nerve cells, 60% of which are pyramidal cells. A cortico-cerebral column is composed of about three to four thousand nerve cells, and each column projects to as many as 50 other columns and receives from a like number. We can have confidence that the structural complexity of the cerebral cortex is an adequate basis for the immense variety of cerebral performances. The wonderful performance of the human brain in memory is being explained by the plastic properties of synapses, whereby usage results in an enormously prolonged enhancement of function.

An important philosophical generalization is illustrated in the subdivision of everything in existence and experience into three Worlds. World 1 is the whole matter-energy world including the human brain. In World 2 are all subjective experiences of consciousness such as perception, thinking and emotions. The concept of World 3 is unique. It includes all the products of human creativity. The brain-mind problem of this roundtable conference is symbolized by the large open arrows between World 1 and World 2.

The way is now open to formulate diagrammatically some of the principal components of the brain-mind problem. The liaison brain is composed of the columns or modules of the cerebral cortex, which is, of course, part of World 1, while the World 2 component of brain-mind interaction is drawn above the liaison brain. This is for diagrammatic convenience. All components of World 2 are shown interacting by arrows, which indicate information transfer directly into and out from the modules of the liaison brain, and across the interface between World 2 and World 1.

Perceptions are linked to specific areas of the cerebral cortex. For example the perceptual experiences of light or colour are dependent on the activation of many large areas of the prestriate visual cortex, which is located anterior to the actual Visual Transmitting area. The perceptual experience of touch is dependent on activity in the somatic sensory transmitting area and the large associated areas of the parietal lobe. It used to be thought that pain was experienced from the activity of components of the large subcortical nucleus, the thalamus, but it is now generally accepted that for the experience of pain there must be activation of the cerebral cortex, particularly in the frontal lobes.

There has been remarkable progress in discovering the cortical areas involved in the conscious experiences (Inner Senses). There are now several techniques for studying the activity of the human cerebral cortex during specific forms of mental activity. The earlier technique was to study the regional blood flow of the cerebral cortex (rCBF), as revealed by a battery of Geiger counters after intracarotid injection of a radioactive material, usually a ^{133}Xenon solution. The increase in blood flow is a reliable index of cerebral activity. Other methods involve positron emission tomography or nuclear magnetic resonance.

The simplest results were observed when the subject was concentrating attention on a skin area in expectation of a just detectable touch, which was only applied after the experimental run. There appeared a highly significant large increase in rCBF over the attended cortical area (the finger) and also a significant area on a large area of the mid-frontal lobe.

If the attention was to the lips the rCBF map was the same, except that the principal area had moved down to the lip sen-

sory cortex. More complicated activity maps were discovered for more complicated tasks such as arithmetic, or in visually imagining the events encountered in a well-known walking route. Many of the items under Inner Sense in fig. 6 could be similarly investigated. For our present purpose it is sufficient to establish that specific mental activities can activate appropriate regions of the cerebral cortex. This raises the challenging problem: how can a non-material mental event effectively act on the cerebral cortex without breaking the conservation laws of physics?

The first rCBF study was made on the intention to move. A complex sequence of finger movements caused a highly significant increase in the rCBF over the motor-sensory area for the movement, but also in the supplementary motor area (SMA) which is anterior to the hind-limb area of the motor cortex. When the subject was merely performing the movement "in his mind", but not carrying it out, the rCBF increase was restricted to the supplementary area. Here, the mental intention activates the nerve cells in the supplementary motor area. Here again, the non-material intention to move effectively acts on nerve cells in the supplementary motor area.

Following a suggestion of the quantum physicist Henry Margenau, it has been possible to develop a microsite hypothesis that accounts for the mind-brain action in intention, because the synaptic action is dependent on the exocytosis of a synaptic vesicle through movement of a particle of about 10^{-18}g, which is well within the range of the Heisenberg uncertainty principle. It can be concluded that mental events, such as intention to move, can effectively cause excitation of appropriate nerve cells of the supplementary motor area. It can be shown that the neuro-physiological processes provide an enormous amplification for these microsite events.

Thus a solution is available for the free-will problem and for moral responsibility, which has always been assumed despite the strictures of the materialist philosophers and scientists. There is not time in this Round Table to present more evidence and arguments, together with a new hypothesis which was introduced in the immediately preceding Study Week. However, this brief introduction should open the way to the epistemological and metaphysical issues to be considered.

3. COMMENTS AND QUESTIONS

3.1 Epistemological status of the body-brain-mind problem.

The importance given by Eccles to the distinction between body and brain in the problem under study points to one of the most important aspects of his approach: the fact that it is essentially a scientific approach. As appears clearly from his various statements, his intention as well as of other neurophysiologists is not to abandon science in favour of philosophical speculation; it is to see whether science can tell more about the mind than is usually supposed, following in this case the suggestion of Descartes; if it can indeed "prove" (in the sense to be explained below) the existence of the mind. A scientific perspective is characterized for one thing by the relevance given to the question where and when? Now the request to specify that the relation is between mind and brain, not between mind and body generically, already implies a spatio-temporal point of view that — as will be seen in the considerations made by pure philosophers — is not what interests a strictly philosophical approach, which is more concerned with distinctions like matter and spirit. Whether the willed motion of an arm is mediated by the brain or not does not worry the philosophers; but it is of the utmost importance to scientists, who want to know "how", the mechanism, more than "why" or "what". To summarize, and keeping in mind the differences in views of different epistemologists, a scientific approach to the existence of a given entity (say, the atom) consists in (a) assuming its existence as a tentative explanation for a number of observed facts; (b) trying to find new facts which can be explained by the same assumption; (c) showing that the collection of observed facts is accounted for in a satisfactory and simple manner by the given assumption; (d) devising a few decisive experiments capable of "falsifying" (in Popper's sense) the theory thus constructed; (e) showing that the given assumption does not contradict established principles of science.

As has been seen, the approach of Sir John Eccles follows exactly this pattern; point (e) is the explanation of his concern about the consistency of his idea of the mind with the principle

of conservation of energy. In other words, the mind in Eccles' sense belongs to that category of entities which science holds responsible for observed facts, without being able to "show" them. Such entities range from atoms to the electromagnetic field. The former can at best directly affect our senses if they are in a great number; the latter can directly affect the senses, at least in some cases, but are not matter in the standard sense, since, for one thing, they are indivisible. These special entities have been dismissed by some philosophers as *entia rationis* not possessing more reality that an abstraction like beauty. Their failure to convince scientists is due to two considerations: (i) the evidence proving that those entities are in fact the ultimate efficient cause of our sensations is overwhelming; (ii) the definition of direct perception is vague, unless one makes it so limited that even the sun would fall into the category of *entia rationis*. The above analysis appears to give a precise meaning to the discussion remark where Eccles states that he does not attempt to define what is the mind. This is not the scarcely defensible anti-essentialism of Popper; it may be taken to mean that, in the context of a scientist's approach, the entity "mind" is tentatively defined as the agent or cause of certain phenomena, and will eventually be defined in terms of its properties or structure only after sufficient evidence has been accumulated and analyzed.

The following discussion remarks and comments may be seen in this context.

3.2. What is the mind?

(Report on remarks by G. Del Re, A. Serra, J. C. Eccles)

A comment by G. Del Re bore on the general question of separation between science and philosophy: "Sir J. Eccles has given an example why that separation is not acceptable. He considers the causes of internally generated events in the brain a strictly scientific problem and at the same time makes the working hypothesis that, if there is anything like the mind, it must reveal itself in the activity of the brain, because the mind takes decisions and puts them into practice in the material world. We cannot say that the mind is something completely outside science, because there is a connection between

mind and body. As in the case of gravitation (or forces in general), you can only see or touch their effects." Within the frame of the same general problem, A. Serra insisted that "one should, if possible, define the mind, because in order to understand the relation between brain and mind it is necessary to know what the mind is and where it originates."

Referring to both interventions Sir J. Eccles remarked: "First of all, I do not define the mind, I only talk about it. The mind is infinitely complex.The whole of our experience is lived in the mental world, from morning to night. All our experiences — loving, hating, creating, imagining — everything is in the mind, and we experience it directly. Now we can work scientifically on this. I think the point that metaphysicians have to realize is that science can now go far beyond its usual boundaries; we can take the whole mental world and investigate it and its relation to the brain. So I think things are opening out. If we can carry something away from this conference it might be that new concepts of brain and of evolution are in fact leading to the supremacy of the spirit and also the divine creation of us all. The more we know about the brain, the less materialistic we should be." Going back to the question posed by A. Serra, Eccles added: "As shown in fig. 9, in World 2 there are outer senses — perceptions of light, colour, sound, smell, etc. — and inner senses — thoughts, feelings, memory, imagination, intentions; but centrally (for I go on into the centre) there is the ego, the self or the soul. This is the mind, in World 2, with the will coming through."

3.3. The mind and free will

(Report on remarks by G. Del Re, E. di Rovasenda, J. Cervós-Navarro, J. C. Eccles)

A further remark by G. Del Re raised the question of free will: "It would probably be useful to state explicitly some of the tacit assumptions possibly underlying the interactionist view, for tacit assumptions do exist in virtually every scientific theory and are a condition for its applicability. In this connection, is the assumption of free will not a condition for the interactionist interpretation of experiments? One could try to do without free will, and say that there is always a deterministic

sequence of states of the brain. At a certain moment I may feel that I am thinking of doing something, but in fact this is but the result of previous states, maybe a delayed effect, but anyway an automatic consequence. If, on the contrary, free will is a reality, then the preceding history of the brain does not determine completely its present state and activity. As a consequence, if there is an act of free will, the neurophysiologist can see it in the brain, and there is proof that there has been an actual activity of the mind. Is this not a condition for the interpretation of experiments? On the other hand, how do supporters of a different point of view, for instance of the holistic view, explain experiments such as those of Sir J. Eccles?"

After remarking that the experiments in question were actually carried out by P. Roland in Copenhagen, Eccles pointed out that "materialists do not say anything. This is the strategy: when you have something that is defeating you, you ignore it. And that is what they do." As to the first question he insisted on the variety of events involved in a decision. "You can be preparing with your mind to do something, planning it, waiting for the conditions to be right, and then eventually you carry out the act. These are stages of the performance you see, from planning to actual intention to do it. This is all recognized and you do get actions in the brain in the planning stage. Then you get to the actual intentions to move and then you see the precise experiment related to the movement that has to be carried out. We have got free will, that shows it. If you think, you can bring your brain into action. Thought brings about action, specific action for a purpose. Though it is not recognized enough, we have the power to do these things. In the diagram (fig.9) the lower full line represents the brain-mind interaction; the intention to move, which we feel all the time before we move, is in the diagram of inner sense, World 2. Will comes through to the brain to give the action. This is the free will problem all settled. And philosophers should know about it, because there is no use in arguing about it; by thought we can trigger the brain to make actions. That is enough to give you a notion of what we can do in experiments to settle philosophical problems."

J. Cervós-Navarro pointed out that "we have to take into account the special human character of free will. We cannot know if an animal is capable of thinking of a movement, be-

cause to think of a movement would be a sort of abstract thinking. I do not believe that animals can think abstractly. Do you think it could be possible that animals can also give orders to the movement area of the supplementary motor area?"

In answer to this comment, Sir J. Eccles emphasized that experiments were carried out on conscious human subjects: "You do not do these experiments with animals because you cannot instruct them to do all we have said; but you can let them make free movements, just to feed themselves, and then you can put electrodes in the supplementary motor area that I am talking about, and there you will find that they are actually doing the same thing. That is monkey work."

Actually, according to E. di Rovasenda "the relation between thought and cerebral action, free will and actual event, remains in some way a mystery. In the mind-brain complex — which is both a coessential and cooperative one — lies the mystery of how the movements and stimulations of which Sir J. Eccles spoke are carried out. I would not definitely see the mystery in the brain operations. What is for me an anthropological mystery is the passage from the conscious assertion 'I will' to the actual inner mechanics."

"As a matter of fact," Sir J. Eccles replied "that was a mystery until very recently, but now I have published a scientific solution of it, *i.e.* of how the mental intention can bring about neural effects. That is done in terms of quantum mechanics without breaking the conservation laws of physics."

Nevertheless, even for a convinced dualist, a mystery does remain, "because we are a unit in our experience, with all the different sounds, colours and movements. This is the mystery of the self, the human self."

3.4. Science, philosophy, and the unity of the self.

(Report on remarks by F. Facchini, J. C. Eccles, V. Mathieu)

The mention of the mystery of the unity of the self was bound to bring to the surface the underlying theme of the whole debate. What Eccles was referring to was that, in spite of the distinction he made between mind and brain on the basis

of scientific evidence and of his interactionist thesis, the human person could not be reduced to either component. As a comment on this, F. Facchini remarked that "perhaps, rather than speaking of a mystery, it might be proper to say that the relationship between brain and mind constitutes a domain of speculation which cannot he completely handled by the scientific method. There is an interface between mind and brain as there is an interface between spirit and body, in man, that cannot be attained by an empirical method of observation and study because it intrinsically eludes that sort of method. It is possible to investigate certain manifestations, certain mechanisms of the brain-mind interaction, but in my opinion the whole necessarily eludes an empirical study because of the limitations intrinsic to that kind of approach."

This comment actually combined two different questions, that of the unity of the self, and that of the nature of the interface between mind and brain. In his answer, Eccles referred to the latter question by pointing out that he had already shown (in his fig.s 6 and 9) that what he is concerned with is precisely that interface "whenever we want to do something, whenever we want to see something, we have to go across it in the brain. We are crossing this interface all the time. Above it is the mental world, and I think we all agree that there is a mental world which is non-material. We have literally millions of events in our mind that we can call for. The mental world is a very real world. Then, there is the brain world; that is the world we are learning more and more about, but there is the interface and, as I have already mentioned, it can be crossed without violating the conservation laws by utilizing quantum mechanics."

The other point touched upon by Facchini was taken up by the philosopher V. Mathieu, who referred to his own contribution and to the contributions by Father di Rovasenda and by Father Henrici reported on later in this study. "Concerning the distinction between philosophical and scientific problems," he said, "I do not think there are separate domains, one entrusted to science, the other entrusted to philosophy. Nor do I think that there are families of methods, a scientific family and a philosophical family. Each investigation demands an appropriate method, but this does not entail a substantial distinction of philosophy from science. I believe that every problem has at the same time aspects that are

possible objects of scientific research, and other aspects which for the time being have not yet become the object of scientific research simply because a method for treating them scientifically has not yet been found. For example, the problem of transmission of certain characters presented many more aspects inaccessible to science up to eighty or fifty years ago than now. However, as science conquers certain aspects, others remain that are irreducible. This is because science succeeds to the extent to which it can operate, and the operating of man is always finite — for man cannot create a reality, but only transform it. Thus, there is as it were a qualitative residue.

"To speak of an interface between the two aspects is legitimate as a metaphor," Mathieu continued, "but strictly speaking an interface can only exist between things that are numerically two, and have a certain homogeneity. Now, when we speak of mind and brain, at least in my view we are speaking, rather, of different aspects of the same reality, of the same *substance* (in an Aristotelian or Thomistic sense), which has material aspects, on which it is possible to operate, as well as aspects which are, let us say, spiritual, meaning by this that they cannot be manipulated or subjected to experimental observations. The boundary is not rigourously fixed, in fact there is a continuous shift also resulting from scientific research, but requiring in any event a physical structure. I should not say that there is an interface between these two aspects, but rather that there is an ontological transition — what existentialists would call an ontological difference."

Mathieu's remarks summarize the essence of the whole problem: whereas Eccles assigns an independent ontological status to mind and brain, even though the one is incomplete without the other, and assumes that they can exchange information, Mathieu speaks of different *aspects* of one and the same thing. In the third part of this report the point raised by Facchini and Mathieu will be the central theme. Before that, we shall report on an alternative view still falling at least partly within the reach of science, but clearly favouring a form of identity theory.

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CHAPTER TWO
SCIENCE, THE MIND AND THE NATURE OF MAN

1. Does spirit animate matter?

2. A geneticist's point of view (Jérôme Lejeune)

3. Uniqueness of human being and thinking machines (remarks by C. Chagas, J. Lejeune, J. Cervós-Navarro, G. Del Re.)

1. DOES SPIRIT ANIMATE MATTER?

As a geneticist and a pediatrician who also adopts without reservations the teachings of the Roman Catholic Church about the human person, Professor Jérôme Lejeune has complex views which he likes to summarize in brief, clear-cut statements. His remarks reported below, and those made in connection with the ontogenesis of man (*vide infra*) suggest that, on the one hand, as a scientist he tends to agree with a dualistic distinction between body and mind, since he insists that the "mind can change the behaviour of matter"; but, on the other hand, by stating that "spirit animates matter," and by identifying of the spirit with information, Aristotelian form, and logos, he appears to take a view closer to Thomism. His main point is that, since man is genetically unique, the mind is characteristic of man as such, not just of the human being with a fully operative brain. This consideration is very subtle, because it shows that if identification of the mind with the essence of man (the Aristotelian form) is legitimate, identification of the latter with the organization of matter to give the body with its brain may be tempting, but is not entirely satisfactory, because it leaves out stages or conditions of man where the brain is not fully operative, and yet not even materialists would claim that the living being in such a condition is not a human being. This is probably the reason why he compares the mind of man to mathematics in a computer. In a sense, it would seem that Lejeune's view is close to that expressed by Mathieu in the preceding discussion.

2. A GENETICIST'S POINT OF VIEW.

Jérôme Lejeune
Pontifical Academician
Geneticist, University of Paris

For the geneticist evidence concerning the existence of the mind is to be found at both ends of the manifestation of human intelligence: after the brain is perfectly functioning, and at the beginning of life. This obvious evidence can be stated very simply: matter is animated by the spirit. All the discoveries on the functioning of the synapses, on the transmission of nerve signals from one neuron to another, all this network, all this functioning, which goes as far down as the rupture of vesicles and the liberation of molecular transmitters, all this tells us that movement felt in our own mind is translated directly into changes in the movement of matter. One obvious experience each of us has is that the mind is able to change the behaviour of matter by making millions of synapses fire as soon as we think of anything that we are looking at. That is the first obvious thing: spirit acts on matter.

The second point is related to the very beginning of life. We know for sure that genetic information is written in the long molecule of DNA, and we know for sure that what makes human nature is a given type of information written in the first fertilized cell. That is so true that if the necessary and sufficient information to qualify human nature were not there at the very beginning, and if this information were not absolutely and exclusively specific of our species, there would be no reason why chimpanzees should not be metaphysicians.

So now we have this evidence at both ends: that is, at the moment when the brain is finished, in which it sends transmitter molecules to open the channels of the membranes, and pump the ions, one by one right down to the regulation of matter itself, and also at the other end, at the very beginning, the spirit, or should I say, as a geneticist, the information, or the form, of Aristotle, or the *logos* of the Stoics, is what really animates matter.

Now when, as scientists, we look at the brain we are very similar to a plumber opening a large computer. We are looking at the wiring, and we have a little device to tell us whether

there is some electrical activity in this part or that part of the computer. That is what is done in experimental neuroscience. Now, the question we are asked is similar to the question we might ask when looking at the computer wiring: "Look where the little lights are on. Could you infer from this pattern what is the solution of the equation of the second degree?" No person working on computer hardware in the way we look at the brain in neurosciences would discover the solution of $ax^2 + bx + c = 0$. Nevertheless the human brain has discovered both the solution and the way of incorporating it in the programmes of the machine. That is not just a metaphor. I had a conversation with a remarkable computer engineer, and one evening he told me, "Well, I have to tell you that with my screwdriver I have not found the mathematics inside the machine." Then I realized how ridiculous was the naive formula of Broca, who said, "I have not found the soul at the tip of my scalpel." The scalpel is not a good tool for finding what the soul is, just as the screwdriver is not sufficient for detecting mathematics. I would say, as a geneticist, that the question of how the mind, the spirit, the information, the form or the logos, no matter what you call it, is able to animate matter, is a strange and mysterious marvel which reminds us that human beings are precious because they are an imperfect but nevertheless a real incarnation of intelligence.

3. UNIQUENESS OF HUMAN BEINGS AND THINKING MACHINES
(Discussion remarks by C. Chagas, J. Lejeune, J. Cervós-Navarro, G. Del Re)

About genetic information and the uniqueness of each human being Cervós-Navarro added that "the genetic information is not just in the DNA, for it has been proved that the enzymatic equipment of the embryo after the first division, i.e. the enzymes, the proteins most important for its metabolism, are neither those from the egg nor those from the spermatozoon. They are new enzymes. We have a new human being. This I think is very important. Therefore it is also not

true what some women say: 'my womb is my womb'. It is then no longer theirs."

Although Lejeune's reference to a computer was made in the same spirit as previous remarks about the limits of experimental studies, Del Re recalled that possible analogies between brain operation and computer operation provide a line along which light can be thrown on the nature of thought. "Certain aspects of what is currently considered as thought activity are in fact reproduced in computers. Moreover, computers can simulate other activities of living beings. In the opinion of many reputed informaticians, it is possible to describe a lot of our logical activities, including choices, as a hierarchical sequence of programmes of a computer. In my opinion, this can be accepted in principle even by those who believe that spirit can only be associated to living matter such as exists in nature. The question is whether a point can be reached on this scale where it can be said: see, here we have a complete reproduction (or simulation, if you like) of human thinking. This question may he formulated in a more extreme (and more problematic) form, taken from Hofstadter: is it possible to suppose that, by going to infinity in a hierarchy of programmes, each governing those of the lower level, complete simulation of human thinking could be reached, up to self-consciousness? Apart from the meaning of the term 'infinity' in this context, and apart from the possibility of reaching it, a positive answer seems questionable to many, including myself, because it is difficult to conceive of the self as a superprogramme and not as a programmer. In fact, those who work with artificial intelligence nowadays do not say that they are trying to reproduce intelligence. They say that they try to reproduce, as far as possible, what the human brain can do. They always stress the fact that they just try to simulate human intelligence 'as far as possible'."

As a reaction to these comments, President Chagas remarked that "the notion that the brain can be very similar to a computer could be very acceptable to those who work with computers, but not so much to people who work with the brain." Lejeune's comment on the machine-man problem was even more categorical. "It is not surprising that machines can simulate activities of the human brain — he said — because the human brain invented the machine. But to claim that there

is a measure of equivalence between man and machine is just wrong because the machine has not invented man. To epitomize in one sentence: to think that machines think would be thinking mechanically!"

CHAPTER THREE
BRAIN DISEASE AND THE MIND

1. SIGNIFICANCE OF NEUROPATHOLOGY

Malfunctioning of the brain has philosophical implications for all those theories of the mind that one way or the other identify the mind with brain activity and organization. Sir John Eccles summarized the problem in a discussion remark (Eccles 1987): "First of all, let me ask a question: when a subject is unconscious with an EEG of delta waves showing very low brain activity, you want to know how long you go on before you take him off the machine? Every night when we go to sleep we are unconscious, but our brains are active. One has to think what is involved in this brain activity. It is too simplistic to say 'there is no brain activity, hence the mind doesn't exist or the soul doesn't exist.' Even after months of deep vigil coma, consciousness may return."

Leaving theological problems aside, points such as those raised by Eccles are crucial for an answer to the question underlying the whole mind-body problem, "what is man?." It may be important to insist on Aristotle's concept of potency, but it may also be important to emphasize that man is a thinking individual even at the purely biological level. In fact, the theme of unity, of the whole as being the actual reality with which anthropology is confronted, has been a *leitmotiv* of the Round Table to which this book is devoted. As hinted at by Eccles, neuropathologists can contribute to clarifying several points on these respects, The following note by J. Cervós-Navarro is intended as one such contribution.

2. BRAIN DISEASE AND THE MIND

Jorge Cervós-Navarro
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In no pathological situation is the body-mind relationship a difficulty, or even an unsolved question in itself, but with the impairment of the mind caused by brain disease it becomes a definite problem for the physician and for the patients. In the neuropathological approach the body-mind relationship is a problematical one.

Any function that implies the human mind such as learning, speaking, remembering, reflecting, self consciousness, emotionality and so on can be impaired or even non-existent in a human being with an abnormal, injured or diseased brain. However, the neuropathological approach to the manifestation of the mind and its correlation to the functionality of the brain will always be negative. It is obvious that a particular lesion in the brain implies a relationship between this faculty and the brain and, in case of a local lesion, to that area of the brain where the lesion is located. The question is whether the causal relation to the lack of a function, i. e. to a *negativum*, implies a causal relation to the function itself, i. e. a *positivum*.

2.1. The localisatory hypothesis.

Findings in a considerable number of brain injuries which were clinically and neuropathologically well studied after the first World War led to the hypothesis of a rigorous localization of psychic faculties in a defined brain structure. However, it soon became evident that the lack of function due to a lesion could never prove the causal relationship between this area and function. Reviewing a sufficient number of cases led to the surprising observation that a single function could be affected by different lesions localized in a wide variety of sites. On the other hand a certain amount of destroyed tissue was necessary for the loss of a function and below this amount no symptoms were detectable. For this reason it was deduced that for the loss of a function the volume of brain tissue is more important than its exact localization. Another argument for

the rejection of the localisatory hypothesis was the disastrous long term results of psychosurgery in the early fifties. Patients showed obsessive symptoms, due to the ablation of the frontal lobe. All these facts discredited a rigorous localisatory hypothesis and the idea that psychic functions are an output of the whole brain were widely accepted.

Nevertheless the localisatory approach never lost its importance even in situations where the the totality of the brain functions seem to be either insufficient or broken, as occurs in mental retardation (l) and in dementia (2.) The main reason for this is the extremely minute localisatorial organization of the nervous system, and as a consequence the strictly anatomical orientation of the neurological sciences. Although without a mature brain the expression of mind is reduced or even absent, with increasing educational attention and improved modern teaching methods children with mental retardation achieve levels of cognitive function and learning abilities that were considered unattainable years ago. The implications of this fact are many. One of them is that an abnormal human brain whose weight does not differ much from the weight of a subhuman primate brain can develop faculties completely beyond the limits of a chimpanzee.

It has to be concluded that the relationship between the brain function in the mind and its expression is evident, but a clear-cut correlation between cerebral lesions and impairment of the mind is not possible, or is at least very difficult to establish.

The clinico-pathological correlation in brain diseases is a particular case of the more general question concerning the relationship between function and structure.

2.2. Function and structure

In dementia functional disturbances are more likely to exist long before changes in the structure are evident. This shows that an essential element for the preservation of structure in biological systems is function. This certainly holds true for the structure and function of the central nervous system: «Any kind of doing is cognition and any kind of cognition is doing.»

Functional processes are disturbed or modified by exogenic changes of the structure; on the other hand functional strains or differences induce changes in of the structure (as an adaptation phenomenon.) Structure and function are two aspects of a single, biological phenomenon.

Biological processes take place only in membranes and within a limited space. They are the expression of a dynamic metabolic process and they cannot exist without it. Therefore the relations of cell membranes to dynamic metabolic processes and to cell functions are emphasized in this context. Especially in nerve cells the process which takes place in the cell membranes (that is in the synapses) represents a very essential, central functional area. Evidence is accumulating that a disturbed or changed function of the receptor membrane exists, among other things, in the senile dementia of Alzheimer's type. Research on pathological processes in the human brain leading to dementia has reached a point where the results of modern neurobiology, neurophysiology, behaviouristic research and also of genetics must be considered in order to better understand the pathogenetic mechanism and to find its causes.

2.3. Notes

(1) Mental retardation is the common denomination of all diseases in which the psychic development of a child is deficient. Some of them are transmitted genetically; in other cases the disease has been acquired before, during or immediately after birth. The most common among the hereditary diseases are the enzymopathies. They are inborn errors of metabolism due to the lack of one or several enzymes that lead to a dysfunction or even to the death of the neuron. From an anatomopathological point of view there are children with simple microencephaly with a reduced brain weight, with or without conspicuous changes in the nerve cells. In other patients, malformations of different types can be easily detected .

(2) Another aspect of the relationship between brain integrity and mind becomes evident in dementia, that is the gradual decay of acquired psychic functions. Although there are exceptions, dementia is commonly regarded as the result of a more

or less extensive destruction or disorganization of the cerebral cortex and its connections by a pathological process. If in mental retardation the manifestation of a patient's mind has been poor from the beginning of his life, a demented patient has been rich at some time and has become poor. It is at any rate a false assumption that dementia coincides with decay in old age. Nevertheless the common conditions in which dementia is most liable to occur are the degenerative processes which tend to affect the brain in later life. There are two main pathological conditions: Alzheimer's disease and vascular dementia.

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CHAPTER FOUR
ONTOGENESIS AND PHYLOGENESIS. ANIMALS AND MAN.

1. SELF-CONSCIOUSNESS AND THE HUMAN PERSON

One way of looking at the mind, seen as that which makes man unique among living beings, is expressed by the term self-consciousness. In the book *The acting person* (Wojtila 1970) Pope John Paul II centred his whole concept of person on this idea. He compared self-consciousness to a mirror, in which a man sees himself as it were from without; this action of looking at oneself from outside and critically assessing one's interactions with others is in fact "being a person." In this all-important problem the diachronic aspect is central. If self-consciousness appeared in man's ontogenesis and phylogenesis only at a certain stage of development of the nervous system, questions arise and conclusions may be drawn that bear on ethical issues. For those who reject the identification of the mind with the activity of the brain, there seem to be at least three possibilities: (i) the mind is defined in

such a way that it is not what distinguishes man from a beast or from a possible automaton; (ii) a man becomes a person only when self-consciousness appears, so that we have to distinguish clearly between "being a man" and "being a person"; (iii) the mind as an entity irrespective of the dualism-holism alternative includes potentialities which correspond to Aristotle's *substance*. As is well known, the latter position is the only one in agreement with both the instinctive attitude of man when not under stress and with the Catholic Church's stand on abortion and euthanasia.

