The main questions and aims guiding Peirce's Phenomenology

As principais questões e objetivos que orientam a fenomenologia peirciana

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Abstract: The purpose of this paper is to clarify the main questions and aims guiding Charles Sanders Peirce's phenomenological inquiries concerning the universal categories. The paper divides into four parts. In the first section, I provide a brief review of the phenomenological categories and I articulate one concern about standard interpretations of the purpose of this kind of phenomenological inquiry. Second, I consider examples drawn from Peirce's own work in astronomy and the study of gravitational forces, and I offer some reasons for thinking that his philosophical account of the universal categories is modeled in some respects on his understanding of the way scientists should analyze the phenomena that call out for explanation. Third, I provide a brief overview of Peirce's philosophical account of the scientific method, and I explain the role that his phenomenological theory has in his account of this method of inquiry. Finally, I consider one example drawn from metaphysics that is designed to illustrate the role of phenomenology in philosophical inquiry.

Keywords: Phenomenology. Observation. Formal. Categories. Error. Analysis. Measurement. Hypothesis. Abduction. Induction. Scientific method.

Resumo: *O objetivo deste artigo é esclarecer as principais questões e objetivos orientadores das investigações fenomenológicas de Charles Sanders Peirce relativas às categorias universais. O artigo divide-se em quatro partes. Na primeira seção, eu forneço uma breve revisão das categorias fenomenológicas e articulo uma preocupação com interpretações-padrão da finalidade deste tipo de investigação fenomenológica. Em segundo lugar, considero exemplos extraídos da própria obra de Peirce na astronomia e no estudo de forças gravitacionais, e ofereço algumas razões para pensar que sua descrição filosófica das categorias universais é modelada, em certos aspectos, por seu entendimento da forma como os cientistas devem analisar os fenômenos que pedem por explicação. Em terceiro lugar, forneço uma visão geral da abordagem filosófica do método científico peirciano, e explico o papel que sua teoria fenomenológica tem em sua relação com esse método de investigação. Por último, considero um exemplo tirado da metafísica que é projetado para ilustrar o papel da fenomenologia na investigação filosófica.*

Palavras-chave: *Fenomenologia. Observação. Formal. Categorias. Erro. Análise. Medição. Hipótese. Abdução. Indução. Método científico.*

Introduction

In the Harvard Lectures on Pragmatism of 1903, Charles Sanders Peirce provides an extended argument for three phenomenological categories. He takes these three categories to be universal, and he maintains that they are fundamental for all scientific inquiry. In addition to being essential for inquiry in the natural and social sciences, he argues they are essential for philosophical inquiry—including inquiry in the normative sciences and metaphysics—if the resulting philosophical explanations are to be properly scientific in character.

Despite Peirce's repeated claims that the three categories are universal parts of everyday experience, and that an adequate understanding of these relations is absolutely essential for scientific inquiry, his account has left many readers with the feeling there must be something they missed. In his entry on Peirce's life and ideas in the *Stanford Encyclopedia of Philosophy*, logician and Peirce scholar Robert Burch echoes the sentiments of many such readers. He says,

> If Peirce had a general rationale for his triadism, Peirce scholars have not yet made it abundantly clear what this rationale might be. It is difficult to imagine even the most fervently devout of the passionate admirers of Peirce, of which there are many, saying that his account [...] of the three universal categories is [...] clear and compelling. Yet, in almost everything Peirce wrote from the time the categories were first introduced, they found a place. Their analysis and an account of their general rationale, if there be such, constitute one of the chief problems in Peirce scholarship.[1]

My first goal in this essay is to make a contribution to this problem in Peirce scholarship. I will start by trying to clarify some of the main questions Peirce is trying to answer. With a clearer understanding of the main questions in hand, we will be in a better position to understand how a phenomenological account of the categories might help us provide more adequate answers to those questions. As I consider the questions he is addressing, and the kinds of answers he is developing, I will attempt to articulate the underlying purposes that guide this kind of inquiry into the universal categories of experience.

The paper divides into three parts. In the first section, I provide a brief review of the phenomenological categories, and I articulate one concern about standard interpretations of the main questions and purposes of this kind of phenomenological inquiry. Second, I consider examples drawn from the natural sciences of astronomy and the study of gravitational forces, and I offer some reasons for thinking that Peirce's philosophical account of the universal categories is modeled in some respects on his own inquiries in these special sciences. Third, I provide an overview of the role that his phenomenological theory has in his philosophical account of scientific inquiry. Finally, I consider one example drawn from metaphysics that helps to illustrate the role of phenomenology in philosophical inquiry.

