THE REALITY OF THE UNOBSERVABLE IN PHYSICAL THEORY: AN ACCOUNT OF C. S. PEIRCE'S "PRAGMATIC REALISM

Demetra Sfendoni - Mentzou
University of Thessaloniki

ABSTRACT

Our aim in this paper is to argue that Peirce's conception of the nature of physical theory and the reality of the unobservable cannot be understood apart from the function and role of his third category. The essencial elements here involved are those of generality and continuity which are grounded on the key-concept of potentiality. Thus, Peirce's Aristotelian-Scholastic realism is the real opponent to the positivist anti-realism regarding the reality of theoretical entities.

RESUMO

Nosso objetivo neste artigo é mostrar que a concepção de Peirce acerca da natureza da teoria física e da realidade do inobservável não pode ser entendida independentemente da função e do papel de sua terceira categoria. Os elementos essenciais aqui envolvidos são os da generalidade e continuidade, que são fundados no conceito-chave de potencialidade. Portanto, o realismo aristotélico-escolástico de Peirce é o oposto genuíno do anti-realismo positivista com respeito à realidade de entidades teóricas.

One of the central issues in current Philosophy of Science is that of scientific realism. Discussion in this context has

been focused on such questions as the following: What is the character of scientific enterprise? How should one define scientific theorizing? Do theories simply describe verifiable individual facts? or do they go beyond experienced phenomena?

Realism holds that reality is not exhausted in the world of immediate experience, or the observable material world, because there is a lot more than that: reality also consists of entities, physical states, processes, inner mechanisms, inner structures, tendencies, dispositions, which go beyond observable experience. Accordingly, it is not only human beings, animals, plants, mountains, lakes, rivers etc. that are real; equally real are such things as electrons, protons, neutrons, photons, mesons, positrons, quarks, fields of forces, black holes etc. Therefore, scientists are committed to supplying explanations of a deeper level of reality, going beyond the realm of observable phenomena. **Anti-Realism**, on the other hand, emphatically expresses its antipathy towards anything that cannot be experienced and verified. Observation, actual individual facts, is the sole material theories are made of, since reality is restricted to the level of actuality. Description of observed phenomena and their verification are the only characters of scientific theorizing.

The hard core, therefore, of the disagreement between realism and anti-realism could be located in the controversy over the reality of the **unobservable**. The term **unobservable** as will be used hereafter is an umbrella term including all kinds of theoretical entities. However, it should be made clear, right from the beginning, that a distinction should be made between two levels of **unobservable**. The first refers to the as yet unobservable at the present stage of science and includes theoretical entities, such as protons, neutrons etc., as well as distant stars, all of which cannot be observed, because of the inadequacy of our instruments. An acceptance of such entities represents the first step of realism over anti-realist verificationism. The second level refers to the categorially unobservable, such as dispositions, tendencies, laws of nature, potentialities. The hardness of the diamond, the fragility of a piece of glass, are instances of dispositions that can be real even though

they will never be tested. Transmutations of elementary particles taking place in high energy physics can be, and have been, interpreted as actualizations of potentialities, which have a real but not an actual being. Laws of nature can never be observed, qua laws, no matter how far science progresses, and yet the realist would insist that they have a real being.

We must say, though, that for all its charm, this view has not always been able to find supporters who would be willing to defend the dangerous scientific enterprise of penetrating into the mysteries of nature. Thus, Mach refused to attribute to science "the power of opening up unfathomable abysses of nature, to which the senses cannot penetrate". Comte, on the other hand, expressed his conviction that the more theories postulate, the further they are from science. Theoretical entities, such as atoms and molecules are nothing but economical tools for representing phenomena. Hypotheses "do not claim in any manner to state real properties". As a result, the framing of theories and hypotheses aiming at explaining the reality of the unobservable is rejected.

