The Brain, the Person and the World[1]

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It is not unusual to hear researchers in the neurosciences and the cognitive sciences saying that 'the brain acts, the brain decides, the brain anticipates, the brain simulates or emulates the real'. However enigmatic or indeed senseless such expressions might seem to be at first sight – they require interpreting by the philosopher as the translation of a physiological thinking looking for the right way to view things and who strikes out in the direction of a type of description which still makes sense in a context where ordinary language is no longer relevant. Since all our usual ways of talking about practical or cognitive activities relate to the whole person, we still lack a language capable of reaching back to the point at which the organisms 'strives to make sense of' – a form of words which is still too heavily marked by a vitalist teleology remote from the computational mechanicism dominant in the neurosciences. For all that, just such an effort at making sense does actually find expression across biopsychological values (hedonic, affective, pragmatic and not just cognitive values) progressively superimposed upon the activation patterns of cerebral circuits as they gradually get enriched. To the extent that the living system – including not just the brain and the body of the individual but also its socio-ecological environment – functions in a normal or pathological mode and that the conditions of this functioning are integrated into intra- or extra-cerebral regions that are ever more varied, ever more extended and remote from each other.

1. Reductionism and anti-reductionism: A Dichotomy?

It is always surprising for a philosopher to note that the same scientists who in their laboratory research are extremely cautious in establishing the facts of the matter display a audacity bordering on ingenuity when it comes to giving public expression to their understanding of living organisms, particularly in what concerns their mental activity and the cerebral functioning that underpins it. Freely extrapolating from a pre-critical ontological thinking, they make conjectures about each level in the analysis of the biological substrate of human experience to make of it the direct support of mental states or the agent responsible for actions. 'The brain, this or that cerebral circuit, the neuron wants or decides this or that.' Without worrying about being at odds with their own professed functionalism they even seem to want to propose a teleological conception : 'The brain, this or that cerebral circuit or again the neuron exists essentially (or is there for) this or that . . .' However opposed they may be officially to any dualism of the mind and brain they are unable to do without a substantialized

[1] Translation from the French by Dr Christopher Macann. [Published in *New Essays in Logic and Philosophy of Science. SILFS 1*,M. D'Agostino, G. Giorello, F. Laudisa, T. Pievani and C. Sinigaglia eds, College Publications, London, 2010, p. 585-599].

mind that haunts the cerebral material, referring to the brain as a sort of demiurge capable of perceiving or of doing anything that the person is capable of perceiving and doing. But since this demiurge could not possibly possess this power as simple material in the brain, they are obliged to surreptitiously confer upon it command of the body and access to the enviroment, which thereby gives rise to the illusion of a brain that contains everything! The paradox is that those who are most prone to this temptation to confer upon the brain a maximum of properties, by precipitating upon the material substrate aptitutes stemming from the whole person, are those who are normally classified as reductionists: the neurophysiologists

From another angle, when the anti-reductionists protest by saying that man can not be reduced to his brain, they do it by presupposing a conception of the brain that is itself seriously reductionist, if not physicalist:

"After all, neural activation, be it here or there in the cortex, is simply neural activation. Something more is needed to explain why a particular neural activation activates a particular learning-like quality, and another activates a particular seeing-like quality. How could different neural activations possibly give rise to different feelings[2]?"

"From the point of view of the brain, there is nothing that differentiates nervous influxes coming from the retinal, haptic, proprioceptive, olfactory, and the other senses, and there is nothing to discriminate motor neurons that are connected to extraocular muscles, skeletal muscles, or any other structures. Even if the size, the shape, the firing patterns, or the places where the neurons are localized in the cortex differ, this does not in itself confer upon them any particular visual, olfactory, motor or other perceptual quality[3]."

"You can no more explain mind in terms of the cell than you can explain dance in terms of the muscles.[…]we need to turn our attention away from individual neurons. […] we need to widen our gaze to encompass large-scale populations of neurons and their dynamic activity over time. But why stop there? […]Perhaps the proper scale at which to make sense of neural functions is that of the living, environmentally situated animal itself? If this seems like a far-fetched proposal, it may be because tradition teaches that the skull is the crucial boundary marking off what is inside from what is merely outside; and crucially, we are inside[4]..."