1 Robert Burch, Charles Sanders Peirce, *Stanford Encyclopedia of Philosophy*, ed. E. Zalta (The Metaphysics Research Lab, Center for the Study of Language and Information: Stanford University), http://plato.stanford.edu/entries/peirce/

1 A temptation we should try to resist

In order to get started, let's examine some of the preliminary points Peirce makes about the aims of phenomenological inquiry. In the 1903 Lectures on Pragmatism, Peirce gives a fairly well developed explanation of his phenomenology and the place of this kind of inquiry in relation to his pragmatism. In these lectures, he tells us that the purpose of such inquiry is 1) to contemplate phenomena as they are, 2) to simply describe what one sees as phenomena, 3) and to state what one finds in all phenomena alike.

As students of phenomenology, our initial task is to

> [...] simply open our eyes and look well at the phenomenon and say what are the characteristics that are never wanting in it, whether that phenomenon be something that outward experience forces upon our attention, or whether it be the wildest dreams, or whether it be the most abstract and general conclusions of science.[2]

Let us lay some emphasis on one of the points he is making here. On his account it does not matter whether the phenomena we observe are part of our outward experience or our wildest dreams. This is because phenomenology—as a study of the phenomena we observe—abstracts from questions about the existence or the reality of the objects that form the subject matter of the inquiry. Phenomenology is an inquiry into the fundamental elements present in our experience. As such, I want to stress the point that the aim of this inquiry is to provide an analysis of the elements present in our observations.

At the initial stages of inquiry, we are not yet in a position to determine whether or not a given observations represents something that is really the case. Our observations might, in some respects, be of a phenomenon that is illusory in nature. In order to draw scientific inferences from any given set of observations, we need to analyze the phenomena for the sake of determining what stands in need of an explanation. Given the significance of observations of experimental phenomena in scientific reasoning generally, it should not be surprising to us to find Peirce focusing attention on an analysis of the general features in our observations.

There are three faculties we must employ as we seek to observe the phenomena, describe what we see and state the features that are always to be found there. The first faculty is that of seeing what stares one in the face—"just as it presents itself"—without any interpretation. Artists put this faculty to work when they, for instance, see the apparent colors present in nature just as they appear. The second faculty is having a power of discrimination that is like a bulldog. We must use this power of discrimination to fasten on the particular features of the phenomena we are studying, and to detect what is in each of those phenomena "beneath all its guises." The third faculty that is needed is the power of generalizing properly. Like a mathematician, the phenomenologist needs to "produce the abstract formula that comprehends the very essence of the feature under examination purified from all admixture of extraneous and irrelevant accompaniments."[3]

2 EP 2:147.

3 EP 2:147-148.

Having surveyed a wide range of phenomena, and having put each of those faculties to good use, Peirce comes to the conclusion that there are three features in our phenomena that are present in all that we do or could experience.

> Category the First is the Idea of that which is such as it is regardless of anything else. That is to say, it is a *Quality* of Feeling.
>
> Category the Second is the Idea of that which is such as it is being Second to some First, regardless of anything else and in particular regardless of any *law*, although it may conform to a law. That is to say, it is *Reaction* as an element of the Phenomenon.
>
> Category the Third is the Idea of that which is such as it is as being a Third, or Medium between a Second and its First. That is to say, it is *Representation* as an element of the Phenomenon.[4]

Peirce provides a number of alternative ways of naming the phenomenological categories. Regardless of the terms used to refer to each of the universal categories, he is quite consistent in suggesting, from quite early in his career until the very end, that there are three—and only three—such categories.

Peirce does make a distinction between two ways of viewing the three categories. The formal features pick out the different kinds of *formal relations* that can be found in experience. There are formal relations of firstness, secondness and thirdness. Firstness is a name that he uses to characterize the monadic elements in our experience. Secondness is the name he uses to characterize the dyadic elements in our experience. Thirdness is the name he uses to characterize the triadic elements in our experience. As such, Peirce appears to be emphasizing two features present in the formal aspects of the elements of experience. By calling them firstness, secondness and thirdness, he is emphasizing the importance of these elements in establishing certain basic kinds of order in the manifold of experience. By describing the categories in terms of monadic, dyadic and triadic relations, he is emphasizing the importance of these formal relations in giving structure to the parts that make of the whole of our experience.

In contrast with the form, there is also the matter that can be found in our experience. The matter in the phenomena can be divided in terms of the quality (i.e., the feeling), the reaction (i.e., the material relation or brute reaction) or the representation (i.e., the symbol, the law) present in the phenomena of our experience. The matter in the phenomena appears to be those aspects that are most familiar to us from our everyday experience.

