

# SCIENCE IS NOT BALKANIZED IN DIFFERENT DISCIPLINES:

Being a super-specialist is not an excuse for not being a wide  
scientist



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As recently as three centuries ago, it was taken for granted that the Universe was a “thing” created by God, exactly as we see it. But during the XIX<sup>th</sup> century the Universe and everything it contains started to be regarded as “processes” (Cereijido, 1994a). This drastic change was brought about by thinkers that wanted to answer “*What might have happened in the past to produce the present that I have now in front of my nose?*” Thus, Lamarck and Darwin wanted to understand why recent geological strata had skeletons of species still alive, while old geological strata have skeletons of extinct species, and their answer was: “There is an **evolution**, whose central mechanism is Natural Selection”. Likewise in trying to explain why there are rich and poor people, Marx imagined a class struggle that, in black and white, is also an evolution. Freud instead wanted to learn whether the problems a patient had walking, were related to the fact that she had been sexually aroused by her brother in law, and proposed a psychoanalytic interpretation in terms of evolution.

Was medicine impervious to the evolutionary tendency of the XIX<sup>th</sup> Century? Not at all. At the beginning, medicine was still impregnated by taxonomy and syndromes (signs + symptoms), i.e. static combinations of having or not fever, anemia, pain, swellings, cough, hemorrhages, diarrhea, jaundice, as grasped by sharp and very perceptive doctors like Down, Turner, Asperger, Korsakoff, Alzheimer who, nevertheless, had no idea about what may be

the cause. Thus tuberculosis was already known in Ancient Egypt, but in the XIX century Robert Koch discovered that it reflects the **progression** of the attack of a bacillus.

XIX century thinkers also drastically transformed the conception of structure/function. In line with the division body/soul inherited from Judeo-christianism, throughout the Middle Ages and Renaissance it was considered that we are an assortment of organs (kidneys, hart, brain, eyes) that function (filtrate plasma, beat, think, bite, see), studied by Anatomy and Physiology respectively. The introduction of powerful microscopes, optic first, electronic later and confocal more recently, combined with cell fractionation, ultra-centrifugation and other advanced techniques, showed that our cells are microstructures that function, and conceived the idea that a function is nothing but the manifestation of a structural change and, conversely, every change of structure elicits some sort of function.

Are structures also involved in functions as “spirituals” as thinking and craziness? Of course, because ideas are generated by neuronal circuitry, when a neuron communicates with the next one, chemical substances (neurotransmitters) synthesized by the first must travel through its cytoplasm enclosed in synaptic vesicles, fuse with the plasma membrane, open toward the extracellular space and deliver the neurotransmitter to the extracellular solution. The chemical structure of this neurotransmitter

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enables it to bind with enormous specificity to receptors in the next neuron, which is thereby stimulated or depressed, and as a consequence the organism sneezes, sleeps, becomes hungry, horrified. Upon binding the incoming mediator, receptors may separate from the plasma membrane, “board” an endosome as if this were a bathyscaphe and travel to the nucleus or some other cellular organelle. A biologist fixing the brain at this moment might not observe a cell in which a visiting substance has penetrated, because most likely the receptor might have undergone phosphorylations, stereochemical changes or integrated to the structure of some cellular structure. This is so incredible, as if a woman comes into our home and minutes later, when her husband who went to park the car arrives, finds her arms integrated to the refrigerator, and her thorax amalgamated to the masonry.

This view is not compatible with the idea that we are in a constant state (in which case we would be a “thing”), nor in equilibrium, but in **steady state** (Cereijido, 2009a), because our nuclei, mitochondria, lysosomes, microtubules, continue being processes, resembling a house, a car, a family whose maddened owner continuously tears down and rebuilds walls, the roof, the balcony, the battery of the car, and in such frenzy divorces his wife and marries another woman.

Every metabolic step depends on enzymes generated by genes that are **almost** exact copies of the ones received from ancient mammalian through intermediate hominidae. We may suddenly suffer anemia, or skin diseases, because a lemur passed a defective gene to its descendants, who fortunately had other genes that compensated the defect and, eventually, it was passed to us, and we lived harmoniously for a time with the faulty plus the compensating gene. Unfortunately, now we are old, the synthesis of this second gene might slow down, and does not match the malfunction of the defective gene, thus we suffer a disease

bestowed by an ancient lemur millions of years ago.

I am not referring to a particular disease. It might be a failure that causes cells to proliferate out of control, generating cancer, or a failure in the metabolism of tetrapyrroles and we become anemic, or distorts the structure of an enzyme participating in the synthesis of a given transcription factor in the brain, and we end up killing our neighbor because we concoct the fantasy that he is courting our wife (Cereijido, 2011).

Since everybody is forced to work in a tiny domain of scientific practice, the science illiterate (Cereijido, 1994b; Cereijido & Reinking 2005) imagines that science is balkanized (Cereijido, 2009b). Expert psychologists, neurologists, and psychiatrists instead stay alert to novelties in evolution, genetics, zoology, neurochemistry, ion channels and other fields. They develop the habit to pick up new knowledge wherever discovered by research, and incorporate it to the theoretical framework supporting his scientific practice.

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