Descriptions of this kind fail to take account of the *θαυμάζω*: the astonishment of the researcher confronted on a daily basis with the astonishing performances of the brain[5]. A brain that displays aptitudes one has difficulty in attibuting seriously and not in a merely metaphorical manner to anything less than the complete person. When the researcher feels obliged to talk about 'the brain acting, deciding, anticipating, simulating or emulating reality' it is important, if one is a philosopher – more a philospher following up the discoveries made in the neurosciences – to consider whether formulations as enigmatic if not plain senseless as these appear to be at first sight might not be the provisional substitutes for alternative ways of ushering in a new type of physiological thinking. A new kind of physiological thinking that is still trying to come to terms with itself and which is stumbling in the direction of more adequate descriptions in a context where ordinary language ceases to be relevant. In fact, since our habitual ways of describing cognitive activities refer to the whole person, we simply do not possess the language needed to render the 'effort' made by the organism to make sense

[2] K. O'Regan, E.Myin, A.Noë, *Pheno & Cogn Sc*, 2005, 4, p. 379
[3] K.O'Regan, A.Noë, *Behavior Brain Sc*, 2001, 24, p. 941.
[4] A. Noë, *TLS*, June 15, 2007, p. 24.
[5] [Prehistoric man painting animals in a Lascaux cave] must have been amazed by what he saw, even though his brain was recreating these shapes from various cues, *just as I am present as a spectator at my own lectures, an impression produced by a brain whose expression I listen to with astonishment*" (A. Berthoz, *The Brain's Sense of Movement*, p. 135).

of… Just such an effort is recognisable in the biopsychological values (hedonic, affective, pragmatic and not just cognitive values) with which the activation patterns of the cerebral circuits are invested as they move forwards gradually from the primary receptive areas to the association areas and from there to the motor areas; or again from the sub-cortical circuits of motivation to the cortical circuits of perception, of cognition and of action. But, in the debate between reductionism and anti-reductionism, no account is taken of this progression from lower to higher orders of meaningfulness.

'*This* (the mind) is nothing more than *that* (the brain as a cerebral tissue)'. Against the reductionist who holds this true but terribly elliptical view, the anti-reductionist holds that the cerebral tissue is only what it is and that mind is not reducible to that. A new claim that is both true and terribly inadequate. What the the anti-reductionist does not see or pretends to ignore in his defence of the irreducible character of the mind or the person is that the conception of the brain he himself has uncritically taken over is itself extremely physicalist. Without knowing it, he is the product of a philosophical tradition going back to Descartes, refusing to see himself as a thinking subject in this 'machine composed of flesh and bones that one encounters in a corpse' and finishing up with Hegel who responded to Gall's assimilation of mind (Geist) to a bone (the cranium) that slapping such a hollow head would only make it resonate, not get it thinking! Without always making their position clear, neurobiologist today are trying to get away from any physicalism of this kind. And they are trying to do this by moving towards a description of the brain that is not just anatomical and structural but also functional and dynamic: a description of the 'brain in act' (Stanislas Dehaene), even of a 'mental cinema' (Semir Zeki).

One finds this reductionism implicit in anti-reductionism in a recent development in the cognitive sciences: Embodied-Embedded Cognition. Initiated by Francisco Varela and now represented by the philosophers Andy Clark, Shaun Gallagher and Alva Noé, the psychologist Kevin O'Regan and others, this movement is trying to react against a neuroscience 'looking exclusively at what goes on in the head or in the brain.' Instead, what is upheld is an emphasis upon the contribution made to cognition by the body, by intersubjectivity as also upon the interaction of the organism with its environment. The contrast underlined in the passages cited above by Alva Noe, between lived experience, feelings or states of consciousness, on one hand, and the action potentials of neurons or electrical activity patterns in brain tissue, on the other, are to be read in the frame of this way of thinking. But this hidden reductionism is also to be found in major schools of contemporary philosophy. In phenomenology, the description of lived experience just as it is lived out from the point of view of the subject itself and without presupposing any underlying explanatory causes is a description that it ought, in principle, to be possible to develop on the plane of phenomenal appearances alone, just as they are apprehended within the horizon of the *Lebenswelt*. Here the reduction applies to the biological substrate of lived experience, and more particularly to the brain. 'Even though my body is at the centre of my experience, my brain, Paul Ricoeur observed, plays no part in my experience. It's an object for science[6].' Running parallel to this reductionism motivated by the defence of the irreducible character of lived experience, one also encounters in contemporary philosophy a linguistically motivated reductionism. Philosophy practised as logico-grammatical analysis claims that any speaker is in possession of a vocabulary of mental concepts sufficent to enable him to attribute mental properties to persons, to describe persons in mental terms, and to explain their behaviour in these same terms. Given that logicians have no doubts about the universality of language, the resources of this vocabulary should be

[6] J.-P. Changeux et P. Ricœur, *Ce qui nous fait penser. La nature et la règle*, p. 64.

enough to make it possible for the ordinary speaker to decide in a satisfactory manner any question concerning the mind of the other[7]. To be sure, ever since scientific psychology got started, there has been a tendency for ordinary language to borrow terms from the physiology of the brain. But the assimilation of such borrowed expressions can only lead to category mistakes which threaten to cloud ordinary language in obscurity and confusion. The systematic pursuit of the study of ordinary language aimed at forbidding any transgression of the 'limits of sense' finishes up by enclosing he neurosciences in a physiology of the reflex and refusing to let them enter in the sphere of cognition[8].