The above points already underlie the interpretation of pathological observations, but they become more evident in the context we are considering here.

2. THE MIND AND THE ONTOGENESIS OF MAN

Report on discussion remarks by
A. M. Chagas, J. Lejeune, C. Chagas

The discussion about virtual and actual self-consciousness arose from a question by Miss Chagas which also arises in connection with the fact that certain phenomena placed by Sir John Eccles in Worlds 2 and 3, and hence in the mind, seem to be shaped by interaction with the environment. This point was not widely discussed, because the discussion immediately shifted to the more general question introduced above. Taking for granted that self-consciousness appears in man a rather long time after conception, Miss Chagas wondered about the mechanism which determined its appearing: "What is the role of emotions and of the environment in the relationship of brain and mind described by Dr. Eccles? I am referring in particular to early emotions, to the interaction of environment and human being at the beginning of life." Sir John Eccles' answer centred mainly on the possible implications of the late appearance of self-consciousness: "The baby has no central core yet, because it is not even self-conscious. This state lasts up to one and a half years. Before that age, we have the same perceptions as animals have. In fact mammals, for example, have all these same perceptions, all the senses, the thoughts, feelings, memories, dreams, imaginings, intentions — and this is there also with the baby, but it has not yet

actualised the core of the self." The possible inference that human nature is acquired only with the appearance of the self was well present to Sir John Eccles, who emphasised that this was not what he meant: "I do not say that there is no self or no soul in a baby. I think that it is latent, not active. I think it is the same thing in the foetus — a foetus is a divine creation, has already a human existence. We have all been through this. As babies we have all been as animals, without any active self, which comes later. Before that, at any rate, I still put all the feelings into the baby." As is well known, in many arguments tacit assumptions and pieces of information taken for granted may invalidate the conclusions. This point was implicitly emphasized by President Chagas when he asked Sir John Eccles: "You said that this inner core, the will, comes up only after one year and a half. What is the evidence that it does not come before?" Sir John Eccles answered: "Babies do not recognize themselves in a mirror until about one and a half years. They do not recognize other children or their parents, either, as selves. They are the centre of their world for getting things, food, toys and so on, but they still do not recognize other selves. That means that they do not possess self-consciousness. Through their behaviour you can follow their development, from being a baby, which is not a person that asks questions or enquires about the world, but accepts it and only wants things like a chimpanzee, until the time when, at about one and a half years, the child has language and is asking questions and trying to understand its world, in short has become a real self." Upon President Chagas's remark that nevertheless a baby "recognizes for instance his mother," Sir John Eccles explained this as a mere recognition of the mother's voice. President Chagas' doubts, however, were supported by other participants in the discussion. Professor Lejeune said: "Although I am more optimistic than Sir John about the beginning of the self in the child, I speak as a pediatrician. A baby of three months recognizes its mother, no doubt about that. It does not recognize itself in a mirror because it has never seen a mirror, whereas it has seen a mother all the time. If the baby were looking at itself in a mirror for the same length of time that it is looking at its mother, it would recognize itself. There is no doubt that the recognition of another self is very early in the human being and the only reason why it does not recognize itself is just

because it does not see itself. Thus I would not really accept the void in the beginning, and I would say that the terms soul, will, self apply to human beings, even to the newborn. I would guess that they apply even *in utero*, although I do not know anything about psychology *in utero*. Actually, a study of the latter would be very interesting because we have to remember something very extraordinary, that the faculties of the baby after birth are impaired enormously by gravitation. During the time it was *in utero* it was weightless and did not have to use its brain to maintain posture, to maintain a lot of things. As soon as it is born, part of its system is used for respiration, for all the control it has to achieve, and it takes a lot of exercise until it can do it entirely automatically and can begin to express its own self. Let me give a very simple experience. A newborn baby a few days old cannot look at you if you do not hold its head. If you hold its head very carefully and you look at it, it will follow your gaze and will almost speak with you. If you just stop maintaining its head, everything is lost because the head is so heavy for it that all its mind is required for posture control. Thus we have to consider the baby not as an immature self, but as having immature control of its body. Then it uses what possibilities it has for an enormous task which is totally automatic for grown-ups." On this hot topic, the comparison with apes comes naturally; in fact, it was introduced by Sir John in his reply: "The question of when the self comes has been studied by Amsterdam who has studied a large number of children, babies, with mirror imaging and so on. Now I am prepared to believe, of course, that if you daily practiced the baby with the mirror, it would learn to recognize itself earlier, but I do not know that this has been studied. At any rate, it would be quite an easy experiment: you have a baby and you just keep on making it look at itself — it is quite painless for the baby — and see when it begins to recognize itself. But you must consider that a very clever chimpanzee can recognize itself in a mirror, whereas a monkey always thinks there is another monkey round behind." Here, Sir John Eccles was referring, for one thing, to experiments reported by G. Gordon and J. R. Gallup in 1977. However, Professor Lejeune did not accept the implication that chimpanzees are superior to babies, his skepticism being based on his experience as a pediatrician, which is often more reliable than *ad hoc* experiments. "For a pediatrician," he said, "there is no

doubt that a human baby is much much better than an adult chimpanzee, even at birth. If you have some experience of playing with little babies, then you cannot doubt that a tiny human being is something totally superior. However much difficulty it may have with a task, it is much better than a clever chimpanzee." The discussion, however, was not closed, because Sir John pointed out that the response would have been different if, instead of a pediatrician, there had been "a chimpanzee devotee who brings up baby chimpanzees. You have to realize that at birth a baby chimpanzee has a brain almost as large as a human baby and it has a performance, with all the ordinary testing, that outstrips the human baby up to a point. It is at about one and a half years that the baby goes right away and leaves the chimpanzee a chimpanzee. You could say that our animal heritage is expressed in this way. Note that, surprisingly enough, the chimpanzee baby looks more human than you would imagine. Later on it gets all the great bony things that make it look like a chimpanzee." The above remarks open the way to a variety of further questions, which all converge on the fundamental problem: "What is man?" Two aspects of this problem are intertwined here: self-consciousness as subjective (or inter-subjective) experience — in the sense of K. Wojtyla's thought — and humanity as a special attitude towards the outside world. The following two contributions discuss the two aspects: dr. de Benedetti-Gaddini concludes, as it were, the discussion on human ontogenesis by emphasizing certain aspects of the experience of one's self; dr. F. Facchini looks at man from the phylogenetic standpoint.

3. THE BABY AND ITS SELF

Renata De Benedetti-Gaddini
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The rationalists are like spiders, spinning webs from their own bodies; the empiricists are like ants, who collect raw materials without selection and store them up without modification; true science must be the bee, collecting and then working the material up into honey.

Francis Bacon

I agree with Professor Lejeune that babies are from the beginning a little different from chimpanzees. Although the central nervous system of the human newborn baby has a size close to that of certain adult primates, its brain is far from being at birth a finished and mature structure such as theirs. In humans the various neuronic structures of the central nervous system keep producing dendritic projections during the first six months of life and later. It has been shown that for their final structural development and for their mielinization it is essential that neurons, i.e. central nervous system transmitters, should be used. A well-known experiment on newborn kittens indicated that if one eye is blindfolded long enough, its optic nerve is found not to have reached the same mielinization as the one not blindfolded.

In general, if an animal is deprived of stimulations in any sensorial system, e.g. sight or hearing, the pertinent nerve cells, though they appear structurally normal, show a significant biochemical deficit, and their protein and RNA content rapidly decreases. The converse is true if nerve cells are subjected to an intense, though physiological, sensorial stimulation; in this case the RNA, protein, and lipid content increases considerably.

These observations suggest that the integration of the central nervous system and the development of higher cortical functions associated with thought and personality clearly depend on environmental stimulations — *viz.* situations favouring structural and functional growth and full development of the central nervous system —, as well as on the potentialities of individual organs and of the various structures associated with them.

The support of the psyche is the soma, and the soma came first in the process of evolution. The psyche begins as an imaginative elaboration of physical functioning, and its main task is to put together past experiences and potentialities, awareness of the present and expectations for the future. Thus does the self come into existence. Of course, the psyche does not exist if there is no functioning brain; but it can be said with assurance that the function stimulates the organ. The case of blindfolded kittens, as well as other observations — e.g. the higher mielinization of ten-month old premature babies compared to ten-month old babies born at the right time (Döblin 1964) — are clear evidence of it.

The development of the processing abilities of a suckling during its first year, from the domain of the sensorial to perception and ultimately to mental activity proper, such as is allowed by gradual maturement of nervous structures can be schematized as follows (Gaddini 1984):

develop. stage	dominant mode	process
pre-natal, peri-natal and neo-natal period	sensation	autistic world
first months	the child begins to perceive its body and through it the external world; a world of relations begins	the baby is stimulated and kept alive through putting itself in relation with objects
follow. months	sensations and perceptions are elaborated in sentiments and thoughts	psychical development as differentiation process (capability of mentalization, of mental metabolism)

As can be seen from this scheme, at the beginning (first column) there is a purely sensorial dominant mode, i.e. there are only sensations, particularly touch and smell, and the eyes are used more to keep contact than to actually see. There is an almost autistic state (Wahler, 1976) where the infant is more involved with itself than with the outside world. Only later does it begin to perceive. I was impressed with Sir John Eccles' idea of perception as beginning when, from physical senses, one moves towards mentalization, with feeling and thinking as

part of it. In other words, at the beginning there are mostly smell and skin contact, only later do perceptions mature, and the individual begins to relate to different experiences. Psychic development has, therefore, to be seen as a process of differentiation into feeling and thinking, with sense data as its base.

We have evidence of that. Take, for instance, the first symbol, the blanket (or gown, or towel, or bear) that the baby uses for comfort when it goes to sleep (fig.s 1 and 2). These are woollen and warm in babies born in winter, and silky or linen and cool for babies born in summer. This means that early sensations experienced in the mother's arms, mostly at the breast, are stored; and later, when neurophysiological maturement allows it, are elaborated into a symbol of re-union with the mother. I think that speaks for itself.

On the relation between the mind-body problem and the development of the individual, Eugenio Gaddini (1981) wrote:

"What we do not know, but hope eventually to find out from those disciplines which study corporeal functioning, is just how a physical functional model is converted into a parallel physical one. The question is, in what way does physical functioning lead to the differentiated function of the mind.

What we do know at present, however, is that even in the individual growth-process, the mind's development is a gradual accomplishment advancing from body to mind, a sort of emergence from the corporeal which coincides with the gradual mental acquisition of a sense of physical self. And since, as I have indicated, psychoanalytical research can only proceed in the inverse direction (from mind to body), the process of investigation has brought it ever closer to the early phases of individual development; that is, towards the initial stages of the mind's differentiation from bodily functions. Long before it has the capacity to assimilate phenomena from external reality, the individual mind is able to follow in what I would call a 'focalizing' manner, the body's own functioning. Much remains to be learned about this primitive mental awareness (...) But still more has yet to be discovered about a form of learning which is present even earlier: that of foetal life. Meticulous scientific observation of foetal behaviour in the womb indicates a heretofore unsuspected level of motor and sensorial activity early on (from the end of the third month), as well as a familiarity with the space in which the foetus

actively moves (Iannirubertо, 1980). The foetal organism appears, in fact, to be active and auto-promotional, even if its available space is extremely limited and protected as compared to the post-natal situation. Moreover, at the opportune moment the foetus seems actively to promote the process of his or her own birth, a process which otherwise (if the foetus is dead, for example) does not take place spontaneously.

How much of this learning is of a purely physiological nature is a controversial question. It seems reasonable to me to observe that the first parallel models of mental learning in this intra-uterine period are founded on models of physiological awareness, and that the birth process and the immediate post-natal situation promote active mental functioning based on these first parallel learning models. This being the case, the beginning of the mind's processes of differentiation from the body could be found at some point in intra-uterine growth. *A propos* of this, it would appear that the establishment of a parallel model is impossible before that of the 'memory' of a physiological model. The memory, in fact, could play a crucial role in the passage from physiological to mental functioning, and in terms of development, it could indicate the presumable moment of intra-uterine life when this passage can begin. In any case, there is no longer any doubt that mental activity is present and operational in the newborn, even if specific manifestations of it are difficult to demonstrate before the end of the second month *ex utero.* In recent decades psychoanalytical investigation has shed much light on the first weeks of post-natal life. The broad divarication that exists between organic functioning and mental functioning at birth is of primary importance. If a newborn child is physically an individual, it is because it is a self-defined organism, separate from its mother's body and distinct from other individuals. Mentally, however, it is none of this. To be more precise, mental functioning is present at birth as differentiated, yet its development and refinement are activated, at the successive adjustments (necessitated by the birth process itself) to the internal physiological functions as well as to the surrounding physical environment. However, while the organism at birth can count on a certain degree of acquired physiological learning and therefore supply, within certain limits, ready physiological responses adapted to the altered requirements of body-functioning and environment, it cannot at the same time count on a com-

parable level of mental learning about its own physiological functions. In the light of this, it would appear that the parallel models of these functions tend to remain unchanged with respect to the upheaval which birth imposes on the priority-established (intra-uterine) organization. But in reality, this is not how things stand. It is more likely that the divergence at birth exists mainly between the level of physiological learning as such and the degree of mental learning, which (...) consists mainly in learning about physiological functioning

For as long as the foetal condition exists, this sequence can be considered the original *continuum*, and consequently it may give rise to basic mental learning prior to birth." (E. Gaddini 1981).

We do know that there are flashes of awareness even in the very early stages (first days and weeks), but there is no capacity of distinguishing between self and other; subject and object are felt to be the same. In this early stage there is no sense of self with a personal inner world. That sense will arise in a process lasting the infant's first months, and is the combined result of its innate physical potentials and of its mother's way of taking care of it (looking at it, talking to it, carrying it around.)

"Psychological birth" (Mahler et al. 1975) is a useful metaphor denoting the process by which an infant emerges as a self. It closes a time during which the baby exists as long as there is someone (usually human arms) to hold it.

The data about newborn babies which we can collect experimentally are mostly physiological and biochemical. This does not mean, as many believe, that a sort of psychical activity already exists at that age. The fact is that psychological studies have to be based on physiological data, as long as the newborn baby alone is studied. Yet it is psychology that is under discussion, for in the newborn child physiology and psychology are one. As Winnicott used to say, we have to assume that, if we see a baby, we also see environmental provisions, and behind these we see the mother. Figure 3 shows one of his unpublished sketches of a mother and a child on the way to building its own self. The darker parts of the sketch, in which mother and child overlap, represent the contribution of the two, where formation of the child's self takes place. On that basis the individual's mental representation and the definition of its own self will take place.

In accordance with the distinction introduced by Sir John Eccles, there is a difference between outer and inner reality, and it is right that questions should arise about the moment in which a connection is established between the former and the latter.

Just to give an idea of how we tackled the body-mind problem using artists' intuitions — because, as Tarkovski (1986) wrote, the logic of poetry is closer to the laws of the development of thought, and hence, to life itself — I shall refer to Piero della Francesca's *Madonna del Parto,* a beautiful fresco in a little chapel in the cemetery of Monterchi near Borgo San Sepolcro (fig. 4). It represents the Holy Virgin a few days before the birth of Christ, in a black mantle open at the height of the waistline on the white dress. The Virgin holds a hand on her bosom, pointing to that white lozenge, and her face has an expression of deep concentration and concern, while two angels on the sides open respectfully her way. This Madonna expresses more than any other work the sense of *primary maternal preoccupation* (Winnicott), in which the mother is the baby and the baby *is* the mother.

4. WHAT PALAEO-ANTHROPOLOGY CAN TELL

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It may be interesting to extend discussions on the relationship between mind and brain to the stage of human origins, on the basis of palaeo-ontological evidence. The reference is provided by parameters related to physical characteristics, in particular the size and organisation of the brain, as well as by parameters relating to culture, i.e. the manifestations which distinguish human activities from prehuman forms.

In fact, it is possible to realize that, within a general continuous trend, there are discontinuities with prehuman forms, which palaeo-anthropological data clearly demonstrate. According to Tobias, the mean cranial capacity of *Homo habilis* is about 45% higher than the mean for *Australopithecus Africanus*. In addition, the endocasts of *homo habilis* show a relative development of certain brain areas, such as those of

Broca and Wernicke, in the left hemisphere, which regulate articulate language. Tobias thinks that *Homo habilis* already possessed the neurological basis of spoken language.

In addition to physical aspects the cultural ones must be recalled, for they are the manifestation of a psychic activity that can be considered reflexive or abstractive. We can think of the making of tools and of territory organization, which already demonstrate ability to project, *i.e.* to design, and realise by appropriate operations tools or objects that have been conceived in thought.

Also in lithic technology, when it is not repetitive or stereotypical or casual, it is possibile to recognize an abstractive intelligence, aiming at specific goals.

I realize, of course, that a chipped stone is insufficient to prove that we have to do with human beings. There may have been an ability to roughly cut stones even in beings which were not yet human. Chavaillon and Coppens have pointed out that cut stones were found in deposits 3 to 2.5 million years old, hence older than *homo habilis* (whose appearance is estimated to have taken place ca. 2 million years ago), and think that they may have been wrought by *Australopithecus*, which lived in Africa from 4 to 1 million years ago.

Similar findings have also been reported from other deposits. Chavaillon and Coppens' opinion is plausible, but does not imply an intentional working based on a project, such as is typical of man. We could say that we are in the presence of pre-cultural manifestations, reserving for man the concept of culture in its creative aspects.

No doubt the biological and cultural discontinuity which we recognize to-day between Man and Anthropomorphic Apes is more difficult to recognize at the dawn of mankind between non-human and human forms. Nevertheless, we can say that we are confronted with expressions of ability to form concepts when technology is realized in a systematic, progressive, innovative way, and in forms which suggest an abstractive capacity. For example, bifaces, which are found with *Homo erectus* in lower-palaeolithic deposits of more than a million years ago, and are related to early pebble working (Olduvaian), are characterized by symmetrical working on the two faces and on the edge (chipping, retouching.) The concept of symmetry, which also corresponds to a certain esthetic sense and is not

linked to the effectiveness of the tool, must thus be possessed by the maker of bifaces. It already reveals a capacity for symbolic thinking.

The real specialization of man in evolution appears to be culture, made possible by an adequate cerebral development. This is the reason of its evolutionary success in the competition with the environment.

On the mind-body problem Palaeo-anthropology, in my opinion, has at least two things to say. Firstly, there is a certain correlation between the development of culture and the development of the brain, suggesting that the former would not be possible without the latter. Secondly, after it appeared, the cultural capacity has had more and more manifestations, but essentially as the development of a characteristic which is the same in early man as well as in modern man — namely his ability to abstract, to plan, however it may manifest itself, in the working of a stone, in art, in computers.

The explanation of these two points, in my opinion, lies outside the horizon and the methodology of palaeo-anthropology, but cannot be ignored by scientists.

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With reference to what has been recalled by Sir John Eccles and to remarks by P. V. Tobias in the Study Week on the Principles of Design and Operation of the Brain which preceded this Round Table Discussion, the real problem remains that of specifying the criteria required for establishing when the human level of evolution has been reached. For the first men, as for modern man, cultural manifestations must be taken into account in addition to physical characteristics typical of man — high cerebral organization, reduction of the teeth, sound-emitting apparatus suited for language, perfectly opposable thumb. In fact, the culture must be considered as an integral and essential element of man, even as a biological species, because it introduces processes of adaptation to the environment and has been in any event a determinant in the evolutionary success of the human species.

For present mankind, the elements of culture as expressed in technology, family and social organization, in symbolic language, in art, in religion are easily identified. Difficulties arise in the case of prehistoric man, where conclusions must

be drawn on the basis of the evidence found about primaeval mankind. Tobias attributes Wernicke's area only to *Homo habilis,* in addition to Broca's area. These areas are essential for spoken language. He recognizes, however, the presence of Broca's area also in the endocranium of *Australopithecus africanus.* He links this evidence to the fact that cut stones were found in Australopithecine deposits, which are earlier than those of *Homo habilis,* as I have mentioned above. Therefore he is inclined to attribute to *Australopithecus* not only stone tool-making activities, but a sort of rudimentary spoken language which in his view accompanied and favoured the transmission of advances in the lithic culture before the cladogenetic splitting of the hominid lineage into *homo habilis* and the robust australopithecines. This capacity for cultural and linguistic behaviour would have remained incipient in earlier forms, and would have developed in *Homo habilis.* Tobias' suggestion is interesting, but would have to be further specified. Even accepting a rudimentary ability to work stone and a language communication by means of particular sounds, it is necessary to discuss the possible content of more or less articulated sounds or cut stones, especially if Wernicke's area, which is responsible for the comprehension of articulate language, was not yet developed. Only when stone tool-making activity is realised according to a plan, and language acquires a symbolic content, must one recognize that one is faced with human activity. I doubt that the contents of those activities, possibly present at the level of *Australopithecus,* had such a significance that they indicate a human psychism, an abstractive capacity. If *Australopithecus* really was capable of some form of language or tool-making, these might have been precultural and prelinguistic activities.

When one is faced with chipped stones, their attribution to human forms becomes plausible if they appear to be the product of systematic working, with a variety of forms. In addition to an adequate development of the brain of the maker, other elements must be present, such as territory organization and social communication. Such evidence is nowadays recognized for *Homo habilis,* but not for australopithecine forms, whose industry was not such as would ensure for them success in competition with the environment, unlike what happened in the case of *Homo habilis,* as Tobias himself acknowledges.

5. COMMENTS AND QUESTIONS

(Report on remarks by J. C. Eccles, J. Lejeune, B. Nicoletti)

The two points, the time at which it can be said that a prehistoric being really was a man, and the difficulty of specifying the time at which the transition took place, are both open problems which border on philosophical anthropology and even on theology. As a discussion remark to Dr. Facchini's communication, Sir John Eccles emphasized the relationship between brain development, especially in size, and the appearance of language; he suggested that such a relationship may be interpreted in terms of natural selection. He also emphasized the probable gradualness of the transition from *Australopithecus* to *Homo habilis,* and mentioned the resulting theological problems, which, as a scientist, he did not attempt to solve, being content with the statement that "this is God's method of creating human beings," and with the fact that the Roman Catholic Church does not oppose the theory of evolution as such.

In his remarks, Eccles echoed a statement of his, reported in the book *The Self and its Brain*, where he wrote (p. 555):

"I believe that there is a fundamental mystery in my existence, transcending any biological account of the development of my body (including my brain) with its genetic inheritance and its evolutionary origin; and, that being so, I must believe similarly for each human being. And just as I can't give a scientific account of my personal origin — I woke up in life as it were to find myself existing as an embodied self with this body and brain — so I cannot believe that this wonderful gift of a conscious existence has no further future, no possibility of another existence under some other unimaginable conditions."

Along the same line, but in a less problematic mood, J. Lejeune pointed out, first of all, that Australopitheci probably had brains at most 10% larger than those of chimpanzees; "chimpanzees do not speak at all, and I guess that 10% does not prove that Australopitheci would speak." Concerning the mystery surrounding the origin of man, Lejeune recalled a study made on mitochondrial DNA. "This DNA," he said, "is very interesting because it is not transmitted by the male, but

only by the mother, because it is in the egg. Now, when you examine mitochondrial DNA in all the human races alive today to see who was the ancestor of whom, you find that all go back to one ancestor — a tiny root, maybe as small as one woman. If we look at the mutation clock, i.e. at the rate at which mutations are inscribed in DNA, then we come to a very recent age, around 200,000 years. This is a piece of information, believe it or not."

Coming to the cultural side on which Facchini had placed much emphasis, Lejeune pointed out that "there is another piece of evidence more directly connected with the mind, namely the time at which living beings on this earth started making tombs, burying their likes. That is the best evidence that those beings had a mind, for they took the trouble to put the departed members of their kin in the grave to protect them from being eaten by wild animals. That time is between fifty and one hundred thousand years ago, not more. Now, the Neanderthal man did not appear earlier than 100,000 years ago, and there are primitive tribes in Australia whose members have skulls which, if fossilized, would be ascribed to Neanderthalians. All this means that when we speak of the appearance of man we are not dealing with millions of years, but rather with a few tens of thousands of years. This is an enormous difference."

Lejeune concluded that since the evidence he had mentioned was as scientific as the evidence about language, the discrepancy suggested that the possibility of Pithecanthropus being capable of some form of language had little bearing on the origin of human beings as we conceive them today. Eccles expressed some skepticism on the validity of conclusions drawn from mitochondrial DNA in favour of a single mother, on the grounds that the world population of Hominids 200,000 years ago should have been at least one million.

The fact that the whole discussion seemed to end without a definite conclusion prompted a remark by B. Nicoletti, who expressed the feeling that the frontiers of science had been reached, and referred to the point of view of Father di Rovasenda reported below, to suggest that the categories of science should be replaced by different categories, those of philosophy and those of theology.

6. ANIMALS AND MAN
(Report on remarks by J. Cervós-Navarro, F. Facchini, J. Lejeune, B. Nicoletti, V. Marcozzi, G. Montalenti, J. Szentágothai)

B. Nicoletti asked for additional comments on the passage from animals to man as concerns psychic activities. This point was treated by V. Marcozzi in a book with the significant title *But man is different* (Marcozzi 1981.) With reference to his philosophical contribution (*vide infra*), Marcozzi insisted that at the level of physiology and of instincts the continuity of the scale of living beings is not interrupted between animals and man; but, in agreement with the ideas expressed by Eccles, ability to think and self-consciousness appear abruptly at the human level, and no trace of them can be found in higher animals.

The question of animals and man was resumed later in the discussion in an intervention of G. Montalenti. We report it here in order to ensure a measure of correlation between different interventions, but, as will be seen, its proper place is not defined, because it is also related to points raised in connection with the ontogenesis and phylogenesis of man as well as to interventions reported in part two of this volume. After pointing out that his capacity was that of a scientist, not however willing to consider science as completely separated from philosophy, Montalenti pointed out that "it might be appropriate to try to specify those features of the brain which distinguish man from other animals. As far as I know, the brain areas that have given man the ability to communicate by language are absent in higher primates. There is a question as to how they appeared along the evolutionary line, but with the ability to speak, they have given man the capacity for abstract thinking, thus starting off the whole subsequent development of the human mind. Another characteristic of the human that finds no analogy in higher primates, as far as I know, is the different roles played by the right and the left hemisphere in rational and emotional activities, as emphasized especially by Sperry. It would seem to me that an interdisciplinary analysis of the body-mind problem would greatly gain from an attempt to polarize investigation from the physical point of view and

from the point of view of elementary psychical activities, such as language, which can help to characterize man with respect to animals. Tobias thought he could find in the moulds of brains of *homo habilis* evidence of an area devoted to language. Of course, to arrive from the mould of a brain to cerebral structure is very difficult; I wonder whether it would not be possible to establish a series of steps of these human characteristics by studying the ontogenetic development of the child. In short, I see the problem from a very mechanistic, indeed materialistic point of view, leaving to philosophers, of course, the development of points more pertinent to their specialty. I am convinced that, in spite of the great difficulties, it would be important to proceed along the lines I have indicated, by detecting all those material features that make the human being unique among animals in all its subsequent developments up to spirituality." Montalenti's remarks were received with appreciation by President Chagas and by the other participants. In fact, even those who do not accept the so-called mechanistic reductionism admit that the starting point of our information about reality is sensible evidence. Although the suggestion given by Montalenti is certainly worth a whole research plan, the discussion did touch upon several of the points mentioned by him. Eccles emphasized again that "we have a new kind of brain, with all the special functions of human life." A more cautious response was that of Cervós-Navarro, who tried to show that the opposite way of looking at things is important too. "It seems to me," he said, "that the problem remains of deciding which are specifically human properties, and comparisons with other animals such as could be done in the framework of a palaeontological study are less straightforward than might be thought. For example, the symmetry of artifacts is not specifically human, for bees produce highly symmetric constructions. After creativity and the ability to innovate, of the three basic capacities — intelligence, will, memory — memory seems to me to be the most important one. Not memory of the Pavlov type, which corresponds to conditioned reflexes, but the memory of my life, which has constituted a continuous thread from the time when I was ten to the time when I am seventy. We know very much about memory in the purely physiological sense, and this kind of memory may be present in animals too, but here I am speaking of personal memory. We cannot really take a

specific feature and try to tell when on the evolutionary time scale it became or appeared as a characteristic of man, because what we know of man is the man we experience today, and even information from written history or from prehistory points to characteristics of man which are the same as those of the man of today. What must be studied to determine the singularity of man is the totality of those characteristics. What is the significance of Broca's and Wernicke's areas as inferred from a mould? It is very difficult to tell the functionality of a cerebral convolution from a mould. When the brain grows in evolution there are only two possibilities: it will either repel the skull-cap or fold up to form convolutions. Therefore, the presence of more important convolutions does not imply automatically that some function was enhanced or had appeared. It is known for example that the rhino-encephalic areas of mammals, which are very important for smelling, become in man much more important for the emotional system. When I register the smell of my grandmother's cakes or of the paint that was used for a certain house, my senses certainly respond less intensely than a dog's, but the emotions that sensation evokes in me are quite another thing, although the same area of the encephalon is involved. I repeat: it seems to me that, all things considered, the most important point in connection with the problem of the mind is to determine what is specifically human in man as we know him."

