The neuron does not say "what"

From Thalès to Kant, all philosophers exhausted scientific knowledge of their time, before starting to develop on a philosophical level. Thereafter, Hegel was the first in charge of a rupture between science and philosophy, rupture of which the harmful effects are not yet to disappear. The field of the sensation in its most generic aspect reveals a major aspect of this harmfulness. All philosophers, whether rationalists like Saint Thomas d' Acquin, or empirists like Locke or Gassendi, insisted on the major role of the sensation in the awareness and the knowledge of the world. On the other hand, these authors did not formulate any assumption on the mechanism of the sensation, for lack of scientific support. For the majority of them, in spite of some unmatched voices, sensations revealed a surrounding world as it "really" is, independently of the observer properties.

About at the time Hegel died, in 1831, Johannes Müller published his own work on the shellfish complex eye, work which should have revolutionized philosophy entirely. Coming after Bell and Magendie's studies, about isolating sensation and motricity at neurophysiological level, Müller asked the question: does each quality of sensation require a specific receiver? Does the same fibre transmit impulses of different forms corresponding to the various excitations qualities , therefore to the sensations? Müller concluded that each sensor answers in an identical way to a varietiy of stimuli; therefore there must be as many sensory receiver types as there are sensations. The only thing that differentiate sensory receivers from one another is a lower threshold to a given type of stimulus.

Muller did not completely realise the importance of the conceptual revolution he made possible: we are conscious of the discharge of a sensory neuron, and not of an external stimulus as such. H. Helmholtz extended Müller's range of analyses by suggesting that the vision of colors is allowed by the existence of three types of visual receivers, each sensitive to a different primary color. H. Helmholtz also proposed a theory stating that there would be particular sensory receivers for each height of sounds. At present and since 1920, the descriptions of Muller and Helmholtz are shown overall, and they can be extended to all neurons whatever their function. However, very few contemporary thinkers have integrated the range of what J Müller discovered. Amongst them Heinz Von Foerster reformulated the mullerian principle under the name of undifferentiated encoding principle: the response of a neuron does not encode the nature of the agents that caused the answer. In other words, ' the "what" is not encoded but only the "how much". A neuron always gives identical answers but with a frequency which depends on the radiant intensity of the stimulus. Von Foerster's career of artificial intelligence specialist prepared him to such a conclusion: in a computer, the striking of a keyboard key can possibly encodes the rest time, but it encodes neither the movement which established the striking, nor the personality of the person at the origin of this striking.

But if qualities of the stimuli are not encoded in the nervous activity, the fundamental question is to know how the brain can function, and in particular how our brain can reveal the extraordinary variety of the coloured world of which we make the experiment at any time. The answer is double:

- all neurons are not identical with regards the threshold of response according to stimulative energy. Thus heat, shock, an electrical current, applied to a neuron of the retina, will give birth to the same impression from light and color that a light radiation, but the later corresponds to a considerably lower threshold than for any other type of energy. Other

neurons will be more sensitive to a sound stimulus, others to a tactile or odorous one. It is what Müller described as specific energy principle. Therefore, in the presence of a defined stimulus, all the neurons will not react in the same way; and the difference will be a source of a considerable information, in fact the most important one.

- all neurons of the body do not have the same site. Since this site is encoded, it introduces a considerable additional variety. Let us take a quantified example: let's consider a very simple system composed of four neurons. Each of those neurons can be inactive or answer to one of 3 identified levels of possible frequency. With a reading of these neurons state every eighth of a second, the number of events which could be recognized or differentiated is about 64000 per a second of observation. Actually, the human organism is composed of 10^7 to 10^8 sensory terminations, distinct either by the specific energy they respond to and/or by their site on the body. The number of identifiable different arrangements is astronomical.

But what is gained in variety, is lost in facility of calculation. Von Foerster insisted on the need for a computation but in 1973, date of a princeps communication, there were few data which could explain this computation. Work of Herbert Simon did underline the impossibility of fast calculation at brain's level. The number of successive operation is at best 20 per second and these operations can only relate to 3 or 4 units of information. A computation in reel time is therfore quite impossible.

The solution was to come from Hubel and Wiesel for which they were given the Nobel price in 1978. These authors showed the existence of extremely sophisticated treatment in parallel of the visuo-retinal data, therefore much faster than a serialized treatment for complex data. Thereafter, Semir Zeki described cerebral zones specialized for the various visual data: the form, the size, the color, the movement, in a whole about thirty kinds of data. Incidentally these authors showed that for animals which are mature right from birth, like the rhesus monkey, these analyses of the visually perceived objects are possible right from the start.. Then it becomes obvious that it is not external forms within the environment which "instruct" the brain, but some specialized cerebral areas which produce a coordination of local informations , generating personal forms.

One sees badly how one could approach the mechanism of the sensation when neglecting these data. At the same time, it is the problem of the reality which must be considered in a completely renewed way. In the line of the opposition noumene/phenomene postulated by Kant, two different meanings must be granted to the concept of reality:

- a reality in itself or noumenal. Such a reality can be logically postulated because we belong to this reality. To deny it, would result in denying ourselves, which does not mean anything. On the other hand, such a reality escapes any description other than the existence.

- a perceptible or phenomenal reality. This reality is accessible to our knowledge but under a subjective form. It is one particular reality among a great number of possible constructions , deduced from the operation of our perceptive brain, indissolubly related to the characteristics of our means of knowing, and limited to our effective meetings with our environment.

A priori, one could think that it is not possible to differentiate in perceptive knowledge, what originates from the cerebral mechanisms, and what is environment's properties. In fact, that is not quite right, as Spencer-Brown formulates it indirectly: "It becomes apparent that if certain facts about our common experience of perception, or what we might call the inside world, can be revealed by a extended study of what we call, in contrast, the outside world, then an

equally extended study of this inside world, will reveal, in turn, the facts first metwith in the world outside : for what we approach in either cases, from one side or the other, is the common boundary between them". The setting of an identical perceptive organization of the brain in the presence of different external targets, allows a reflexion on these cerebral mechanisms. In its turn, this reflexion allows a better definition of the targets. This process of reciprocal improvement can continue indefinitely, and assess a constructivism.

Thus, the principles under consideration by J Muller and largely confirmed, implies that we have access only to one phenomenal reality, determined by the properties of our brain. But if the new-born baby opening the eyes, immediately has access to a reality, this one gets considerably richer by living. A new born sees a world in color; in geometrical forms, in objects well delimited on a background, but he is unable to give a meaning to percieved objects; he has to build significations. So, the radical constructivism on the double philosophical and psychological levels, is no longer a simple option , but instead the most coherent approach, the only satisfactory one, in the current state of Science.

All the brains are not equal in the construction of a phenomenal reality. Daltonism is only one example of differentiation. It is thus legitimate to consider that at the beginning, each individual builds his reality, according to the environment actually met as much as to the cerebral variations. The child builds his own space but this space is not the same one for the young Pygmy of the dense forest and for the young eskimo of the frozen lonelinesses. Then an essential situation of reciprocal adjustments (and thus of progress) opens, which is the social confrontation of individual phenomenal realities.