2. The Homunculus in the Brain: How to get rid of it?

As soon as expressions normally employed in reference to persons are recycled in the context of infra-personal sub-structures (brain, cerebral areas, sub-cortical centres, neuronal networks, cells assemblies or individual neurons) this very usage automatically introduces a reference to a fictive agent responsible for the thoughts and actions that would normally be imputed to the whole person. In his Preface to *New Essays on Human Understanding*, Leibniz warned us against the danger of falling back into a 'barbaric philosophy, like that of certain philosophical scholastics and doctors of the past, who, crippled by the barbaric character of their century, and today rightly disregarded, saved appearances by concocting occult qualities and faculties envisaged as little demons capable of doing unwittingly what one wanted, as if our pocket watches marked the time in virtue of a certain chronological faculty without needing wheels, or as if mills crushed grain by virtue of a fractional faculty, without needing mill stones'. The lesson Leibniz drew from this, to stick to mechanisms for the explanation of corporeal movements and to limit recourse to internal faculties for the living individual and its mental activity, would not be of much help in the cognitive sciences, where what is sought are the cerebral mechanisms correlated with mental acts.

So that it does become possible to accept the claim advanced by Ryle, Bennett and Hacker that certain speakers misuse language when they attribute personal properties to parts of the brain. But this doesn't prevent other speakers from abusing language in the same way by simply doing their job as neurobiologists. More precisely, in so doing they are simply testing Horace Barlow's hypothesis linking mental concepts to the responses of individual neurons: "The firing of one neuron would be important enough to trigger a major decision, such as stopping at a traffic light […] I am suggesting that *one* cell would be enough, and the following psychophysical linking hypothesis expresses this claim: Whenever two stimuli can be distinguished, in normal life or in a psychophysical experiment, the proper analysis of the impulses occurring in *a single neuron* would enable them to be distinguished with equal or greater reliability. One can argue for the correctness of this hypothesis along the following lines. Nerve cells are the only means we know about whereby items of information occurring in different parts of the brain can be combined; sensory discriminations require the combination of information from different parts of the brain; therefore this operation must be performed by a cell, and if one could record from the cell that did this, one would obtain results at least as good as those of the whole animal[9]."

But exactly how is this kind of selectivity of the information carried by the activity of an individual neuron possible? In fact this selectivity is already written into the presuppositions

[7] G. Ryle, *The Concept of Mind*.
[8] M.R. Bennett and P.M.S. Hacker, *Philosophical Foundations of Neuroscience*.
[9] H. Barlow, "The twelth Bartlett memorial lecture: The role of single neurons in the psychology of perception", *The Quarterly J. of Experimental Psychology*, 1985, 37A, p. 133-134.

of the electroencephalographic record, since the linear and hierarchic organisation of the nerve pathways carrying the cognitive information has simply been assumed. In the frame of such a linear and hierarchic organisation, higher order neurons collect, combine and synthesize the information transmitted to these neurons by numerous neurons of a lower order. From level to level, an ever more important body of information is concentrated in an ever more limited number of neurons. And to such a degree that, if only two cells remained to be activated at the penultimate stage in the hierarchy dealing with the processing of visual information, it might be difficult to avoid admitting the logic of Barlow's position when he states: "I don't see how the information from the two or more essential cells could be combined, except by *another cell*." This is how the concept of the 'grandmother cell' was devised, a hypothesis claiming to have identified a neuron without which it would be impossible for you to recognise your grandmother, even if she were to present herself to you in person. As grotesque as such a hypothesis might appear to be, it shows what can be done with a neuron once its psychological performance is placed on a par with that of the individual. The theory of the neuronal encoding of cognitive information – without wanting to minimize the importance of the improvements brought to this theory by introducing computational procedures – is fatally committed to this paradox. It should be added that the grandmother neuron is nothing more than a modern version of Leibniz' homunculus. Leibniz talked of little demons capable of accomplishing, unwittingly, what one wants. Unwittingly, that is, without employing known means. But this is exactly what we don't know about Barlow's cardinal cell, what he doesn't even claim that we know: "It is also true that we do not know *the means* by which such a cell is able to make the discrimination".