On Cervós-Navarro's remarks the palaeo-anthropologist Facchini added a few comments. "I have insisted on the innovative, projective character of man, which is the exact opposite of the stereotype, *i.e.* what can be found in the behaviour of animals. Bees, birds, or any other animal, always perform the same actions, even if directed towards a well-specified result, in a repetitive way; therefore I believe that the problem must also be looked at from the same point of view concerning the search for abilities that distinguish man from non-human primates, including anthropomorphic apes. Therefore, also in connection with brain evolution and the problem of the moment at which the human threshold is reached, I believe a global approach is necessary, which would consider not just one element, but the biological aspect in all its complexity, the various, merely functional aspects as well as the cultural aspects. Man is all of this, not just one part. The importance of combining different pieces of evidence even within a strictly palae-

ontological approach is illustrated by the study adopted by the American palaeontologist Laitman: it consists in trying to find out from the base of the skull at what time the larynx moved down to provide room for sound production. This was detected already on a fossil of *Homo erectus* of 1.6 million years ago and could be added to encephalic evidence already available. As soon as a skull base of *Homo habilis* becomes available, the same study will become possible on that ancestor of man."

J. Szentágothai suggested that one could look at speech as an instance of a typical characteristic of human beings. "It is very good," he said "that Professor Montalenti suggested that we should now look for the specific human characteristics of the brain. Everybody agrees that the most specific and the most typical human characteristic is speech, although it is not the only one. (I could go on to enumerate various other things which miraculously developed in some concerted way. That is the beauty in phylogeny, that things do not happen to one or the other aspect, but they somehow come together in a creative manner so as to bring out something very new; and the development of the human being is really one of the greatest miracles in nature.)

"What I now want to stress, in agreement with my previous remarks, is that language and speech are hardwired into the human brain. The human brain is a speaking brain. It has this ability, in spite of very gross size differences, from various pathological causes, as have been briefly mentioned in the course of this discussion. In spite of these alterations, a human being will still have a certain capacity to speak, even though with gross incongruences or pathological changes. The argument of Chomsky is to me very convincing, otherwise you could not understand how quickly a child becomes able to speak, in general at an age of two, but very often several months earlier. This is a fantastic speed. Even the greatest genius who performs some great scientific discovery, is really a nincompoop compared to the average human child who is, within two years or within three years, able to use language with the correct vocabulary and syntax, though at a child's level. Improvement takes a couple more years.

"What is important is hardwired into the brain, so the connectivity is given. A simple example is the spinal cord: the segments which normally supply a forelink, and the lumbar sacral segments which normally supply a hindlink or a lower

link for us, — this connectivity is hardwired for the characteristic movement of the limb. This is also true for speech, of course at a much higher level. However, this hardwiring waits to be reinforced by the environment. First, of course, the child produces its own phonemic sounds and they will be reproduced by the environment in the mother tongue of the child — one of the thousands of languages we have on the earth. For instance, in the Chinese environment the phonemes will be produced in Chinese and from then on the whole language will go on in one direction or the other. But what if the opportunity for this rinforcement was lost? There were always mythological stories about humans raised by animals. We have a couple of genuine cases with photographs of children who were raised by wolves."

At this point Szentágothai recalled a recent case of the same kind, that of a girl called Genie, who had been kept in complete seclusion until the age of 13, when she was finally rescued. Over a period of two years she developed considerable linguistic and cognitive ability, but her language was still limited to groups of three or four logically connected words. Szentágothai continued: "The thing is that once the opportunity is over, certain faculties will not develop. If you raise a kitten during a certain critical period in darkness, or raise it showing it only a vertically striped environment, then it will supress everything but will see only vertical stripes and will bump into horizontally striped things. The same fact holds for speech. In the case of Genie, as described by Susan Curtiss, the words learned were never spontaneously produced, only on questioning the child. They were never used in context and were processed by the right hemisphere. This confirms that once the prearranged left hemisphere mechanism is lost and the child is not in a normal situation where it can experience and hear the language of a familiar environment, then that is a loss which cannot be retrieved. There is a minimum possibility to make some rather imitation-type speech with the right emisphere, but that is not human speech. This sort of consideration points to the fact that this mechanism is very important for understanding the reality of being human."

Eccles agreed to some extent with Szentágothai, pointing out that he knew about Genie for having corresponded with Susan Curtiss and for having received the book *Genie*. But he was less drastic in his general conclusions. "Genie," he said,

"was kept until 13 years and 8 months in isolation with no speech, so she really lost the left speech areas, in agreement with what Lenneberg would have predicted, that if the left hemisphere was not used they would disappear. So she uses her right hemisphere to speak.

"At this time (1988) Genie is about 25 years old, living in a family with their 3 other children. I think she has adapted as well as could possibly happen. Her speech is limited, and she does not speak much, but it is human speech. She is silent most of the time, but she can use it. Reading and writing is much more difficult; she has great difficulty and does not like it at all. But one should not think that she is a poor thing, because she has wonderful abilities in many other respects, manual abilities, drawing and fabrics and design. In the recognition of all patterns, she comes at the highest level. And she is human, undoubtedly with a sense of humour, and speaks about her past. Those who have helped her have done a wonderful job: it is a great credit to everybody. For example, she has never been on TV, and hardly even in the news. That is remarkable, to save her from all the publicity."

Lejeune expressed a certain disagreement with the implicit conclusion of the remarks of the two neurophysiologists. "I have great difficulty," Lejeune said, "in accepting the idea that a child will never speak if it had not spoken at a given age. I can hardly believe it especially here in Rome, because the twins, Romulus and Remus, were really raised by animals.

"It seems to me difficult that they were not able to speak when they were grown up. They would not have founded Rome. Now, you could tell me that my example is wrong, not only because it is mythology, but because they were twins and we know that twins talk together in a language of their own before they are able to understand the language of their parents. It means, as you said, that our brain is plastic, and I agree entirely.

"The reason why I am mentioning this exception is that fortunately they were twins, so they could speak to each other, but if they learned to speak it was because it was somehow written in their brain. Nevertheless, I must point out that in every observation now reported of children who supposedly were raised by animals, who were found and who later did not learn to speak, or were even taught more than 20 or 30 words,

they were walking on all fours instead of two feet. Those children looked very much like psychotic children. If they had been living in isolation, if they had been rejected by society, it is possibly because they were psychotic at the very beginning, and that it is their phychosis which was manifested by the rejection by society or their parents, producing their later difficulty in learning. This idea is supported by other examples of very extreme conditions to which tiny human beings have been submitted, namely concentration camps. A few babies had been born there and after the war they were horrified when they first saw any grownups. They would leave the room or crawl under the table whenever an adult entered the room. A friend of mine who took care of them was very surprised, after six months, to see that none of them had become psychotic; none of them was abnormal. That means that although they had been treated maybe in a way worse than children living with animals, they had not lost any human characteristic. They are now living a normal life.

"Thus, I am very optimistic about the notion that, all things considered, human language is really half written in our brain, and man is made to speak if not forbidden to do so."

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CHAPTER FIVE
THE BRAIN AS SELF-ORGANIZING SYSTEM

1. SYSTEMS AND INFORMATION

In their book *The Self and its Brain*, Eccles and Popper explicitly state their view that the brain is a complicated piece of machinery. This statement is obviously shocking for philosophers whose notion of a machine is that of a system of levers blindly transmitting a force from one site to another. A last generation machine differs from that model as much as a mammal differs from an amoeba, and perhaps qualitatively even more, because its operations are based on completely new principles. The simplest one is called feedback, and sometimes "reflex": it consists in the ability to adapt the conditions and mode of operation to its effect, so as to continuously correct the effects in view of a specified end. The most current (and perhaps simplest) machine of this kind is an airplane in automatic flight: every change in the trim of the aircraft is translated into electric signals which cause the "automatic pilot" to modify the positions of the controls and the thrust of the engine so as to restore the original trim; thus the aircraft behaves in the same way as a walking man, who checks and corrects his posture, speed, and direction at every step on the basis of information from the eyes, the ears, and the semicircular ducts. This simple example points to the crucial issues in the comparison of the brain with a machine: intentionality and consciousness. Whatever the view a thinker holds, it is important not to forget that, in an interactionist view, consciousness and intention may be properties of the mind, so that the issues in question do not really concern the idea that

the brain is a biochemical information processor similar in operation, but enormously more complicated than last generation machines .

The terms "reflex machine" and "information" characterize the following contribution by J. Szentágothai: it illustrates a route from science to the mind that is definitely different from that of Sir John Eccles. The differences, however, should not conceal the common points, which are well worth emphasizing, because they may be considered as typical of the approach to the mind-brain problem of scientists who reject radical materialism. In a paper of 1987 (1), János Szentágothai wrote: "As a neurobiologist who struggled for a lifetime with problems of the "blueprint" of the nervous system, but as one who always tried to see the meaning behind the blueprint, I had to face thorny questions already at the very beginning of my studies. These questions arose mainly from aspects of "wholeness" versus "parts" (...) The current discussion about the relationship between brain and mind is little else than the formulation of the age-old question at the contemporary level of the neurosciences."

Thus, although — at variance with Sir John Eccles — he tends to identify the mind with brain activity and organization, he too is faced with epistemological and philosophical issues in the very heart of his research. This is further illustrated by a problem he has discussed in several papers: downward causation, namely the idea "that whatever it is, our mind can causally interfere with the physiological operations of our brain neuron circuits." (Szentágothai 1987.) The recognition of this concept places his view in sharp distinction to reductionism; "but," he adds, "does this compel us to accept a dualistic view? I do not think so; there has to be an acceptable third way between the essentially reductionist and the dualist interpretations." (Szentágothai 1984.)

A great difficulty of all new and old "emergentist" theories lies in their religious implications. Aquinas himself resorted to the notion of "substantial form" in order to explain the immortality of the soul. Being a Christian, J. Szentágothai is confronted with a similar problem, but proposes a way of solving it which reminds us of Leibniz — our personality may be reduced to organized information, and God can reproduce it in a new body without the necessity of an intermediate state

where the soul would be disconnected from the body (cf. Garrigou-Lagrange, 1947.) If one thinks of Einstein's discovery of the relativity of time, then even the notion that there will be a time interval between our death in this world and our reappearance at the end becomes questionable.

The immortality of the soul is perhaps a problem where theologians should be allowed to have the last word. However, it is significant that scientists are faced with it even in their attempt to rationalize the concept of mind. This is not surprising, because an answer to the question "what is man?" cannot ignore the religious dimension.

2. ABOUT A PARADIGM OF NEURAL ORGANIZATION.

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The main trouble in our present views and discussions about the age-old problem of Body-Soul relations is caused, as far as I can see, by the fact that even most brain scientists still think in the old and outdated paradigm of the brain as a complex reflex machine. According to the old Cartesian paradigm (dating back to Plato), the brain is essentially a passive, albeit non-linear, transformer of impulses which come from the environment, with a few genetically inbuilt behaviour patterns, drives, and instincts. It can be easily shown by tissue culturing and tissue recombination techniques that neuronal centres are — at their very bases — active agents (devices) that have a life of their own. Their activity arises in embryonic development from random, spontaneous activities of neurons. This becomes subsequently "self-organized" into highly complex spatio-temporal activity patterns before any connection with the sensors and effectors could be established. The ultimate source of neural activity is, hence, random (and chaotic) neural "noise" that in consequence of mutually coupled excitatory and inhibitory neurons becomes self-organized, even if only about 10 neurons were to be randomly interconnected. Such activity patterns do not need any neural input from sensory channels. They are, though,

philosophy that early Christianity found in Greek and Hellenistic philosophy and used as a convenient framework to formalize the new insights. According to the Apostolic creed we believe in the resurrection of the flesh (*Auferstehung des Leibes*) and not in the continuity of some immaterial soul. If we are able, with our modern and often dangerous science, to create new life — at least in principle — on the basis of information (the genetic code) from some rather simple organic molecules, then it would be ridiculous not to believe that this is possible for God. If God is omnipotent and omniscient as He proclaims Himself in the Scripture, He is in full possession of all information about everything, including all information that passed through our thoughts and through our unconscious. Why should I then not believe in the pronouncement of the Scripture that in His own good time God can recreate us all in the form He thinks appropriate, certainly well above our imagination; and that God will be able to judge us, hopefully not on the basis of our merits, but in His infinite mercy? There is no material or immaterial continuity needed for God to fulfill this promise.

3. COMMENTS AND QUESTIONS.
(Report on remarks by J. Cervós-Navarro, J. Szentágothai, J. Schotte, A. Serra)

The discussion following immediately J. Szentágothai's report centred mainly on two novel aspects he had identified in our nervous system: self-organization and randomness. The notion that self-organization may be the answer to Eccles's observation of events in the brain that cannot be traced back to previous ones is certainly attractive for emergentists as well as for holists. As Cervós-Navarro pointed out, this implies affirmation of "the autonomy of the nervous system, which is very important; it is, as it were, the centre of all that is going on in our psychic life." However, Cervós-Navarro suggested, "there is some sort of self-organization or even autonomy in living beings which do not have a nervous system, say, sponges. Therefore, perhaps self-organization is not just something inherent in the nervous system — although the latter has a

special kind of it — this autonomy with respect to external stimuli also seems to exist in other structures."

Szentágothai agreed on this remark, which — we add — is clearly supported by all we know of the biochemical events leading from DNA in the fertilized egg to the formation of new proteins, new cells, and finally a whole organism. To probe deeper into this subject in order to discuss the meaning of self-organization, organization, informational structure and related concepts (cf. *e.g.* Del Re 1989) is certainly a fascinating and complicated task. What can be said here is that the above remark opens up an additional chapter, that of levels of organization, which Szentágothai summarized as follows: "in bacteria as well as in protozoa you can detect many actions or phenomena that cannot be explained without the concept of self-organization; when the nervous system appears in the animal kingdom we are dealing with a new level."

Concerning randomness, some misunderstandings can arise, and that danger was pointed out by Mgr. Jan Schotte. In fact, Szentágothai agreed that living organisms are genetically controlled even before connection with the outside world is realized. (...) Man has a brain specifically designed for the activities typical of man. Mgr. Schotte then asked whether this was not in contradiction with the notion that randomness precedes self-organization in the nervous system. A. Serra wondered whether the contradiction might not be removed by considering that the environment, and only the environment, has a random influence on a nervous system.

The above remarks show how delicate a role the concept of chance plays in modern science, and actually the feeling that Szentágothai's use of randomness might be contradictory is simply due to a sort of confusion between two different aspects of nature. In fact, the above remarks would apply even in the general case of self-organization in non-living matter, because, of course, successive instantaneous states of a given system are such that the system remains what it is (say, an atom) at least for a certain "lifetime". The point is that complex systems have nevertheless a measure of freedom *within the limits imposed by natural laws or by the plan contained in the genetic code*. Thus, a vessel containing a given gas cannot change at random as far as the nature of the gas or the volume is concerned; but the local concentrations of molecules inside the vessel do change at random, and, under certain conditions but at an

unpredictable instant, give structures which survive for a time. The same holds here. Of course, the brain and even the structures and possibly the connexions of the neurons are genetically determined; but enough freedom remains in neuron firing, as Szentágothai pointed out: "if you have an isolated neuron, or you take any neuron inside the nervous system, if it is not driven by something else, it produces impulses at random. In some lower animals we have pacemaker neurons, but in general, if you pick out a neuron it just starts producing impulses, which, as far as we know, are random. On the other hand, the nerve cell itself is genetically determined." In conclusion, Szenthagothai's discussion answers might be taken together to indicate that, whereas there is a large area of genetic determinism in all organisms, in their structure as well as in their organization, when we come to the organization of the *activity* of the nervous system, more specifically the brain, we are dealing with a different level where not everything is specified by genetics. This point is of enormous importance in modern theories of information, and has been the object of countless studies.

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APPENDIX TO PART ONE
AUTOMATA AND THE IDENTITY OF MAN

AUTOMATA AND THE IDENTITY OF MAN.

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1. The machine as a model of man

In the time of Descartes and Lamettrie western thought began to consider the hypothesis that men were machines. The ancient mechanical magic of Heron and Architas, the technical artifices of the Arabs, the computing devices of Raymond Lull, the medieval jaquemarts, the moving statues of Renaissance gardens, and later the ingenious clockwork automata of Vaucanson seemed to support that idea; which, however, soon proved insufficient, for Cartesian mechanism could not explain the chemical functions of the living organism. It was in the time of Newton and Laplace that, overcoming the barriers of vitalistic physiology, man started to be considered a thermal machine, in accordance with a description of the world where it was expected that a combination of the thermodynamics of Joule and Carnot with eighteenth-century mechanics would provide models leaning to complete intelligibility of both nature and man.

Soon the well-known objections of Gibbs, Maxwell, Boltzmann to nineteenth century mechanism demolished the illusion of explaining all nature in deterministic mechanical terms, and initiated the search for a model no longer deterministic but probabilistic; in addition, the theory of

homeostatic systems at the biological level inaugurated with C. Bernard, P. Richet and W. B. Cannon a new physiology for which the mechanistic model appeared to be obsolete. At any rate, precisely the birth of the *theory of control and communication in animals and machines* revealed the absolute insufficiency of the man-automaton equation built in terms of nineteenth-century physics, and led to posing again the question whether the cybernetic model, on the contrary, would be fully adequate for that aim. This has been, perhaps, the latest formulation of the anthropological problem given by western thought. The attempt to prove or disprove the man-machine equation has been the most exacting trial devised by man today in the hope of accounting for himself; *i.e.* of explaining, by means of science, certain specifically human activities such as life, consciousness, thought, will, feelings; of solving those fundamental problems which have always troubled man — the existence of the soul, the relation between mind and body, between life and matter, between self and the other, between nature and society.

In this search, the machine appears quite naturally as the guideline, the model, as the scheme indefinitely modifiable, adaptable to circumstances, susceptible of converging more and more towards man or of diverging more and more from man, depending on whether or not an adequate explanation is provided by it.

2. The cybernetic hypothesis

A most intuitive procedure for accounting for the place of man in nature thus consists in comparing man to a machine (and that far, at least, there seems to be a quite general consensus); but the consensus is promptly lost when the question becomes: is this comparison to be made between the behaviour of man and the behaviour of the machine, or between the corresponding structures? There are also questions of a more preliminary nature: what machines must be taken as models? In what do they differ from Newtonian, *i.e.* purely "mechanical" machines? Is the analogy between man and machine constructed by means of a more and more perfect imitation of man by the machine, or is it constructed by

reducing the complexity of human phenomena to the comparative simplicity of mechanical phenomena? In other words: should machines be described in terms of the conceptual schemes of philosophical anthropology, or should man be described in terms of the concepts of cybernetics?

As is well known, disagreement on any point can only be significant if agreement on the meaning of terms used has been reached first. In our case an agreement on what is meant by the cybernetic hypothesis should be reached, even before wondering whether the cybernetic model is adequate for human beings.

In the history of the whole problem there have been at least two different formulations of this hypothesis:

1. *a*. The physical foundations of intelligent activity can be reproduced in automata by means of appropriate mechanisms for the reception, the transmission, the processing and control of information. The essential feature of those systems is some sort of negative feedback .

b. It is not necessary to resort to anything else in order to explain man.

2. *a*. Granted that there are machines (the automata of cybernetics) capable of performing certain operations, and men who perform operations of the same type, it is always possible to construct an automaton capable of exhibiting any given type of behaviour exhibited by man.

b. There is no activity of man that cannot be performed by an automaton.

In the above list, the minimal formulation and the maximal formulation of 1 and 2 have been labelled (a) and (b), respectively. In either formulation, both assumptions have received the adhesion of cyberneticists, philosophers of science, psychologists, physicians, and have played a specific role in the development of the problem.

The minimal formulation of the first hypothesis is of limited philosophical import, for it amounts to the statement that human intelligence rests on some physical support — an undeniable fact, even among philosophers, and one never denied by anybody, as far as we know — whereas it has an

enormous neuro-physiological import, since it commits itself to describing in a completely "automatic" way the structure, the behaviour and the functions of that physical support. The maximal formulation, on the other hand, puts forward the classical anthropological viewpoint of mechanistic materialism, thereby accepting a methodologically incorrect assumption, namely that the physiological structure of the nervous system is a necessary and sufficient condition for the manifestation of intelligent activity.

The minimal formulation of the second assumption is the correct expression of the theoretical intent of the first one: cybernetical machines differ from Newtonian machines in their operation because, like the physiological system of man, they include control and information processing mechanisms, but the structural analogy is not sufficient; machines must first be started, and only then is it possible to explain the behaviour of man in analogy with the behaviour of a machine. As long as this is all there is to it — *i.e.*, as Wiener pointed out (Rosenblueth, Wiener, Bigelow 1978), as long as the whole thesis amounts to the claim that the great classes of behaviour are the same in machines as in living organisms, while limited, specific classes may be characteristic of only one group — this has no great philosophical import, in spite of the remarkable heuristic role it has played in connection with behavioural science.

3. Can machines do all that men can do?

Everything changes when the question is: «Can machines do all that men can do?» This question may be taken as the correct formulation of the assumption implied in the man-automaton equation, *i.e.* that it is possible to interchange the two terms without causing the context to change its truth value. Equivalently, to deny the possibility of the equality means also to deny the possibility of such a substitution. In a new formulation the problem may be looked at as the attempt to define the entity "man" by means of concepts borrowed from the theory of automata. The cybernetic hypothesis then becomes a hypothesis of philosophical anthropology.

Now, to define a term is equivalent to showing how one can do without it; therefore, the possibility of doing without it will be the conclusion of the definitory process and not its premise. In our case many different definitions can be propounded for the term "man", and a different anthropological theory stands behind each definition: the theory of the spirituality of man, the theory of the substantial unity of soul and body, the Cartesian theory of dualism between *res cogitans* and *res extensa*, materialistic theories, etc. Thus, the definition of man that emerges from the cybernetic hypothesis actually rests on an implicit philosophical anthropology based on the notion that the conceptual system of the theory of automata is capable of supporting not only a physics, but a metaphysics of man.

4. Two models for the man-automaton equation

In short, it may be said that, historically, the man-automaton equation was stated first at the level of simple behaviour; then as the equivalence between the physiological structures of man and that of the automaton; finally, as Turing's hypothesis of 1950, which goes back to behaviour, but assumes equivalence at any level of complexity. The significant names of these stages have been respectivly: N. Wiener, R. Ashby, W. McCulloch, W. Pitts, A.M. Turing. Now, to consider something from the behavioural point of view means to regard that something as "a black box" (intuitively: an object whose inner structure is not visible so that only the external behaviour can be known), with a certain number of input and output gates connected to one another according to well defined mathematical functions. If something is said about how the black box is made internally, *i.e.* in which way those functions are realized in the interior of the black box, this happens at a purely heuristic level, useful for tactical reasons in the strategy of research; but what really matters is that a number of input symbols processed according to a finite number of instructions (= operations) should be found as the output.

To consider something from the point of view of its behaviour means thus, grosso modo, to work on "algorithms"; to consider something from the point of view of structure means, on the contrary, to open the black box and to inspect

"form in relation to function," that is to find and describe within a map of relations the functional unit which receives the input signal, that which transmits the instructions, that which executes them, that which sends the results to the output gate.

Now, what is usually meant by the structure of an organism is a set of elements, each in specific interaction (within a certain class of relations) with one or more others, according to a specific topographic plan (in the sense of a map); the physical laws to which the single elements are subjected are (inductively) transmitted to all the others, from microstructures to macrostructures. This is, move or less, a mechanicist's view of an organism. As a logical consequence, if the construction plan and the physical laws which the bricks of the physical edifice obey were known, it would be possible to reproduce the whole by means of an appropriate mechanical model, which would necessarily exhibit (in an adequate environment and under suitable conditions) the same behaviour as exhibited by the organism.

A tentative solution of the problem along these lines requires that a technical, visualizable realization of the model should be available: a flow-chart on paper is not sufficient, because it is necessary to prove that a model realized according to the project will really work.

On the contrary, the point of view which interprets the man-automaton equation in terms of behaviour patterns requires neither that the elements of the black box be functionally localized, nor that the physical laws which govern them be specified, but starting from the phenomenological-descriptive detection of input and output gates (symbolized by mathematical and logical variables), mathematical functions are generated which, in a unique way, can correlate each input signal (or input system) with a specified output signal, without explaining how and why that unique correlation is realized. One of the first examples in this connection is the imitation by means of automata of Aristotelian syllogistics: the deductive activity of man is no longer studied, this time, as if it were an organic function, a subjective process, where the physico-chemical laws governing the functional elements are the same as those governing the logical activity of the individual, but adopting exclusively the point of view that, after processing,

the input symbols are transformed according to certain rules into corresponding output symbols. Behaviour and structure thus approximately correspond to the two models which have been used in cybernetic research on artificial intelligence to understand man and animals, though at a minimal level: the mathematical, logical model and the physical-mechanical model.

5. The two models

The two models under consideration, elaborated and enunciated in the contemporary age, are rooted in the theoretical travail that characterized the birth of modern science. The algebraic representation of geometry and logic, and the gradual emergence of an explanation of nature in mechanical terms made possible the earlier formulations of the problem: "Is it strictly necessary to resort to extra-physical principles in order to explain the whole of human activity?"

The evolution of technology brought about by the concretization of the results of scientific research in more and more complex mechanical devices finally created the optimal ground for proceeding to the actual construction of technological manufacts susceptible of being interpreted as models of living beings and of man himself, thus giving raise to the formulation of the cybernetic hypothesis. But the theoretically decisive fact is that the cybernetic hypothesis concerns the very individuality of man, as Norbert Wiener has explained:

"The earlier accounts of individuality were associated with some sort of identity of matter, whether of the material substance of the animal or the spiritual substance of the human soul. We are forced nowadays to recognize individuality as something which has to do with continuity of pattern, and consequently with something that shares the nature of communication." (Wiener 1950.)

In this perspective, considering that the cybernetic hypothesis actually amounts to an anthropological hypothesis, a re-examination of the whole body-mind problem is clearly in order.

6. Theories of body and mind

The two proposed solutions of the mind-body problem that are considered most plausible and are historically best known, namely anthropological dualism and materialism, have since long ago accepted to pose the problem in terms which make research fruitless and risk to take dogmatical as well as antithetical positions.

In short, the object of the discussion is to decide whether or not the living human organism is controlled by some entity distinct from it and not material. The two opposed answers are well known: materialism claims that man can be explained without passing beyond the physical-biological horizon (*i.e.*, man is just his body); anthropological dualism starts from the hypothesis that non-existence of my body does not imply my non-existence as man (*i.e.*, man is just his soul.)

Of course, at least from a purely logical point of view, two more hypotheses concerning the identity of man can be stated: man is neither his body nor his soul; man is both, his soul and his body. In the former case substantialist categories are replaced by "functional" concepts, according to which man is considered as a "word", an information process, and information cannot be defined within the categories of materiality and immateriality (Rossi 1981). In the latter case, on the other hand, we are confronted with the unity of the substantial form of man (*Idem ipse homo est qui percipit se intelligere et sentire; sentire autem non est sine corpore*, Aquinas, *Summa Theologica* q.76 a1), the fulcrum of Thomistic anthropology. The latter contained the germs of a very fruitful development, but has been so much underestimated and neglected by both spiritualists and materialists that it could not find a place in specific treatises on the mind-body problem; consequently, nineteenth-century anthropology seems to be merely the record of a discussion between the proponents of the man-soul thesis and the proponents of the man-body thesis.

Now, concerning the two traditional solutions, it is well known that Wittgenstein in his Philosophical Studies, took away many arguments from those who claimed that there is a mind which exists separateely from the living organism. It is also known that the inadequacies of behaviourism and the collapse of deterministic mechanism have deprived materialism of many of its winning cards.

The decisive objection of Wittgenstein to anthropological dualism is that we do not obtain psychological concepts by means of internal observation or introspection; he arrives at this, as is well known, by analyzing emotional language and the concepts of "public" and "private", in order to remove the risk of solipsism. As to materialism, it has presented under more and more refined garments variants of the well-known so-called scientific materialism, according to which man is but a very complicated biophysical mechanism; logical behaviourism and the identity theories are the best known examples.

Logical behaviourism, which in its most modern form has abandoned physicalism and reductionism, claims that the question is not what man is but **how** man is. In fact, as has been proved by Nelson (Nelson 1969), behaviouristic theories are not even sufficient to describe automata (Turing machines, finite automata...) and therefore, *a fortiori,* cannot describe man.

Of the theories of psychophysical identity, Feigl's formulation (Feigl 1960) has been abandoned by its author, and Smart's formulation (Smart 1969), according to which brain processes and internal experiences are identical, has been shown to be highly questionable by Malcolm's objection concerning the place in which this identity is realized. The doctrine of psychophysical correspondence, or principle of simultaneous isomorphism between brain states and thought is usually considered as a form of identity theory, but, in my opinion, cannot be considered either materialistic or monistic in general as long as the entities under study are not reduced one to the other.

In view of the great variety of reformulations and of fruitless objections and discussions, the temptation might arise to consider the whole question actually meaningless; in fact, it cannot be avoided, because it is a necessary preliminary to any discussion of the more general question of the nature of man.

7. Can machines be conscious?

Having delineated the above premises, I shall now concentrate on two tasks:

a) showing that cybernetic models in the philosophy of the mind go beyond traditional philosophical categorizations, which have so far proved fruitless;

b) analyzing the question of consciousness, which, in my opinion, is essential with a view to a discussion of the identity of man.

This analysis will permit us to demonstrate the inconsistency of both materialism and anthropological dualism.