The formal features in the phenomena appear to have some kind of priority in his account over the material features. Making out the relationship between the form and the matter is not easy.[5] In this essay, I will focus on the formal features that distinguish the three universal categories. With a clearer understanding of some of the main purposes that guide inquiry concerning the formal features, I believe we will be in a better position to understand the relation between the form and the matter in the three universal categories.

4 EP 2:160.

5 ATKINS, 2010, p. 94-110.

At this point, with this overview of Peirce's account of the categories on the table, I would like to identify one of the temptations that many readers face as they attempt to understand Peirce's account of the phenomenological categories. It is easy to fall prey to this temptation, and it is one that I think we need to resist. The temptation is to assume that over the course of his writings, Peirce draws a wide range of conclusions directly from his analysis of the phenomenological categories. He seems, for instance, to draw the following conclusions. Given the fact that these three categories are *universal* and *necessary* features of all experience:

a. there are three kinds of signs (i.e., icons, indices and symbols);
b. there are three leading principles of inference (i.e., abduction, deduction and induction);
c. there are three parts of semiotic (i.e., speculative grammar, critical logic and methodeutic);
d. there are three normative sciences (i.e., aesthetics, ethics and semiotics);
e. there are three basic metaphysical categories (i.e., chance, brute causality and the growth of order);
f. similar triads must be found in all parts of the natural and social worlds.

In each case, the conclusion somehow seems to follow quite directly from the phenomenological analysis of firstness, secondness, and thirdness. It is not enough, I think, simply to assert that all of these conclusions "somehow" follow quite directly from the phenomenological account of the categories. We need a more complete explanation of the connection between the phenomenology and the other parts of his philosophical system.

A fair number of Peirce scholars seem to be prone to the temptation I have described. Over the course of a series of essays and chapters on the relationship between Peirce's phenomenology and metaphysics, Carl Hausman has developed an interpretation that is as sensitive to the difficulties of making sense of Peirce's universal categories as any. Despite the lengths to which Hausman goes in his efforts to understand Peirce's phenomenology, he says quite directly that the transition from the phenomenological categories to the metaphysical categories seems to have "been taken for granted by Peirce from the beginning."[6] He goes on to say that Peirce "seems to have assumed that examining phenomena phenomenologically was consistent with and simply preparatory to viewing the categories as having ontological status." He believes that other Peirce scholars, such as Sandra Rosenthal, also think that the metaphysical categories follow directly from the analysis of the phenomenological categories.

Peirce tells us that his account of the universal categories of experience was the result of a sustained and careful examination of Aristotle's ten-fold classification of the categories in the *Organon*, and also of Kant's table of 12 categories in the first *Critique*. I am more than willing to admit that, generally speaking, Peirce's account of the categories is built, at least in part, on the basis of a careful examination of Aristotle's and of Kant's inquiries in logic, epistemology and metaphysics. At the same time, I think we need to avoid the mistake of assuming that Peirce's three universal categories in the phenomenology are the same as, or somehow lead directly to, an analogous set of metaphysical categories.

6 HAUSMAN, 2004, p. 97-117. Also see HAUSMAN, 1993, chap. 3; ROSENTHAL, 1994.

We have good reason to suspect there is something missing from this way of framing our understanding of the relationship between Peirce's phenomenology and his metaphysics. The first and most obvious problem is Peirce states quite clearly that phenomenological inquiry into the character of the universal categories requires of us that we abstract from all questions about whether the features of experience we are studying are something that outward experience forces on us or are just wild dreams. Phenomenological inquiry abstracts from the distinctions between the existence of some of the objects we observe, or the imaginary character of other objects, or the reality of the general regularities we seem to detect in other parts of our experience. Metaphysics, on the other hand, is very much concerned with the distinctions between what is actually the case, what is merely possible, and what is real. As such, we have good reasons for digging deeper into Peirce's account of the phenomenological categories in the hopes of making the relationship between his analysis of the phenomena we observe and the other parts of his philosophical picture clearer.

In the decade leading up to the lectures on Pragmatism that Peirce delivered at Harvard in 1903, there is a clear effort on his part to make the distinction between the aims and methods of phenomenology and those of metaphysics as clear as possible. What we find is a clearer and clearer separation between his phenomenological account of the universal categories of experience, his logical analysis of the various kinds of signs that function in reasoning, and his account of the main conceptions and principles that give shape to his metaphysics.