The most disconcerting thing is that the paradoxical character of the concept in question – the irrationality of recurring to humunculi in the brain – has not prevented the neurosciences from getting closer to an empirical verification of Barlow's hypothesis. We know that the organisation of the principal visual nerve pathways, including, in this order, the retinae, the retinal gangliae, the optic nerve, the lateral geniculate bodies of thalamus, and the striate and extra-striate cortices of occipital brain areas, is globally linear and hierarchic. Everything seems to happen as if the entire functioning of these pathways was organised in such a way as to lead from the sensorial captors towards the perceptual representation that gets constructed in the polar temporal regions (especially). Towards the peak of this hierarchy in the perceptual processing of visual information, in the superior bank of the superior temporal sulcus, neurons have been recorded which respond to the presentation of features of the face or of the face in profile. But also, neurons, which seem to be responsive to the individual character of the face whether or not it is presented in profile. They are activated by the face of one experimenter but not by the face of another, even though the latter may be as familiar as the former to the monkey. One is tempted to attribute to these neurons the capacity to recognize the individuality of the observed face, a capacity one would have wanted to reserve for the person of the observer. But as to knowing how these neurons succeed in such a performance, all that can be said is that they do it by synthesizing the information supplied by cells of a lower order. Not forgetting that the computational approach makes it possible to arrive at a more detailed answer to the question. But the inventor of these facial neurons, David Perrett, is forced to admit: "the details of the next stage of processing after the visual cortex but before the structural encoding that has been studied in the temporal cortex are to a large extent unknown[10]". In other words, we are once again confronted with these little demons capable of accomplishing, unwittingly, what actually gets done.

[10] D. Perrett et al. *J. Exp. Biol.* 1989, p. 92.

3. Affective and Motor resonance or the alienation to the internal homunculus.

What, in the end, could a homunculus in the brain possibly be, if not an alien in me who does everything for me without my personal participation? An alien all the more mysterious and worrisome for doing all this without knowing anything about my relation to the world and to other persons, since he is radically solipsistic and acosmic. Whether it is cerebral or numerical, a computer is always in fact shut up in itself. If it is indeed this absence of any personal participation on the part of the subject in its own mental life that is responsible for this feeling of alienation that one quite reasonably experiences when confronted with neuroscientific explanations presupposing a homunculus in the brain, a solution begins to dawn. A new current of research in the neurosciences, the neurosciences of emotion and action, is bringing to light the neural foundations for our being directly involved in the operations of perception and cognition.

The idea that is going the rounds is that emotion and action are not as one might have thought, accessory or peripheral functions with regard to a central core of cognition based upon representation and computation which, for their part, remain affectively neutral and kinaesthetically inert. On the one hand, emotion and affectivity in general is once again recognised as lying at the root of the pulsional core of mental life. On the other hand, we are learning to re-discover the fact that the motor capacities of our body disclose the practical resources of the environment and render us sensitive to the motor intentions of other agents. If we take this evolution seriously and draw whatever consequences follow therefrom for our problem the phantom of the homunculus in the brain should gradually give way to a better knowledge of the incarnation of cognition in a sensible and acting body. The foundations of our being involved in events and in action are being investigated in the new neurosciences of emotion and action under the head of phenomenona of *resonance*. Some are more interested in the affective repercussions of the predictable consequences of our decisions, repercussions which normally accompany and guide the taking of a decision, and which would be handicapped by any emotional deficit[11]. Others are more interested in the resonance of the observed movements of another agent in the repertory of action and the motor memory of the observer, a resonance which makes it possible for him to immediately understand the meaning of the actions undertaken by the other. The more we know about these phenomena of resonance the closer we get to promoting resonance into a new paradigm, a paradigm which might even replace the paradigm of the computation of information developed with respect to internal representations. If the further development of the neurosciences makes it possible to confirm this prediction, we shall be able to get rid of the homunculus, this fiction of an abstract calculator with whom it is impossible to identify because he feels nothing and does everything effortlessly.

4. The Contribution of the neurosciences of Emotion

The neurobiology of the emotions is not limited to a conception of emotional experience modelled on the processing of visual information, that is, to an analysis of external stimuli, the statistical extraction of invariants and their interpretation from the standpoint of cognition in general. At the root of the most basic emotions, let us say emotions common to man and other mammals, the existence of specific nerve circuits is presupposed, circuits including a collection of sub-cortical centres in the brain[12]. Formed earlier on in the evolution of the sensorial and motor cortical regions responsible for cognition, the cerebral amygdala, the

[11] A. Bechara, A.R. Damasio, *Game Econ. Behav.* 52, 2005, p. 336.
[12] J. Panksepp, *Affective Neuroscience*.

hypothalamus and the periaqueductal grey nucleus exert an excitatory and modifying influence on the former regions, which make it possible for behaviour to be adjusted to the emotional state of mind. The activation of these circuits, whose electrical and chemical conditions are beginning to be understood, provokes impulses releasing emotional behaviours at the same time that they invest the stimuli that prompt these comportments with positive and negative values. The entire wealth of the emotional experience of man is rooted in the diversity of these subjectively experienced impulses. Even if we still do not know the processes by means of which the subjective emotional experiences are engendered on the basis of the electro-chemical activation of these circuits, the relation in question is no longer thought of in the cold and arbitrary terms of an encoding of mental representations in the neuronal action potentials. And this because the association between the felt emotion, the stimulus by which it is released, and the behaviour is always *motivated*.