I shall start with the central question: "Can machines be conscious?" This question must be accompanied by the specification that it refers to the world of man, for it would either be non-pertinent or beg the issue — depending on the answer — if it referred to the universe of machines.

Studies on pattern recognition and problem-solving have clearly shown that in those activities a non-formalizable type of information comes into play - the so called "presence information" —, which cannot be processed except by entities provided with a body. It may be suggested that the typical activities of consciousness are of a similar kind, and that consciousness necessarily implies a body, even though it cannot be reduced to it.

Here, consciousness will be understood as the body-scheme, *viz*. the phenomenological conterpart of the real body. Our aim will be to show that a machine cannot exhibit such a scheme, not just because of practical construction limitations, but by its very nature.

In other words, the problem of the identity of man will be discussed under the working assumption that man is indeed a body, but a body provided with characteristics not entirely reducible to the body itself. Of course, at least for the sake of completeness, the question of machine consciousness must be analyzed in the frame of a discussion on artificial intelligence, and the philosophical and epistemological aspects of that dispute must be discussed.

8. Definitions

As usual, our central question: "Can machines be conscious?" requires definitions of terms.

Unfortunately this is possible only for the word "machine". The term "consciousness", like all terms referring to "inner states", is not easily defined; to try to define it would be like asking somebody saying that he has toothache to give an adequate definition of it. As everyone of us has experienced such a state, we are inclined, in an adequate context, to understand what that person is saying; in the same way, all we can say of the term consciousness is: "I know what it is, but I cannot express it in words."

In the last analysis, the only way in which we can understand terms which denote inner states is to place them in an adequate context. Nevertheless, in the difficult area of the automation of human activities, those entities which are to be realized in a machine must be made explicit on the language plane.

It would therefore make sense to try to stipulate a definition of the term "consciousness", provided it is not so limited that it can only be applied to the world of man, nor so general as to be useless.

Consider the following description of an ordinary experience. I close my eyes and imagine something, I see that thing as if it were within me; then I open my eyes again and find that same thing on my desk; I perceive it under a visual stimulation, and yet, although I know it is something different from me, I also see it as something "within me". From this experience two things can be deduced: a) the perception of myself; b) the perception of the object different from me but in which, in some way, I participate. I shall therefore use the term consciousness to mean at the same time awareness *and* intentional relation. The term consciousness will thus be implicit in all sentences of the type "I realize...," "I know that...," "I see...," "I feel...," "I have the experience that...."

The question of machine consciousness can then be restated as follows: "Can machines possess awareness and have perception of an intentional type?"

In the specialized literature on this problem the question is stated in a way different and, in my opinion, not susceptible of

theoretical development. When a problem has become the object of a prolonged dispute, it often happens that the opposed sides tend to accept without discussion levels of discourse that usage has made traditional: a typical case of this is precisely the habit of stating the problem of machine consciousness as the question: "Can machines have feelings and emotions?" In order to see to what extent this is legitimate, the best thing is to go back to the origin of the problem and to examine in detail the argument in its original formulation.

Let us therefore examine the archetype of the reformulations just mentioned of the question: "Can machines be conscious?" Jefferson, in his well-known paper *The Mind of Mechanical Man* writes:

"Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain — that is, not only write it but know that it had written it. No mechanism could feel (and not merely artificially signal, an easy contrivance) pleasure at its successes, grief when its valves fuse, be warmed by flattery, be made miserable by its mistakes, be charmed by sex, be angry or depressed when it cannot get what it wants." (Jefferson 1949.)

From Jefferson on, this has been the battle horse of a large number of "anti-machinists", who were always faithful to the meaning of the above argument, even though they have introduced variations on the theme, including amusing ones like that of Kramer, according to whom we can build a machine that will wave its tail, but not a machine that will be merry (Kramer 1958.)

Exactly one year after the publication of Jefferson's paper A. N. Turing wrote a paper on *Mind*, in which the objection was adequately dealt with:

"I propose," he wrote, "to consider the question: "Can machines think?" This should begin with definitions of the meanings of the terms "machine" and "think". The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous.... Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

"The new form of the problem can be described in terms of a

Fig. 1. An example of a traditional object which children often use for comfort in going to sleep, when detachment from the constant and reliable external reality takes place.

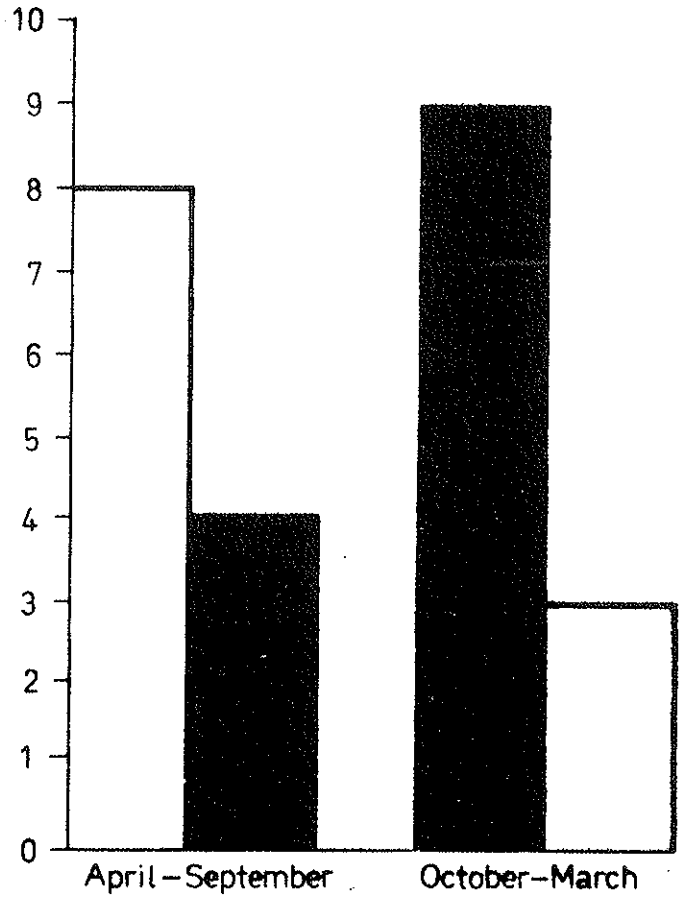

Fig. 2. Type of object adopted at bedtime. *White:* **Nylon, silk, cotton, flax;** *black:* **Wool, plush.**

game which we call the "imitation game". It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either "X is A and Y is B" or "X is B and Y is A". The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?

Now suppose X is actually A, then A must answer. It is A's object in the game to try and cause C to make the wrong identification. His answer might therefore be:

"My hair is shingled, and the longest strands are about nine inches long."

In order that tones of voice may not help the interrogator the answers should be written, or better still, typewritten. The ideal arrangement is to have a teleprinter communicating between the two rooms. Alternatively the question and answer can be repeated by an intermediary. The object of the game for the third player (B) is to help the interrogator. The best strategy for her is probably to give truthful answers. She can add such things as "I am the woman, don't listen to him!" to her answers, but it will avail nothing as the man can make similar remarks.

We now ask the question, "What will happen when a machine takes the part A in this game?" Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman? These questions replace our original, "Can machines think?"

The new problem has the advantage of drawing a fairly sharp line between the physical and the intellectual capacities of a man...

The question and answer method seems to be suitable for introducing almost any one of the fields of human endeavour that we wish to include." (Turing 1969.)

In essence Turing asks whether, assuming that a man and a machine, concealed behind a wall so that their physical and somatic attributes are not recognizable, are asked a certain number of suitable questions, it will be possible to detect which is the man.

Evidently, whenever the questioner cannot infer from the answer the differences between man and machine, the theory that man and machine are equivalent is confirmed; but if a difference can be detected, the cybernetic hypothesis will not necessarily be falsified, since the machine could always be improved and programmed again so as to perform the task in question.

The history of the automation of intelligence is to some extent the history of a great game of imitation where the anti-machinist is one of the two players (the one who claims "Only I am the man") and the machine helped by its project engineers is the other player. Thus, the problem the philosopher must solve is not so much whether activities exsist that a machine cannot perform, but whether activities exist that a machine will never be able to perform.

On this basis Steinbuck is right in writing: "How much paper could be saved today if those who, with many good intentions, claim that machines cannot write literature, would just read only once the papers of Turing." (Steinbuck 1950.)

In fact Turing's brilliant answer forced Jefferson into an uncomfortable alternative: either accept that "the only way to know that a man thinks is to be that man, gliding thus to a solipsistic position, or accept the imitation game in the form of an oral examination." (Turing 1950.)

At this point, of course, in order to continue the argument without submitting the machine to further examination, one would have to defend oneself first of all from the accusation of solipsism. This is precisely what Mays tries to do in setting up Jefferson's defence: he claims that the alternatives are not exclusive, and, in his opinion, Jefferson does not imply that machines will never be able to write sonnets, but that he cannot bring himself to define as "thinking" this ability of theirs, until they do write poems or compose concerts or construct mathematical theorems on the basis of experienced thoughts and emotions, where experience is the operative term (Mays 1952.)

There is some truth in all this, but it is immediatly invalidated by the fact that the argument remains at the level of Jefferson's examples, *i.e.* at the level of "feelings": a poem, a concert, artistic production in general are the translation on the informational level of something that has been experienced, but it not possible to ask the author for a

demonstration of the experience itself: the only way in which he could do it would be to send us back to the poem, the concert, the painting... If we do not accept the artistic form as the self-motivation of the feelings experienced, and insist on objecting that it could be a purely artificial signal (something like a *Divine Comedy* written by an army of apes hitting the keys of a typewriter), we place ourselves in a decidedly solipsistic position, and Jefferson's objections to the man-machine equation could well be turned against him by asking "and who tells me that you too are not just sending artificial signals?" That core of truth which we were attributing to Mays' considerations lies, on the contrary, in requiring that "experiencing" should come before communication of experience (which is trivial); but as long as we stick to feelings and use the term "to experience" in the sense it has in the language of emotions, it will not be possible to adequately tackle the question of machine consciousness. The situation would be different if we moved to the level of knowledge and used the terms "to experience", "to feel", "to see", "to perceive", in the sense specified above. A terminological difference in this connection is already found in common sense, for we ask a person whether he is angry, excited, sorry, while we state that a man has not understood, he has not seen, he has not heard: in other words, common sense suggests that the level of knowledge can be made objective: the emotional one is already implicitly solipsistic, whereas another person's "knowing" may very well not be so.

The fundamental problem thus becomes: "Can machines have sensations?" which is a necessary (although not yet sufficient) condition for the question whether machines can have awareness and can have perceptions of intentional type to be legitimate. A positive answer to this question is a necessary condition for consciousness to be attributed to machines. The proposal of using the imitation game in the form of oral examination as a criterion of verification seems to be in the last analysis the most acceptable proposal in this connection; when we say that most probably even others have "minds like ours", we do this precisely on the basis of repeated experiences of the fact that, every time others have been submitted to an oral exam of the type proposed by Turing, answers have been obtained that are similar to those we ourselves would have given in the same situation.

9. Can machines have sensations?

The original questions on the consciousness of machines have led us to two new questions:

1. Can machines have sensations?

2. Can machines be submitted to oral examinations and answer about their own internal states? Consider first the second question, for the whole discussion would be closed if the answer to it were to be negative. One of the most traditional answers starts from the consideration that the terms "sensation", "thought", "consciousness" acquire meaning only from the context in which they are inserted, and that for a machine to be susceptible of an oral examination it is necessary that it should use man's language. Now in the context of ordinary language the term "consciousness" is permitted for the world of man, or at least for higher animals, and therefore a machine correctly using the human language and conscious of being a machine, when asked: "are you conscious or thinking or sentient?" will necessarily answer: "No, I am not, because, being a machine, I cannot be."

This objection essentially calls attention to the following: Either a machine speaks man's language, and then the oral exam is already finished at the first question, or the machine does not speak man's language and then it is not even possible to start the examination.

In practice the objection is formulated in a much more subtle way, but here it has been stated in a schematic form in order that its inconsistencies may become more evident. If a machine were really capable of answering in that way, then the answer would be paradoxical, for it would sound: "It is precisely because I know that I am a machine and know that I can use human language perfectly that I cannot be conscious."

Now a paradox does not admit solutions but only dissolutions, in other words it admits only the possibility of detecting the inconsistency which is responsible for that typical characteristic of being unsolvable; in this particular case the paradox comes from taking as a decisive argument of unpredicability of consciousness for the machine the claim that consciousness determines "consciousness" can be used only in the context of men. The question is not so much that the term "consciousness" cannot be predicated outside the world of

man, but why it is so. As is well-known, some answers to this problem are highly unsatisfactory, because they refer to other specific and ill-defined concepts, life or the mind.

It is therefore necessary to see if it is possible to do without such concepts and to explain the whole thing in a different way. Before that, however, it may be useful to solve the question given above, which might also be a cause of the above misunderstanding: "If to provide machines with human language necessarily leads to a paradox, should we then renounce the oral test which is, after all, the only test which could provide a solution of the problem?" This point has been discussed in detail by H. Putnam, who wrote: "the real question is not one of synchronic linguistics, but one of diachronic linguistics." (Putnam 1960.) He means, in short, that there are questions always outside the semantic rules of natural language, and questions that are outside those rules now, but could acquire a clear meaning in the future. The question "How can I know I have an ache?" is a question which will be forever meaningless, but the question "Is an ache identical with the stimulation of nerve C?" could become meaningful if the state of scientific knowledge led to a change in the meaning of terms. In our case this had already been seen by Turing, when he wrote: "...I am convinced that by the end of the century the use of words and current opinions will be so much changed that anybody will be able to speak of thinking machines without expecting to be contradicted." (Turing 1950.) In other words, the expression "thinking machine, conscious machine..." is semantically unacceptable in the present state of language, but might become meaningful if the state of knowledge of automata were to change, so that such an expression would acquire a standard usage in the current language. Thus the question is not the meaning of the word "consciousness" today or the inference that the use of that term in a non-human context yields an expression which is irregular in the semantic context of current language, but the possibility that it could acquire a regular meaning in the future. We are faced here with a problem similar to the famous question whether non-Euclidean geometry violates the venerable principle of the excluded third and produces therefore an antinomy. When this question was posed in connection with non-Euclidean geometries the point was neglected that a given sequence of symbols is a proposition only if it is

provided with an adequate interpretational model, *i.e.* an appropriate universe of objects upon which it can be interpreted. The antinomy, in this case, stems precisely from asking whether a given expression is true or false in an absolute sense, without presupposing any interpretational model. Now the linguistic expression which states Euclid's fifth postulate is neither true nor false in itself, but will become so depending on the type of interpretation which is given to it. As a consequence the term "straight line," which in a Euclidean context means a certain thing, means something completely different in a Riemannian context; and the problem of establishing which statement about the parallel of a straight line is true is meaningless, because different things are meant in either case. Now, in our specific case the term "consciousness" used in the context of vitalistic philosophy means something very different from what the cybernetician means by consciousness: in the former case that term appears in relation with specific concepts such as "life", "spirit", "mind", etc.; in the latter case it is in relation with other concepts such as "learning", "solution of problems", "self description", etc. The vitalist proposes the universe of living beings as a model for the interpretation of expressions in which he uses the term "consciousness", and constructs a theory of man in which that term acquires a specific meaning; the cybernetician tends to construct a theory of man by proposing a model in mechanical terms. The problem is not so much to see if expressions like "conscious machines, thinking machines, sentient machines" will ever acquire a standard usage in current language so that the question may be answered, but to see if the theory of man postulated by cyberneticians is adequate. The statement, "a machine may be conscious", is not a statement about machines, but one about men, for it implies that man can be described in completely mechanical terms. Now, if man is accustomed to use the term consciousness in certain contexts, associating it with concepts such as life, mind, protoplasmic organic structure — in short, if man is accustomed to make certain biological assumptions concerning himself — that habit is only a psychological and not a real obstacle to putting that term in relation to concepts belonging to a different context, and as such cannot be an argument for denying the possibility of making different assumptions.

It might seem, from what has been said so far, that the objection under consideration is trivial because, (i), our problem is not to ask whether a given expression is semantically regular now but whether it always will be; (ii), the expression "conscious machine" implies a hypothesis, a model different from the one which we ordinarily use in order to explain human facts; therefore it must be seen if the assumption can be verified, and it is not enough to state that it cannot be propounded on a purely linguistic basis.

Now, the purely linguistic aspect of the problem is based on a game of the following type between the terms of the discourse:

Q. "How much is 2+2?"

A. "Four."

Q. "Do you think it is correct?"

A. "No, I do not."

Q. "Why not?"

A. "I am a machine and I cannot think"

Q. "Is the result correct?"

A. "Yes, it is."

However, the ontological aspect of the question is much more problematic. In fact, the referent of the term "consciousness" in the human discourse is in a sense the set of those psychological predicates like thought, opinion, awareness, which we use in a human context. Now if we intend to take the working of machines as a model of human activity (and thus we also wish to use it to explain those psychological predicates in terms of automatisms), then it is not correct to provide the automaton with a language containing those predicates from the beginning, because it will mean forcing the automaton to explain its activity with terms that should on the contrary be clarified by means of it. As to the objection under consideration, the point is that the oral test cannot serve as a decision process unless the machine is able to use the terminology of the cybernetic hypothesis not only by saying: "I am conscious," but by giving the contents of it as man does. In other words, the machine should be capable of describing emotions, feelings, sensations, desires, beliefs, opinions, etc. in accordance with present and past experiences, with memories, imaginations, family and social education

etc., and of doing this in the same way as a man speaking to a friend or a patient talking to a psychologist. Moreover, this will have to be done using machine terms, which, at the end of the decision process, will have to be shown to be equivalent to the above mentioned psychological terms.

10. Memory and body-scheme

It is now possible to go back to the question: «Can machines be conscious?» from a point of view that will not imply continuous reference to terms undefined or defined by stipulation only.

In a description of the term "to see" in connection with man and machines, E. Agazzi concludes by saying: "...The response of a living organism to the signals it receives always has a characteristic of globality, it engages the organism in a testimony of globality which seems really to point to the presence of a structure which is something different from the simple sum of the parts." (Agazzi 1978.) This is an extremely stimulating idea, which might be elaborated starting with a well known work by Miles (Miles 1957.) Taken as a fact that we are self-conscious, let us examine in this connection some abnormal clinical facts:

1. the "phantom-limb" experience;

2. the inability of certain patients affected by cortical lesions to tell the location of the stimulus.

An enlightening relationship exists between the two facts. It is described by Head with reference to one of his patients, who had lost his left leg some time before a cerebral lesion destroyed his ability to recognize its position; after the amputation, as happens in nearly all similar cases, he felt some movements in a phantom leg and foot. But these sensations immediately ceased after the brain damage: the blow that had abolished the recognition of the position had destroyed at the same time the "phantom limb" (Head 1929.) In other words, as Miles summarized (Miles 1957), only normal people appreciate the position of a certain finger as the true position of that finger. Cerebral damage affects the ability to compare parts of the body. If the brain is intact but a limb has been amputated the conditions for the awareness of that limb may still be

present in the brain and the person feels he or she has a phantom limb.

Starting from this reflection, the body-scheme concept can now be introduced through the assumption that the brain should contain some symbolic representation of the body. In other words, a cortical structure is postulated which serves both to explain phantom-limb phenomena and to appreciate the change of location. The term "scheme" should not be used with reference to this cortical structure or to the real body of a person, but with reference to what may be called the phenomenological counterpart of the body (Miles 1957.) Wisdom does perhaps better, by suggesting that the idea of a phantom-limb should be extrapolated by inventing the concept of a phantom-body, which could be a non-material pattern occupying the physiological body (Wisdom 1953.) Starting from such a concept the hypothesis can be made that man possesses the typical characteristic of consciousness of his own self as something different from the external world, and of the external world as something in which he participates precisely because of his body-scheme. This idea could also be seen as a serious answer to Ryle's objection to the concept of mind expressed by the facetious expression "the ghost in the machine." At any rate, Miles' conclusion that man can relate his perceptions to his body-scheme, but a machine cannot, because it has no body-scheme to which perceptions could be related, poses quite a serious problem to those who would like to attribute consciousness to machines or to the machine. In fact, what explains human life in the variety of its manifestations and the precise identity of every subject of action is precisely the undefinable intentional relation obtaining between man and what he perceives: *si quis autem velit dicere animam intellectivam non esse corporis formam, oportet quod inveniat modum quo ista actio, quod est intelligere, sit huius hominis actio* (Aquinas, *Summa Theologica* q.76 a.1.)

Many thinkers have claimed that although it is true that man derives his typical awareness and intentionality from something which could be very similar if not identical to Miles' body-scheme, while the machine has no body-scheme to which it can relate its perceptions, all this may be the fault of the constructor or of the designer and not of the machine. In other words, if, like man, the machine had thousands of sensors and effectors capable of putting it in relation with the ex-

ternal world it too would have something like a body-scheme. This is the trite position of those who postulate that the physical structure necessarily produces the psychical characteristics; the answer was given by C. Sherrington (Sherrington 1965), which we report here almost literally. When I look up to the sky I see the vault of heaven, the shining sphere of the sun and beneath it hundreds of other things. What are the events that occur in this case? A ray of light from the sun hits my eye and is focused onto the retina; this produces an alteration, which in turn is transmitted to the cerebral cortex. The complete chain of these events, from the sun to my brain cortex is physical in nature, each link being an electrical reaction. At this point alterations take place that are completely different from all those that have brought it about and are totally unexplainable: a visible scene is present to my mind, I see the vault of heaven and the sun in it and hundreds of other things; in fact I perceive a picture of the world surrounding me. I suppose I ought to be astonished, but I am too used to it to be puzzled. There is an abyss between an electrical reaction in the brain and seeing the world surrounding us in all its perspectives, in all its effects of light and shade.

Now the proposition that this gap can be filled, that also machines can have body-schemes to which they can relate their perceptions, that a machine too not only *records* but *sees* images, is again something that must be proved. In our opinion, it is in this sense that Jefferson's "experiencing" must be understood: it is not sufficient that a machine give back a very neat image of the world around it; it must also be capable of speaking to me in a way similar to Sherrington's descriptions, before it convinces me to take away this aporia from the man-machine problem.

A traditional objection to the latter proposition must still be discussed: if the machine behaved as if it saw or it felt, or it experienced, then there would no longer be any objection to attributing to it an intentional activity or a body-scheme to which it could relate its perceptions. Scriven (Scriven 1953) answers giving examples: 1) to claim that the evidence of behaviour implies consciousness is like saying that a lift which, if called, comes back down implies the presence of a man in it; 2) consciousness is to behaviour as torture is to pain, consciousness always implies a certain type of behaviour

just as torture always implies pain, but the converse is not necessarily true. He adds that behaviour can decide if a living being is conscious but not if any entity is so. Life, Scriven says, decides consciousness not behaviour; the machine could do all that man does, but it is not all that man is; it would only be the magical creature of myth that has werely the appearance of life but is not alive. The same considerations are made by Ziff in two different points : 1) only living beings can experience feelings (Ziff 1958-59); 2) it is structure which decides, not behaviour; in a mechanical flower behaving like a natural flower (growing by means of gears, etc.) we shall say "what an ingenious mechanism" and not: "what a strange flower" (Putnam 1964.)

The above answers are wrong, and perhaps it is because of them that cyberneticians are no longer disposed to take seriously objections concerning consciousness. Nevertheless, beyond the specific consideration that "x is conscious only and only if it is alive," it is important that the point has been made that behaviour does not discriminate between unconsciousness and consciousness.

In a second paper completely opposed to the one just recalled, Scriven (Scriven 1960) gives the real grounds justifying his previous conviction, even though unfortunately he now tries to say just the opposite. He intends to show that a blind man who knows the semantic rules which govern the language of colours and who can relate sounds and colours so as to learn that a certain acoustic frequency corresponds to a certain colour, or to a certain shade of colour, can very well give the impression that he sees. The trivial fact is precisely that the blind man will behave as a man who sees, but will not see. Also this proposal of Scriven's is entirely bound to the dimension of tricks or of acting; as the actor confines himself to behaving as if he were worried, so the blind man merely behaves as one who sees; but actually neither the actor is worried nor does the blind man see.

I shall conclude with one further example: the machine has a memory which is technically called topographical; in other words it remembers something according to the place in which that something has been recorded, whereas man recalls memories according to their semantic content. A record in a machine memory is a number, a record in a man's memory is a meaning. Now, if we were confronted with a behaviour

demonstrating the recalling of a memory by a machine and by a man, this surely would not enable us to say that both man and machine remember in the same way. We could say that both remember, but we should not forget that this expression is of the same type as other expressions currently used, like "running," which can be said of man and of an automobile, but which clearly refers to the result and not to the way in which the result is obtained.

11. The paradox of machine consciousness.

The general problems illustrated in these pages, which demand the solution of the more special problems posed by seeing, experiencing, being aware etc., lie at the basis of any description of man intended to be complete. If the model must at least permit a treatment of properties considered essential for the entity requiring explanation, the mechanical model of man cannot be an adequate hypothesis as long as the terms pertinent to it cannot be used to account for those properties. It is precisely in this sense that we stated above that the materialistic explanation is essentially inadequate. In fact, the solutions proposed by materialism, either reductionist or behaviourist, are at odds with that dimension of globality of human action to which the term consciousness applies. That term has been replaced here by the body-scheme concept, which, in the last analysis, could well represent the specific structure of informational schemes to which the analysis of intentionality of knowledge refers.

But if materialism does not succed in such a task, anthropological dualism, which has always called in its defence the concept of consciousness, has to deal here with something that can no longer be used for its ends, precisely because it does not admit the substantiality of the body, and in this way precludes the possibility of assuming in man himself those intelligent activities which demand a certain type of body structure.

But there is more, and it takes the form of a paradox: the question which has prompted the contrasting answers of anthropological dualism and of materialism, namely whether the human organism is controlled by something immaterial

and different from it or not, when analyzed in its strict consequences, gives rise to an unpleasant situation for both contenders.

If materialism claimed the equivalence between man and machine, the mind-body problem would arise for the machine, because in the machine the physical structure is essentially different from the informational structure. Consequently, the informational structure is that which "governs" the physical structure and yet is different from it. But, if so, it would support the thesis of anthropological dualism. As to anthropological dualism, if it were to be consistent with its own assertions, it would have to claim that, granted the above reasoning, man is a machine whose informational schemes, in the form of formalization of information, govern the physical structure.

In other words, the two contenders would interchange their arguments: on one side, anthropological dualism would have to claim that man is a machine, on the other, materialism would have to claim that he is not.

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PART TWO

PHILOSOPHY AND THE MIND

CHAPTER ONE

WHERE DOES SCIENCE END AND PHILOSOPHY BEGIN?

1. SCIENCE AND THE MIND: A COMPOSITE, UNFINISHED PICTURE

In the preceding chapter we have collected as far as possible those interventions and discussion remarks which pertained more specifically to the contributions that science can make to the mind-body problem. The picture that emerges from those interventions is incredibly rich, even though certain topics have not been really discussed, such as the observer-observed relation in the cosmos, as discussed by J. A. Wheeler (1988)

and G. Diambrini-Palazzi (1988), or the psychoanalitic views of Freud, Jung, and their followers. But it is a composite picture which, in spite of the implicit or explicit metaphysical presuppositions present in every scientist's statement (say, the existence of the mind or the existence of external reality), essentially consists of a variety of loosely connected pieces of information from different disciplines.

The unsatisfactory state of the overall picture is partly due to the interdisciplinary nature of the mind-body problem, since even the language and that common background which constitutes the basis of communication seem to be incomplete: it is not obvious that neurologists really know the principles of operation and the performances of modern automata, or informaticians really know what kind of organization governs the brain.

The inter-scientific language difficulty could perhaps be overcome by a series of *ad hoc* workshops; but it is not the only one. The main point is that since no progress in putting order in the scientific picture can be made unless questions clearly outside science are answered, philosophical reflection must be called into play, especially in connection with the basic question: what is man? As was pointed out by the neuropathologist Cervós-Navarro, who in his everyday life sees sick men, not just sick living beings, simple comparison with animals is not sufficient to really and completely define man.

Thus, we have to invoke philosophy, and, albeit at a purely scientific level, even theology; because both these fields throw light on the intellectual and existential aspects of the human person, which are precisely those aspects science must accept and possibly translate into some theory capable of relating them to the "World 1" of material phenomena which it studies.

But is such an integration of scientific inquiry really possible? Can problems be tackled by science and philosophy without splitting into different and unrecombinable subproblems? This question is treated in the first two contributions of this second part. E. di Rovasenda tends to exclude the possibility of anything but exchange of information. G. Del Re tries to show that, on the contrary, scientists arrive at questions which are central to their own research, but should not be discussed without the assistance of philosophers — epistemologists, logi cians, metaphysicians.

In the rest of this second part philosophers give their own views of the mind-body problem, proving, if need be, that they in turn have to base their consideration on a critical assessment of scientific information — which means that they also have to be scientists or that they must work in close collaboration with scientists.

2. SCIENCE AND PHILOSOPHY: DISTINCT BUT CO-OPERATING DOMAINS.

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I should like to begin with two methodological premises. First of all scientific knowledge must be distinguished from philosophical knowledge. Moreover, scientific knowledge must be distinguished from the teachings of the faith, and any "concordism" is to be avoided. In fact, distinguishing does not mean separating: one distinguishes within a convergence, within a dialogue. I should like to set myself within the general frame of culture, which includes all rational disciplines and possibly also refers to theology.