The hostility to theoretical entities expressed by the positivist trend in the 19th century is not schared by the majority of Philosophers of Science any more. Certainly, new discoveries in 20th century Physics offered to scientific realists rich material for the development of sound arguments. However, one should not forget that the present day realist movement, represented by such Philosophers of Science as M. Hesse, R. Harré, I. Hacking, K. Popper and H. Putnam, owes much to C. S. Peirce who advocated his ideas in a age when the dominant trend was that of positivism. Peirce was critically opposed to the ideas of A. Comte, E. Mach, H. Poincaré, K. Pearson and other significant philosophers and scientists, all of whom were stamped by Peirce as "nominalists". He was convinced that the unobservable is the most essential ingredient of scientific theories and that the nominalist exclusion of investigations from the domain of reality located beyond actual, individual existence "blocks the road of inquiry".

What I propose to do in this paper is to examine Peirce's realism both of theories and of entities[1]. I shall thus be dealing with

issues that have traditionally been treated separately, such as abduction and hypothesis, the logic of scientific discovery, the role instinct in the framing of hypotheses, scientific truth and scholastic realism[2]. I must confess right from the beginning that stressing the inconsistences and discrepances, which no doubt exist in Peirce's writings, is not what I find most fascinating. On the contrary the real challenge for me is to pass the string through the pearls and render explicit the coherence of his thought.

I shall thus argue that Peirce's "pragmatic realism" can be seen to develop on two levels: (a) scientific, (b) aristotelian-scholastic realism, the latter offering the ground for a deeper understanding of the former. To accomplish this purpose, I shall begin with an examination of Pierce's theory of abduction, focusing on its anti-verificationist and explanatory power. Although the general tendency is to treat Peirce's theories connected with science apart from the ontological aspect of his thought[3], my attempt will be to indicate how his theory of scientific theorizing is interrelated with the three ontological categories and more particularly with Thirdness. In this respect, my interest will not be confined to the scholastic idea of generality, the subject which has attracted most interest from Peirce's scholars[4]; it will also embrace the aristotelian idea of potentiality. Thus, I shall maintain that the essential ingredient, in the function of the triadic relation: reality-generality-law is the idea of potentiality[5], which can contribute to our underatanding of Peirce's account of the reality of the unobservable in physical theory.

The generation of hypotheses is the first and most essential phase of scientific inquiry; in his writings Peirce emphasizes both its anti-verificationist and explanatory character[6]. He explicitly rejects the positivist position that "a verifiable hypothesis... must not suppose anything that you are not able directly to observe" (5.597)[7], and with not a little irony, he emphasizes that one of the most notorious defenders of this position, namely Comte, was very soon dramatically falsified by the facts.

When Auguste Comte was pressed to specify any matter of positive fact to the knowledge of which no man could by

any possibility attain, he instanced the knowledge of the chemical composition of the fixed stars; ... But the ink was scarcely dry upon the printed page before the spectroscope was discovered and that which he had deemed absolutely unknowable was well on the way to getting ascertained. (1.138) Peirce's conviction, by contrast, is that the further a hypothesis is removed from direct observation, the more fruitful and rich it will be in content; "if I had the choice between two hypotheses, the one more ideal and the other more materialistic, I should prefer to take the ideal one upon probation".(5.598). Thus, Peirce believes that scientists are mistaken in rejecting theoretical entities, as for example did one of his contemporary nominalists, Claud Bernard, who defined disease not as "an entity but merely as a sum of symptoms". This, in Peirce's opinion, was only a metaphysical position, one of those that "block the road of enquiry" The real scientist, for Peirce, is not the one who is merely satisfied with arriving at an acquaintance with phenomena nor the one who uses his theories as mere instruments of prediction. The real scientist is the one who aims at supplying explanatory hypotheses for what is to be found beyond phenomena. Thus science is defined by Peirce as a "diligent inquiry into truth ... from an impulse to penetrate into the reason of things (1.44). Peirce calls the framing of hypotheses abduction, and less frequently retroduction, presumption and hypothesis[8]. The importance of the explanatory role of abduction and its character of inferring facts "not capable of direct observation" (2.642) was stressed by Peirce after 1878[9] (see 2.716).