For the subject as a living organism, being moved is a matter of feeling, in its very being, the absolute seriousness of an episode of (potential) importance for its life. Emotions are written into the individual as an imprint of an ancestral history where survival depended upon bringing into play the behaviour in question, and rapidly mobilizing the energy needed to do so. Emotions are fundamental modalities deposited in the genetic memory of the individual, recording its active engagement in a situation of vital significance. Sedimented in our being, though constantly available for reactivation, they are the possible forms of our presence in the world. It is in this sense that Jaak Panksepp distinguishes (1) a 'seeking' circuit responsible for directing our search for an object of interest, (2) a 'rage' circuit directed against those who represent a frustration, (3) a 'fear' circuit anticipating an imminent danger or a vague feeling of insecurity, (4) a 'panic' circuit expressing attachment and distress at being separated from the object of attachment, etc. The direct activation of these circuits through intra-cerebral electrical stimulation evokes complex and complete comportments, together with their intentional orientation and their affective tonality. A cat jumps towards the face of the experimenter, its claws unsheathed; a rat lies prone or takes flight; a patient thinks he is being followed or in an obscure tunnel or that he has fallen into the sea. Rarely seen in their most basic state in the adult, these instinctive tendencies are filtered in daily life by culturally dictated learning patterns and by higher cognitive activities. But even across these modifications, emotions never stop saturating our mental life and orienting our behaviour in such a way as to ensure that the individual will be able to come to terms with the existential situations it is confronted with. And so uphold its readiness to get involved with the event, which is a contribution made by the living being to the sense of its life. This continual emotional saturation of human experience, taken together with its impulsional underpinnings, is enough to render futile and gratuitous the objection that the activation of a sub-cortical circuit is, in the end, nothing but a flux of chemical molecules or electrical potentials bearing no obvious relation to our passionate interests, our rage or our fear.

Having said this, we should be warned against any excessive hermeneutical optimism. However obvious it might be to the philosopher, this solution to the problem of the homunculus via affective resonance it unlikely to be as obvious to the scientist himself. And of course the problem is not nearly as serious for the one as it is for the other. Jaak Panksepp's hostility to the domination of computationalism in cognitive neuroscience ought to have pushed him in the direction of an incarnate and situated neuroscience, that is, a neuroscience that has rid itself of humunculi. For all that, wanting to promote his hypothesis concerning the biological foundations of consciousness against the competing hypothesis of Antonio Damasio, he finishes up characterizing the sub-cortical circuits of the emotions as if they were controled by a humunculus exercising sovereign control over the totality of mental life, even

including the perceptual and the cognitive. 'The only reasonably well-developed alternative to that view is the posibility that emotional command systems can establish various distinct types of resonances in the neuro-symbolic representation of a primordial body (the 'SELF') situated largely […] within deep and ancient mesencephalic areas, such as the periaqueductal grey nucleus and surrounding tectal and tegmental systems. […] The SELF is capitalized to highlight that this is a postulate concerning some type of primordial organization of the brain – a coherent neuro-symbolic humuncular schema of the organism, a virtual body heavily weighted toward the representation of the basic motor-orientational and visceral processes. […which] emotional and motivational processes control the attentional and information-processing capacities of the somatic-exteroceptive (i.e., sensory thalamic-neo-cortical) nervous systems[13].'

The dominant current in cognitive science explains cognition through representational functions of the mind whose materialization is effected by cartographic properties of the homunculi lodged in the brain centres, thereby making it possible for the feeling and acting body to be brought under the control of the brain as if this body were reducible to an aggregate of external information captors and muscular movement effectors. A new tendency consists in emphasizing the role of the feeling and acting body as a major factor in high order cognition considered not just as an unconscious infra-personal mechanism but also as a dynamic process responsible for the emergence into full conscious awareness of psychical formations (affects, percepts, intentions). Antonio Damasio[14] bases the consciousness of self and, in addition to self-consciousness, the representational capacities of the subject (augmented by learning, language and culture), on the infrastructure of a proto-Self which he identifies with an intimate sense of the homeostatic control process of the internal milieu of the body. Nevertheless, his conception, inherited from Cannon's homeostatis, remains a non-dynamic point of view, closed in on the internal milieu. The feeling of the own body goes much further than the subject who experiences it. It is also a window open on the own body of the other as another subjective centre with its own world. An opening on an other I know something about from within as a result of a resonance going far beyond the purely intellectual cognitive capacities of a (solipsistic) subject. For the bearing of any such intellectual cognition is definitely limited to my ability to infer, whether syllogistically or analogically, on the basis of my representations alone. If the discovery of resonant systems in the brain and the determining role of such systems in the understanding of actions and emotions does not seem to have enabled neuroscience to make much progress in the direction of the recognition of the role of the body as an organ of cognition and not simply the effector of actions, this is undoubtedly due to the fact that the discovery of mirror neurons has been taken over by a cognitivist ideology, which rejects the incarnation of meaning and which refuses any somatological hermeneutics.