It seems to me that, at least as regards the main aspects of his life, man could be defined as the pilgrim of knowledge. By this expression I do not refer to the historical meaning of evolution about which I have no reservation as far as its purely physical sense is concerned; I intend to speak of anyone of us, who makes a pilgrimage of knowledge as he begins to apprehend the world by means of the external senses, then gets to the knowledge of imagination and of memory and is thus conscious of his sensorial cognition. But thereafter he rises to rational knowledge and even higher; to wisdom, which aspires to the synthesis of all knowledge and to contemplation, to finally reach the morality of human acting.

As a mere comment, going back in the history of our Academy, I should like to recall the point of view of Francesco Cesi and of his fellow-members in 1603, according to which we are *sapientiae cupidi*, we long for wisdom, the goal of which I have defined as the pilgrimage of knowledge.

I should like to recall some remarks by the well known R. W. Sperry. Sperry defines mind or consciousness as an emergent quality higher than the circuits which constitute the brain; at the same time he speaks of the body-spirit pair. In fact, I find it contradictory to conceive of such a pair and at the same time to make the second term a property of the first. R. W. Sperry affirms that consciousness — or better the mind — is a quality which emerges from a purely physical reality; but quality is not a new subject, it is inherent in a subject and is no longer susceptible of forming a pair with another subject. I accept only in part this point of view, as I will make clear later. I think it is essential in the framework of our problem to point out the difference between the physical level and intelligence or mind. Intelligence can conceive of future events, what is not real at present: we can dispute about all possible worlds. It catches what escapes the senses. However this is not a Platonic position, in that I do not assume spirit to be completely independent of the brain. In fact, the image of the external world which reaches the mind is processed by both external and internal senses, which are localized in the brain. Already Aristotle considered various faculties (such as the imaginative faculty, common sense, which he viewed as the synthesis of all sensations) to be localized in the brain: the activity of the senses, which is localized in the brain and in other organs, mediates between external reality and the life of the spirit. This is not a relationship of absolute separation but one of a cooperation, within which — at variance with Sperry's ideas — our spirit is not to be thought of as emerging from the brain, but as transcending it and the activity of the senses. The question is now to see how can a transcendental principle cooperate and be associated with the senses, the brain and the organs. This is the mystery of man. But the fact that there is a mystery, *e.g.* in the transfer of will to a purely physical action, and more generally the relationship between the transcendence of spirit and the sensible organic reality does not destroy either collaboration or the very transcendence of the human spirit. This is why Sperry's position is contradictory.

Now, if the transcendence of the spirit is established, and granted that owing to its objective infinity it cannot originate from brain activity, the question is: Where does the spirit come from? At this point we can have recourse to metaphysical

knowledge, religious, spiritual knowledge. In fact it should be remembered that even a natural, completely rational theology — as conceived by Varro in the past and later by Leibniz — might affirm the existence of God, the divine derivation of the spiritual soul, of the mind, of the spirit, which in a creationistic view is assumed to be created by God. However, evolution in the history of reality is not denied by the assumption that the spirit was created by God. In 1887 a renowned theologian and preacher of Notre Dame, Pere Monsabre, regarded evolution as guided by God and enriched by the contribution of second causes, *i.e.* causes present in nature and in man. In this sense he considered it as a richer way of interpreting the history of reality.

Thus I should like to conclude, affirming that science must be completely free in its researches, and its autonomy should not to be limited; on the other hand science must not invade the field of philosophy, nor of religious knowledge. It is necessary that the various forms of knowledge be distinct in order to cooperate; metaphysics speaks of the soul as a spiritual reality, as having a characteristic of its own, an origin which cannot be traced back to a preceding purely sensible, organic, cerebral reality.

3. NON-OVERLAPPING FIELDS OF KNOWLEDGE?

(Report on remarks and questions by G. Del Re, R. Dardozzi, P. Henrici)

The rigorous distinction advocated by E. di Rovasenda between science, philosophy, and theology could not fail to divide the audience, since, as is well known, many efforts have recently been made precisely in the opposite direction, integration as it were of the three domains. In fact, precisely because confusion can arise from such initiatives in the absence of a clear awareness of epistemological differences, di Rovasenda's warning was perhaps required. The other epistemological and philosophical contributions collected in the second part of this volume will prove that dangers of confusion and of misuse of methods and criteria exist, and should not be overlooked.

On the other hand, it would seem that attempts by scientists to assess the philosophical and ethical implications (or presuppositions) of their work should not be discouraged, because scientists are men, and in the absence of a serious reflection on existential and metaphysical issues they will be uncritically open to all sorts of opinions, mainly received through the mass media. Moreover, there seem to be cases where metaphysical reflection and scientific reflection cannot be separated in a clearcut way; and the mind is precisely one of those cases. This difficulty was the object of a comment by G. Del Re, who insisted on a point which will be found again in his contribution to the Round Table, namely that "if there is anything like a mind, it must reveal itself somehow in the activity of the brain, because the mind takes decisions and puts them into practice in the material world. So we cannot say that the mind is something completely outside the realm of science. It may very well be that when we come to defining what the mind is, we have a merely philosophical problem; but when we study what the mind *does*, we have a frontier problem, because after all the mind is the cause of an event that can be subjected to scientific analysis."

E. di Rovasenda explained that his intention "had not been to suggest that scientists should not tackle philosophical problems, but simply that the three domains are distinct from one another. It is necessary that every field of wisdom should clearly define its object, its aim, and its method. This seems to me to be essential. It also holds for theology: theologians know very well the enormous importance of the first *quaestio* of the Summa of Thomas Aquinas, *De sacra doctrina.* On such a short article of perhaps fifteen pages, certain teachers spend the whole year, just to clarify what is meant by sacred doctrine, what is meant by theology.

"The distinction I have in mind does not apply to individuals, but to fields of inquiry: the recently beatified scientist and bishop Nicholaus Stensen was at the same time a scientist and a theologian. Father Marcozzi too is an example of scientific competence joined with competence in theology.

"Secondly, I should like to emphasize that I have explicitly spoken of collaboration, and hence of connections. I am not a Platonist, in the sense that I do not believe in innate ideas, but rather that man acquires knowledge starting on the pilgrimage I have recalled in my speech with an intellect which is so to

speak a *tabula rasa*. Therefore, there must be a genuine, authentic collaboration between different fields of knowledge."

To further amplify the subject Director R. Dardozzi expressed the wish to hear also P. Henrici's opinion on the matter: "where do the three fields of knowledge situate themselves, with their autonomy and distinction, in the context of the unity of man?" Father Henrici answered: "This is a fundamental, but very difficult question. As a first approximate answer, I should say that scientific knowledge is the result of man's ability to perform and correlate observations on ordinary things; philosophical knowledge is reflection and logical and coherent ordering of man's own thought; theological knowledge is a structured, coherent knowledge of things revealed. Since it is always the same man who has this power, the three kinds of knowledge are not outside each other, but strongly interact."

4. THE MIND-BRAIN PROBLEM: HOW FAR CAN THE SCIENTIFFC APPROACH BE APPLIED TO IT?

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4.1 A suggestion by C. E. M. Joad and the what-is question

In his book *The Recovery of Belief*, C. E. M. Joad wrote: «Everybody is dissatisfied with Cartesian Dualism. Yet, the ground for dissatisfaction lies, surely, in the presumption that the relation between mind and brain is, or at any rate should be, intelligible by us, and that it should, therefore, be possible to give an intelligible account of it. But (...) suppose that we not only do not, but cannot understand how an immaterial activity can inform a material medium in which it is manifested. By committing this initial act of agnosticism we reap certain very great advantages» (Joad 1952).

If nothing else, the above passage is honest in its recognition of the difficulties inherent in the mind-brain problem. On

reading it a second time, however, one becomes aware that it cannot be accepted at its face value, because it relies on too many tacit assumptions and definitions. To list only a few, we can ask:

1. Is what we mean by mind an immaterial activity?
2. And, anyway, what is matter?
3. Is it really possible to do without the principle of intelligibility of nature, nay, of the whole material and non-material world with which we are in contact?
4. Is our concern that of understanding how the mind controls the brain?
5. Or is it its very existence?

4.2 The "ghost in the machine" or "immaterial activity informing matter"?

These questions emphasize that the mind-brain problem starts with definitions.

The Cartesian statement that the mind is "the ghost in the machine" is really a definition — and an incomplete one, for that matter — which we can accept as such. In other words, if there is no contradiction, anyone has a right to define a ghost as some immaterial being endowed with intelligence and free will, capable of acting on matter, and to define a machine as a strictly material entity capable of performing the most extraordinary operations but incapable of carrying out the type of information process which we call a *decision*.

These definitions do not seem to be questionable from the point of view of logic; therefore, what remains is the question: are there really in man a machine and a ghost capable of interacting with one another? In other words, once the definition is completed by stating what is meant by machine and by ghost, the problem is reduced to the search for a proof of existence.

But what if the proof cannot be found, if indeed it can be shown to be false? Does this mean that the mind does not exist? No: it only means that the mind is not the ghost in the machine.

Similar considerations hold for the definition of the mind as an immaterial activity informing a material medium. This definition should be improved (in particular the word "activity" should be explained) and the need for "information" of the material medium should be proven, *viz.* the implicit definition of the brain as an instrument or a tool (and not as an autonomous control system) should be justified; otherwise, the metaphysical meaning of information, whereby the word "matter" is taken in Aristotle's sense, should be specified and justified in the light of today's conceptions. On this point remarks by F. Calvo at the end of this volume are important.

Otherwise, a third definition, that of "hypostatized organization" would have to be adopted, of course with all the problems which go with it.

In short, we have plenty of scientific and philosophical answers, but they depend on the question to be asked: if you ask about the existence of a mind, you must already have a definition of it, otherwise the question can be given many different, even contradictory answers. In order to make the question more susceptible of further discussion one ought perhaps to start from facts: and here it would seem that we are in the realm of science, be it psychology, sociology, neurology, or even physics and chemistry; although some reservations about this inference are legitimate, as will be shown presently.

It may happen that facts are such only within a given theoretical framework, as many epistemologists have shown (*e.g.* the statement that an electric current is flowing in a wire is factual only if the theory of electricity is accepted); but we can proceed by the method of Descartes, looking for *prima facie* facts, those which are the object of direct experience inasmuch as they are perceived directly by our inner and outer senses, and are considered incontrovertible by all men. It may be granted that their formulation in words, in any event, implies a semantic problem, since the terms cannot be specifically defined outside a context which plays the role of a theory. Nevertheless, it is possible to consider those facts also as primary concepts, and to *construct a theory on them.*

4.3 *Cogito*: a fact of science or of metaphysics?

If we always have to start from facts which we consider incontrovertible, then in our case the basic facts appear to be the ones from which Descartes started — I think and the existence of a material reality. From this we can proceed to statements such as:

1. I know that I know something.
2. I react to external stimuli not only as an animal would, but after "understanding" the meaning of those stimuli;
3. I have emotions, feelings, etc.;
4. I also act on the basis of my knowledge;
5. I am conscious of my action and of the freedom implicit in it. In short, I am a self, indeed, a person (Wojtila 1980).

Thinking and perception of the *esse* of both inner and outer reality are primary facts of our inner experience. A less immediate but hardly questionable fact is that the brain is involved in this and in all the facts listed above (Hofstadter 1980); and this fact belongs to our outer experience, to that sort of information which we obtain directly or indirectly with our five senses.

If this much is a fact, where is the problem? Since the collapse of mechanistic reductionism, specialists and non specialists alike agree that the brain is not reducible to its parts, although it results from the coordinated operation of its parts. Thus, in the language of a scientist, the problem is whether or not that self-consciousness that is the self is just a name for a special aspect of the "brain at work" (the "identity" theory) or is something else, to be specified (Popper and Eccles 1977).

4.4 Meta-empirical entities and scientificity.

Is this a scientific problem? This question calls into play the famous problem of "scientificity." In spite of many discussions, it seems that one had better stick to the naive definition, according to which science is the rationalization of empirical evidence; a rationalization which, in its course, may lead us to infer the existence of entities not directly perceived by the senses or instruments.

If inner experience is excluded from scientific evidence, then the mind-body problem is meaningless for science. But nowadays not even positivists claim that; inner experience, as was pointed out by Sir Arthur Eddington a long time ago, is even involved in the notion of time's arrow (Eddington 1935); more important, brain scientists can prove its objectivity and even measure it. There are realms of inner experience (*e.g.* acts of will) where the correlation with brain states is not sufficient to discriminate between different theoretical interpretations; but further progress may remove these dark spots.

Moreover, what is really empirical? What are, so to speak, the boundary conditions for the production of scientific knowledge? The cases of psychoanalysis, of evolution theory, and of other fields governed by the same type of paradigm suggest that internal coherence or, as some say, self-consistency is the main such condition, whereas criteria like falsifiability are limited to those sciences (physics, chemistry, microbiology) which study phenomena susceptible of faithful and complete reproduction in the laboratory.

In conclusion, the mind-brain problem is not scientifically meaningless. We must rather say that it seems to be a "frontier" problem, in the sense that, although it is posed by science in its striving towards coherence, its solution may lie outside standard empirical science, because it requires some entity to be postulated, just as chemistry required the atom long before physics succeeded in proving experimentally its existence (under certain epistemological premises).

Unfortunately, to state that the mind exists is not equivalent to stating what it is. Those who say that it is an "epiphenomenon" of matter seem to stick to the now obsolete physicalist picture of science, but there remains the alternative between the mind as an entity proper and the mind as the organized activity of the living brain seen as a single unit.

The rise of cybernetics and biological theory has recently restored "organization" (which is a notion very close to the Aristotelian form) in its rightful place in science. But it has thus created a paradox: that essential feature of complex systems cannot by itself produce a reading on an instrument, even less can you touch or hear or see it, except as a pattern of individual readings from the parts of the given system. For example, Ingvar's (1990) study on ideation was an attempt to

infer information on organization from information on the spatial and temporal location of brain signals.

Keeping this point of view in mind, let us turn again to the question whether or not the mind-body problem is a scientific one. The answer is positive as long as we grant that observable events in specific locations of the brain require an explanation in terms of a "cause" which cannot be associated with specific events having taken place at the same or at other specific locations in the nervous system, say a stimulus from the outside world. This leaves us, as far as I can see, with two possibilities: either the cause is the brain itself acting as an organized whole or it is some immaterial entity. Once it is granted that the two alternatives are the only reasonable ones, can we consider "scientific" the identification of the mind with organization, and "unscientific" the inference of some sort of spiritual entity acting on matter, or vice-versa?

In fact, as has been mentioned, both are as it were second-level, meta-empirical entities, for neither organization nor a spiritual entity give direct signals to the senses — both act through local pieces of the brain machinery. On the other hand, neurophysiologists have been able to infer the existence of an organized activity of the brain quite independently of whether or not it is related to "internally generated events," or to free choices. Thus, the claim that the mind can be detected and to some extent defined by empirical means is scientific; the ontologically alternative inferences that it has an independent existence or that it is a mode of existence of the brain can be discussed within a scientific frame if they can be shown to have different logical or material consequences, but otherwise would seem to lie entirely outside the realm of science proper.

4.5 Free will and the computer analogy.

To illustrate the above conclusion, let us discuss two points that seem to be central to the whole subject.

1. Internally generated events and free will. This first point is perhaps the main preoccupation of Sir John Eccles (Popper and Eccles 1977): what causes internally generated brain activity, such as attention, expectations, and most important,

free actions? Here science and philosophy intersect, because it is the assumption of free will that makes the question meaningful: if the operation of the brain were a purely automatic sequence of events, we could claim that there are no strictly internally generated events, but only, possibly, delays, and a certain degree of randomness. Whereas there is no doubt that a great amount of information processing is required for decision, it is impossible to prove that the information processed contains some indeterministic element. How can we prove that the choice an individual makes in a given case in not just an optimization of many, possibly conflicting factors according to criteria that do not leave any alternative open, given the specific characteristics and history of that individual? A choice would then be felt as such simply because during the optimization process a number of possibilities surface in consciousness and are rejected. The attribution of freedom of choice to others would also be the result of our awareness that even environmental influences can change the outcome of the optimization process. Of course, these considerations do not exhaust the free will subject, but they show that the possibility that choices are in fact the outputs of highly sophisticated computer-like programmes cannot be excluded .

2. Can a finite self-programming computer support an infinite regression? For all its importance, what Sir John Eccles mainly stresses is not free will, but self-consciousness, the ability to see oneself as an entity distinct from the rest of the world. In the sentence "I am free" the subject is even more important than the predicate. Now, as is well known, the brain can be looked at as a self-programming machine — which does not mean, of course, that man is a robot. In other words, the organization of the brain may be seen as that of a computer having several levels of programming, with each level controlling the lower one: the very fact that we can give meaning to statements such as "I am thinking" and act in a specific way as a result of such statements is proof that our brain elaborates programmes whose instructions are themselves programmes, possibly in turn governing subprogrammes, and governed by superprogrammes, and so on. Where would self-consciousness come into play at this stage? Hofstadter (Hofstadter 1980), in an attempt to dispose of the soul, pointed out one important thing: If the ability to

establish a hierarchy of programming levels is seen as the main characteristic of human intelligence, then self-consciousness could be seen as the limit of an infinite succession of such higher and higher levels. Contrary to what Hofstadter concludes, the mind, even in the sense of self-consciousness, could thus be indeed just the "form" of the body, being at the same time the organization (a set of the levels of programming) and the governing entity of the brain. Along some such line of reasoning, in short, the main argument against identifying self-consciousness with brain organization would break down. However, it would seem that a new unsolvable problem arises here. The brain is finite, and has a finite, though astronomical, number of neurons: can a finite structure support an infinite sequence of levels of programming? I believe that the answer must be negative, for there is a rigorous isomorphism between the states of a computer and the programme instructions it can accept.

Thus, also the analogy with a computer leaves a mysterious core which seems to elude direct scientific analysis. In this respect, we must once again acknowledge the weight of Sir John Eccles' arguments, when he speaks of "neuronal machinery" (Popper and Eccles 1977), and when he implicitly rejects the self-programming hypothesis by saying: "The nearest analogy I can provide is that my mind is like a programmer and my brain is like a computer. I am the programmer, over and above my computer."

4.6 Conclusion: Science as an open chapter of knowledge

Here, it would seem, the frontiers of science are reached: We are confronted again with the necessity of proceeding beyond the analysis and the interpretation of sensible data in terms of efficient causes and reproducible experiments. A detailed discussion of this whole question lies beyond the scope of this contribution. But two reflections may be mentioned as concluding remarks.

Firstly, as has been seen, there are questions which science can very well consider, but which are undecidable because of their logical structure. This is the case of internally generated

events; it is not possible to prove scientifically that they are not belated effects of an extremely complicated interplay of external factors. Such is also the analogy of the brain with a computer; to many researchers it does not seem possible to prove scientifically that the functions of the brain could *not* be simulated by a sufficiently sophisticated computer; but most if not all the same researchers would agree that this does not imply that the brain is but a chemical computer. The question may become one of definition, or may depend on the answer given to the question: what is man? Secondly, there is a source of information about man which even the neurosciences can only partially reduce to a scientific subject. This is the domain of inner experience, which has come up several times in the preceding sections. On this question too, one must probably take a stand before attempting any scientific study. Intentionality, aesthetic sense, love, in short those contents of what Eccles and Popper call World 2, which man does not share with other animals, and which characterize our minds are felt by everyone of us as facts. If they are accepted as such, then their manifestations at the material level will be interpreted along certain lines. If, on the contrary, our practical conviction that we must choose between Good and Evil, our response to Harmony and Beauty are just ways of feeling which have no objective counterpart in reality, then the interpretation of the same observations may be different.

5. MEN AND MACHINES

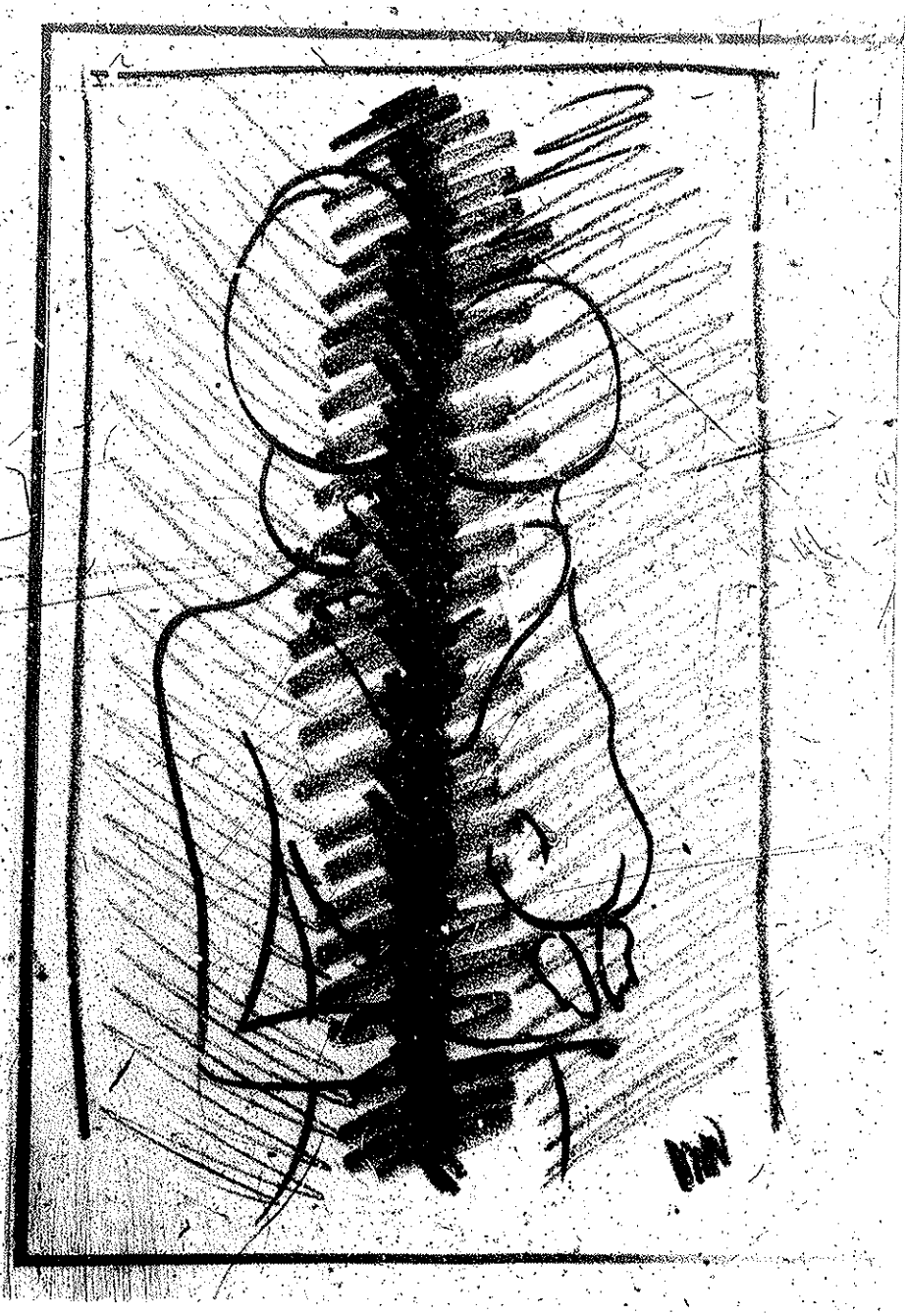
(Discussion remarks by J. Cervos-Navarro, G. Del Re, V. Mathieu)

The double aspect of the mind-body problem already mentioned in the introduction — the fact that it is interdisciplinary both within science and within the triad science, philosophy, theology — was the source of several remarks on the preceding paper, which mentioned explicitly the problem of artificial intelligence. Some of the remarks made in this connection had been touched on in the discussion following J. Lejeune's contribution. A point connected to philosophical arguments was also raised, starting with a remark by Cervós-Navarro.

"From the point of view of the pathologist," he said, "it is very important that the brain is capable of repairing lesions by itself. The plasticity of the synapses is such that they are capable of finding other ways to restore the function that had disappeared after a lesion. As far as I know, this is not possible with a machine." Although stated within a purely scientific context, this remark hinted at the problem which V. Mathieu treated later, namely the fact that the notion of mind arises because of the unity manifested by the human being as an acting person. Now, the scientific point could be rejected by recalling the case of telephone networks, which are so constructed that, if the direct connection between two telephones is damaged, calls will automatically be rerouted through another exchange, and the callers will not even realize that something is wrong, except noticing that the lines are more busy than usual. The three-computer system of electronically controlled airplanes and spaceships is based on the same principle.

Extrapolation of these examples suggests that sufficiently complex automatic machines may have a unity of the same kind as the brain. The nature of this unity in machines, however, poses a problem which goes back to Aristotle: the distinction between natural and artificial. V. Mathieu recalled it by commenting: "Machines have an ideal unity, given by the inventor. Living beings have a natural, not artificial unity." Is this distinction actually valid for machines of the last generation? These are machines such that they will cease functioning if one part is damaged, that each part functions correctly if and only if all the other parts are correctly functioning, that shortcircuiting one part will destroy forever the entire machine. It would seem, to say the least, that the notions of unity and artificiality ought to be studied again in the light of the advances of technology.

Another difference between men and machines which bears on philosophical issues was pointed out by C. Chagas, who said: "There is no man identical to another man, whereas machines have to be constructed, one exactly like the other — the machines that come out of a plant are exactly similar to one another." President Chagas stressed this point by recalling that "the HLA system shows clearly that no man can be compared to another." Here again, examples can be given of high precision machines which require individual adjustment be-



fore being considered good, and the adjustment is required precisely because they are not identical; a simple example is given by high precision quartz clocks. But is this the same kind of non-identity as exists between two men? This question sends us back to the old concept of essence: is non-identity essential for men to be men? It certainly is not for machines produced according to the same design, for in fact they are expected to be identical to one another, even if in practice they turn out to have slight differences.

It would seem that again and again the body-mind problem turns out to be a form of the most fundamental problem of philosophy: "what is man?" In fact, this has been pointed out explicitly by C. Marchesi, at the end of the following paper, where V. Mathieu discusses again the distinction between science and philosophy. Whereas E. di Rovasenda had mainly insisted on a general epistemological view, and G. Del Re had only tried to specify the topics which could be considered borderline ones with specific reference to the body-mind problem, V. Mathieu made a step forward by specifying where the essential difficulty lay, and by tracing the whole difficulty back to the fact that science is empirical and analytical, whereas, all things considered, the concept of mind is related to the unity of man, and is an indivisible concept. As has been mentioned above, certain statements about machines do not seem to apply to modern machines — which can have a concrete unity such as is studied by the theory of systems, and can be objects of research not intended as tools but as an expression of man's creativity, just as living beings are an expression of God's creativity. However, Mathieu's arguments are not dependent on the problem of machines, and they certainly deserve great attention especially as a foundation for the Aristotelian-Thomistic anthropological model proposed in the next chapter by V. Marcozzi and P. Henrici as the best philosophical scheme for the mind-body problem.

6. WHAT KIND OF UNITY?

Vittorio Mathieu
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1. Philosophers, in my opinion, cannot add anything to scientific knowledge about the mind-body problem. Nevertheless, they can, and must, cooperate with scientists because they have complementary views.

2. They can *qualify* scientific knowledge in many senses of the world "qualification." It is very useful to science as a form of knowledge to be aware, not only of its boundaries, but also of the qualitative limits intrinsic to its type of knowing. Philosophy can help in this.

3. In the case of life and mental activity, the main question arises about the *kind of unity* involved. It is doubtful that science alone can adequately cope with that kind of unity.

4. Living and thinking beings are *systems*, whose properties are not the mere sum of the properties of the components. Some sort of unity must therefore make these systems a *whole*.

5. The unity of a system is not identifiable with the links that keep the components together. For instance, a machine is kept together by some physical constraints, but its unity does not consist only in that. It consists in an *idea*, which unifies the whole project. Without that, the machine would not work, and "useless machines" are not machines at all. Machines must have a purpose, as a patent office knows very well.

6. Logical systems are kept together by logical constraints, but this is not enough. Not any consistent set of axioms produces a working logical system.

7. An ordered succession of signs (*e.g.*, a word) gives information, but only if taken as a *whole*. The nearness of the signs symbolizes their unity, but does not constitute it. The wholeness of a piece of information remains rather mysterious in all fields, and is an interesting issue for the study of mental activity in a broad sense.

8. Each science gives an accurate description of the links (*e.g.*, forces or interactions) which make its objects a whole; but this description covers only some aspects and manifestations. The root of the unity is ultimately *presupposed* and unaccounted for.

9. More precisely, science can account for all aspects of unity which consist in a *composition*. The reason is that a scientific explanation is the description of a procedure through which we could, at least theoretically, obtain the object. For this purpose we need some elements to start with and some relations capable of putting these elements together. The result is necessarily compounded.

10. The elements can be considered as "simple" only in a relative way. Generally, they are also compounded, but we *presuppose* their composition, reserving the task of expounding it for another research.

11. *Absolutely* elementary starting points are not objects of direct experience, but can be thought of as "particles" or "strings," or something like that. In any case they must be assumed as given and by no means as resulting from a process.

12. On the contrary, the final unity of a complex system can generally in general result, either from a natural process or from an artificial one.

13. *All* the results of an artificial activity can also be produced at random (given the isomorphism of both ways of compounding), except for the enormous improbability of this. As everybody knows, this improbability can be strongly reduced if natural selection intervenes.

