ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Philosophy

Bachelor Thesis Philosophy of a Specific Program (Econometrics)

A Critical Philosophical Reflection of "A System of Logic: Ratiocinative and Inductive" by John Stuart Mill

Author

Bart H.P. de Zeeuw (434299)

Supervisor

Dr. Tim K.A.M. de Mey

Advisor

Dr. Katherina M.E. Bauer

July 7, 2019

Abstract

Proper, indisputable knowledge is the very root of science as we know it today. Therefore, John Stuart Mill (1806-1873) has formalized the scientific method to acquire this type of knowledge, in his book *System of Logic*. Particularly, he maintains that inductive logic is the only true basis of knowledge. This paper will elaborate on the most principal features of Mill's *System of Logic*. Subsequently, a skeptical stance towards Mill's views will be put forward. This will consists of a summary and elaboration of the Mill-Whewell debate. Besides, Hume's view on inductive logic will be presented. Consequently, I will conclude that Mill missed a chance to really address *Hume's problem*, which entails the question whether one can infer a general law from single, observable instance.

Contents

1 Introduction

John Stuart Mill (1806-1873) is one of the prime characters when people speak about modern philosophy. Born in 1806, London, England, Mill's life was dedicated to education. In *SparkNote on John Stuart Mill (1806-1873)*, it is stated that at the age of fourteen, Mill was already deeply educated in logic, mathematics, history and economic theory. This has laid the foundation on which System of Logic rests.

Mill presents in his *System of Logic* a revolutionary approach towards the scientific method. Before Mill's book, Aristotle's system of logic, which is described in his *Organon*, was predominant in the scientific world. This system of logic consists of rules for creating syllogisms, which are arguments that begin with a general premise and infer a conclusion about a particular instance. An example of a syllogism is: "All men are mortal, Socrates is a man, and therefore Socrates is mortal". However, being inspired by English philosophers such as Francis Bacon and John Locke, Mill was an empiricist. He believed that all principles that we call general, originate from dozens of particular instances that we have experienced. This is in line with what other empiricists have stated throughout the history of ideas. However, Mill distinguishes himself from his empiricist contemporaries in his attempt to write, as Aristotle did for deductive reasoning, a system of rules for how to arrive at general principles from particular instances. In his *System of Logic*, Mill makes a distinction between deductive logic, which corresponds to Aristotle's logic, and inductive logic, where we infer general principles from specific cases. He maintains that inductive logic is the only true basis of knowledge. Moreover, another motive of Mill was to present a revised account of the relationship between deductive reasoning, or syllogistic, and inductive reasoning.

This thesis will consists of the following parts. In Section 2, the state of Logic will be described before Mill's *System of Logic*. Subsequently, in Section 3, Mill's formalization of the Inductive method will be displayed. Section 4 will give a historical overview of the Mill-Whewell debate on the way conceptions are acquired. Section 5 will pose a critical, skeptical stance to Mill's *System of Logic*; in particular to the validness of induction as an instrument for acquiring proper, certain knowledge. Finally, there will be a conclusion.

2 Logic Before Mill

In this section, possible causes for the writing of *System of Logic* will be displayed. Furthermore, some definitions of key terms, such as "syllogisms" and "ratiocinative logic", will be given. This will improve the reader's ability to understand the remainder of this thesis.

2.1 The Great Paradox

The very first beginning of Mill's work on logic was in 1828, in the *Westminster Review*. It was an extensive review on Richard Whately's (1787-1863) work *Elements* (1870). Mill accepted many of Whately's views on logic. Primarily the one that logic has to be seen as the art and science of reasoning. Moreover, he maintains, just as Whately, that syllogistic reasoning is the only proper form of reasoning. As a result, induction is not a form of reasoning.

> Syllogistic reasoning is not a *kind* of reasoning, for *all* correct reasoning is syllogistic: and to *reason by induction* is a recommendation which implies as thorough a misconception of the meaning of the two words, as if the advice were, to *observe by syllogism.*
> (CW, vol. XI, p. 15)

However, Mill was still unsure about the informativeness of logic itself. In 1828, Mill remained unconvinced of Whately's assertion that logic's informativeness is as a "logical discovery". This explanation asserts a mere cognitive function to logic, rather than an epistemic function.