5. The contribution of the neurosciences of action

What the neurosciences of action presuppose is that the possession by the organism of a repertory of actions makes it possible for the latter not merely to choose the action adapted to the circumstances but also to project its own categories and practical values (affordances in James Gibson's sense of that word) upon the surrounding world and, amongst other things, to directly recognize the actions of others, without inference or computation but through a phenomenon of resonance. The concept of resonant system is a generalization of the concept

[13] J. Panksepp, "The neuroevolutionary cusp between emotions and cognitions. Implications for understanding consciousness and the emergences of a unified mind science", *Evolution and Cognition*, 7, 2, 2001, p. 153-154.
[14] A. Damasio, *The Feeling of What Happens*.

of mirror neuron. Mirror neuron: that is, a nerve cell operating in a dual visuo-motor field linking the observation with the execution of an action. Resonant system: a functional loop integrating the nerve centres distributed about distant cortical areas (or sub-cortical centres) and linking the observation with the execution of an action or observation with an emotional experience. Example: a resonant system of manual prehension with all its modalities integrating a collection of premotor mirror neurons (in the monkey, homologous with the Broca area) with somato-sensorial neurons (in the parietal area). Reduced to its most elementary expression, the fact is the following: in electrophysiology, based upon the unitary recording of electrodes implanted in the monkey, the manual actions of the experimenter activate neurons in the frontal area 6/F5 of the monkey by either a positive or negative modulation of the frequency of the discharge, a discharge profile very similar to that spontaneously associated with the execution by the monkey of actions of the same type. These 'actions' are different sequences of a complete chain running from attentive but passive observation to the execution of actions oriented toward the taking hold and manual ingestion of food. The general hypothesis is that any automatic mimetic comportment solicits the activation of a parallel resonant system in the brain[15].

The discovery of mirror neurons is therefore due to the recording of individual cells, an approach dedicated to the validation of Barlow's hypothesis, or to saving it in some improved form (population encoding, temporal encoding, etc.). Let's show this. Under what conditions are mirror neurons activated? We have just explained: under two conditions: 1) when the monkey executes manual gestures oriented towards the ingestion of food; 2) when it observes the experimenter (or a fellow monkey) in the process of executing one of the manual gestures belonging to its own motor repertory. Classically, the function of mirror neurons has been interpreted as that of matching an observed alien action with the corresponding action belonging to the repertory of the observer. However, operating between the mental act of recognizing the identity of an action and the simple and objectively verifiable fact of the similarity in this discharge of the neuron, the notion of matching seems poorly determined. This, despite the fact that there is no possibility of confusing two things: one, the similarity between the activation curves traced on a histogram, which, for its evaluation, requires examination by an expert; the other, the act of the perceiving subject engaged in recognizing an action he knows how to accomplish himself in one he sees being accomplished by an other agent. It is this confusion between these two things that introduces a homunculus into the brain: a fictive interior observer capable of recognizing the identity of the action on the basis of the intra-cerebral observation of the frequency curves of the neurons activated in the two sets of circumstances. In line with our Cartesian heritage we tend to associate the capacity to recognize an identity, or to grasp a thought, with an agent capable of bringing a local diversity into an integrative unity:

« Car on peut bien concevoir qu'une machine soit tellement faite qu'elle profère quelques paroles *à propos des actions corporelles qui causeront quelques changements en ses organes*; comme si on la touche en quelque endroit, qu'elle demande ce qu'on veut lui dire, si en un autre, qu'elle crie qu'on lui fait mal, et choses semblables; mais non pas *qu'elle les arrange diversement pour répondre au sens de tout ce qui se dira en sa présence*, ainsi que les hommes les plus hébétés peuvent faire (*Discours de la Méthode*, Cinquième Partie). »

Let me cite myself. In one of the first philosophical articles to draw attention to the discovery made by the Giacomo Rizzolatti group, a citation repeated with approval in his