For the sake of this paper, I want to stress two purposes that are controlling the development and resulting shape of Peirce's larger philosophical picture. First, he is trying to build a more adequate philosophical account of the scientific method. Second, he is trying to build his philosophical explanations on the basis of a scientific approach—one that draws on the experimental method. Taking these two aims together, it should be clear that Peirce is faced with the challenge of using the experimental method in philosophy to articulate the foundations of the scientific method. This strategy poses a number of challenges, not least of which is that fact that it is hard to see how it will be possible to rid ourselves of erroneous conceptions that are endemic to the principles we are using as part of the experimental method. Those errors will infect the explanations we develop to account for the foundations of the scientific method. How can we correct for these kinds of errors? The phenomenological inquiry concerning the categories is an important part of his strategy for dealing with this challenge. On the interpretation that I am trying to develop, the inquiry is designed to put us in a better position for understanding what kinds of inferences can and can't be drawn from the observations that figure prominently in our scientific inquiries.

2 Models for Peirce's phenomenology: astronomy and the study of gravity

Much of Peirce's work in philosophy is concerned with the nature and foundations of scientific inquiry.[7] In order to get a better handle on what Peirce is trying to do with his account of the phenomenological categories, it will be helpful to consider

7 See the first chapter in SMYTH, 1997.

examples drawn from the actual practice of working scientists. Let us start with an example drawn from the science of astronomy. In the written works on astronomy in Peirce's day, it was typical to distinguish between two parts of the inquiry: the nomological phase and the phenomenological phase. The phenomenological phase of the inquiry deals with the observations being made of the astronomical objects that form the subject matter of the inquiry. The nomological phase of the inquiry deals with the explanation of the underlying regularities governing the astronomical objects.

It is important to distinguish between these two phases of the inquiry because scientists face different kinds of problems in each phase. In a number of respects, the phenomenological phase of the inquiry comes first. In order to illustrate the point of phenomenological inquiry in the science of astronomy, consider the efforts made by astronomers to determine the distances between the earth and the moon at specific times in its orbit. One of the methods astronomers have used to determine this distance relies on the phenomena of what is called parallax.

We are all quite familiar with the general phenomena of parallax in our everyday experience. For instance, today as I sit writing at the table, my daughter is sitting directly across from me painting flowers. Behind her, sitting on a side table is a vase filled with sunflowers. From my current location, the vase appears to be to the left of where she is sitting. If I leave the table and later sit at a different seat, the location of my daughter in relation to the vase will appear—from my new perspective—to have changed. If, upon returning to the table, I sit at a seat several feet to the right of where I was sitting before, it will appear that the vase of flowers is now to the right of where she is sitting. The phenomena I observe will change depending upon my location relative to my daughter and the vase, and the phenomena will change even though the vase and my daughter did not change locations relative to one another or to where I was sitting before.

Astronomers have drawn on this familiar fact in order to determine the relative locations of heavenly bodies. One method of determining the distance between the Moon and the Earth using parallax is to make two observations of the Moon at exactly the same time from two locations on Earth, and then to compare the positions of the Moon relative to the stars from each of these viewpoints. Observations can be recorded by making photographs of the positions of the moon relative to the fixed stars using cameras mounted on the telescopes at two different observing stations. Using the orientation of the Earth, those two position measurements, and the distance between the two locations on the Earth, the distance to the Moon can be triangulated.[8]

Another method for determining the lunar parallax from observations made from one location is by studying the phenomena associated with a lunar eclipse. For example, a full shadow of the Earth on the Moon has an apparent radius. Astronomers can measure the curvature of the radius of the shadow in order to determine the distance of the moon from the earth. This procedure for determining the distance between the earth and moon was used by Aristarchus, Hipparchus, and later by Ptolemy.

In "The Architecture of Theories," Peirce raises the question of whether space is both unlimited and immeasurable, or immeasurable but limited, or unlimited

8 HIRSHFELD, 2001.

but finite.[9] He points out that, at his time, it was not known which of the three hypotheses is true. The largest triangles that could be measured were those that had a fixed star as the altitude of the triangle and the orbit of the earth as its base. While the parallaxes of about 40 stars had been measured, only two of the measurements resulted in negative angles. This result for two of the stars would seem to imply that we have at least a tentative answer to the question of which of the three hypotheses is correct. Peirce cautions against drawing such a conclusion because “these negative parallaxes are undoubtedly to be attributed to errors of observation.”[10] The reason he gives for thinking that the results are likely due to observational errors is that the probable error of such measurements is in the range of plus or minus 0.″075. Given the distances being measured, he suggests that we should expect to see larger negative parallaxes if some of the angles were indeed negative, and we should also have expected to see a larger number of stars with negative angles.

Starting in 1861, Peirce worked for several years in Cambridge, Massachusetts making computations under the direction of his father, who was the superintendent of the Coast Survey.[11] At this early stage in his scientific career, he was given the task of making mathematical reductions of a large set of observations of the position of the moon relative to Pleiades that had been made and collected by other scientists. The purpose of these reductions was to make corrections in Hansen’s lunar tables of the position of the moon, including its right ascension and declination, and in the coordinates of the moon in reference to the star Alcyone, which is the brightest star in the Pleiades cluster. Based on these calculations, it was possible to make more accurate determinations of the longitude of the stations from which the observations had been made.