The great paradox that Mill faced was to be able to assign an epistemic function to general reasoning, or better said, logic. While searching for his answer to this question, he remarked that in every syllogism, the conclusion is already contained in the premises. The paradox that Mill faced was to illuminate how a conclusion could contain any new truths (so not the truths that are already contained within the premises) *and* how, for example, the theorems of geometry -where the axioms and definitions (i.e. premises) differ greatly from the theorems (i.e. conclusions) - can be contained in the axioms and definitions.

As stated in Mill's *Autobiography* (CW, vol. i), Mill probably found the way to resolve this great paradox in Dugald Stewart's *Elements of Philosophy of the Human Mind* (1821). As Mill does not explicitly state where in Stewart's work he found his resolution, David Godden suggests in Mill's *System of Logic* (2014) that it was Stewart's idea about the probative role of axioms in demonstrative reasoning.

> It was long ago remarked by Locke, of the axioms of geometry, as stated by Euclid, that although the proposition be at first enunciated in general terms, and afterwards appealed to, in its particular applications, as a principle previously examined and admitted, yet that the truth is not less evident in the latter case than in the former. He observes farther, that it is in some of its particular applications, that the truth of every axiom is originally perceived by the mind, and, therefore, that the general proposition, so far from being the ground of our assent to the truths which it comprehends, is only a verbal generalization

of what, in particular instances, has already been acknowledged as true.
(Stewart (1821), p. 23)

Accepting this statement made by Stewart, Mill increases the epistemic value of particular claims, while general claims lose their epistemic priority. Hence, the increase in knowledge does not necessarily occur in the deductive, or ratiocinative, process of deriving theorems from general axioms, but rather in deriving those axioms themselves. As Mill is an empiricist, this is only possible through the direct experience of the particulars in question.

One may conclude that Stewart's core ideas about the epistemic function of logic are similar to Mill's. The view that Mill now adopted, does heavily contradict the ideas of Mill when he reviewed Whately's *Elements* (1897). There Mill maintained that deductive logic, is the only proper way of reasoning. However, Mill's views only changed in relation to the foundation and utility of, and the relationship between, ratiocination and induction. Moreover, in *System of Logic* (CW, vol. VII) Mill follows Stewart, rather than Whately, in stating that the epistemic function of syllogistic reasoning is primarily based on the induction of general premises. On top of that, Mill maintains also that the function of syllogisms is evaluative, rather than epistemic. In this way, Mill has clearly moved from Whately to Stewart.

2.2 Real Versus Apparent Inference

In order to understand Mill's conception of ratiocinative logic in *System of Logic* (CW, vol. VII), it is advisable to take into account two distinctions that Mill makes: the distinction between real and apparent inferences, and the distinction between real and verbal propositions. First, in order for logic to have a real epistemic function, the premises in question need to contain real inferences. This implies that from the premises, and the truths within these premises, we should arrive at new propositions that contain real distinct truths. For Mill, real inferences are ampliative. In other words, the conclusions drawn from the premises, contain more information than the premises themselves. On the other hand, Mill states that apparent inferences are inferences that on analysis are no more than a repetition of the same or partly the same, in the premise and the conclusion. According to Mill, in case an apparent inference is made, there is not really an inference. It is nothing more than a repetition of what already is stated in the premises, in the conclusion.

Besides, Mill makes a distinction between real and verbal propositions. This corresponds to Kant's distinction between synthetic and analytic judgements, respectively. First, real propositions are propositions that have a predicate that is not connoted by the name. Real propositions extend our knowledge, and therefore are truth-apt, because one may check its validity. For example, the proposition: "Tommy has a beard" is a real proposition. This proposition adds something to our knowledge and is truth-apt. By contrast, verbal propositions have only one function, which is to illuminate to those who do not know it yet, the whole or part of the meaning of the name. For instance, the proposition: "all bachelors are unmarried" is a verbal proposition. By definition, bachelors are unmarried, so there is no additional information in this proposition.

For Mill, sciences in general, including *a priori* sciences such as mathematics and logic, must consist of real propositions in order to be informative. Moreover, sciences must have real inferences in order to be able to extend our knowledge. Deduction, however, is clearly a method which uses merely apparent inferences. So, Mill concludes that knowledge cannot be advanced using deduction in the conventional manner, and has to be reconceived. At this point, Mill introduces ratiocinative logic as an alternative.