[15] G. di Pellegrino, L. Fadiga, L. Fogassi, V. Gallese, G. Rizzolatti, "Understanding motor events: a neurophysiological study", *Experimental Brain Research*, 1992, p. 176-180.

recent book with Corrado Sinigaglia: 'Everything happens as if the neurons reacted not to the stimulus as such, that is to its form, its sensorial aspect, but to its meaning for the animal. But reacting to a meaning is what is meant by understanding. Should we not then be talking about understanding rather than about a simple stimulation[16]?' A question that applies equally to man, with regard to the Broca area being postulated as the support of 'the understanding of the same act of communication'. Ever since, in cerebral imagery, this area has displayed a similar activation profile in cases of the production and of the simple observation of silent speech. And this applies yet again in man with regard to the cerebral amygdala or the insular cortex, which display similar activation profiles when the subject experiences an emotion and when it observes someone else experiencing the same emotion. Etc.

Situated in the classical rationalist tradition for which the mind of the other is not initially given in a fundamentally intersubjective experience but is the conclusion of a piece of reasoning on the part of a solitary subject, a neo-cognitivist tendency interprets the function of mirror neurons to be that of underpinning a strategy of attributing mental states to alien bodies whose behaviour we want to be able to predict. The resources we already possess for planning our own actions furnish us with an analogue for a theory of the mind of the other. Another neo-behaviourist tendency relies on the directly immediate, and necessarily unconscious, character of the synchronization of the agent's resonant systems with that of the observer to advance the view that the motor repertories can, through their synchronization, explain not just motor control but also communication and social cognition. An outcome of the collaboration between the neurophysiologist, Vittorio Gallese, and the analytical philosopher, Alvin Goldman, a notion of simulation floating between resonance and analytical inference is not going to be enough to resolve the tension between these opposing tendencies[17].

All the more so given that the notion of resonance stemming from work on mirror neurons remains largely metaphorical. The subject of the verb 'resonate' is still so poorly defined when one speaks of resonant systems that one hesitates between too many alternative applications: 1) that it is the person of the agent and the person of the observer of the same action or emotion that can be said to resonate; 2) that it is the brains of these persons that resonate; 3) that different resonant systems dedicated to the recognition and the execution of actions mobilize different areas or brain centres; 4) that individual mirror neurons, and by virtue of the duality of their modes of activation, directly link the visual stimuli of the observed movements with the motor programmes of the observer or his emotional systems. This ambiguity probably results from the fact that, split between the multi-unitary recording of neurons by micro-electrodes implanted in the brain of the monkey and functional cerebral imagery in the case of human beings, research on mirror neurons using the two technologies still lacks any common interface.

But resonant systems, hypothesized as neuronal groups distributed across distant regions in mutual interaction, play an active role in the neurodynamics of the whole brain. In order for the nature of this contribution to be specified more exactly, individual cellular activities will have to be compared with local field potentials and with whole brain cerebral rhythms by

[16] J.-L. Petit, « La constitution par le mouvement : Husserl à la lumière des données neurobiologiques récentes », in J. Petitot et al., *Naturaliser la phénoménologie. Essais sur la phénoménologie contemporaine et les sciences cognitives*, p. 306, passage cité in G. Rizzolatti, C. Sinigaglia, *So quel che fai. Il cervello che agisce e i neuroni specchio*, p. 49.

[17] V. Gallese and A. Goldman "Mirror neurons and the simulation theory of mind-reading", *Trends in Cognitive Sciences*, 1998, 12, p. 493-501.

procuring EEG recordings simultaneously at all three levels. A seductive hypothesis[18] is that resonance has to be attributed to a neuronal mode of communication based upon the agreement between oscillation phases of different anatomically connected regions of the brain, all of which are mobilized by the activation of one and the same resonant system. For individual neurons in distant, but synchronously oscillating regions, an effective channel of communication would open up, one that would be closed down by the failure to synchronize of the respective oscillation patterns. This synchronization-desynchronization mechanism should make it possible for us to offer a causal (albeit holistic and not localistic) account of the intentional sequence: emotion-motivation-intention-preparation-action. Except that we are still very far from realizing this ideal, if only because work on mirror neurons and eletroencephalographic measurement of the inter-regional coherence of the brain are carried out by quite different communities of researchers.

