A PHENOMENOLOGICAL STUDY OF RAINBOWS

Goethe's method of science and that of Newton

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Contents

Foreword to second edition

A quarter of a century has passed since I published the first edition of this paper with the title: On the Phenomena of Rainbows – Goethe's Method of Science, and although it was propably an odd aquaintance to the proponents of modern optics and physical chromatics, and perhaps a naive one at that, I still defend the idea that the philosophical foundations on which Goethe's science rested, were sound and in need of further investigation.

To this second edition I have included some suggestions how Goethe's thinking might be approached by comparing it to the thinking of Martin Heidegger and some modern scholars of antiquity. I will also bring forth some recent academic articles which explain where Goethe found the idea that prismatic colors are the result of both light and darkness, and not only light as it is understood in modern physics.

I have left out some parts of the first edition which discussed the symmetry of light/sight paths in a raindrop. Also the ray-tracing calculations which were provided by Dr. Eero Rauhala have been omitted from this second edition.

Since this is a study into phenomenology, I hope it will be understood as such, and not as something trying to replace physical sciences, or even to say that it is in any way better science than physics. My intent is understood correctly if it is taken to present an extension of scientific and philosophical interest, and a complementary view into reality. Reality is not "one-kind-only". It can be rich and manyfold in a way that one era in human history with a temporally and culturally dependent scientific paradigm may not be able to unveil all its secrets. Reality for us humans is something that is being built in our sciences, in our thoughts, in our efforts trying to understand that, which we experience.

Pastel drawings: Klaus Salomaa and Raimo Rask
Photography: Simo M. Pitkänen

PART I

1. The purpose of the study

The purpose of this paper is to present a preliminary sketch for a study of the rainbow phenomenon from a holistic, phenomenological point of view. In this I shall try to follow an approach to phenomenology pointed out by *Johann Wolfgang von Goethe* (1749 - 1832) in his writings on natural science and especially those on colors.[1]

Since phenomenology might today be considered as an unorthodox method in a physical science, this study has a subobjective in serving as an example of a phenomenological study in a field that is usually considered as genuinely physical. The aim here is to call forth discussion on Goethe's way of science and his notion of chromatics as a science of color, independent of the physical theories of light and electromagnetic radiation. The first part of this study concentrates on showing how modern writings on phenomenological philosophy have shed new light on Goethe's approach to scientific inquiry. Although there are differences in the phenomenological methods of Goethe and modern phenomenologists, the core of their philosophy is basically the same. Goethe's philosophical stand has been found to represent an early form of phenomenology, a phenomenology of nature. It was not until recent phenomenological investigations on Goethe's way of science and his method of enquiry that his work has been found to conform to that of modern philosophical thinking. Today Goethe's work is seen by many scholars as of such importance that one may not have a phenomenological science of nature without a reference to Goethe.

The second part of this study will present an investigation of the phenomena of rainbows in "Goethe's spirit". Here one can only suggest how Goethe might have approached the rainbow phenomenon according to the ways in which he approaches prismatic color phenomena in general, and the few hints he gives in his correspondence with Boisserée. In that sense this work is preliminary, and it may at the most be said that the present study is inspired by Goethe's way of science. However, the wish and opinion of the writer is that those more acquainted with Goethe's methods will eventually correct the possible faults and shortcomings of this study in order to come to an investigation, doing more justice to Goethe's own aims.
As we are dealing with thematics at the core of physical optics, a few words will be appropriate

[1] Goethes writings on colors have appeared in various editions. I have had at my disposal a German version of the "Farbenlehre", edited by Gerhard Ott and Heinrich Proskauer, Verlag Freies Geistesleben, 4. Edition 1988.

to explain what can be understood by the term phenomenological in this context and what are the aims of this study in respect to the mainstream physics. These will be discussed in Part I of this study, concerning the philosophy of natural science and that of phenomenology.

The self-adequacy of mathematical physics is not in question here. Having interest in amateur astronomy and telescope making, the author is well aware that without the mathematical-physical science of light, practical instrumental optics and all of modern technology would simply not be possible. Therefore, by choosing a different methodological path than that of academic physics, an effort is made, not to discredit modern science but to find a complementary way of looking at nature that would widen the scope of academic physics itself. That this effort includes opposing views in respect to the conventional philosophy of physics rises mainly from the need to produce an independent philosophical stand for the present study. The author sees this as a matter of comparison, as a necessity emerging from the presentation of a complementary view. Mathematical physics remains just as adequate within the framework of phenomenology as it is without it. Yet, it should be understandable that every new paradigm changes our views of the wholeness and the paradigm introduced here is that of complementarity. How such a complementary way of looking at nature is possible and why it is necessary, will be discussed in the chapter *Phenomenology and Goethe's Way of Science.*

1.1 Defining the problem

In this study I shall ask the question: how can one understand the phenomenon of the rainbow from the point of view of Goethe's phenomenology, starting from his understanding of the emergence of prismatic color phenomena and the few remarks he has left about his own study of the rainbow phenomenon? As was mentioned above, in answering this question we shall try to place Goethe's phenomenology in the framework of modern phenomenological philosophy, and see what its special features are in respect to such philosophical tradition.