2.3 Ratiocinative Logic

For Mill, valid ratiocination is: "all reasoning by which from general propositions previously admitted, other propositions equally or less general are inferred" (CW, vol. VII, p. 166). All valid ratiocination can be represented syllogistically, according to Mill. There are four forms of valid syllogisms: two affirmative syllogisms and two negative syllogisms. For a more extensive review of the different types of syllogisms, see *The Collective Works of John Stuart Mill* (vol. VII, p. 168).

Ratiocination is a way to acquire real knowledge, therefore ratiocinative reasoning must consist of real propositions. The major premise is always universal. This premise "asserts, that all things which have a certain attribute (or attributes) have or have not along with it, a certain other attribute (or attributes)." (CW, vol. VII, p. 177). The minor premise asserts that the subject of the minor premise has the first-mentioned attribute, while the conclusion has, or has not, the second. Thus, the terms of the major premise are connotative names. This means that they denote objects and connote attributes. Hence, if one finds one of the two (sets of) attributes, one must find the other. The two attributes connoted, either always or never coexist together. For example,

All men are mortal,
Socrates is a man,
therefore
Socrates is mortal.

The attributes connoted by "man" never exist without the attribute mortality.

To summarize and formalize the former statements, one can say that affirmative syllogisms'validity is founded on the principle that if the former attribute coexists with the latter attribute, the latter coexists with the former ($A = B \iff B = A$). On the other hand, negative syllogisms are tested on their validity based on the following principle: "that a thing which coexists with an- other thing, with which other a third thing does not coexist, is not coexistent with that third thing" ($A = B \wedge B \neq C \iff A \neq C$) (CW, vol. VII, p. 178). These two principles can be denoted as one principle, namely the principle of transitivity of coexistence, and this is the fundamental principle of Mill's ratiocination. This principle resembles the axioms of mathematics, and thus it has the character of a universally true law of nature.

To solve the Great Paradox, Mill assumes that valid ratiocination involves real propositions. The remaining question is whether or not the real propositions in valid ratiocination constitute real or apparent inferences. Mill's solution lies in the epistemic foundation of general propositions. This corresponds to the epistemic status of the major premise in a syllogism. The only relevant view which is compatible with Mill's empiricism is that we know generalities through particulars. For Mill, a general truth was nothing more than an "aggregate of particular truths, by which an indefinite number of individual facts are affirmed or denied at once" (CW, vol. VII, p. 186). Hence, a general proposition may be the cause of a particular instance, in a logical sense. However, it is not an epistemic consequence. Epistemically, the particular truth has to be known *a priori* when the general propositions is presupposed, according to Mill. Because of this, the general propositions are nothing more than "registers of inferences already made". Thus, ratiocination is not capable of advancing human knowledge, because it is not real inference, as Mill defined it. Subsequently, Mill states that ratiocination can be a mode of acquiring real knowledge, but only if it itself depends on induction, where the major premise is already known by induction.

> All inference is from particulars to particulars: General propositions are merely registers of such inferences already made, and short formulae for making more: The major premise of a syllogism, consequently, is a formula of this description: and the conclusion is not an inference drawn from the formula, but an inference drawn according to the formula: the real logical antecedent, or premise, being the particular facts from which the general proposition was collected by induction.
> (CW, vol. VII, p. 193)

By doing this Mill solved the Great Paradox. First, agreeing with Stewart that general truths have no epistemic ground in ratiocination. The general truths do supply the basis of reasoning. However, the proper foundations for this reasoning are to be found in the particular truths, which are presupposed by the general propositions.

Finally, Mill elaborates on the proper function of the syllogism. Mill maintains that syllogisms are primarily a form of reasoning in which we may detect flaws in our inductive reasoning; it is a test of reasoning.