6. Kinaesthetic constitution: An extrapolation from the neurosciences

Faced with this deceptive ambiguity concerning the philosophical significance of neuroscientific evidence, the philosopher might be tempted to attempt an extrapolation. What follows should be taken as a fable by appeal to which the dilemma with which cognitive neuroscientists presently find themselves confronted might be resolved, and this without reference to the ongoing course of empirical research. Might it not be possible to account for mental acts in terms of underlying physiological processes without recreating, within the subject whose acts are now in question, a second subject responsible for the acts of the first? −Our point of departure in the philosophical tradition is the kinaesthetic theory of transcendental constitution[19], a theory developed by Husserl in mansucript material stemming from the thirties and from a point of view quite close to the intuitions of Helmholtz and Poincaré on the origin of geometric space in the sensation of bodily movements. The idea is that any object of interest, any perceptual form, any unitary entity which might present itself in experience as endowed with the meaning of being something for a subject – that is to say, for myself – must have been engendered by the activity of this same subject in the course of its interaction with this object. By retracing, in an uninterrupted succession, the complete sequence of acts responsible for conferring meaning upon objects fully constituted in human experience, the theory of transcendental constitution should ideally be capable of dispelling the phantom of the homunculus, which latter only appears as a result of the gap that has been allowed to develop between the meanings finally constituted in and through the process of sense formation and the subjective acts responsible for this process of formation itself.

Moreover, this transcendental constitution does not presuppose any transcendental subject overseeing human experience and constituting its sense formations from above. On the contrary, here the operative subjectivity is incoporated in the intimate sense of my being able to activate ('I move myself') my organs of sense and my body, the body of a concrete human being. For such an essentially kinaesthetic subjectivity, 'real' objects only make sense as invariants in a continual variation of profiles in the perceptual fields of the organism (binocular visual field, cutaneous tactile field, sonorous space), a variation correlated with the kinaesthetic series of bodily movements performed by the perceiving subject in the course of its exploration of its surrounding world. No permanent object without a kinaesthetic lived experience advising the agent interacting with this object of the recurrence of a series of

[18] R.T. Knight, "Neural Networks Debunk Phrenology", *Science*, 316, 2007, p. 1578-1579; P. Fries, "A mechanism for cognitive dynamics: neuronal communication through neuronal coherence", *Trends in Cognitive Sciences*, 9, 2005, p. 474-480.
[19] See A. Berthoz et J.-L. Petit, *Physiologie de l'action et phénoménologie.*

perceptual profiles associated with the movement of the eyes, of the hands or the entire body as the inverse correlate of a previous movement. The thing is not constituted prior to the subjective experience of the thing but is dynamically constituted in and through the latter. The thing emerges from this process of constitution endowed with all its layers of meaning: as a simple thing in space, as a materially resisting thing, as a tool, as a work of art, etc. and this emergence of the thing will be strictly simultaneous with the act through which the acting subject gets hold of the thing in the course of an action. The connection between 'meaning something for…' and 'giving meaning to …', this formerly broken connection because of the common-sense or scientific objectivations, will now be re-established. Finally, any kinaesthetically embodied experience is, in addition, intersubjectively situated, to the extent that our kinaesthetic experience is duplicated, or rather get deepened through, our awareness of others, and this because we also have empathic access to the kinaesthetic experience of the other. Thanks to all this, our world can not be conceived as initially solipsist, only to become later a social world through some fictive convention, but is to be seen as the world of several persons from the outset. Objects in this common world do not just exist for me but always equally for others: the intersubjectivity of the operations responsible for conferring meaning also endow the objets with an absolute objectivity, the kind of objectivity one only normally concedes to the theoretical objects of the mathematician. And so it is that the closed world of every day life gets opened up upon the infinite world of the idealities of science.

Conclusion:

- Anti-reductionism tends to favour a purely physical description of the functioning of the brain and in such a way as to highlight the irreducibility of mental life.
- A hypercritical philosophy leads us to condemn as absurd any attribution of the mental activities of a person to the brain or to parts of the brain.
- The residue of an ancient philosophical tradition, the humunculus argument is not so easy to dismantle, no matter what the approach attempted in the neurosciences, because the methodology employed lends itself to the introduction of humunculi.
- Prompted by its very method to relaunch Barlow's hypothesis concerning the grandmother neuron, research on mirror neurons runs the risk of conferring upon individual cells (or the resonant systems in which they are lodged) a personal capacity to understand the meaning of actions.
- Anchoring our philosophical interpretation in the effort made by the organism to make sense of, and in the ability of the neurosciences to elucidate the mechanisms at the root of such tendency, we focus our attention on an intermediary phase where one notes an interesting friction between mechanically oriented explanations and a teleologically oriented common intuition of the essence of the living being.
- For his own personal satisfaction, the philosopher can always claim the right to extrapolate, on the basis of empirical evidence, in a direction that brings about a subjective synthesis of his sympathy for a certain tradition of thought with the progress made in a science, just as long as he pays close attention to the development of this science. This is what we have tried to do by bringing Husserl's transcendental theory of kinaesthetic constitution to bear upon the work done in the neurosciences.

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