The introduction of the explanatory function of hypothesis becomes its unique justification in Peirce's mature period, i.e. after 1890[10] as does the recognition of its role as the first and most essential stage in the process of science. This stage has been much discussed by those interested in the problem of the logic of scientific discovery. And it was N. R. Ranson[11] who first brought to light the importance of Peirce's treatment of the logical aspect of hypothesis framing. At this point I shall only take a very brief look at the issue, my main concern being to indicate how it can be interrelated to an overall account of Peirce's approach to scientific theorizing.

Peirce claims that a hypothesis is needed when a surprising fact, i.e. a fact that clashes with prior expectation, occurs and he gives the steps that are followed:

The surprising fact, C, is observed;

But if A were true, C would be a matter of course,

Hence, there is reason to suspect that A is true. (5.189)

There are two distinct characteristics of the process of hypothesis framing evidenced in the above passage: (a) its logical structure and (b) the fact that it leads to the discovery of new ideas: "It is the idea of putting together what we had never before dreamed of putting together which flashes the new suggestion before our contemplation" (5.181). Peirce repeatedly emphasizes that the progress of science can only be a accomplished by the excercise of the power of the human mind to introduce new ideas. Observable facts are not excluded, but their role is minimized; they must be seen as merely offering the raw material. "Experience", admits Peirce, "is our only teacher". But he then goes on, stressing the fact that there is no "other source than the power of the human mind to originate ideas that are true" (5.50)[12].

However the question is: What contributes to the origination of new ideas? I believe thar Peirce's answer should be taken to be that neither the inquirer's reasoning alone is enough, nor actual experience, taken as a brute fact. On the part of the scientist the role of imagination and instinct is decisive, while on the part of reality to be comprehended one must presuppose the intelligibility of universe. Both of these factors will be discussed in the subsequent pages.

Peirce repeatedly emphasizes the contribution of the scientist's imagination in the discovery of truth. "...there is after all, nothing but imagination that can ever supply him an inkling of the truth". However, we should observe that he then goes on to attribute a rational character to the scientist's imagination: "but in the absence of imagination they [physical phenomena] will not connect themselves together in a rational way" (1.46)[13].

Even more striking is Peirce's appeal to instinct for the explanation of the process of scientific inquiry[14]. One is certainly taken by surprise when Peirce declares that a man of science should have "a **natural light**, or **light of nature**, or **instinctive insight**, or genius" (5.604)[15] that will show him the way to the the framing of hypotheses; to support his thesis he cites some notorious names in the realm of science.

> Galileo appeals to **il lume naturale** at the most critical stages of his reasoning. Kepler, Gilbert and Harvey -not to speak of Copernicus- substantially rely upon an inward power, not sufficient to reach the truth by itself, but yet supplying an essential factor to the influences carrying their minds to the truth.(1.80)

And, certainly, Peirce would be delighted to have Einstein's name added in the list when the great scientist confessed that:

> The supreme task of the physicist is to arrive at those universal elementary laws from which the cosmos can be built up by pure deduction. There is no logical path to these laws, only intuition, resting on sympathetic undestanding of experience, can reach them[16].

At this point a serious question is raised: should Peirce's appeal to instinct be taken as something wholly disconnected from any kind of reasonable thinking? There has been much discussion on the issue, but the fact is that the role of instinct has not received due attention by those who have been dealing with the logical character of scientific discovery in Peirce' of theory of abduction[17]. This is due to the fact that, in various Peirce compares man's power of guessing at the truth with the instincts of animals[18]. However it is important to notice that there is also a rational character assigned by Peirce to instinct. This is based on the idea of the kinship between man's intellect and the truth, or the rational character of the universe. The scientist can hope that after a number of guesses he can capture the true explanation[19], because "the human mind is akin to the truth" (7.220)[20].

To appreciate the meaning of the above idea, it must be seen in the light of Synechism, or the principle of continuity, which will be discussed later in the paper, as a character of the Third category. At this point it is only requisite to point out that for Peirce the human intellect must be seen as part of the Universe, so that the laws of nature can be in agreement with the laws of the mind. The Universe, according to Peirce, has an intelligible character which is expressed in the functioning of general laws: "nature follows general laws, in other words, has a reason" (6.568) Scientific inquiry opens a "conversation with nature from an impulse to penetrate into the reason of things"[21](1.44).