14. But the problem of a random formation of living and mental systems should be seen in a quite different light: can all the properties of these systems be considered as the *result* of some process of compounding? If not, it is perfectly useless to substitute random processes for an intelligent action as a source of those systems: both are anthropomorphic representations.

15. Also, in artificial compositions there is sometimes an aspect that cannot conceivably be the result of a compounding activity; *e.g.*, a piece of music is beyond doubt a composition of sounds, and can also be produced at random. But the difference between a *good* piece of music (in the aesthetic sense of "good") and a meaningless one cannot be explained in this way, because you cannot formulate a technique ensuring success in this sense (although the experience and the example of great composers can give some hints). The beauty of a piece of music is not compounded.

16. I maintain that some aspects of mental life cannot be ob-

tained by compounding given elements, either at random or by techniques (which are isomorphous processes). They simply *are not the result* of any imaginable process, natural or artificial. Their unity is not of the sort that can be conceivably produced; and nevertheless it is real and active.

17. I leave undecided the question whether this can be said of life in general, or even of existence in general (in fact, we are not acquainted with processes generating existence, but only transforming it). I will first draw attention to some conscious facts, but only for the sake of convenience, because but a very little part of mental activity is conscious, as was already stated by Leibniz, to whose apologue in paragraph 17 of the *Monadology* I shall refer.

18. Suppose we get into the brain as in a big mill and that we can distinguish every single gear and linkage between parts, nowhere will you find something like a sensation. The apologue means that a sensation as such is not a compound of elements. Notwithstanding, it is real.

19. There is no doubt that a sensation is real when something very complicated takes place, but you cannot explain the sensation as an effect of complication. Consciousness arises precisely when that complicated process is summed up in a simple act. Now, the more you analyze a process, the less you approach simplicity. Therefore Leibniz points out that in the mill you cannot pick up anything like a sensation.

20. Even if we were able to reproduce the natural process by which a body becomes a sentient or a thinking animal, we could not say that we have engendered a feeling or a thought, but only that feelings and thoughts have developed in that body.

21. In fact we continuously perceive the natural development of mental phenomena in ourselves and (indirectly) in other people. At the same time we have a sufficiently detailed knowledge of the processes in which sensations and so on develop. But we have not the slightest idea of a bridge which relates these complex phenomena to the simple act of feeling.

22. Therefore we are not allowed to established a *causal relation* between the latter and the former; that would be a μετάβασις εἰς ἄλλο γένος, and causality cannot sensibly apply to phenomena of completely different natures.

23. Moreover, causality connects two different things, the cause and the effect. On the contrary, the physiological basis and the corresponding mental event are *the same* thing, in two different modes of existence. (By the way, it is an Aristotelian-Thomistic theory that mind and body are the same substance, monistic materialism has only obliterated the conditions that make it possible to think so.)

24. The passage from the physical to the mental level cannot be the object of a scientific investigation because no technical procedure is able to bring out of a complex reality a not-compounded simplicity.

25. A word to express that a complex reality becomes a simple one could be "individualisation." Individuality is equivalent to "indivisible reality." But individualisation is no a process we can observe, explain or induce (except indirectly, by generation.) And yet we and other real subjects imply in ourselves an individuation.

26. Philosophy has not the impossible task of providing a model for individuality and individualisation, but it recalls that a reality of that sort exists and possibly constitutes the unity of a mental system, as far as it is not the unity of a compounded complex.

27. The existence of individuation could hardly be disregarded, because it is bound to the fact that we are born to be. To be or not to be is not a trifling question .

28. By becoming indivisible realities we acquire an *identity*, expressed by our name. That identity embraces very different materials constituting *pro tempore* our body and the successive stages of our existence, which differ greatly from one another. Nevertheless we are "the same" in all.

29. Our reality ultimately depends on this identifying power, called "the self." Being indivisible, the self cannot be grasped in itself, but makes relatively indivisible everything that belongs to it.

30. Mental activity consists in exerting this identifying action or individualising power. A sensation, for instance, becomes real through the individualisation of its content and through identification of it with a *self*.

31. This is expressed by the English verb "to realize," that means "to become aware of" and also, more originally, "to

make real." No model of this "making real" can be produced, because the result is not a compounded reality.

32. All finite selves become real (and not simply ideal) individuals when they assume a peculiar point of view on the universe, expressed by the short word "I." But nobody can assign a reason to my saying "I" in a given situation, inside a particular body, rather than in any other. You can always find a reason why I am tall, blond, stupid, and so on; but you cannot by any means suggest a reason why I am I, and not another person. Individuation has no antecedent at all.

33. Someone has tried, therefore, to banish the word "I" from our vocabulary, but that is inconsistent with the facts. Of course, for science, "my" headache is on the same line with everybody's headache, but it would be nonsensical to pretend that it makes no difference if I or another person is suffering from headache.

34. Also a machine has an individuality, but an ideal one, because the machine is compounded in accordance with the simple idea of the inventor. That is not the case for our body, although it is also a machine. Real individuation may not therefore be denied as an important feature of mental activities.

35. The mind-body problem arises precisely when the individualisation of the body (or the embodiment of the self) is not performed following a project.

36. The main difficulty is that the mind-body relation is not a relation between two things, but a relation of a thing with itself, and by no means at the same time an abstract identity. Different ontological levels are therefore required, on which the same thing can be itself in different ways. The investigation of these levels is a task of philosophy, because you cannot reach an operational formula in order to transform the self as it is on one level into the same self at different levels. That means that philosophy adds nothing to scientific knowledge, but must avoid the confusion of different modes of being.

7. A VISION OF TOTALITY.

Discussion comment by Giovanni Marchesi S.J., "Civiltà Cattolica," Rome

The concept of totality that has emerged in this seminar is very important. We have all received the heritage of dualism, the human being divided into spirit and body. However, the biblical concept may help us to understand more deeply what is man, what is the human being. The biblical vision of the human being is a vision of its totality. The human being is a unity, a metaphysical unity. In Platonic words, man is a spirit incarnated. But the human being is a unity and has a totality, indivisible totality. Because of this, each part of human understanding, the scientific side, the philosophical and theological understanding, must take into account and aim to throw light on the secret of this totality; but no single science, no single part of human understanding can have the monopoly, the exclusive vision of understanding man.

This Round Table discussion, in which everybody is giving a great contribution to arrive closer to the mystery of the human being, is doubtless a valuable initiative. The contributions towards a better understanding of the nature of man, at least as far as man in this world is concerned, may be extremely useful and constructive. On the other hand, it seems to me, it is also important to keep in mind, in connection with the mystery of man, a word of Thomas Eliot about man's understanding in front of the infinite or the divine absolute. He wrote that our knowledge brings us nearer to our ignorance.

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CHAPTER TWO

HOLISM VERSUS INTERACTIONISM

1. GHOST IN THE MACHINE OR STEAM ABOVE THE FACTORY?

The last papers of this volume are not only philosophically oriented, but are all in favour of a specific view about the body-mind problem, called the "holistic" view. That view is neither popular nor well understood among scientists and philosophers, except if they had contact with Thomism; yet its defenders claim that it is the only reasonable solution to the problem, even (since they are usually Christians) at the price of disagreeing with one of the greatest minds of Christendom, Augustine of Hippo, whose views can be interpreted in a dualistic key. Before presenting the arguments in favour of holism, it may be useful to recall the main traditional attitudes about the mind-body problem as summarized by the sociologist J. S. Bruner and the historian of medicine Roy Porter in *The Fontana Dictionary of Modern Thought* (Bullock *et al.* 1988).

Physical monism (which underlies the so-called identity theory) is essentially a reductionist view, which actually explains away the mind by claiming that all mental phenomena must be analyzed in terms of the laws of physics and biology. According to Bruner and Porter, this may be the most widely accepted view among natural scientists. This is probably not

wholly true, as is shown by a sort of tract (Cotterill 1989) written by R. Cotterill against dualism, which he considers the currently standard view, but is certainly true of a large number of physicists interested in the mind. A bold very curious attempt to construct an entirely physical theory of consciousness in this direction (apparently even ignoring that the processes of life are actually biochemical) has been recently published (Lockwood 1989.)

Mental (or neutral) monism, which has received its present expression by E. Mach, is essentially "based on the premise that, since nature cannot be known directly but only by the mediation of a human observer, one defines nature and mind alike by the kinds of observations one makes and by the kinds of inferences one draws — whether these refer to a postulated 'external' system of physical nature, or to the 'internal' system called mind."

Epiphenomenalism (which T. H. Huxley described by the metaphor "the steam above the factory") admits a radical difference in nature between mental and physical events, but sees the former as the product of the latter, and does not accept any "downward causation" as discussed by Szentágothai in this volume .

Interactionism — which is superficially similar to Cartesian dualism, but is not identical with it — is the theory adopted by J. C. Eccles, and is widely discussed in this volume. Finally, psychophysical parallelism is a doctrine which sees physical and mental events as just parallel, thus having no relation of upward or downward causation.

It is remarkable that among the above views the only one compatible with free will and the presence of a spiritual principle in man is the interactionist view. In fact, some claim that evolution can hardly be reconciled with any version of dualism, and this is a way of saying that the interactionists' human mind must have appeared in man by some sort of "act of God." As far as we know, no systematic analysis of this side of interactionism has been carried out, but what has been published certainly suggests the identification of the mind with the soul, whether immortal or not.

As has been mentioned, the sixth view about the mind-body problem, the holistic view, which is not even mentioned in the Fontana Dictionary and is actually ignored by many intellec-

tuals, has the great merit of attempting a combination of belief in a spiritual reality with a version of the identity theory allowing for the evolutionary scale of living beings. The reason for this widespread ignorance is that Thomism is not generally viewed as a philosophical system, but as a system providing a philosophical support to the Christian faith. Of course, the fact that the philosophy of the Aquinas was developed with a theological purpose is no good reason why it should not be taken as a philosophical system in its own right; but well-known underlying historical motives, largely connected with the Reformation and with the Enlightenment explain why such a view has been so widely accepted.

The three contributions which follow try to do justice to holism. The anthropologist Vittorio Marcozzi recalls the underlying historical scientific views; the philosopher Peter Henrici discusses the relative merits of Cartesian dualism and of holism; and the philosopher V. Mathieu takes up again the problem of the unity of man in order to suggest that the philosophical and scientific approaches may be complementary, but should be seen as two faces of a coin, never to be placed on the same plan.

Of course, much work remains to be done if the holistic view is to be brought up to date, but it was a general impression at the Round Table to which this volume is devoted that it does offer the only valid non-materialistic alternative to interactionism. The scientific results of the neurosciences, especially those discussed by Eccles, should be interpreted in the framework of holism. Also the problem of artificial intelligence should be tackled by taking into account what we have called the "last generation machines," to which, as has been mentioned in several places, statements valid for automobiles or desk calculators cannot be applied.

An optimistic outlook for a combined effort in favour of holism, perhaps capable of reconciling it with interactionism, is offered in the reflexions of B. Kiely, which close this chapter.

2. THE BRAIN AND THE PSYCHE IN THE SPIRITUALIST SCHOLASTIC VIEW

Vittorio Marcozzi
Antrophologist

2.1 The material and the spiritual dimension of man

First of all the meanings assigned to "material" and "spiritual" must be specified. "Material" will refer to all that occupies space, or, if it moves, that requires time. "Spiritual" will be used to refer to all that has the opposite (not just contrary) properties: does not occupy space and does not take time to move; scholasticism would say that it is intrinsically independent of matter.

That man has many material manifestations does not require proof.

Materiality is less evident in phenomena, such as sensibility, imagination, sensible memory, tendencies, and instincts; they could seem to be immaterial. As a matter of fact, they are less imbued with materiality, but participate in the essential notes of space and time. The image of a person is reproduced by our memory in a somewhat mysterious way with all its characteristics: extension, colour, motion; therefore, it is not completely alien to materiality. It is not the same when I utter the names of justice, beauty, wisdom. I could evoke particular instances, but they would not be justice or beauty. These abstractions have no corresponding image, nor can they be localized in space or in time.

The difference between concept and image is most clear in the case of the images of a point and of a line. The abstract geometric point has no extension, because, if it had, it would be a small surface, not a point.

The concept of point has no extension in space and time. By the same token the straight line, in the abstract, is extended in just one direction; the image we construct of it in our imagination (an image which is no longer spiritual) is that of a two-dimensional strip, however narrow. In man, a property that is evidently spiritual is free will.

2.2 The relation between spirit and matter

There are several views of this relation, but the main ones are two: the scholastic conception and the Cartesian conception.

Among scientists it is probably the latter that is better known. It is radically dualistic: soul and body are two distinct substances, only accidentally united. The soul is the seat of all psychic functions, the body is but a machine which the soul directs as a pilot directs his ship (Descartes).

This view presents several difficulties. We shall mention a few. It does not preserve the substantial unity of human nature. Man is not a body plus a spirit, but a substantial unity. The same self which says that it thinks is the entity that digests, imagines, thinks. Moreover, Descartes is mistaken in thinking that animals are automata. They are authentic living beings, capable (certainly at least the higher animals) of psychical activities. This can be deduced from their nervous system and from their behaviour, which is similar to ours in several aspects.

In the scholastic view, the soul is not a complete, separated entity which is accidentally united to the body, but an ontological principle, which, by substantially uniting with the spatio-temporal ontological principle, gives rise to a single entity, man. The human soul is spiritual because man also has spiritual manifestations that transcend the spatio-temporal co-principle, but the soul together with the spatio-temporal co-principle, produces (or produce) all the other physical and sensible psychic manifestations. On these grounds it is possible to understand the scholastic, spiritualistic way of looking at the relation between the brain and the psyche.

2.3 Brain-psyche relation

The brain, or, better, the encephalon, is an organ animated as part of the whole organism by the spiritual human soul, which also has the capabilities of sensitive and vegetative life. Countless functions take place in the encephalon; they can be

grouped into three categories or levels: physiological, sensible, psychical, and intellective or spiritual psychical functions. They are all vital functions of the same individual, but they cannot be reduced to one another, nor are they produced in the same way. The physiological functions are material in nature. They are extremely complicated physico-chemical phenomena in which an almost incredible number of nerve cells and fibres take part. The number of fibres of the "magic frame" of the brain is astronomical. The number of synapses even of a single neuron is hundreds or thousands: the largest number is close to 80 thousand. According to J. C. Eccles, the nerve impulses differ among themselves only by their frequency: higher frequencies correspond to more intense stimuli (Eccles 1973). J. Lettvin (Lettvin 1973) remarks that if the impulses passing through a nerve fibre of the brain were reproduced by a loudspeaker, we would hear an irregular beat, similar to a Morse message sent by a madman. We would not understand anything of what those messages mean; and it is not admissible that facts or phenomena of the same nature, even by becoming extremely complicated, should become the psychic phenomena which we experience, such as sensation, perception, imagination, and still less intellection. They are functions belonging to different, irreducible levels, although they are mutually conditioned and interdependent. Sensible experience cannot occur without physiological phenomena, nor can spiritual experience occur without sensible experience. Ideas and concepts originate from images by an abstraction process performed by the intellect. The intellect extracts from the image what is abstract and immaterial, and thus forms the abstract concept; but then goes back to images even in the use of concepts (Marcozzi 1981). Even though the collaboration between the various functions of the brain is very close, the relation they have with it is different. Physiological and sensible psychic functions, although they belong to different ontological levels, are material, and are produced by the brain. These functions are associated with particular structures of the brain.

Intellective or spiritual functions cannot be produced by a material organ, for *nemo dat quod non habet* — no one gives what one has not — but they can be realized in different regions or *centres* in which the sensible facts or phenomena we need occur. Of course, if the operational condition of the

brain is optimal, also the intellective activity will be so; and any malfunctioning of the brain will affect the intellective sphere, even as far as idiocy or insanity.

This view of the psyche-brain relation goes back to Hippocrates, and, through the Greek-Alexandrian and Greek-Roman schools especially Galen, the Jews, the Arabs, it was handed down, enriched with new knowledge, to the Scholastics of the Middle Ages by Avicenna. The Scholastics, especially Albertus Magnus and Aquinas, accepted Aristotle's philosophical views, but had completely different views on the anatomical and physiological role of the brain in connection with psychological activity. Aristotle had thought that the centre of the psyche was the heart; the Scholastics, following Avicenna, believed that the brain was the organ of sensible psychic functions and the tool of intellective ones. They assigned in the brain centres of the various functions, which they localized in the central part and more precisely in the ventricula, which they supposed to be three. The front one was taken to be the centre of sensibility and imagination; the rear one, the centre of memory; and the middle one, connecting the other two, was considered as the seat of the *sensorium commune* or sensible consciousness. H. W. Magoun, who discovered that the *reticular system* is the regulator of waking consciousness, found it remarkable that the Ancients had placed that centre close to where the reticular system is located.

As the neuro-physiologists have extensively shown, the brain is indeed a multi-structured system with an undeniable division of work, but the various tasks, instead of being separated, are connected and intertwined.

Think of the great number of associations, connections and interdependencies involved even in a comparatively simple performance. For instance, a single judgment implies the formation of phonemes and their combination into morphemes; the latter must be associated to images of objects; the images, to meanings, and so on; only at the end will the judgment occur. The breakdown or even just the impairment of one of these processes and connections will make judgment, which is spiritual in nature, impossible.

The same consideration will hold *a fortiori* for a decision of free will, in which other factors, in addition to those

mentioned above, may be at work: inclinations, subconscious motives, affections.

It is wrong to compare the brain to a computer, however sophisticated the computer may be. It cannot be denied that its operations can have a degree of analogy with some operations of the brain. But to compare the brain *sic et simpliciter* to a machine, however complicated it may be, is a serious mistake, since a machine only has an accidental unity, while the brain is a part of an organism which is an *individuum*. It is not conceivable that a machine, however sophisticated and complex it may be, can be the seat of psychical phenomena such as joy, pain, hope, despair, remorse.

3. THE HOLISTIC ANTHROPOLOGICAL MODEL

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That the Cartesian dualistic model appears to be unsatisfactory even from the point of view of science has been mentioned several times during this Round Table.

That model can be questioned on two accounts. Most often, it is criticized for its purely mechanical view of the body, and, more specifically, of the brain; but, as a historian of philosophy, I should add that it can and must be criticized for its conception of the mind, the *Cogito*. In the last analysis, it would seem that Descartes must bear the responsibility for the very fact that it is today customary to speak of the mind-body problem (which is also the title of this Round Table) — thus stating a problem that *cannot* find an answer, because one of its terms — the mind, relates not to a real entity, but to an abstraction artificially produced by Descartes by means of his methodical doubt. That doubt, according to Descartes, was to reveal the real nature of our mind, but in fact, being rather a literary artifice than an operation that can be actually realized, it does but bedim the real conditionings of our consciousness.

The position of Descartes can be well understood if it is realized that the course of his *Meditations* (as had been already that of his *Discours*) does not correspond at all to a natural,

spontaneous motion of our thinking (and Descartes was perfectly aware of this [1]), but is artificially constructed [2] in order that it should answer a foundational problem of the science of his time — *viz.* of Galilean science and Copernicanism. Faced with the objection by Cardinal Barberini that the system of Copernicus could indeed claim the status of a hypothesis, but no apodictical certainty, Descartes tried to devise a method ensuring absolute indubitable certainty — and it could be easily shown that the two leading arguments of the objection by Barberini (that the *resolutio* can have no demonstrative power and that divine omnipotence could have created an infinite number of other systems of the world) find a punctual matching in the way in which the certainty of the *cogito-sum* is established and in the recourse to the veracity of God. In addition, Descartes intended to provide a foundation for the Galilean mathematical intelligibility of the world by the proof that only the mind separated from the body, from senses, and from imagination — *viz.* the mathematically thinking mind — is capable of knowing truth. A third motive of an apologetic nature moved Descartes: he was trying to prove, against the libertines, the immortality of the soul, on the grounds of its separation from the body.

These three motives prompted Descartes's attempt to distill from concrete living experience, by a process of eliminations that could even be purely imaginary (as when he had recourse to a deceiving God or to a malicious Genius), a pure conscious being, purely intellectual and "punctual," separated not only from the body but from any sensible or imaginative dimension of perception, and at any rate lacking a subconscious or unconscious sphere. This conscious being, inasmuch as it seems to be a verifiable, indeed an entirely indubitable fact, is considered as something subsisting (a *res* or substance) and receives the name of "Self." It is at this point that the problem arises of the relation between this Self and its body — from which it had previously been carefully separated. The body-mind problem is thus but the reflux of the Cartesian attempt to discover (or to construct) an entirely bodiless Self. Descartes himself could not see any better solution than to assume for these two substances, now made independent of one another, an interaction relation. For the sake of historical accuracy, however, it must be added that Descartes himself rejected anthropological dualism at least in words; the following pro-

fession of faith he prescribed to an overzealous disciple bears witness to this: "Ubicumque occurret occasio ... debes profiteri te credere hominem esse verum ens per se, non autem per accidens, et mentem corpori realiter et substantialiter esse unitam, non per situm et dispositionem ... sed per verum modum unionis, qualem vulgo omnes admittunt, etsi nulli, qualis sit, explicent"[3].

The history of Cartesianism has extensively proven, first with the aporias of occasionalism and then with the transformation of interactionism into psycho-physical parallelism performed by Spinoza and Leibniz, that the interactionist model is speculatively unstable, not to say untenable. Today, indeed, even the three motives of Descartes could be questioned. No theorist of science would think of claiming for science apodictical certainty. Kant showed that mathematics and especially geometry, although they have *a priori* validity, cannot be considered as purely intellectual sciences, since they are necessarily grounded on sensible intuitions. In fact, even theology would be wary of using dualistic models as means to support the immortality of the soul — the more as even Descartes' self has to be held in existence by God at every moment.

Last but not least, the very soundness of Cartesian psychology could be questioned, especially in its seemingly introspective aspects. Not only has the vast domain of unconscious psychical life been rediscovered, a life which Descartes had so well removed that its rediscovery was laborious and hardwon, but a more accurate phenomenological analysis has shown that most of what Descartes had artificially removed is in fact unremovable. Today, my consciousness appears to be much more deeply rooted in the body than interactionism would suppose. Suffice it to recall the studies of Maine de Biran, Bergson, Blondel, and Merleau-Ponty, to mention only French philosophers. The heart of the matter really is that I define myself as a Self much less through the Cogito than through the external senses — a decisive fact, though not always sufficiently realized. To a large extent my self-consciousness is established by the fact that I touch, see, and even hear myself, and I identify myself with this externally perceived entity. This "exteriority" of my identity with myself even involves the use of tools capable of mediating between me and me: as my face, the shine of my

eyes do not exist for me but in a mirror (which however gives an inverted image of them) or in the answering smile of another face, so I do not "possess" my own brain but in that most imperfect way which is allowed by electroencephalograms and tomography... If nothing else, these remarks suggest at least the inadequacy of enunciating the problem of the psycho-physical unity of man starting from a more or less Cartesian definition of consciousness.

In order to find an anthropological model more satisfactory and in better agreement with scientific discoveries, it may be appropriate, rather than extend Descartes' approach, to inquire whether there are pre-Cartesian (and hence pre-modern) models that can still be used and possibly brought up to date. Those pre-modern conceptions are at any rate ontological conceptualizations and not scientific models, and hence they are not necessarily obsolete simply because of the birth and progress of science. They propose models of "thinkability" of the human phenomenon that can also be applied to extended and renewed phenomenological and scientific data. Of those premodern models I will present here in outline only the so-called Aristotelian-Thomistic hylemorphism, which appears to be especially convenient for the elaboration of an anthropological conception that will take into account the most recent results of brain research .

In fact, that model is not based on psychological introspection, but on external, *viz*. "scientific" observation of the living organism. Therefore, it does not pose our problem in terms of "mind-body," but in the more concrete terms of "animated organism."

Bodies are observed that show a particularly complex, highly diversified and yet strictly unified structure, and are capable of spontaneously performing certain functions. We call them "living," denoting by this term not only something extended in Descartes's sense, something self-moving and self-preserving throughout time, but a particular *unity*, the unity of a whole which determines its parts to be shaped and behave in such and such a way, and which expresses itself in specific complex and unitary functions that the parts as such would not be capable of executing (as is negatively demonstrated by the phenomenon of death, in which the parts, at least for a short time, remain in working condition, but the functions of the whole cease.) The unity causes the parts not only to lie *in*

the whole, but to "live," *i.e.* to exist *for* the whole, and by the whole.

The hylemorphists' interpretation comes into play at this point. It sees the unity of an organism not just as our interpretation (as would be, for instance, the view-framing of a photograph), but as a real, ontological fact, and affirms that, since this fact is really new and superior with respect to its parts (which are its "material," the ὕλη), it could not emerge as a mere (possibly evolutionary) *result* from that material, but constitutes its "form" (μορφή) or the end (the *entelecheia*) in view of which matter became organized in this and not in another manner. In other words: the very unity of the organism is considered here as a real "principle" or ground-for-being-as-it-is (which principle is also immaterial, for matter as such implies diversity and dispersion, not unity). This principle is seen as the *cause* of organization and hence of the holistic functioning of an organism. A cause, of course, which is not like a separate being, acting on the material as it were from outside (in the efficient-cause mode), but a cause immanent in the organism, as an *informing* (*i.e.* "formal") finalizing and finalized cause: a principle that provides the "why" of the organization and function of the whole. By virtue of this informing principle the body is organized *in order that* these (vital and even conscious) functions should be possible. On this view, living organisms are neither a simple mechanical assemblage of parts (*viz.* a Cartesian automaton), nor a hybrid compound of two beings (one material, the other spiritual) of which it would not be too clear how they combine together, but one *single* unified being, organized *in view* of the capability to live (and be conscious). This capability shall therefore be called its "constitutive principle" [4].

What holds for life in general also holds, at least in a first approach, for human consciousness. On this view, also man must be considered as one single being organized (in particular with regard to its brain) *in view* of consciousness. Therefore, although it is correct to say that it is my (living) brain that thinks, it would be more accurate to say that it is I (meaning by this term the functioning whole) who think, thanks to my brain. My being conscious is not something heterogeneous with respect to neuro-physiological processes, which is added to them and soars as it were over them; it cannot be interpreted as something resulting from them either, as something

emerging from those processes, because the latter do not exist, are not realized, nay, would not even be possible but *in view* of consciousness. Consciousness is therefore the "principle" of neuro-physiological processes, in the full logical and temporal sense of this term. Nor is the objection valid that the conscious self cannot be this principle, precisely because it is not conscious of what its brain does (except possibly of the end of a neuro-physiological process). Here indeed lies the difference between hylemorphism and Cartesian interactionism. The above objection actually holds against the latter, which assumes an independent self, perfectly conscious (by definition) of its own operations. A consciousness such as is assumed by hylemorphism, a being only coming into existence in and from the organization of the body and in and from neuro-physiological processes (which are realized precisely *in view* of this consciousness), such a consciousness could not be conscious of its own (continuous) genesis. Only to the extent to which the human organism that I am is constituted in its self-identity (in German I would say: «wenn mein Organismus zu sich gekommen ist») am I conscious of myself («bin ich bei mir selbst») as well as of the world with which I am confronted («und bin ich in der Welt».) With this explanatory model, scientists can never go too far in the neuro-physiological explanation of the phenomena of consciousness, and they will never forget that everything takes place, in man, *in view* of this consciousness, and therefore in dependence on it.

The hylemorphic model, which I have attempted to present briefly, at least in its fundamental features, still demands two sets of specific comments, which I shall take over from Aquinas. In his presentation of the Aristotelian doctrine of the soul, Aquinas remarks that the more perfect a soul (*i.e.* the organizational principle of an organism) the more numerous and diverse will be the organs it needs, and the more complex, therefore, will the organism be [5] — a principle widely supported by comparative studies of brains. On the other hand, paradoxically enough, the more perfect the soul and hence the more diversified the organism, the stricter will be the unity of the whole [6] — a point that is easily seen by comparing a unicellular being with a plant and a plant with a higher animal. This is but the principle of increasing "centro-complexity" which Teilhard de Chardin (and before him Herbert Spencer) assumed as the parameter of evolution.

The other set of comments concerns more explicitly the human soul, and is best presented in a theological perspective. It should not be surprising that philosophy consults for help not only the natural sciences, the humanities, and the social sciences, but theology, which is a "science" in quite a different sense. In fact theology not only presents data that are not naturally knowable, but on whose thinkability philosophy will have to ponder, it further adds to every human truth a supplement of meaning, a teleological "overdetermination" that can illuminate the philosopher in his task of finding the meaning of things. In other words: it will not be possible to define completely, except in a theological perspective, the specification "in view of..." with which we have described so far the constitutive principle of the human being. Nor should this ultimately theological definition of man be cause for wonder; for in all cultures man is defined in relation to a specific religious dimension, a higher destination that even reaches beyond death, a particular relation to the divine from which his distinctive dignity stems.

In this perspective it is the call to the beatific vision of God that will assign its ultimate meaning, indeed its particular configuration, to the "in view of.." of the human body, particularly of the human brain. Man is called to see God face to face; therefore he must be able (without ceasing to be genuinely human), (a), to know, not only by abstraction, but in a concrete-intuitive way, a thoroughly non-material, neither sensible nor imaginable, and indeed unconditioned (*i.e.* "absolute" or "perfect") reality, and, (b), to retain in face of this intuitively perceived Absolute, his own self identity. It was precisely on these premises that Descartes constructed his Self or *Cogito* — ultimately on Augustinian grounds. No wonder that Descartes's greatest and most influential disciple, Malebranche, held that our mind has, already in this life, an immediate vision of God (or rather of the intelligible ideas *in* God). More modestly we may assert that the ultimate reason *why* my brain is organized in such a manner that I am able to be self-conscious and to perceive or conceive non-material significations and relations beyond all material signs and sense data — a capability already glimpsed at the phenomenological level — is to be found in my being called to the beatific vision.[7] Just *how* these capabilities are embodied in the organism, *e.g.* in the brain, the philosopher cannot tell; he can only state that

they exist to a certain degree, and are a necessary condition for the supernatural destination of man.