1.2 About the method used

The method of this study is presented in a series of pictures illustrating phenomena necessary for the understanding of the rainbow as a whole. These illustrations form a "landscape" of optical and prismatic color phenomena through which the reader is encouraged to travel. Goethe described his method for understanding natural phenomena as "zarte Empirie" (delicate empiricism, as translated by David Seamon – an "effort to understand a thing's meaning

through prolonged empathetic looking and seeing grounded in direct experience.") [2] The actual method then, is the process of the looking- seeing- and drawing-activity of the observer. As with all study of phenomena in Goethe's sense, the reader is encouraged to "look for himself" and repeat the observations illustrated here.
The aim is to find a *basic or primary phenomenon* ("Urphänomen" or the primordial phenomenon in Goethe's sense) where meaning – the cognitive aspect of the phenomenon becomes apparent or "visual". This means that both the sensory and the cognitive aspects appear together in the phenomenon – as the phenomenon. This Ur-phenomenon will not be a mathematical or a physical law in conventional sense but a phenomenon, which is most basic and primary in the sense that it explains all other related phenomena as being secondary and inferred from it. Furthermore, it will reveal its ideal, conceptual aspect as it defines the specific natural conditions under which nature always necessarily produces this phenomenon.

The final aim is to come to an understanding of the rainbow phenomenon, but at first an effort is made to dwell among the *observations* in a way that gives the phenomena themselves a possibility to present their essence, without being obscured by immature theoretical reasoning imposed on them by the observer. The notion of the Ur-phenomenon will be discussed more closely in the chapter *Phenomenology and Goethe's Way of Science*.

For those experienced in mathematical physics, it must be noted that the fact that this study lacks mathematical formalism is not accidental or a result of ignorance on what is the "modern way of doing physics". In addition to the fact that the author would not be qualified to conduct such a mathematical study, it is precisely this lack of reductionism, quantification and mathematical formalism that makes a phenomenological inquiry into nature possible in Goethe's sense. Yet it is a method that adds to our knowledge on the phenomena concerned. This knowledge is then qualitative in its nature, compared to the quantitative knowledge of a mathematical-physical study. In this sense Goethe's method can be said to be of a complementary nature.

The pictures given here have come about, during a series of courses I have held for the first year students at Snellman College on rainbow-formation in the years 1990-2000. Most observations mentioned in this study have been illustrated in pastel drawings, 53 pictures in all, (48 of them printed here) in sizes of 50 x 70 and 70 x 100 cm. These drawings formed an independent exhibition on "Goethe's way of science" and on his phenomenological method. In this written study they are reproduced as observational material. My friend and colleague, Klaus Salomaa, to whom I owe more than just his aid in producing some of the pictures, also assisted me in the laborious task of constructing the exhibition. He has been a co-worker and partly

[2] David Seamon, *Goethe, Nature and Phenomenology*. An essay in Goethe's Way of Science, edited by Seamon and Zajonc, p. 2.

responsible for the summing up of the conclusions of this study.
The idea of drawing the observations (instead of merely recording them in some mechanical way, for instance by photography) is based on the notion that by indulging in the artistic act of drawing or painting that which one sees or observes, one is looking and actually seeing more intensely and with more awareness than in the case where one does not use this effort. When drawing the observations, it becomes necessary to compare and evaluate that which has been produced on paper or canvas to that what is seen in nature.
The process is basically the same as that, when we tried to draw the rear leg of a horse in our childhood, and never got it right. We *saw* the back leg of a real horse and noticed that it bends in a funny way (as if the knee was bending backward), but in drawing it, it came to resemble the leg of a man with the knee bending forward, right there where we "knew" it to be, about half way down the leg. This dissatisfaction of "not getting the picture right" showed that the back leg of a horse was something we did not yet understand properly. If we "forced" our picture to resemble that of an actual back leg of a horse by perhaps copying it from a photograph through a thin sheet of paper, the outcome was even more confusing. We saw that the copied leg was like the one in the photograph, but what was then wrong with our original drawing? The hooves and the knees and the hips and heels were a confusion of concepts. Not until we *understood* that a horse is a *digitigrade*, and that the peculiar bend backward in its leg is not its "reverse-knee" but its heal, did we get the picture right. Now, all of a sudden, all the knees and the hips and the hoofs and the heals of a horse jumped to their right places, as if by a magic word and – there it was!

The story above tells us that when observing a phenomenon, the observer must become aware of all such notions, theoretical ideas and preliminary assumptions *in his thinking* which perhaps have little to do with that which actually appears but which might affect his way of seeing the phenomenon in a distorted way. It is a question of becoming aware of how the cognitive lives in our sense activity (in our seeing ability for instance), of how the cognitive affects our observations of nature. Goethe's phenomenology will prove to be an effort to remain loyal to that, which appears. This makes it a true scientific method anchored in the phenomenal world and in the empiricism mostly lacking in modern physical science [3]. However, it surpasses common materialistic empiricism in that it reveals the true nature of our theoretical concepts and their relation to the phenomenal appearances.

[3] Empirism is commonly regarded as the other building stone of the modern physical sciences (rationalism in the form of mathematical formalism the other). Bortoft writes that it is precisely here where the greatest confusions lie. A most confusing characteristic of modern physical sciences is that it was originally intended as a science founded on the evidence of sensory observation - on empirism. "The beginning of modern science came when people experienced a new awakening of interest in the world encountered through the senses, an interest in the natural world instead of religious matters, but failing to realize that the science of the 'sensory world' which was developed was not derived *from* the senses. The modern science of the natural world is not a sensory science." Bortoft 1996, p 155.

Johan Wolfgang von Goethe is known as a celebrated German poet, however, his scientific accomplishments have remained rather unknown. Yet, Goethe had a keen interest in all the science of his time and he has written a number of books and writings on mineralogy, geology, botany, morphology, osteology, zoology, meteorology, chemistry, physics and chromatics.

This work concentrates on Goethe's studies of prismatic color phenomena and the formation of rainbows from a phenomenological point of view, they are also compared to the Newtonian physics of the time. 48 color photographs are included which illustrate the studied phenomena. Goethe's phenomenological way of doing science can be said to be complementary to way of mathematical physics.

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