It is clear, then, that a consideration of Peirce's account of scientific theorizing could not possibly be confined to the level of observable experience. As I hope to have shown thus far, what scientific inquiry aims at is not simply a description of a regularity of succession; it rather aims at explanation, i.e. comprehension which involves generality. For it is only so far as facts can be generalized that they can be understood"(see 6.173). Accordingly, since generality is an expression of the third ontological category, it seems that the only way to reach a thorough understanding of Peirce's scientific realism is by an appeal to his aristotelian-scholastic realism.

In his mature period, i.e. after 1883, Peirce time and again declaires his bond with scholastic realism. What makes pragmaticism so different from any kind of "prope-positivism" according to Peirce, is "its strenuous insistence upon the truth of scholastic realism" (5.423). For "pragmaticism could hardly have entered a head that was not already convinced that there are real generals" (5.503). Furthermore, he explicitly expresses his belief that physical science of his days "gives its assent much more to scholastic realism ... than it does to nominalism"(6.361).

However, I believe that, although Peirce's commitment to scholastic realism is an idea shared by the majority of his commentators, we must be careful to notice that Peirce's version of realism should not be taken as identical with the scholastic doctrine of universals and more particularly with that of Scotus, as

has convincingly been argued by F. Michael[22]. What I shall argue, in addition, is that Peirce's realism must be considered in close connection with the Aristotelian ontological scheme. Drawing the relation of Peirce's ideas of generality, real natural kinds and real similarities, with scholastic realism, is not sufficient for a thorough understanding of his scheme. Equally important, and even more fundamental, to a deeper understanding of the main issues connected with the character of scientific theories is the idea of potentiality.

Peirce is convinced that the question concerning the nature of reality is at "the heart of the dispute" (1.21) between nominalism and realism. The modern (nominalist) philosophers ... recognize but one mode of being, the being of an individual thing or fact (1.21). By contrast, Peirce offers his own position; he names not one, but three modes of being represented by his three ontological categories: Firstness, Secondness and Thirdness. "They are the being of positive qualitative possibility, the being of actual fact, and the being of law that will govern facts in the future" (1.23). The sum total of reality, even the laws of nature is to be seen in a process of growth and development, which, if my interpretation is at all correct, should be taken as analogous, in many respects, to the aristotelian idea of continuous transition from potential to actual being. In several places Peirce himself points out the relation of his thought to that of Aristotle (See 1.22, 1.1).

In his "Guesses at the Riddle", c. 1898, he explains that his aim is,

> ...to make philosophy like that of Aristotle, that is to say to outline a theory so comprehensive that, for a long time to come, the entire work of human reason ... shall appear as the filling up of its details. The first step toward this is to find simple concepts applicable to every subject.(1.1)

What is important concerning the First category, is the fact that Peirce describes it as a "mere possibility", an "atmospheric" possibility, or a possibility "floating in vacuo". It thus has a feature of "may-be" which belongs to the simple idea that has not

yet been actualized, and which is in many respects analogous to the aristotelian idea of **potentiality**, as I have argued elsewhere,[23]. By potentiality I mean that which derives its reality in the present, from the fact that it is projected into the future, or, in other words, that which denotes what has not been realized yet, but can be or could be realized in the future.

What needs to be added here is the fact that Peirce directly connects the potential qualities of bodies with generality.

> If, however, you hold that the bodies become indeterminate in regard to their qualities, they are not actually perceived to posses, then ... you must hold that generals exist. (1.422)

Thus, if my reading of Peirce is right, then generality of the First category, must be seen as interrelated with indeterminacy which involves potentiality. In this respect, I believe, potentiality can function as a connecting link between Firstness and Secondness, which represents the world of dyadic relation, of action and reaction[24] of struggle[25], of **haecceitas**, of **thisness**[26]. In other words, it is that part of reality which belongs to the positivist world of actual experience, of particular fact, of what could be called in one word **observable** as opposed to the **unobservable** of Thirdness. Thirdness represents the most essential part of reality, and offers the most important ground for the connection between the First and the Third category.