After a period of making these kinds of computations, Peirce started in 1867 to make astronomical observations at the Harvard College Observatory. For the next nine years, Peirce was one of the three observers at the observatory who, working together, used a filar micrometer attached to a large 15” refracting telescope to make measurements of the positions of double stars, nebulae, satellites, asteroids, comets and the occultations of stars and planets by the moon.

In 1867, the Harvard observatory obtained a spectroscope, and Peirce made measurements of bright lines in the light spectrum from the auroral light. Later, in 1869, he used the same instrument to study a solar eclipse. Observations of the solar eclipse were made at several stations in Kentucky, and at the station in Shelbyville a group of observers were able to make a series of about eighty photographs—seven of which were taken during the totality of the occultation of the sun by the moon.

The Coast Survey arranged for the construction of a new micrometer to make measurements of the distances between the center of the sun and the center of the moon, and the photographs of the solar eclipse made it possible to make the measurements free from the effects of solar irradiation. Charles Peirce was given the task of using the micrometer to make measurements of the radius of the sun. As he made mathematical reductions from the measurements of the photographs,

9 EP 1:295; W 8:108.

10 W 8:108.

11 See the excellent work of Victor Lenzen on Peirce’s research in the special sciences. LENZEN, 1964; LENZEN, 1972, p. 90-105.

Peirce tried to determine whether there was any tilt on the photographic plates in relationship to the optical axis of the telescope being used to make the observations. In order to make this determination, he compared the effects of refraction on the apparent diameter of the sun when measured vertically and horizontally. Based on these reductions, he was able to determine that the tilt of the photographic plates was significant.

Unfortunately, it did not appear that the tilt had any fixed character. Peirce discovered that different plate holders were used to make the photographs, and that the act of switching from one holder to the next had an effect on the tilt of the plates in relation to the optical axis of the telescope. If the tilt of the plates had been consistent, it would have been possible to make corrections in the measurements of the diameter of the sun and of the moon. As things stood, the inconsistency in the angle of tilt meant that it was not possible to make the corrections. In a report to his father, Charles Peirce states, "I had hoped that the sum of the sun's and moon's radii would be given with accuracy, and by combining it with the values of the differences of the radii found by internal contacts [...] that good values of the semi-diameters would be obtained. But [...] the circumstances just narrated [have] entirely destroyed this expectation."[12]

Based on his experience in making these astronomical observations and in making mathematical reductions from the observations, Peirce decided to study the method of least squares as part of a larger procedure for dealing with observational errors. The results of his inquiry were published as a memoir, "On the Theory of Errors of Observation."[13] In this study, Peirce focused on observations of phenomena that are unexpected and that occur quite suddenly as a basis for his mathematical discussion of the method of least squares. One of the aims of the study is to determine the effects of human variability—such as a lag in reaction time—in the making of the measurements.

At this point, having considered a few examples drawn from the science of astronomy, let us consider a second set of examples drawn from Peirce's work on the measurement of gravitational forces.[14] Starting in 1872, Peirce was engaged a series of experiments designed to measure the force of gravity on the surface of the earth. The research project he directed at the Coast Survey was part of a larger program that included scientists from a number of different countries. The larger program was initiated at a European conference, where it was recommended that the absolute value of the force of gravity on the surface of the earth could be determined by the use of pendulums at points in a geodetic network. One of the purposes of measuring the strength of the gravitational field at different locations around the globe was to determine the figure of the earth with greater precision.[15] At the time, it was known that the force of gravity on the earth caused it to take the shape of a flattened ellipse and not a perfect circle, but it was not known with any real precision how much the outline of the elliptical shape of the earth was flattened.

12 W 2:180-88.

13 W 3:114-160.

14 W 4:79-144; W 4:12-20.

15 W 4:529-34.

The research was done with pendulums suspended on a knife-edge from a wooden support. The initial experiments in Europe and in the United States were conducted using invariable pendulums with single knife-edges. For two years, Peirce directed experiments at stations in Western Massachusetts and, in 1875, he was sent by the Coast Survey to Europe in order to obtain a reversible pendulum with two knife-edges. The main reason for using a reversible pendulum with two knife-edges instead of an irreversible pendulum with one knife-edge was to correct for variations in the length of the pendulum caused by changes in temperature.

Over the course of his stay in Europe, he used this new apparatus to engage in gravity experiments in Berlin, Geneva, Paris and London. During the course of the experiments in Geneva, he measured the amount of flexure of the wooden structure used to support the pendulum, and made corrections for the consequent changes in the period of the pendulum due to the flexure of the support.