That all this applies to man as a whole, as a living, self-conscious organic being, and not to a Cartesian pure mind nor to a separate soul in Plato's sense, is confirmed by two further theological observations. Aquinas can lead us in discussing them. In his Commentary on Aristotle's *De Anima* he asks whether the human soul can be defined as a (complete and subsisting) "something" (*hoc aliquid*). His response is twofold, yes and no: yes, in accordance with the fact that the soul can subsist (after death) by itself; but no, insofar as the soul is rather a part of a species than a species by itself.[8] The latter statement is explained by its context. Aquinas contrasts the human soul both to material ("composite") substances, which exist as complete beings and therefore are "something," and to angels who, being "separate substances," are each its whole species and therefore equally "something" (*hoc aliquid*). But the human soul, though capable of subsisting by itself, is neither the complete existing human person, nor is it humankind. This rather intricate reasoning underlines a fundamental and obvious anthropological fact: I am a human being only as a part of the human species — not only with regard to my (generated and generating) organism, by which I biologically pertain to the species *homo sapiens*, but also with regard to my soul or Self. I am myself in and thanks to the human species; there are no completely separated human minds nor can there be any, and the Cartesian "other minds problem" is as fallacious as his mind-body problem. Phenomenologically this may be seen by the fact that (self-) consciousness is generated by dialogue (in particular in the mother-child relation), and by the necessity of language for the development of human mental faculties. At a deeper level, the unavoidable insertion of the human Self in the species has specific soteriological implications. My soul, since it is a part of the human species, is lost and is saved in solidarity with the whole humankind — as the dogmas of original sin and of the redemption of all in Christ made man point out. This theological insight seems to be at the base of Aquinas' reasoning.

This is even clearer for a second argument. As is well known, according to Aquinas the rational soul is the *only* substantial form of man, *i.e.* it informs directly the whole organism and all its functions, and performs for this very reason

also the function of a sensible and vegetable form. Now, this doctrine, which is the most questioned part of the Thomist thesis, but also represents hylemorphism in its radical opposition to the views of Plato (and of Descartes), is placed by Aquinas in connection with faith in the resurrection of the body. This gift of God, Aquinas explains, makes the body proportionate to its form, which is incorruptible by its own nature.[9] The question may arise: how can human corporeity be preserved beyond death, in which it seems to be completely lost? Aquinas answers that the corporeity of man is indeed nothing but his soul itself, insofar as the latter requires that it inform an organism;[10] more precisely, the very reality (*ipsa substantia*), — though not concrete ability to operate — of sensitivity and of the vegetative life of man lies in the rational soul, which carries them as it were with itself in its incorruptible unicity.[11] In this sense, even the soul separated from the body in death will never be a disincarnated soul, but will remain concretized in its informative capabilities (and exigencies). If I may put forward a conjecture, I should say that here lies the deeper reason of the insistence of Aquinas on the hylemorphic model and on the unicity of the human soul. That the spiritual soul, destined to the vision of God, should be in control, indeed establish the structure and the operation of the human organism in all its aspects, is perhaps the statement that most deserves attention in a debate between philosophers, theologians and neuro-physiologists.

3.1 Notes

(1) See the note after the first exposition of the reasons for doubting in the first *Meditation*: «Sed nondum sufficit haec advertisse, curandum est enim ut recorder; assidue enim recurrent consuetae opiniones...nec unquam iis assentiri et confidere desuescam, quamdiu tales esse supponam quales sunt revera nempe aliquo modo quidem dubias..., sed nihilominus valde probabiles, et quas multo magis rationi consentaneum sit credere quam negare» (*Meditationes* 1, A.-T. VII, p.21.)

(2) As is already shown by the titles of the *Discours de la méthode pour bien conduire sa raison et chercher la Vérité dans les Sciences* and of the *Regulae ad directionem ingenii.*

(3) Letter to Regius of January 1642, A.-T. III, p.493 .

(4) The "principle" or ground (ἀρχή) is one of the most ancient and most difficult philosophical notions. It means that with which something or some fact originates, and which therefore explains *why* it stands as it stands. The notion, today, appears restricted to epistemological or ethical principles; in ancient and medieval thought, however, its meaning was first of all *ontological*. It meant a real but *not* an efficient, but rather a formal or teleological *cause*, which accounts for a reality being as it is. The ontological principle is not extrinsic, but intrinsic to the "principiated" reality.

(5) In *De Anima*, lectio I, n. 230: «Anima enim, cum sit forma perfectissima inter formas rerum corporalium, est principium diversarum operationum; et ideo requirit diversitatem organorum in suo perfectibili.»

(6) *Contra Gentiles* Lib. II, cap. 68: «...quia quanto forma magis vincit materiam, tanto ex ea et materia magis efficitur unum.»

(7) We do not mean by this that God could not have created spiritual beings without calling them to the beatific vision; we only point out that, since *in fact* God has called man to that end, there follows, for the philosopher, a better intelligibility of the "abnormal" ontological structure of man.

(8) In *De Anima*, lectio I, n.215: «anima autem rationalis, quantum ad aliquid potest dici hoc aliquid, secundum hoc quod potest esse per se subsistens, sed quia non habet speciem completam, sed magis est pars speciei, non omnino convenit ei quod sit hoc aliquid.»

(9) *Contra Gentiles* Lib. IV, cap.81: «Deus...in institutiones humanae naturae aliquid corpori humano attribuit supra id quod ei ex naturalibus principiis debebatur, scilicet incorruptibilitatem quandam, per quam convenienter suae formae coaptaretur...; et talis quidem incorruptibilitas... erat... quodammodo naturalis ex ordine ad finem, ut scilicet materia proportionaretur suae naturali formae, quae est finis materiae.»

(10) *Ibid.*: «Oportet igitur quod corporeitas, prout est forma substantialis in homine, non sit aliud quam anima rationalis, quae in sua materia hoc requirit quod habeat tres dimensiones; est enim actus corporis alicuius».

(11) *Ibid.*: «Si vero per partes praedictas intelligatur ipsa substantia animae sensitivae et nutritivae, utraque earum est

eadem cum anima rationali; non enim sunt in homine tres animae, sed una tantum...»

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CHAPTER THREE

TOWARDS A SOLUTION

1. FORM AND MATTER IN THE CONTEXT OF MODERN THOUGHT

The arguments of Marcozzi and Henrici in favour of an anthropological model based on Aristotle and Aquinas are strong and sufficient to prove that, contrary to a superficial impression, it does constitute a possible non-materialistic alternative to interactionism.

However, it may be useful to point out, especially to scientists reading the two papers, that they should not be misled by the language used, based as it were on a specialists' slang where terms normally used in science and contemporary philosophy have quite different senses. No matter how well that is known, difficulties arise because of the inevitable superposition of meanings. For example, the word "substance" may mean matter to a modern philosopher, and certainly means a chemical substance to a modern scientist; science has other words — entity, being, and physical system — which cover at least in part the same meanings, but are not exactly equivalent to the Aristotelian substance. Similarly, whereas the word "information" does not give rise to a problem, especially after recent progress in biology, the words "form" and "matter" are indeed a problem; the more so as modern physics has succeeded in making space-time itself the very material of physical reality by attributing to it well defined properties, so that a familiar expression like "the

structure of matter" also applies to space and time. Needless to say, Aristotelian matter has no structure by definition.

After a period of decline, the Aristotelian answer to the "what is" question is returning — perhaps in disguise — through modern biology: the problem of complexity and the problem of individuality, *i.e.* of the persistence of an entity in a continuously changing environment and with a continuously changing building material, have forced scientists to introduce concepts like teleonomy, organization, information, etc., which are clearly related to Aristotelian form (Caspar 1985; Del Re 1986, 1989). It is extremely easy and attractive to identify the Aristotelian form with organization, starting with that primitive, passive and incomplete form of organization that is the geometrical relation of parts which make a clay pot a pot and not something else.

If scientists were brought to see the fundamentals of the Aristotelian-Thomistic philosophy in the above way and with the appropriate terminology, there would probably be no difficulty any longer in establishing a dialogue; and the above-mentioned book by Caspar, bearing prefaces by J. Lejeune and P. Ladrière is an illustration that progress in that direction is already taking place.

An additional difficulty of language specific to the mind-body problem is the use of the verb "to inform" as applied to living beings. Expressions which may be read as «the soul informs the body» are reminiscent of vitalism, a theory happily buried by biologists together with physicalist reductionism. Of course, the real meaning would be that the soul informs that portion of matter which constitutes the body, but then the fact that molecules come and go to and from the body is hard to reconcile with a purely metaphysical notion of matter. It may be objected that specialists of Aristotelianism can easily explain the whole thing; but there is no doubt that conflicting terminologies will make it difficult for certain scientists, especially physicists, chemists, and molecular biologists, to follow their arguments. This difficulty does not stem from obsolete reductionist attitudes, for, we repeat, a vast majority of scientists nowadays accepts the notion that the whole may have novel properties with respect to the parts; organismic biology and the general theory of systems have provided a great amount of material in support of that point. Even a radio set has properties which depend on the simultaneous

cooperation of all the parts of its receiving unit, and emerge when all the components of that unit are "active." Thus, the mistaken impression that scientists do not understand the necessity of treating a whole as such in addition to studying its parts and their interaction may lead philosophers to try to force doors that are open, instead of tackling the real problem, which is one of language.

The effort made in this direction by V. Marcozzi and P. Henrici was appreciated by all the participants in the Round Table Discussion on the Mind-Body Problem. A further contribution, which may rightly serve as a conclusion inasmuch as it starts a direct dialogue, was given by B. Kiely in the two interventions reported below.

2. THE PROBLEM OF CONSCIOUS ACTIVITIES

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As regards the problem of conscious activities, the problem of how certain activities of the central nervous system are linked to conscious activities of perception, thought and decision, we have two *epistemological lines of access*: one given by the methods of neuroanatomy, neurophysiology, and neuropsychology, and one given in our direct experience of ourselves in action.

The scientific line allows us to reach a gradually expanding set of conclusions about the structure and functions of the brain and reveals a very complex set of levels of operation, with a high degree of flexibility and adaptability, especially on the higher levels; on the lower levels of organization, the brain may to some extent be compared to a computer; on the higher levels, it might perhaps be compared to a piano able to improvise new compositions upon itself.

The line in which we reflect on what we know directly of ourselves reveals that we perform certain activities *consciously*. «By consciousness is meant an awareness immanent in cognitive acts.» (Lonergan 1958).

The idea of consciousness is probably best represented by an

adverb: we do certain things consciously: 1) we perceive empirically, 2) understand (*i.e.* generate ideas that might be true), 3) judge of their truth or falsity, absolute or probable, on the basis of sufficiency of evidence, and 4) also deliberate and decide. Is anyone willing to accept that the sense of responsibility — not stealing another person's research, for example — is just a matter of chemistry or of passive conditioning? (Passive conditioning is exemplified in learning the local pronunciation in childhood.) This analysis into four levels of conscious operations comes from Lonergan.

Various points suggest that the two aspects uncovered by these two lines of approach are two aspects of a *unity*. Obvious influence is exerted in *both* directions. A highly abstract insight like that of Archimedes can activate the whole organism, and bad news can depress the whole organism. At the same time, simple chemicals like alcohol, lithium carbonate, or phenylcyclidine (1-(phenylcyclohexyl)-piperidine, also known as "angel dust") can produce dramatic alterations on psychic states and activities; and it has been shown, about 20 years ago, that various drugs (tranquillizing, stimulating and psychedelic) produce effects on the way that spiders spin their webs, paralleling the effects of the same drugs on humans, so that primitive biochemical processes would seem to be involved. Besides, the Study Week just concluded on the principles of design and operation of the brain dealt to a large extent with the mapping of different functions onto the structures of the brain.

So, while we apparently have to do with a unity, and with two convergent approaches to the understanding of this unity, yet we still face a large gap in our understanding of this unity; the two lines are still far from converging to a point where they meet in a coherent and unified understanding.

When the brain is thought of as a hierarchical organization of electrochemical processes, we are faced with the problem that conscious activities are not the kind of thing that we could deduce from electrochemical processes, however highly and flexibly organized (alternatively, we are faced with the possibility that our understanding of electrochemistry has been very inadequate). Colours, as consciously experienced, are present in the dark cavern of the cranium; colours are present to us, and we are present to ourselves as perceiving colours; yet how this presence comes about, while it is a fact

that we cannot question, is mysterious: how does (so to speak) the light of consciousness go on? We can also understand ideas that can have no *adequate* material representation, such as a geometric point. We know the Euclidean definition that a point has position without extension, and that two points cannot touch at all unless they coincide completely. At the same time, a finite diameter is ascribed even to an electron, and besides, electrons never stand still. Similar problems accompany judgement and decision, freedom (responsible freedom, not just indeterminacy) being the hardest experience to explain in biological terms.

All levels of consciously performed activities are usually marked also by the quality of *conscious intentionality*; what goes on within the brain regards the world outside, and this also is a mystery when one begins with electrochemistry.

The analytic direction, going from tissues to cells to molecules to atoms to subatomic particles to wave-functions describing these particles, does not seem to throw any light on conscious activities, either on the fact of consciousness or on conscious intentionality. Nor can I see how increasing complexity explains the generation of *conscious* activities (as distinct from complex activities.)

It seems to me that, at the present limited level reached by our understanding, it is important to state the question(s) as well as possible while burdening the investigation with as few unwarranted assumptions as possible. The hylemorphic (matter-form) approach of Aristotle and Aquinas in which the soul is the form of the body, while the intellect depends on phantasms arising from sensory experience, seems, already on an intuitive level, the approach most in harmony with the unity of the human organism on its different levels. It is also in keeping with the patterns of cognitive development as elucidated by Jean Piaget, successive levels of higher organization and abstraction emerging gradually over many years in a way presumably attendant on organic developments in the brain.

While a dualistic-interactionist approach has the undoubted merit of taking seriously the data of our direct experience, and going well beyond any kind of closed materialism like that of Bertrand Russell (1957), yet it seems to bring with it certain burdens traditionally associated with dualism, including the

difficulty of any idealistic epistemology in explaining the problem of 1) error and disagreement and 2) learning by a gradual and self-correcting process. If truth is "seen" or "contacted" in a way for which visual perception is an adequate metaphor, then all error becomes as hard to explain as perceptual error (hallucinations are not easy to explain), and learning by trial and error becomes as hard to explain as perceptual correction of a kind that would at the end yield very different perceptions from before.

On the other hand, if one takes knowledge as rooted in sensory experience (in turn linked to neural processes), and maintains a systematic distinction between intelligence and judgement (intelligence generating hypotheses which *might* possibly be true, and judgement pronouncing upon actual truth, falsehood, or probability, as sketched above), then the facts of error and of gradual learning (familiar to the working scientist) are much easier to handle. This is the position which Lonergan calls critical realism.

It seems to me, then, in summary, that the most we can hope for at present is to state the question about the mysterious but real activities that we know we perform consciously in a way that, as far as possible, will not compromise further reflection. It also seems to me that it is in the thomistic tradition (as updated by authors such as Lonergan) that we can find clues to an approach which is congenial both to the working neuroscientist and to religious traditions, including the Christian, which cannot make sense unless claims to objective knowledge and responsible freedom are allowed.

A hylemorphic approach gives us a way of thinking of the human person as an ontological unity with an integrated hierarchy of qualitatively different activities (some of which are regarded more directly by the methods of neurosciences, and some more directly by our immediate experience of ourselves). This approach has the merit of not excluding any source of evidence or any kind of human activity; so it has the openness which must be provided by any good heuristic approach.

For the present, then, we have to accept *all* sources of evidence without neglecting any source in a reductionistic fashion, and accept also the considerable gaps on our

knowledge which still remain, and seem likely to remain for a long time.

3. INTERACTIONISM VERSUS HYLEMORPHISM

Discussion statement by B. Kiely

I would like to try to define areas of agreement and disagreement between myself and Sir John Eccles, as to the dualistic-interactionist approach versus the hylemorphic.

Given my complete sympathy with the aims of Sir John Eccles in defining an adequate vision of the human person (the self, free will, ability to relate to God, and so on), I must at the same time recognize several different levels of conscious activity: sensory perception, intelligence, judgement, responsible decision, and possibly mystical states as representing a fifth level. Likewise, in the organic level, one can perhaps distinguish as many as eight levels of organization: those of subatomic particles, atoms, molecules, subcellar structures, cells, organization of cells such as neural circuits, organs such as the brain, and the entire body. One might then distinguish as many as thirteen levels of organization.

Each level may be conceived as an organization and integration of components of the levels below, and as exercising some control over the lower levels.

If one contrasts the highest levels *directly* with the lowest (for example, responsible freedom with the regularities of basic physical and chemical processes) then one comes to something like dualism. But each level has its importance: somewhere in the intermediate levels of organization one would locate the effects of drugs on psychic activities, or the symbolic processes that are important in depth-psychology. So such a notion of a hierarchically organized hylemorphism, embracing many levels, seems more adequate than the dualistic-interactionist approach (Lonergan 1958).

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CONCLUSION

CONCLUSION

The Round-Table Discussion ended with the reading of a brief summary prepared by a group of participants. It consisted of a number of highlights of the discussion, which we reproduce here in a somewhat revised and extended form. They confirm what appears from the various parts of this volume, namely that, as could be expected in a first attempt to bring together philosophers and scientists, the results are rather an improved list of topics to be studied than actual conclusions. Nevertheless, they support the claim that the Round-Table Discussion was a real step forward, because they indicate where philosophers and scientists could work together, the obstacles to be removed, and the alternatives to be analyzed.

1. In the light of modern neuroscience, the mind-body problem could be called more correctly the mind-brain problem (MBP), since the body depends on the brain. The facts most significant for the MBP are: a) the existence of localized internally generated events in the brain; b) phenomena like attention or intention, affecting the response of the brain to external stimuli, but not reducible to a specific material cause. A widely accepted way of explaining these and many related facts is interactionism, which is similar to Cartesian dualism, but makes the mind-brain relation much closer to an ontological interdependence of the two partners.

2. The mind may be seen as "spirit animating matter." The appearance of an idea modifies the flux of particles in the brain. Brain injuries and alterations show that there is extensive compensation by reorganization; this may be seen as a strong indication of an organizing factor which may be called the human mind.

3. The paradigm to be applied to the MBP might change from one treating the brain as a Cartesian machine or as a passive material to a new one, which treats the nervous system as a self-organizing system. Then the human mind might be seen essentially as high level information actualized in a living organism. This might even have theological implications, for it might place emphasis rather on the resurrection of

the flesh than on permanence of the soul in a disembodied state.

4. Since genetic information determines the nature of the human brain, the nature of man and more specifically the human mind must be looked at also in the light of genetics. This point opens the question of the emergence of the mind during the ontogenetic and phylogenetic development, and may be discriminatory for the philosophical holism-interactionism alternative. It also places emphasis on the fact that the MBP largely overlaps the problem of defining man with respect to animals as well as to non-material minds.

5. In order to lay the ground for a discussion at the philosophical level, it must first of all be understood in what sense the MBP lies at the frontier between science and philosophy. The farthest science can go is by throwing light on cause-effect chains in brain operation, the role of organization and self-organization of the brain in mental activity, and the possible existence of a hierarchy of self-programming levels of the brain seen as a very special sort of computer. Beyond these points the intervention of philosophy is needed to clearly state the logical, epistemological, and metaphysical assumptions and implications of attemps to define the mind.

6. This kind of analysis suggests that more should be known about the distinction between science, philosophy, and theology. If these fields are seen as complementary but non-overlapping fields of inquiry, then apparently conflicting views on the MBP are admissible, and the very project of reaching any kind of consensus makes little sense. On the other hand, if the three branches, especially philosophy and science, are seen as integrated parts of a global quest for understanding, then the role of the epistemological and metaphysical presuppositions of scientific theories and the role of the image of the material world in philosophical points of view are the very hinges of a constructive approach to the MBP.

7. Our consciousness is an emerging quality superior to cerebral circuits. This is one of the arguments indicating that the mind is something immaterial (not directly accessible to experiment); therefore, for treating the MBP, it is important to distinguish between material reality, characterized by extension in space and time, and spiritual reality, which is

outside space and time. Already in the Middle Ages the idea was that the spirit does need the brain but transcends it because it belongs to a different order of things. In this connection, however, the place of notions such as information, organization, etc. must be clarified.

8. From the philosophical point of view, the question of the mind is related to the concept of unity. There are two kinds of unity, unity by links and essential unity such as that of ideas. The former is a kind of unity which can be decomposed into parts, which results from parts — material unity. The latter is a kind of unity which cannot be decomposed, and this is consciousness, ideas, and so on; it is obviously not reducible to the unity of the compound and of the compoundable. This is why the mental level, whose unity belongs to the second category cannot be studied by the analytical criteria of standard experimental science. This is borne out very clearly by the main question of the MBP, which is centred on the unity of the self: I am I; why am I not another person?

9. Advocates of an alternative to interactionism suggest that it has been overcome by the modern phenomenology of consciousness, and probably a more satisfactory model could be found by actually going back to the past, to the Aristotelian-Medieval model of animation of the body, constituting a being as the unity of an organizing principle with an organized principle. The difficulties certain scientists find in this connection might be related to the fact that their terminology uses the same words for different concepts. A principle in modern science is a fundamental law, and cannot be either active or passive; matter is always studied as "informed" matter, down to Einsteinian space-time, which is seen as the ultimate material reality, and is endowed with properties. Moreover, philosophers speaking of an organizing principle must cope with the undeniable existence of self-organization.

10. Since it is clear that further progress on the MBP will only be posible if scientists and philosophers reach a better common understanding of conscious activities, it is important to emphasize that there are at least two epistemologically different lines of access to the problem of conscious activities, that of the neuroscientists and that of our direct experience of ourselves. A gap still exists between what we learn from these two approaches, especially regarding consciousness and conscious intentionality. It has been suggested that the hyle-

morphic model might be better suited than the radical version of the interactionist model to approaching man as an ontological unity, with a range of hierarchically organized functions, without excluding any source of evidence.

It might appear surprising that no explicit mention is made in the above list of theories of the mind other than interactionism and holism. This is not due to the fact that the other theories cannot be easily reconciled with Christianism, but to the fact that some of them are implicitly taken into account in the above points (e.g. emergentism), others simply explain the mind away (e.g. physical monism), and others are not really concerned with the human mind (neutral monism). Of course, in a more extended meeting room should have been made for specific discussions on all points of view; but it is claimed here that already as it stands, the present report should be a valuable working document also for thinkers and scientists holding points of view different from those explicitly discussed here.

APPENDIX TO CHAPTER TWO

THE MIND-BODY PROBLEM AND POPPER'S EPISTEMOLOGY

THE MIND-BODY PROBLEM AND POPPER'S EPISTEMOLOGY

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1. The problem

Mind-body: why is it a problem? What is the secret of that frail hyphen which joins and separates the two? Where does the force of attraction come from which again and again gives rise to the question: Is it a link? Is it a contrast? Since the time of Plato's *Phaedo*, if not before, man has kept questioning himself about it, regarding it now as a sign of union, now as one of contrast. It could seem surprising that, two thousand years after Plato's age, we still debate such a "philosophical" question, the adjective philosophical meaning for most people "useless" as well as "insoluble." Against all likelihood, though, from Descartes on, not only has modern thought left the terms of the problem open, but has even sharpened them. It is in fact with the reduction of matter to pure extension, that the body (any body) acquires both the metaphysical and scientific weight of a separated and independent entity whose explanation is wholly entrusted to the laws of geometry, and rejects, once and for all, any resort to heterogeneous conditions, and first of all the notorious "forms of which so much is disputed in the schools." Matter is no longer the *substratum* which invokes form as its own determination principle and which, without it, is nothing but pure metaphysical virtuality (the so called *materia prima*). On the contrary, it comes to be the true and perhaps the only

subsistence, the only knowable aspect of reality. *Res cogitans* and *res extensa* parallel each other, but only the latter, thanks to the possibility of measurement and quantification, makes some inference on the former possible. Once matter has been made the genuine representative of "substance," as in Kant, one inevitably ends up either inferring the paralogistic (*i.e.* false) nature of the substantial determination of the soul, or, if one does not go that far, multiplying systems asserting *parallelism* or *occasionalism* (a more open form of parallelism) as the only possible correspondence between the states of matter and the states of those immaterial entities or functions which remain in the dimension of "spirit" (in man they are: intelligence, will, or what we could more generically define as "consciousness".)

This reduction to a single fundamental plane of reality leads to a further methodological simplification: since reality is matter and acts as a great mechanism, the cognitive method will assume it, from now on, as its own referent. The causal relation which in former times orchestrated *phenomena* in different planes, in the attempt to reformulate them scientifically so as to «save» as it were their density, thus finding its expression in the different modes of causality — *formal, final, efficient, material*, now restricts itself just to the model of the efficient cause. *Phenomena* are tuned to one another on the level of absolute reciprocal exteriority and total equivalence of meaning, as in a great machine; to the classical image of the "cosmos" is substituted the colder one of the "clockwork".

In this conception body and mind also live as separate entities, and the mystery of that hyphen which graphically joins them confines itself to demanding an efficient cause: is it the body (the brain) which determines psychic states (epiphenomenism)? Is it the mind (intelligence, will) which causes bodily responses? Or is there a reciprocal causality? Finally: on the one hand there is the body, on the other the mind: what "efficient" relation joins and separates the two? In general then, as it is impossible to do without the observability principle in scientific research, one considers the problem from this point of view and goes as far as reducing it down to the monistic hypothesis, according to which it is the extraordinary (material) complexity of cerebral processes which induces us to think that there must be some higher principle which we call "mind"; while a complete experimental recogni-

tion of cerebral *phenomena* would lead us to eliminate the lingering "ghosts" of metaphysics and to consider the problem in the more veritable terms of physical, chemical, electrical processes. Although Kant denied the soul any reality, he felt some kind of hindrance when it came to explaining "vitalistic" *phenomena* in mechanical terms, and refused for them any recourse to the model of efficient causes, pointing out that it was impossible that there would ever be a Newton "even of a single blade of grass." But later positivism did not share this extreme scruple. According to its principles, recourse to a metaphysical instance, as that of a "mind," is nothing but a sign of our ignorance of the extremely complex material processes, which, once they are dominated, will confine our "spiritual" chimera to the attic of myths.

Materialistic monism appears to be the inevitable effect of modern recourse to the principle of efficient causes: the effect cannot be heterogeneous in nature from its cause. Now if, according to the observability principle, we make the body the cause, the states which derive from it cannot be regarded as real except on the physical plane. One can certainly try to react to it by defending dualism, however out of fashion it may be. This is what K. R. Popper and J. C. Eccles do in their book *The Self and its Brain* (henceforth abbreviated SB) (Popper and Eccles 1977).

Let us ask the question brutally: is man more than a mechanism (body), not only for what he does or is able to do, but also for what he is to himself (mind and self), or does anything in him equal the operation of a machine, however wonderfully complex it may be? In sum, which is right — monism or dualism? Or — and I only hint at it here — is there a third possible solution? At a time when, as Lord pointed out some twenty years ago in his paper *Consciousness*, "modern metaphysicians of all shades have shown a notable unanimity in rejecting the dualist position" (Lord 1965), Popper and Eccles became courageous defenders of the dualist thesis. To what extent is it possible to share their argument? And where is it weakest — not through a lack of materialistic monism, but surely because it fails to recognize the real ground of the spiritual nature of the self (at least for Popper, to whom I shall from now on confine myself)?

We might appreciate the issue better if we begin with a quotation from Pascal, cited by Eccles at p. 357 of SB. "When I

consider the short extent of my life, swallowed up in the eternity before and after, the small space that I fill or even see, engulfed in the infinite immensity of spaces unknown to me and which know me not, I am terrified, and astonished to find myself here, not there. For there is no reason why I should be here and not there, why now rather than at another time. Who put me here? By whose order and design have this place and this time been allotted to me? (...) The eternal silence of those infinite spaces strikes me with terror" (Pascal). Indeed whereas for Pascal the inner discomfort was the starting point of a deeper and really striking quest, some modern scientists seem to feel very much at ease with it, to the point of taking it as a good basis upon which a new ethics of knowledge should be built up. I am referring, as one can easily gather, to Monod's well known *Le hasard et la nécessité* (1970). Despite his dualism, this might be assumed to be to some extent also Popper's position. Thus one might wonder whether such an outcome has its roots in a specific epistemological conception or whether it is just a matter of personal and indeed unquestionable inclinations and beliefs. The latter seems to be the answer which emerges from a reading of the last pages of SB, where the Authors, though sharing to a large extent the same epistemological assumptions, come to quite a sharp desagreement on this very point. But behind Popper's position there is too much philosophy for us to be content only with the objection that faith (or non-faith), too, must also have its relational basis (*fides quaerens intellectum*). In fact, Popper's dualism expresses a precise philosophical view. And so does his peculiar notion of objective "spirituality" of the self, which leads him to offer a historical rather than a personal evaluation of it, with all the consequences which derive from it and which I cannot examine here in any detail (personality, survival and so forth).