In the V "Lecture on Pragmatism" Peirce claims: "Now Reality is an affair of Thirdness as Thirdness, that is, in its mediation between Secondness and Firstness" (5.121). But how is this mediation accomplished? It is accomplished, according to Peirce, through generality as is illustrated in the following passage:

> Reality consists in regularity. Real regularity is active law. Active law is efficient reasonableness, or in other words ... Reasonable reasonableness is Thirdness (5.121).

What Peirce has in mind is the scholastic definition of logical generality: "Generale est quod natum aptum est dici de

multis" (5.102). In other words, a general term includes the notion of an infinite number of differentiations "which no multitude of existent things could exhaust" (5.103). It involves, therefore, the idea of continuity which is defined by Peirce in a similar way: "A true continuum is something whose possibilities of determination no multitude of individuals can exhaust" (6.170). As a matter of fact continuity and generality eventually become identical in Peirce's scheme[27]. It is important to keep in mind that Synechism, or Peirce's principle of continuity, is an integral part of Thirdness. There is an internal unity in the idea of generality-continuity-law.

A direct consequence of the above idea is the irreducibility of generality to any actual number of concrete instances. Its distinctive characteristic is that it never comes to a completely actualized state and thus it always refers to the future. It is essential to notice that the definition of law given by Peirce in the "Logic of Mathematics", c. 1896, is analogous to that of continuity and generality.

> No collection of facts can constitute a law; for the law goes beyond any accomplished facts and determines how facts that **may-be**, but **all** of which never can have happened, shall be characterized. (1.420).

This is an explicit claim against the positivism of his time. Physical theory does not confine itself to any actual number of individual facts. It goes beyond the level of observable experience; thus, law should be connected with the ideas both of generality and potentiality; "law is a general fact" and "a general fact has an admixture of potentiality in it" (1.420). Or, in other words, "concerns the potential world of quality" (1.420). What is so very important about this passage is the fact that it shows the intimate relation between law and potentiality, located both in the Third and in the First category. Furthermore, what deserves particular attention, in my opinion, is the role assigned to potentiality, which can serve as a key-concept for a proper understanding of the reality of the unobservable in Peirce's scheme.

This can further be clarified by his insistance on the reality of the unobservable qualities of things. They are real even

if we do not perceive them. A red thing remains red even when we do not see it, and a hard thing remains hard even if it is not pressed. And in 1909 one encounters an explicit definition of the unobservable qualities of generals in terms of "habit, disposition, or behaviour" (1.27 nl). It must be noted that in Peirce's ontological scheme the 'would-be' is another expression for potentiality and it is interelated with generality and the law of habit, which is expressed by a conditional proposition. "It is therefore essentially an assertion of a **general** nature, the statement of a 'would-be'" (8.380).

We must also notice here that the two interrelated notions of 'would-be' and 'habit' have an essential character in common: the character of inexhaustible possibility which is open in the indefinite future. "Real habits" (or would-be's) are defined by Peirce as that "which Really **would** produce effects, under circumstances that may not happen to get actualized, and are thus Real generals" (6.485). It is exactly this idea that constitutes, according to Peirce, the distinctive remark between a positivist and a realist attitude towards unobservable entities, generals and physical law. In the "Logic of Mathematics" c. 1896 he had already claimed, that "the nominalist does object to the word 'law', and prefers 'uniformity' to express his conviction that so far as the law expresses what only **might** happen, but does not, it is nugatory" (1.422).