While it might appear, at first glance, that these two sources of error in the pendulum experiments would be relatively minor, nothing could be further from the truth. The corrections that Peirce was able to make to account for the flexure in the support, and his ability to eliminate some of the variation caused by changes in the length of the pendulums by switching from an irreversible to a reversible design had the effect of calling into question some of the results of 10 years of gravity research by European scientists.[16] Given the significance of the difference between Peirce's experimental results and the results of the European research teams, Peirce drew the conclusion that the enormity of the differences in the results could only be explained by the flexure in the support used by the European research teams. Many of the European scientists disagreed with Peirce's conclusion, and it took two more years for the scientific community in Europe to recognize that Peirce was, indeed, correct.

At this stage of the discussion, let us take a step back from Peirce's work in astronomy and the study of gravity and ask what the implications are for his philosophical work in phenomenology. The first point I want to make is that the scientific study of the 'phenomena' was not used at Peirce's time to refer to a specialized area of study unique to philosophers. Rather, the term had a well-settled use in the special sciences. In astronomy, as in the other sciences, the examination involved the careful study of the observations that have been made of some experimental phenomena. In the definition he prepared for the Century Dictionary, Peirce characterizes phenomenology in the following quite general way: "A description of history of phenomena."[17] One of the primary purposes of such an inquiry concerning the phenomena in the special sciences is to clarify the character of those observations. Gaining greater clarity about the character of the observations makes it possible to determine what kinds of abductive or inductive inferences can and can't be drawn from the data.

Such an inquiry also enables scientists to examine the possible errors that might crop up in the observations of the phenomena, and to study the possible sources of those errors. Having located some errors in a set of observations, the next step in the inquiry is to determine whether or not it is possible to correct for the observational errors. If such corrections are possible, then the next step is to arrive at the best method for making the needed corrections.

16 W 3:217- 234; W 5:275-8; W 4:515-528; W 5:262-74.

17 Century Dictionary Online, s.v. "phenomenology."

I want to suggest that we can gain a better understanding of Peirce's philosophical inquiries into what he calls 'phenomenology' if we think of them as being modeled on similar kinds of inquiries in the special sciences—including his own work in astronomy and the study of gravity. One of Peirce's main purposes for developing a phenomenological account of the universal categories was to provide a basis for studying the observations that function in philosophical inquiry. Let us recall that these observations are drawn from common experience. The reason that we need a careful analysis of the phenomena that have been observed is that they are so familiar to us. As such, we are highly prone to making observational errors of one kind or another.

3 Phenomenology and the scientific method

In this section, let us consider the role of phenomenology in Peirce's philosophical account of the scientific method. In section of IV of "Deduction, Induction and Hypothesis," Peirce provides an example of scientific reasoning about some physical phenomena.[18] He is trying to develop a philosophical explanation of the differences in the procedures involved in the formulation and testing of empirical formula, on one hand, and general laws and causal explanations, on the other hand. His goal is to examine the roles of observations and measurements when making abductive, inductive and deductive inferences concerning these different kinds of explanations.

The example he considers deals with the expansion of water when heated. Let us imagine that we are university students studying physics, and that we are in a physics lab studying a set of experimental phenomena. Knowing that there is a relationship between the heating of the water and the resulting expansion, we make a number of observations of a container of water at different temperatures as it is heated. Upon scrutinizing a few of these observations, a formula is suggested that expresses the approximate relationship between volume and temperature. Taking v as the volume of the water, and t as the temperature, the mathematical formula can be expressed in the following terms: $v=1+at+bt^2+ct^3$. The inference to this formula from a limited number of observations is abductive in character.

Having formulated the hypothesis, the next step is to examine observations of the volume of the water at other temperatures. In order to have some assurance that the observations are representative, we should take them at random from the collection of observations that have been made. Having seen that the additional observations conform to what was predicted on the basis of the formula, we can draw the inductive conclusion that the formula holds for all of the temperatures within a specified range.

One of the limitations on the inductive inference is that the conclusion will hold only for the range of temperatures similar to what was actually observed. As such, if our observations were of volumes at temperatures ranging from 5 degrees up to 80 degrees Celsius, then we are warranted in concluding that the formula describes the relationship between volume and temperature of water roughly between the freezing and boiling points.

Having formed the hypothesis, and having tested it, Peirce says that it is a relatively easy affair to find the values of the constants that satisfy the observations best.