2. Monism, Dualism, and the theory of the three Worlds.

The problem is, as we have seen, the mind-body problem, or to put it better, the problem of the relationship (and "emergence") between the mind and the body — its restatement in terms of self-brain problem is mainly meant as

an anthropological specialization of it. Since the age of the Cartesian separation of a *res cogitans* and a *res extensa*, this relationship has become a very acute problem for modern thought. Like Descartes, Popper is a dualist. Differently from him, however, Popper claims that mind and body do not indicate two different substances, but rather states and processes.

Now, the main purpose of the dualistic hypothesis is to avoid that thought be interpreted in terms of an epiphenomenal outcome of physical or material processes, and, on the other hand, that all reality be reduced to thought, in the sense of Berkeley's *esse est percipi*. These two opposed aspects of monism are widely criticized by Popper in the first section of SB: The asserted dualism is further specified by him as an *interactionism*: this means the unacceptability of the idea of a parallelism between mental and physical states — as it happens to be in Descartes, Malebranche and Spinoza. Moreover, interactionism is claimed to justify or describe the deep relationship or better, the mutual ownership (Wisdom 1970), namely the evident capacity of both sides to act and react causally upon each other, without the possibility of being thereby reduced to each other. Incidentally, regarding this relationship we find a further hypothesis both in Popper and in Eccles which can undergo methodical criticism. The matter in hand is the need for finding some pre-eminent localization for the interaction. For Eccles this link is supplied by the liaison-brain, for Popper by language. The difficult point in this matter seems to be the following: either this element belongs to either (i.e. body or mind, self or brain) and in this case there would be no real intermediation, or supposing it is a really intermediate third thing, it would be possible to raise an endless demand for further intermediations. This may sound a sophistic objection, but it is not.

On the contrary, it is meant to show the main weakness of any dualism whatsoever (also to be found in parallelism), where starting from two entities (no matter what their nature may be), the result is that the intermediating factor eventually becomes the most important thing. This is an old, well known story in the history of philosophy, a story which culminates in Hegel's dialectic and is basically due to the philosopher's incapacity to disentangle the order of analysis from the things analyzed, or, in other words, to conceive a unity that comes

before its constituent elements. To make all this clearer: this idea of a topological determination of the relationship of mind and body is reminiscent of Descartes' hypothesis of the pineal gland as the place of the soul, and indeed betrays a somewhat substantialistic preconception of mind and body as two *a priori* separate entities. This suspicion is strongly corroborated by Popper's appreciation of the Platonic metaphor of the helmsman and the ship (which actually is not to be found in Plato) to show the relationship between mind and body. One might perhaps try to avoid such an extrinsic picture of this relation, by appealing to the functional character of the elements, thus coming near to the Kantian doctrine of a "schematism" between the concepts of the intellect and the forms of intuition (another way of starting the same eternal problem).

In any case, my criticism is not in the least a plea for monism: all it intends to do is to recall something that has remained ignored for many centuries now, and ignored, needless to say, also by Popper's historical account of the mind-body problem. I mean the idea of a fundamental unity of man, that from Aristotle to Aquinas went traditionally under the name of "hylemorphism," a unity which needs not to be explained in terms of an addition or interaction of elements, but which explains the elements in terms of the line of reciprocal reflection (*horizon*) of two metaphysical conditions that cannot be thought of apart from each other (*i.e.* matter and form.) This is the only serious attempt in the whole history of the mind-body problem that comes close to an evaluation of the inner spiritual principle of man without *a priori* separating it from the body, or reducing it to a sheer outcome of brain processes.

On the contrary, in Popper's dualism this evaluation is entrusted to the conception of the self as connected with the three-worlds epistemological model. Before moving to further perplexities, let us very briefly summarize this three-world model. The interactionistic interpretation of dualism presupposes two levels of reality: physical reality and mental reality. These are called by Popper World 1 and World 2. Previous to its interactionist role, World 1 plays in Popper's epistemology a very important function. It constitutes the realm of the final evidence for existence and reality. First of all come the physical bodies, and these are assumed to be the very first referent

for the ordinary use of the word "real": "the most central use of the word 'real', says Popper, is its use to characterize material things of ordinary size", (SB. p. 9.) "Ordinary size" has obviously to be interpreted as the possibility for something to be the object of a normal perception under normal conditions. Solid material bodies become thereafter the ultimate referent of the reality of all those things that, though not perceptible and even not material, nonetheless manifestly produce some effect on the world of physical reality (a pretty much Kantian idea). In Popper's words "We accept things as 'real' if they can usually act upon, or interact with, ordinary real material things" (SB. p. 10). This is not a "deduction" of reality in the Kantian sense of this word, namely a philosophical demonstration of its necessity, nor are physical bodies taken by Popper to be the ultimate level of reality. We are dealing rather with what Popper would call a "conjecture," in this case a sort of nominal definition. And yet it is not such an innocent definition as it appears to be. In fact it states the possibility of inferring the existence of anything which interacts with the bodies without committing oneself as to what reality and existence are to be (Berkeley would have had no difficulty in criticizing the issue). But Popper manages to avoid such "quibbles" because of the programmatic refusal of what he calls the "what is" questions.

In any case Popper claims to have established a sound basis in World 1 which can guarantee not only the reality of its hidden states and processes, but also the reality of a second-level World 2, the realm of mental states, which is real because it interacts with World 1, and real in itself because on the sole account of World 1 we could not possibly understand such an interaction (we could not make of the effect as it were the cause of its cause; *i.e.* World 2 is not a simple epiphenomenon of World 1.)

Moreover, there is another World, World 3, which is to be distinguished from both World 1 and World 2. Again, it is real because it interacts with World 1 through World 2 and it is real in itself because it cannot be reduced to being an epiphenomenon of World 2 (or of World 1). To sum up, we have "first the world of physical objects and of physical states, secondly the world of states of consciousness or of mental states, or perhaps of behavioural dispositions to act; and thirdly the world of objective contents of thought, especially of scientific and poetic thoughts and works of art" (Popper, Oxford 1972).

This tripartite scheme entails for Popper not only a structural heuristic import, but also an evolutionary meaning. Indeed it is clear that the numbers 1, 2 and 3 are not given at random, and that, as in the succession of numbers, they imply the (temporal) priority of the lower stages. Furthermore, as for numbers, the succession is not continuous. This means that evolution from the lower to higher stages, at least for some of its steps, is creative: the higher states cannot be reduced to the simple outcome of the increasing complexity of the lower ones. We should rather admit that at a certain evolutionary point something new "emerges," something that is totally unpredictable and even most improbable on the sole account of the lower levels. Thus we can say that World 2 emerges above World 1, and World 3 above World 2. (There are for Popper at least three other sublevels of emergence - but epistemologically they can be resolved in the tripartite model.)

Popper describes World 3 as the realm of objective knowledge. He claims that it is necessary to discriminate from an epistemological point of view the psychological processes of knowing (World 2) from the object of knowledge itself. The last cannot be explained in its real value and meaning simply in terms of mental processes. This may seem to be very sound and even unquestionable: indeed, the objective import of knowledge has very little to do with psychological processes. But one may begin to wonder whether the very opposition between subjective and objective knowledge is real and unavoidable, or if the defence of an objective knowledge that at times arises in modern philosophy (Popper quotes Bolzano, Frege and Husserl, though also other names could be mentioned, first of all that of Nicolai Hartmann) is prone to a failure that is parallel to the one he criticizes, being in fact rooted in the same — false — initial opposition, which is the epistemological equivalent of the dualism we have already noted between mind and body.

Let us now sketch very briefly Popper's account of World 3, in which, as he says, the self is "anchored." First of all Popper refers explicitly to Plato's doctrine of a world of ideas. The objects of World 3 are very much akin to Plato's ideal paradigms. The main difference lies in the fact that whereas Plato's ideas are divine in nature and eternal in being, World 3 objects are man-made and changing. Still, they may be regarded as separate or independent from physical and

mental reality and activity or, what is equivalent, they are not to be seen as the product of a generalization of experiences nor of induction. Being separate, however, they are not essences, but problems and problem solutions that call for a purely intellectual trial and error. Thus World 3 can be seen as the store of the tradition of the highest (but why so?) intellectual achievements of humanity, but such a store that continuously applies for reassessment and restatement.

At this point it is possible to show the meaning of the three-world model of Popper's anthropological dualism and his notion of the self. Of course if it were possible to establish an immediate equivalence of body, mind and self with the three-world series, our analysis would be far easier. Yet, things are not as simple as that, even though that kind of parallel is not after all very far from being true. What is most important in any case is to throw light on the meaning of World 3 in order to evaluate what Popper calls the "self." For him the self is a moment — a higher stage — of the mind, but it does not entirely concide with the mind itself. There is much in "mind" that cannot be recognized as "self": automatic psychic processes and more or less conscious instinctual mechanisms cannot be part of the self's higher sphere, which implies on its side a real detachment from the purely psychic processes. This detachment is given in self-consciousness, *i.e.* the consciousness of one's own personal identity, which therefore constitutes the basic mark of the self. Animals undoubtedly show a certain awareness of their condition — and hence cannot be considered as mere machines — but they have no feeling of a personal identity and cannot therefore be seen as "selves." In short, the self implies certain prerequisites which simple conscience (mind as phenomenon of World 2) cannot guarantee. It is in fact in the mind's capacity to transcend itself that Popper finds the specific nature of the self. Now, what does this act of transcending mean but the mind's capacity — as self — to enter World 3? The self is not World 3, nor is World 3 the self; but the possibility both have of being what they are arises from their acting and reacting each upon the other. On the other hand, the possibility the self has to "emerge" above the flow of psychic processes, to recognize itself as an objective, durable reality, is offered by the retroactive effect of World 3 upon World 2 — that is to say, the self is the "precipitate" of a series of objective, linguistic or

theoretical, processes, and hence a reality which can be apprehended only within the background of those processes. (Medieval philosophers had already recognized this "secondary" nature of self-consciousness and called it *intentio secunda*.) On the other hand, World 3 presupposes, at least as a condition for its existence, an activity which has its roots in World 2, though World 3 itself keeps, as far as its meaning is concerned, a position of objective autonomy vis-à-vis World 2.

It will now be clear, then, that the epistemological theory of the three worlds, and specifically the "discovery" of World 3 as the world of objective knowledge, is used by Popper to redefine the overall picture of the body-mind relationship, with special reference to the two questions of interaction and emergence of the self. In particular, the full evaluation of the self is due not so much to self-consciousness, but to the self's own capacity to face and solve problems, to concentrate upon and comprehend theories, in short to find and keep its place in World 3.

This point deserves further enquiry, for indeed it might seem that here we meet with one of those occasions — rare for modern epistemology — where the significance and spiritual value of intellectual activity are rooted not so much in the supposed "spontaneity" of intelligence, but rather in its capacity or readiness to be measured by (or to measure itself upon) a world of objectively autonomous realities. Unfortunately, this is not the case. The originality of Popper's position towards modern rationalism does not in this case go beyond the apparent autonomy he acknowledges to an objective world, the fundamental function of which lies in its providing a framework or an appropriate context for the formation and production of new knowledge.

One can undoubtedly purge this function of all possible psychological connotations, but this is not enough to make of it a real objectivity and to obtain the complete elimination of the "knowing subject." It is after all obvious that Popper's whole treatment of World 3 is but a positivistic variation of what Kant called the transcendental conditions (for the subject) of an objectively valuable knowledge.

3. INTENTIONALITY, SPONTANEITY AND THE EMERGENCE OF THE SELF

Thus the self recognizes itself against the background of World 3. But what are we to understand as "recognition"? Indeed this is a very good term for appreciating the real meaning assigned to the appraisal of the spiritual value (or "emergence") of the self. Here, before sketching the modern rationalistic background in which also Popper's position must be understood, it can be very much to the purpose to develop for a while the solution that classical philosophy gave to the problem. I take Aristotle as the most representative figure of antiquity, not only because of his more developed technicality, but also because, in contrast to his master Plato, he tries to avoid as far as he can any kind of opposition between body and mind in evaluating the spiritual import of the act of knowing. For Aristotle every genuine act of knowing can be said to be an act of recognizing reality such as it is. This must not be interpreted as bare empiricism. On the contrary, here we face the idea of man's plunging into reality, an idea which, without denying the value of cognition through the senses, nevertheless represents a true going beyond this initial level.

Aristotle's teleological conception of nature and reality, which was so strongly influenced by his biological researches, shows the need of an explanation of reality in terms of the inner agreement of each being with its own hidden nucleus of organization. Each being is supported (up-held) by its essence (or form) as by a sort of internal objective memory, the same that echoes in the Greek imperfect tense (ἦν) implied by Aristotle in the formula signifying the essence. This ancient idea has been given new life in our times by the discovery of DNA's genetic memory. To know is to approach as closely as possible that hidden nucleus, and the final step of all this is the clear recognition one gains of the nucleus itself in its (ideally) perfect definition. Thus recognizing, recollecting, knowing is but the result of an act of *intentionality, i.e.* man's disposition to be filled by the very form of the thing. The act of intelligence is therefore at the same time active and passive: it is the intellect's openness to receive and to be informed, but only in its own particular way — that of the universality. One does not know reality in the passive mode of a print upon wax

(to recall Locke's celebrated metaphor, which was in fact proposed by Plato for the first time and adopted by Aristotle himself), but rather is in-formed (*i.e.* knows) provided he enters the paths of the hidden intelligibility of reality. The ultimate apprehension (*noesis, apprehensio*) is form.

But this notion of form, as the intimate condition of being for each reality (*forma dat esse rei*), manifests a double aspect as far as the act of knowing is concerned. Besides the fact that form is the object of the final apprehension of the true nature of reality, we must also acknowledge the fact that the character of form is also shared by man's intelligent mind (in the sense of Popper's self). Mind or soul is the form of the body, the inner condition for the body itself to be. But it is a form that in itself has no form, apart from the capacity of being informed by reality. Now what is more important for us is that it is precisely in this idea of a "formless form" as the true nature of man's intelligent mind that Aristotle rooted his evaluation of the absolute openness and spirituality of the intellect without being forced to exclude it from the body. What is most poor and in itself absolutely bare, is for this very reason most rich and pure. Intentionality and receptivity is for Aristotle the mark of human spirituality. It is clear then, that with this superaddition of an ontological and noetic character (mind as the form of the body and mind as the receptivity of forms) we are supplied with both a substantial and a functional description of the human mind. Here we cannot deal with all the subtleties and difficulties of this doctrine. Let us rather take this brief account of what spirituality meant for Aristotelian (and indeed scholastic) anthropology as a mere device against which to measure the radical shift that the notion of form has undergone in modern thought, and the import of this upon the notion of the spirituality of the mind. This crucial modification of the notion took place in philosophical tradition when knowledge began to be interpreted as nothing more than a relationship between a knowing subject and an external object, which relationship could adequately be accounted for by means of the same principle of causality which is used by physics (*i.e.* in terms of efficient cause and effect). By the time of Descartes — I consider him as the most outstanding figure of this new trend, though the story can be traced back to earlier Nominalism — the very sensible warning of Caietanus, a Dominican

philosopher of the early 16th century, was completely lost. I would like to quote his warning here: "it would be awkward to give an account of sense and of the formal object of sense, of intellect and of its formal object, and also the act of sensing and understanding in the same way as we do of other things. One must learn to elevate one's mind and to enter a higher order of reality" (Caietanus). Since Descartes, then, thanks to the generalization of the model of efficient causes, knowledge began to be considered as a type of production either in the subject or of the subject.

The first direction (production in the subject) was chosen by empiricism, the second one by rationalism, but both led to a complete dissolution of metaphysics. Let us follow this second path for a short while: indeed it is the one which is relevant for understanding Popper's position. Popper's claim that his theory's goal is the foundation of an "epistemology without a knowing subject" does not weaken in the least his strong dependence on modern rationalism. As a matter of fact rationalism, at least from Kant on, has never spoken of the "subject" in such a psychological fashion as the one Popper criticizes. We must therefore admit that his criticism is mainly directed against the empiricist's notion of the knowing subject. On the contrary, Kant's Transcendental Subject (and even Descartes' Ego) goes back to at least such a strongly objective foundation as the one Popper seeks for his notion of the self. Moreover, Kant's example and suggestions are so deep and widespread throughout Popper's epistemology from its very beginning, that it seems difficult to deny the same patronage on this very point.

To summarize Kant's position: let the subject be the producer, *i.e.* the "legislator" of nature thanks to what Kant calls the "spontaneity of the understanding" (*Spontaneität der Verstand*), then in order not to fall into arbitrariness (such as the psychological "habits" or "beliefs" of empiricism result in) we have to find out some kind of rule, as an objective standard (already internal to the subject) of the act of legislation. This standard, according to Kant, may be found through a work of transcendental reflection upon those branches of knowledge which already exhibit the requisites of necessity and universality of their statements. Thus from mathematics and Newtonian physics (in other words from World 3 objects!) Kant draws the idea of a synthetic *a priori* judgement, and by

combining this assumption with formal logic, he "deduces" his famous table of the categories, *i.e.* of the internal intellectual objective conditions of human scientific knowledge. Needless to say, with his *Kritik der reinen Vernunft* (1781, 2nd ed. 1787) he supplies a philosophical foundation of nothing more than those very branches of science he had started with. All the rest is left to a form of psychological experience ("judgement of perception") devoid of any kind of necessity. Ten years later, when Kant came to enquire about other forms of scientific activity (that he called "empirical sciences," namely all the classificatory sciences, plus biology) he was bound to seek for a somewhat looser principle of knowledge. This was the outcome of his *Kritik der Urteilskraft* (1790), where Kant shows how in order to account for the scientist's choice among different explanatory models of description of an empirically given material, as well as for the first featuring of these models, we have to assume a sort of aesthetic activity, a first creative draft of what is later to become an object of scientific systematization.

It seems to me very clear that Popper's World 3 is meant to play the same epistemological role as Kant's "transcendental principles" in both the *Kritik der reinen Vernunft* and the *Kritik der Urteilskraft* — that of securing an objective screen for the acts of the self without prejudice to its claimed creativity. Indeed Popper criticizes the sclerosis of the Kantian "table of categories," while totally ignoring the new perspectives opened by the "third" *Kritik*. When Popper, in an attempt to rectify Kant, maintains that "theories are seen by the 'free' creation of our own minds the result of an almost poetic intuition, of an attempt to understand intuitively the laws of nature", this is not in the least a "modification of Kant's solution" as Popper believes. On the contrary, without being aware of it, he is speaking in the same spirit as the *Kritik der Urteilskraft*. Popper adds, in terms that must not deceive us, "we no longer try to force our creation upon nature. On the contrary, we question nature, as Kant taught us to do; and we try to elicit from her *negative* answers concerning the truth of our theories: we do not try to prove or *verify* them, but we test them by trying to *disprove* or to falsify them, to refute them. In this way the freedom and the boldness of our theoretical creations can be controlled and tempered by self-criticism..." (Popper, London 1972). This prudential statement, with its reminiscence of

Popper's well known "falsificationism," does not lead us any closer to an objective conception of reality, such as the one shown in the classical notion of form. Reality is already silent and subject to being forced by us, when objectivity is taken as a mere guarantee of human knowledge. When Popper claims that it is not possible to assert that things "are so," but only that things "are not so," does this make any difference as to the import of reality upon knowledge? Furthermore, what kind of an objective function of control is ensured by reality, if any hypothesis and experiment, as Popper maintains, is alive and meaningful only within a context of theories? If the act of formation and reassessement of theories is but a process of *making-matching-making*, the middle term corroborating or falisifying does not indeed face any reality, but always and only a theory.

Neither the innovating audacity nor the prudential flexibility of scientific creativity is unknown to Kant, who in fact anticipates many of Popper's solutions in this matter. Here, however, I am not looking for philological details. I have introduced this reference only to clarify the nature and function of World 3 as the world of objective knowledge. Popper says he wants to abandon the subject-object polarity in the theory of knowledge, and for this he appeals to a knowledge without a knowing subject. But this refusal affects only the subject as psychological entity, not at all the subject as transcendental principle of the laws of nature. This is precisely what Popper tries to found "objectively." Popper's objectivity, then, indicates above all the impersonal character of theories, but never an objective connotation of the theories themselves. Popper completely neglects what the scholastics called the "formal object," that is to say the delimitation, founded upon the object's nature, of a certain ambit of "knowability." He in fact fully shares with rationalism (and partly with idealism) the prejudice towards the objectivity of form which necessarily follows from establishing the subject as "legislator" of nature. The function of that curious blend of Plato, Hegel, Comte, Hartmann and a few elements of Darwinian evolutionism which is World 3 becomes fully clear as an answer to the need to ensure an objective stimulus and control to the free "Copernican" creativity, which is the source of the *making-matching-making* process. Once you reject the rigidity of categories the risk presents itself of giving way to

epistemological arbitrariness such as that theorized by Feyerabend's anarchism. Feyerabend at least has the merit of having unmasked the inevitably irrational outcome of a rationalism brought to its extreme consequences. Being, as a "moderate" rationalist, convinced of the *Wertfreiheit* of science (*i.e.* of its independence from all those alien conditionings which are for Feyerabend its real principle), Popper must in any case establish an "objective" limit in order for creativity not to become gratuitous and for science not to become a prey to all sorts of external conditioning. This limit, however, is still within the dynamics of knowledge and never aims at a real objective determination of it. (We have already seen how even the *ultima ratio*, the physical world, is no more than an hypothesis.)

Here we really see the perverse mechanism (human, all too human!) of any genuine rationalism at work: the theoretical stage requires its meta-theoretical stage, and so on endlessly. This happens when one totally ignores the sense of the fundamental affinity which prepares human intelligence to accept, in the act of knowing, an intelligible form. Form is in fact the ever renewed seal of that intellect's readiness to consent to being. When scientific creativity roots its own fundamental norm only in the (transcendental) subject, it is inevitable for it to recognize its highest moment of expression in an "aesthetic", almost poetic act. Here scientific creativity comes closest to what Kant called "intuitive intellect" or "archetypal intellect." Faced with this extreme possibility, however, a "critical" rationalist, though longing for it, must pause: he cannot share it. Creativity must still be "reasonable" and hence acquire a system of self-control without ever being forced to reach something beyond itself. Whether it be called World 3, or complex of theories, or paradigm, or meta-theoretical complement of the self, the context of "objective knowledge" offers but a series of projecting stages, each of which postulates a successive one as its own indispensable condition of interpretation. In this endless discursiveness man, like a new Midas, can never touch anything that has not been already contaminated by his intemperate "creativity."

4. WHAT IS THE SELF?

The major effort of Popper's dualistic hypothesis is directed against any form of reduction of the superior activity of the mind to a bare outcome of a mechanism. Something higher "emerges" above the levels of the physical and psychobiological mechanisms. This is the self. And to this extent we must appreciate Popper's dualism as a bold effort against the overwhelming trend, nowadays, of materialistic monism. But this is all.

The self "emerges": *what is* the self? I have chosen this way of putting the question (that Popper most dislikes) on purpose. A "what is" question is in fact to him a question about essences, and therefore a meaningless question. At one point in SB, however, Popper admits that "the talk about a substantial self is far from being a bad metaphor" (p. 146.) The image of the "ghost in the machine," in which he, despite all Ryle's arguments against it, claims to believe, is not a bad metaphor for him either. But a ghost and a substance are not quite the same thing, even if they are used as metaphors! Again, then: What is the self? A ghost, a kind of substance in process, a helmsman, a pure function? Alas! Anything goes! Or rather: there is no answer, just because what is questioned coincides with the question itself. It is not just because we are facing a "what is" question that there is no answer, but because we are questioning the self, *i.e.* the possibility itself of asking questions (the universal legislator of all questioning) in such a way that if we take the question seriously we are immediately involved in an endless circle.

As we have seen, it is precisely this kind of "principality" of the self, its autonomy or "spontaneity," that hinders the demand for a really objective foundation of it. What Popper offers to us instead is the so called objectivity of World 3. In other words: there is no real objectivity (a demand which to Popper is a myth due possibly to an equivocal overevaluation of the import of perception upon knowledge): objectivity for him is rooted in language and is manifested by those human products (problems, theories, works of art) that appear to be nothing more than a specialization of language.

We go back to Pascal's dilemma: in the solitude of infinity

what sense has this trifle — ourselves? Is Popper's "self" enough of an answer? It does not look like it. The self "emerges," is a superior function, it is anchored in World 3. Hence it is always (at least virtually) in touch with the highest conquests of intelligence; it is an unforeseeable, indeed altogether improbable, event, but above all it is the critical ruler of any perspective we might have of reality. "Reality," the "universe" — are not these concepts, acts of the self, impulses of World 3 to act back on it? But then the significance of the self is the self itself (as object of World 3), and all questions lose strength and taste. For Popper in fact the world of values (and within it the value of the self) is always a stage of World 3. Kant, who wondered most at the starry sky above him and at the moral world within him, had, with this distinction, tried to save the reciprocal autonomy of facts and values thanks to a schizophrenia of worlds (nature and freedom) which is difficult to uphold. For Popper a consequential rationalism cannot rightly allow this distinction to be made. The value of the self coincides with its being, *i.e.*, with its function.

And this "coextensivity" once more makes any non-psychological distinction between fact and value vain, so that in the end we cannot distinguish in this matter between value and non-value. This is exactly the same source of Pascal's *pari*, equally distant from yes and no. A rigorous rationalism (and such was Pascal's) allows no more than this — we may find no convenience in either pole, no external suggestion may come from without ourselves, from the world that surrounds us and of which we are part. We have only the loneliness of risk and of absolute freedom. Popper, removed as he is from Pascal's tremblings, looks at all this skeptically. Of the three traditional characteristics of the soul — spirituality, immortality and personality — he accepts the first as a mere hint of "emergence," is inclined to discard the second (which he finds simply fearful), and considers the third as a specialized function of the consciousness. There is nothing in them that might constitute a real basis for the appraisal of the self. It is highly significant that, in this *pari* situation, Eccles, though starting with the same epistemological presuppositions, should often come, with equal right, to opposite conclusions (SB part III).

Recalling Pascal, we asked ourselves at the beginning whether the alternative imposed on men by the "sense of

being" between looking after their own business (as Voltaire suggested) or opening themselves up to higher hopes (Pascal's choice), can be solved by recurring to philosophy, or whether it is a question of merely personal beliefs. What we can say at the end of the enquiry, is that Popper's critical rationalism (like any form of rationalism) excludes any possibility for the self to appraise its value, in that the self coincides with the totality of possible experiences without any space being left to its contrary determination (against which alone can something be qualified as value.) Hence Popper's position leads to the conclusion that the problem must be solved on the level of personal belief, but it also strengthens the unavoidability of that *pari* situation which is itself vitiated right from the beginning by the rationalistic divorce between the I and the world that surrounds it.

And yet, with its prefix of reiteration, the word "recognition" invites us to meditate precisely on the singular complexity of the act of human knowing which, the more it opens itself up to embrace reality, the more it stays within itself — the more it knows the form of being, the more it recognizes itself and its spiritual breadth. Indeed, it is only in the "potentiality" of the self and its formal determinability that the meaning and value of a genuine objective "emergence" projects itself. In this determination lies the appeal of the depth of form — a depth which is not just the kernel of a concealed thing in the sense of Heraclitus' "nature loves to hide," nor the opacity of form's being always intertwined with matter as far as man's experience is concerned. Far more than that: it is the depth of what, in revealing the measure, foreshadows at the same time the ontological ground in which a thing is rooted and gives room to the real question. "Why is there being instead of nothing?" It is only within such question that one discovers the sense of an objective value. Since — as Leibniz saw very well — "nothing" is simpler and more logical than "being," the very source of objective value is being. The spread of its roots in being measures for each being its objective value. Surely the improbability or the unforeseeability is not enough of a token of the value of the Self, as Popper would maintain it to be. On an absolute scale, such as the one commanded by Leibniz's question, there is no more improbability for a Self to be than for a pebble to be. If something is there, instead of nothing, then this "something" must have a meaning. Yet, Leibniz's

formula is not enough. If one were to stop at it, "being" would have a pure logical value. True wonder — what, as Aristotle says, renews itself "in the past and now and forever" — is produced by being manifesting to us as form. In other words, if the existence of something (instead of nothing) prompts us to wonder, the fact that being appears to us as form must be seen as even more wonderful. This "must" is no longer an invocation which is pressing out of an existential anxiety, in front of which philosophy has nothing to say. Silence is allotted to philosophy whenever the Self is torn away from its consent to the intelligibility of being.

When the experience of reality no longer prompts man to face the depth and radicalness which alone can pave the way to meditation on his spiritual dimension, then the self prepares for itself that loneliness which either makes it a slave of its own image or forces it to expect that immediate contact with the root of all "why's" that is the denial itself of all grace ("grace", *i.e.* the manifestation of form and meaning). "When a man is truly lonely — says Lamartine — God sends him a dog." What, then, if the dog, and all that comes with it, is but the shadow (be it called conjecture or concept or whatever) that the self casts upon reality, and each form is imposed on being thanks, as it were, to a right of "projection"? Man can no longer escape his circle, nor can he avoid making inevitable the dilemma between the *credo quia absurdum* and Wittgenstein's icy statements, "what one cannot speak of, one must keep silent about" (Wittgenstein 1922). It will be the task of philosophy to unmask that dilemma, once Aquinas' warning is again taken seriously: "amongst all errors the most indecent seems to be that because of which we err about the intellect, thanks to which [*i.e.* the intellect] we are born to know the truth, after having avoided all errors" (Aquinas). That is, only through the poverty of the self can its real wealth emerge.

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