Peirce is very careful to clarify the essential difference between physical law, as he understands it, and uniformity used by philosophers as Hume or Mill: "while uniformity is a character which might be realized in all its fullness, in a short series of past events, law, on the other hand, is essentially a character of an indefinite future" (8.192). Thus, to understand the special character of Peirce's conception of physical law it is necessary that we be able to see clearly the following triadic relation: law-generality-potentiality, which has the common element of futurity:" ... a general (fact) cannot be fully realized. It is a potentiality; and its mode of being is **esse in futuro**" (2.148)[28]. I, therefore, believe that if the central role of Thirdness, grounded on the idea of potentiality, be accepted in Peirce's conception of unobservable reality and of

physical law, then we could be led to a deeper understanding of Peirce's attitude towards the whole body of scientific discourse. It is essential to see here how Peirce defines the goal of scientific inquiry. A synoptic answer is given in his "Review" of Pearson's **Grammar of Science**, 1901:

> As he [the man of sciencel] gradually becomes better and better acquainted with the character of cosmical truth... he conceives a passion for its fuller revelation ... The very being of law, general truth,...reason consists in its expressing itself in a cosmos and in intellects which reflect it, and in doing this progressively. (8.136).

What is of particular interest here is that Peirce not only interrelates but also identifies law -which is another expression for generality- with general truth. What then is truth for Peirce[29]?

The first thing to be noted is the intimate relation of truth and reality which is one of the most essential presuppositions for a thorough understanding of Peirce's realism, both of theories and of entities. It is a relation, so to speak, of chicken and the egg: you cannot have the one without the other. "The opinion which it fated to be ultimetely agreed to by all who investigate, is what we mean by the truth and the object presented in this opinion is the real" (5.407). Truth is thus connected with "all who investigate", i.e. with the community of inquirers. It consequently bears a collective and inter-subjective character, since it must be seen as the result of the "ongoing community of investigators" which will (is destined to) arrive at the final opinion. Agreement with final opinion may be postponed "indefinitely" says Peirce. Its distinctive characteristic is that it has an **esse in futuro** i.e. it remains an open possibility that would be reached "in the long run". In this respect, truth, plays the role of an "ideal limit" to be reached "in the long run" by the "unlimited community" of investigators.

We should be careful to notice that the idea of ideality implicit in these last characteristics should be mainly connected, as I have argued elsewhere[30], with the triadic relation: generality-law-potentiality. To the extent that the world of Secondness, of

actuality, of observable reality is not excluded from Peirce's scheme, his idealism cannot be located in the identification of reality with thought. It should rather be seen in harmony with the real process of nature and the actual procedure of scientific inquiry, which is conceived by Peirce as a living enterprise (see 7.50). The merit of such an interpretation is that it could also shed light on Peirce's expressed preference for idealistic hypotheses: "the idealistic hypothesis would be the more verifiable, that is to say would predict more and could be put more thoroughly to the test" (5.598). In other words the idealistic hypothesis is the one based on the idea of potentiality which involves futurity. Futurity in its turn must be seen as an essential element of Peirce's idealism (see 8.284). It should be added here that Peirce rejects the idea of the thing-in-itself (5.311). He is convinced that there is nothing beyond our ability to reach and know, nothing that could be characterized absolutely incognizable, "and consequently whatever is meant by our term as 'the real' is cognizable in some degree" (5.310)[31].

A corollary of Peirce's expressed strong belief in the cognizability of reality is his opposition to the positivist proponents of his time, who saw "mysteries" in the Universe, in the sense of facts "to which no approach to knowledge can ever be gained"(8.156). Mach's refusal to attribute to science "the power of opening up unfathomable abysses of nature", could find no place in Peirce's scheme.

CONCLUSION

If my preceding analysis be accepted, then Peirce's conception of the **nature** of **physical theory** and the reality of the **unobservable** cannot be understood apart from the function and role of his Third category. The essential elements here involved are those of **generality** and **continuity** which are grounded on the key-concept of **potentiality**. Thus, Peirce's Aristotelian-Scholastic realism is the real opponent to the positivist anti-realism regarding the reality of theoretical entities.

NOTES

1. I borrow this twofold distinction from I. Hacking. Realism about entities is taken to claim that a variety of theoretical entities, such as protons, photons, fields of force and black holes, really do exist."**Realism about theories** says that scientific theories are either true or false independent of what we know: science at least aims at the truth and the truth is how the world is" I Hacking, **Representing and intervening.** Cambridge University Press, 1983, p. 27.