18 EP 1:194-7; W 3:332-336.

A simple step-by-step outline of the scientific method might look something like this:

a) Start with accepted theories.
b) Observe a surprising phenomenon.
c) Formulate hypotheses by abduction to explain the phenomenon.
d) Draw out the consequences by deduction from the hypotheses.
e) Conduct experiments to test the rival hypotheses.
f) Determine by induction from the data which hypotheses are confirmed or disconfirmed by the tests (and return to the first step).

Peirce develops a normative theory of logic that is designed to articulate the main classes of inference, establish the leading principle for each class and then to explain the philosophical bases of the validity of those leading principles. Consider the kind of relationships that must be established between observations of experimental phenomena and each of the main kinds of inference for the method to work. There must be the right kind of connection between observations of surprising phenomena and the formation of explanatory hypotheses. There must be the right kind of relationship between deductions from explanatory hypotheses and the possible observations that can be expected when the explanations are put to the test. There must be the right kind of relationship between the inductive inferences and the data that are gathered during the tests.

In his normative theory of logic, Peirce stresses the formal features that are part and parcel of each of these three kinds of inference. We are now in a position to state the main question guiding Peirce's account of the phenomenological categories. He is asking the following kind of question: what are the formal features in the phenomena that make it possible to form the right kinds of relationship between observations, signs and inferences?

Peirce's approach to answering this question draws, in part, on his larger semiotic theory.[19] Over the course of his writings, he has developed an account of the kinds of signs that function in processes of reasoning. Experimental reasoning involves signs that function as icons, indices and symbols. It is no easy task to articulate how it is possible to forge the "right kind of relationship" between the formal features in our observations and the formal features of our signs and inferences. We are dealing with the question of what is necessary for the validity of experimental reasoning that is based on observations. In his discussion of the example of scientific reasoning about the expansion and contraction of water when heated, Peirce seems to suggest that part of the answer will come from the study of the conditions necessary for making proper measurements.

Consider what he says about the example where we are trying to formulate and then test an empirical equation that is designed to explain the expansion of liquids at various temperatures. He points out that formulae such as these (i.e., $v=1+at+bt^2+ct^3$) are very useful "as means of describing in general terms the results of observations".[20] At the same time, they do not have a very high rank among

19 For an introduction to Peirce's semiotics, see LISZKA, 1996, especially chapter 2. For a more detailed explanation of the relationship between Peirce's phenomenology and his semiotics, see THOMPSON, 1953, and SHORT, 2007.

20 EP 1:194; W3:333.

scientific discoveries. The induction such processes of scientific reasoning embody takes the following form: the "expansion by heat […] takes place in a perfectly gradual manner without sudden leaps or innumerable fluctuations". But this is something that we anticipate quite naturally.

First, like all observations, these are subject to error. As such "the formula cannot be expected to satisfy the observations exactly." The discrepancies between the formula and the further data we collect when testing it can't be due solely to the errors in the observations we have collected. Instead, the discrepancies must be due, in part, to errors in the formula. What is more, he states that we have "no right" to suppose the real facts—if a complete set were handed to us on a silver platter—could be expressed by such a formula at all. The real facts might be expressed by a similar formula, but it might be one with an infinite number of terms. That, however, would be of little use to us.

Finding the proper relation between the formal features in the observations we make and the formal features in the signs and processes of reasoning depends, crucially, on the use of an appropriate scale for measurement. As Peirce says, "[w]e may, however, and do desire to find formulas expressing the relations of physical phenomena which shall contain no more arbitrary numbers than changes in the scales of measurement might require."[21] The great difference between a mere empirical formula and a law of nature rests, in part, on the kinds of measurements that support scientific inferences. There are different kinds of scales of measurement, including nominal, ordinal, interval and ratio scales.[22] Peirce draws on mathematics as a resource for his phenomenological inquiries concerning the universal categories. One of the reasons he draws on mathematics is to deepen our understanding of what is required to apply one or another scale of measurement to a set of observations.[23]

On Peirce's account, the concept of continuity is central for developing an adequate account of scientific inquiry. One reason the concept of continuity is so important in the philosophical account of the experimental method is that the concept of continuity is essential in the process of measurement. In "The Doctrine of Chances," Peirce takes note of the following:

> The rudest numerical scales, such as that by which the mineralogists distinguish the different degrees of hardness, are found useful. The mere counting of pistils and stamens sufficed to bring botany out of total chaos into some kind of form. It is not, however, so much from *counting* as from *measuring*, not so much from the conception of number as from that of continuous quantity, that the advantage of mathematical treatment comes.[24]

21 EP 1:195; W 3:333.

22 See STEVENS, 1951.

23 Peirce's writings on the theory and practice of measurement are a relatively unexplored area of scholarly research that are calling out for exploration by those versed in his work in mathematics. Two important texts on measurement are Charles S. Peirce*, The New Elements of Mathematics, Vol. 2*, ed., Carolyn Eisele, (Atlantic Highlands, NJ: Humanities Press, 1976), *New Elements of Geometry Based on Benjamin Peirce's Works and Teachings*, Book I, Fundamental Properties of Space, Chapter V Measurement; CP 7.280-312.

