Of Conceptualization, Crises, Crayons, and Creative Circles

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To put the cards directly on table: I will take the perspective of a (confirmed) computer-scientist in the following discussion, as this allows for an interesting point of departure. Computer science is above all a science that *creates* theoretical results, but that also creates tools (in form of computer programs) that help others (e.g., engineers, designers) in their creative processes. Consequently, one would presume that this includes also a kind of meta-perspective on the process of creation itself. Leaving aside the question whether the latter is really part of today's academic research, I want to make computer science's role as "the science of formalization" the center of my attention. Other influences that will shine through the following discussion are the science of complex systems, constructivism (may it be radical or critical), a touch of pragmatism, and our discussions in the graduate workgroup «arts&sciences» with A. Glykos.

The main question is: *how can a scientist invent or discover* new *things, i.e., new concepts, new entities, new theories*. Before delving into the details of the creative process itself, one must take a closer look at the most important word in this question: novelty. When is a freshly emerged entity really "new"? As frighteningly often, computer science offers a formal approach: "the most interesting type of emergence is *emergence relative to a model* which can be summarized as a deviation of the system's behavior form the observer's model of it" [1]. Cariani discusses in favor of the supremacy of this type of emergence over all others [2], and I will just take his position: Emergence is a purely formal notion that depends on the discrepancy between a (formal) model of the object of research (e.g., physical processes of our real world or scientific theories itself) that includes our observations and expectations. Being "new" becomes a question of formal modeling and *not* ontology, and consequently falls into the domain of formal conceptualization.

But, we must begin at the beginning: with the crisis. The origin of the creative process is the contraposition of two different, distinct entities; this relates to well-known basic concepts in other approaches like "dialectic opposition" (Hegel and followers), "fold" (Deleuze et al.), and frontier (this colloquium's title). Instantiations of this crisis, with respect to scientific epistemology, are for example: researcher vs. reality (to avoid any ontological doubt: let us assume there is a reality), scientist vs. research community (think of the prototypical Galileo Galilei), and researcher vs. the uncontrollable, unforeseeable outcome of his experiments.

Let us focus in the following on the interactions between a scientist and his formal modeling of some aspects of the object world. (Note that the neutral term object world allows us to speak about the 'real' world as well as objects in abstract domains, e.g., literary theory.) For simplicity, I will leave all other contextual embeddings aside for the moment, and focus the three following relations: (a) the perception of the world by the scientist, (b) the scientist and his formal model, and, finally, (c) the formal model and the aspect of the reality it models.

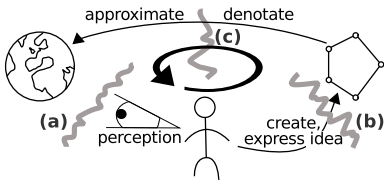

FIG. 1 : *The three gaps bridged by the creative circle: (a) the epistemological gap bridged by visual perception, (b) the artist-work distinction or "how to formalize ideas?", (c) the gap between formal semantics and formal ontology [3], that is also the origin of emergence.*

These three relations can also be seen as bridges over frontiers as depicted in Fig. 1. But it is the interplay of these frontiers that constitutes the dynamics of scientific creation: (i) the scientist tries to formalize an aspect of the the object world, (ii) he makes a *sketch* and then (iii) renders this sketch into a formal languages; then, (iv) he compares the expectations derived from the formal model with experiments in the object world, and (v) uses this as feedback for his modeling task that now restarts ad libitum and ad infitium at point (i). This is a classical example of a *circulus creativus* [4]. Again, I want to turn my attention to a detail: the role of the "sketch". Formal models are not made from scratch, they are first roughly sketched in an informal formalism (maybe with a crayon on a napkin…) which is then translated into a formal language (which could also be diagrammatic [3]) with strict syntax and semantic rules. To use the words of Bailer-Jones: sketches are the mental reification of theoretical scientific treatment [5]. Sketches are the bridges over the frontiers (a) and (b). Independent of whether thinking and conceptual perception itself is a purely visual action [6] (a hypothesis that I vehemently defend) or not, each scientist catches himself extremely often red-handed doodling with a crayon in his hand.

So let me finally derive my basic hypothesis: Scientific innovation is based on conceptualization/formalization and takes place in a creative circle that bridges (in our simple model) three gaps. One of these gaps directly describes the quality of innovation and novelty whereas the other two are bridged with the help of sketches; hence, by informal, non-standardized, individual means of creative expression. My next iteration of this circle of formalization would embark from "draw a distinction" [7] towards a more detailed look onto the influence of the "edge of chaos" [8] to the dynamics of a creative circle.

References:

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