2. In my interpretation of the relations holding between scientific and scholastic realism, I follow the opposite direction to that followed by Skagestad in his most interesting attempt at a combining approach of Peirce's theory of scientific inquiry. Skagestad claims that there are, at least, two different and incompatible trends in Peirce's Pragmatism, namely, his verificationism and his scholastic realism. He then elaborates the thesis that Peirce's later Pragmatism, characterized by Skagestad as verificationist semantics, seems to be advocated as an empirical hypothesis which becomes not only compatible with realism but also serves as premise from which realism may be derived as a consequence. See P. Skagestad, **The Road of Inquiry** (New lork: Columbia University, 1981).

3. See for example, N. R. Hanson, "Is there a logic of scientific discovery?", in H. Feigl and G. Maxwell (eds), **Current Issues in the Philosophy of Science** (Holt, Rinehart at Winston, 1961); **Patterns of Discovery** (Cambridge: Cambridge University Press, 1965). See also K. T. Fann, **Peirce's Theory of Abduction** (Martinus Nijhoff-The Hague, 1970); N. J. J. Fitzerald, "Peirce's theory of Inquiry", **Transactions of the Charles S. Peirce Society**, 4 (1968), pp. 130-143); N. Rescher, **Peirce's Philosophy of Science** (Notre Dame-London: University of Notre Damé Press, 1978)

4. See for instance, S. Haack, "Pragmatism and Ontology: Peirce and James", **Revue Internationale de Philosophie**, 31(1977), pp. 377-400; "A Scholastic Realist of a Somewhat Extreme Stripe" unpublis hed paper; fred Michael, "Two Forms of Scholastic Realism in Peirce's Philosophy", **Transactions of The Charles S. Peirce Society**, 24(1988), pp. 317-348.

5. My approach concerning the role of potentiality in the function of the Third category is based in part on my essay "Towards a Potential-Pragmatic Account of C. S. Peirce's Theory of Truth, to be published in **The Transactions of Charles S. Pierce Society.**

6. For a thorough consideration of Peirce's Theory of abduction see, F. E. Reilly, **Charles Peirce's theory of Scientific Method** (New lork: Fordham University Press, 1970); K. T. Fann op. cit

7. References of this form are to the **Collected Papers of Charles Sanders Peirce** (Cambridge, Mass: Harvard University Press, 1931-1958). (5.597) for example, refers to volume 5, paragraph 597 of the **Collected Papers.**

8. We must say that in his early articles, hipothesis is considered as type of inference, together with deduction and induction.

9. In particular in his "Deduction, Induction, Hypothesis", 1878 and "Theory of Probable Inference", 1883.

10. See e. g. 2.776
11. N. R. Hanson, op. cit.
12. Cf. Abduction is the only operation which introduies any new idea" (5.171); "All the ideas of science come to it by the way of Abduction" (5.145); see also, 1. 120, 6.528-30.
13. Cf. "The scientific imagination dreams of explanations and laws"(1.48).
14. For an illuminating examination of the role of instinct as the first "instant" of the abductive phase and its close relation to Synechism, see Timothy Shanahan, "The First Moment of Scientific Inquiry: C. S. Peirce on the Logic of Abduction", **Transactions of the Charles S. Peirce Society**, 22 (1986), pp. 449-465.
15. See also, (1.181).
16. Einstein, "Principles of Research", In Einstein, **Ideas and Opinions** (New lork: Bonanza Books, 1954), p. 226.
17. As for ex., N. R. Hanson, op. cit.; N. Rescher, op. cit.; K. T. Fann, op-cit.
18. Cf. 6. 491, 6. 500, 6. 531, 6. 497.
19. Cf. 7. 219.
20. Cf. 1. 81.
21. This conversation will be continued "till the mind is in tune with nature" (6.568).
22. Fred Michael (op. cit.) claims that, what Peirce takes from Scotus is the idea of the independent character of reality over against thought in contradistinction to fiction (cf. 5.311, 5.430) and the acceptance of the reality of the universal (cf. 8.14), but not the idea of final opinion neither that of the futurity of the real (5.311).
23. Towards a Potential-Pragmatic Account of C. S. Peirce's Theory of Truth" op. cit. p. 10 ff.