

G.V. Schiaparelli from astronomical observations to scientific imagination

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A letter to Ernst Mach

- Around 1900: Correspondence Schiaparelli-Mach

A letter by Schiaparelli dated Milan, April the 25. 1898*:

“I received your kindly letter and the very nice book [Popular Scientific Lectures, 2' engl. edition], the most of that I've just read with real pleasure and usefulness: I see, we agree about a number of ideas. I maintain as a great luck that the most important idea of my book that natural forms depend on a system of parameter was just conceived by yourself [...]. But I am not the mathematician who can find the fundamental formula by which these parameters will describe the infinite number of forms in organic nature and the change from one type to another one.”

* [Archive of the Deutsches Museum Munich, NL 174/2891](#)
(draft at the Archive of Brera Observatory)

A letter to Ernst Mach

- A general statement (“the forms depend on a general system of parameter”)
- A disclaimer (“I will not be that mathematician”)
- Method: One has to begin with simple things (“the analysis of a part of the system where forms are simple and allowing for a concrete idea of what kind of parameter are implied”)

- Mach knows very well a former Schiaparelli's paper:
Studio comparativo tra le forme organiche naturali e le forme geometriche pure,
Hoepli, Milano 1898

Key notion: "Forma geometrica pura" (pure geometric form), i.e. a form or a "family of forms" specified by an adequate mathematical formula (e.g., conics in the plane: circle, ellipse = algebraic equations of 2nd order in two variables x, y)

Parameters: they specify the kind of conic and also the particular curve

Transmutation of forms, i.e. change in parameters

E.g.: the simple case of eccentricity in ellipses tending to 0 and defining the circle as a case limit, i.e. ellipse of 0 eccentricity

Application: Abstract mathematical types of forms: the set of different forms module equivalent relation defined by a transformation group

Schiaparelli's aims

- Aim of the program: define some “archetypes” in Goethe's and von Baer's sense
- Collateral aim: interpretation of some of the form transmutations in nature in the framework of a well-defined type as evolution in Charles Darwin's sense!

The main questions

1. **Distinction between the whole configuration space and the real dynamical process of evolution** (in the words of S.J. Gould: Why some possible forms from the geometrical point of view are not realized in the evolution?). It's one of the most interesting examples of the general problem of morphogenesis (see e.g. I. Prigogine, R. Thom and others)
2. **Discrete vs continuum mathematics: in principle, variation is continuous, but historical evidence in evolution is discrete.** For Schiapparelli this problem implies a choice of the appropriate subset of the real number system (e.g., integers only)

The emergence of simplicity

- This was just a program (it found a real development despite Schiaparelli in some application of mathematics to biology: d'Arcy Thompson, Mandelbrot and so on).
- Schiaparelli's underlying seminal idea in general biology casts light on his method in particular problems of astronomy

An example from astronomy

- There is another letter to Mach (Milan, February the 16th, 1900)* which allows for some hypotheses about Schiaparelli's approach to scientific problems.

→ See the work Schiaparelli (most probably) send to Mach in attachment to this letter:

“Osservazioni astronomiche e fisiche sulla topografia e costituzione del pianeta Marte”, sixt memoir, Salviucci 1899.

* [Archive of the Deutsches Museum Munich, NL 174/2892](#)

Astronomical observations as scientific analysis

- This is a real and severe communication of scientific data; but one can find also sentences as: “Il regno della confusione è finito, dappertutto le forme si definiscono e si differenziano” (p. 295)

Hypotesis-making as the goal of observations

- A more general view by the popular work *Il pianeta Marte* (original edition 1893; edited by A. Mandrino, A. Testa, P. Tucci for Mimesis, Milan 2002):
 - Form differentiation is the best information nature gives us (Schiaparelli uses a sentence originally stated by Galilei: “La cortesia della natura” – The courtesy of nature, p. 77).
 - In this contribution we can find Schiaparelli’s general method as expressed in his first letter to Mach: “Nella spiegazione dei fatti naturali conviene sempre cominciare dalle cose più semplici” – In explanation of natural facts it is always worthwhile to begin with the simplest things.
 - Because of their richness, possible organic forms from Mars would be of the greatest interest (e.g. Vegetable life forms)
 - An extraordinary conjecture: classification of forms and their transmutation could cast light on the question whether planets host life, even intelligent life (soul).