24 EP 1:143; W 3:276-277.

The upshot is that I believe Peirce's phenomenology is an integral part of his philosophical account of the scientific method. The philosophical account is designed to explain how it is possible for human beings to gain knowledge of the objects of inquiry on the basis of observations and processes of reasoning involving signs. In a number of respects, the connection between the observations and the processes of reasoning is made in terms of procedures for scientific measurements.[25]

We can understand the relationship between the main parts of scientific inquiry in the following way: first, we make observations of the objects of inquiry; second, we engage in an analysis of the observations, third, we make measurements of what we have observed; fourth, we draw various kinds of inferences from the observations. The phenomenological theory is based on the study of the formal features in the observations of the phenomena that are necessary for the success of this process. The theory of measurement is based on the study of the mathematical characteristics of different standards, procedures and scales of measurement.

Conclusion: the phenomenological categories in philosophical inquiry

As I suggested earlier, several Peirce scholars, including Carl Hausman and Sandra Rosenthal, think Peirce is moving directly from points in the phenomenology about the categories to conclusions in metaphysics. They seem to think that the main question driving Peirce's inquiries in metaphysics is the following: what does a truly scientific metaphysics look like, given that we can only draw on mathematics and logic to construct such a view of the phenomenological categories? I am taking issue with this way of framing the question.

It is clear that Peirce is using the scientific method in philosophy as a basis for developing and testing the explanations he is forming. Given this general point, it would be more accurate to say that, in the normative sciences and in metaphysics, Peirce often starts with an analysis of the main phenomena that call out for explanation, and then he moves fairly directly to conclusions about the kinds of hypotheses that are necessary for an adequate explanation of the phenomena.

We do not have the space in this paper to flesh out the details of the way Peirce puts the phenomenological categories to use in philosophical inquiry—including inquiry in metaphysics. As such, we will have to leave this task for another occasion. We do, however, have the space needed to consider one example and to draw some tentative conclusions from the example. Consider one of the arguments Peirce makes in "The Doctrine of Necessity Examined."[26] Having considered the claim that the doctrine of necessity is a postulate that is necessary for the logic of science, he turns to the question of whether the doctrine might be supported by observation. The doctrine seems to be based on the idea that the quantities of what we observe—such as the distances between two masses, or the direction of their travel, or the rate at which the masses are accelerated after a collision—can be measured with complete exactitude.

25 Thomas Short suggests that a proper reconstruction of Peirce's phenomenology will require an understanding of his account of measurement. I agree. See SHORT, 2008, p. 111-124.

26 EP1:303-305.

This assumption is at odds with the fact that the measurements we make of the phenomena we observe are often of continuous quantities. Physics has a recognized method for estimating the probable errors in the magnitudes of the phenomena we observe. Considered as an explanatory hypothesis, we do need to suppose that there is some regularity in nature in order to account for the observations that have been made in the science of physics. We are in a very different position when it comes to the doctrine of necessity. There is no need to develop such a hypothesis in order to give an adequate account of the phenomena. What is more, the doctrine of necessity is actually inconsistent with many of the things that have been observed.

In the longer term, Peirce believes that many of our metaphysical hypotheses should meet the full test of experience in the special sciences—such as in the sciences of physics, chemistry, biology or psychology. In his essays on metaphysics, we find that Peirce is often drawing conclusions about the kinds of hypotheses that could or could not be tested against our observations. The conclusions he draws are based on a rich understanding of the kinds of measurements that can or cannot be applied to the phenomenon at hand and the degree to which it will or will not be possible—as a matter of principle—to correct for or to eliminate certain kinds of observational errors.

My conclusion is that scientific inquiry requires a proper fit between observations, measurements and the inferences necessary to form explanations and then put them to the test. A philosophical theory of the scientific method must include a phenomenological theory of the formal features in our observations, a semiotic theory of the formal features of our signs and modes of inference and an explanation of what is necessary to bring the two into synthetic unity. The philosophical theory must draw on a mathematical account of the formal properties involved in different procedures of measurement.

The success of the scientific method hinges on our ability to arrive at the proper kind of synthetic unity between the formal features in each of these three parts of the method. Peirce's phenomenological theory is a central part of his explanation of the experimental method because, on his account, all inquiry concerning positive matters of truth should be initiated and confirmed on the basis of observations of reproducible phenomena. Philosophical inquiry, insofar as it too is based on an experimental method, is no exception to this rule.

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