3 Induction as the new form of logic

As stated in the previous section of this thesis, induction provides the only valid epistemic foundation for ratiocination, according to Mill. Therefore, Mill investigates in his third book a proper account of inductive inference. For Mill, the grounds of induction lie in the so-called uniformity principle. This principle assumes that all the natural laws and processes that are active in our daily lives, have been operating continuously throughout history. The universe is governed by general laws, which have existed and will exist eternally. This principle is the general axiom of induction, according to Mill. In Section 5 the validity of this principle will be put into question. However, as far as this Section is concerned, it is necessary to assume that this principle is sound. Following the uniformity principle, Mill created five "methods", which are the only adequate methods to engage in an experimental enquiry. Consequently, this Section will elaborate extensively on the uniformity principle and Mill's methods.

3.1 Laws of causation

Nature and its uniformity is what Mill called the Law of Universal Causation. However, Mill soon realized that the uniformity that exists within nature is very complex. Moreover, the uniformity of nature is not properly uniformity, but *uniformities*. As Mill said: "the general regularity results from the coexistence of partial regularities" (CW, vol. VII, p. 315). The job to be done for a logician, then, is to find the particular regularities, and determine the conditions that make an instance happen rather than that something else happens. Knowing those individual causes, will enable the logician to determine whether a single instance is sufficient for a complete induction. In other words, if the causal law that initiates an instance is known, it is sufficient for a complete induction. Therefore, Mill investigated the laws of causation in detail. So, the principal task of a logician does not differ with that of a natural scientist; both have to articulate and ascertain the causal laws that govern the universe.

3.2 Mill's Methods

Mill introduces in *System of Logic* five different methods of scientific inquiry, in which one ought to be able to identify the aspects of our experience that contain true causal efficacy. First, Mill presents the *Method of Agreement*. By holding the instance that we want to study constant and varying the other antecedent conditions, this method seeks to illuminate the operative causes that work on a certain phenomenon. Furthermore, this method tries to isolate precisely those conditions that are sufficient for a certain phenomenon to occur. If only one circumstance remains, that is the cause. If multiple conditions remain, either they are the cause, or the cause is contained among them. The presence (i.e., agreement) of conditions in different phenomena, makes it possible to conclude that this condition is the cause of this certain phenomenon. To illustrate this method and the other methods, I take the liberty to quote Mill from his *System of Logic*, as these illustrations are very clear.

> Let A, then, be an agent or cause, and let the object of our inquiry be to ascertain what are the effects of this cause. If we can either find, or produce, the agent A in such varieties

> of circumstances, that the different cases have no circumstance in common except A; then whatever effect we find to be produced in all our trials, is indicated as the effect of A. Suppose, for example, that A is tried along with B and C, and that the effect is a b c; and suppose that A is next tried with D and E, but without B and C, and that the effect is a d e. Then we may reason thus: b and c are not effects of A, for they were not produced by it in the second experiment; nor are d and e, for they were not produced in the first. Whatever is really the effect of A must have been produced in both instances; now this condition is fulfilled by no circumstance except a. The phenomenon a cannot have been the effect of B or C, since it was produced where they were not; nor of D or E, since it was produced where they were not. Therefore it is the effect of A.
> (CW, vol. VII, p. 388)

Thus, the "agreement" in the effects of A B C & A D E is a, because this effect is produced in both instances. The way to conclude that A is the cause of a, is well-explained in the quote, therefore I will not elaborate further on this.

The *Method of Difference* is the second method that Mill poses. Here, in contrast to the method of agreement, the antecedent conditions are being held constant, while the condition under investigation, is present or absent in the second case. On this basis, one may conclude that the condition under investigation is the cause of a phenomena, or not. To illustrate, the following quote is, once again, from Mill.

> If our object be to discover the effects of an agent A, we must procure A in some set of ascertained circumstances, as A B C, and having noted the effects produced, compare them with the effect of the remaining circumstances B C, when A is absent. If the effect of A B C is a b c, and the effect of B C, b c, it is evident that the effect of A is a.
> (CW, vol. VII, p. 391)

Thus, the "difference" between the two sets of conditions is A, while the difference between the two sets of effects is a. Therefore, one may conclude that A is the cause of a.

At first sight there is not a great difference between the two first methods that Mill has proposed. However, the Method of Agreement and the Method of Difference have the following principles which elucidate the difference between the two methods: "Whatever circumstance can be excluded, without prejudice to the phenomenon, or can be absent notwithstanding its presence, is not connected with it in the way of causation" (CW, vol. VII, p. 390) and "Whatever antecedent condition cannot be excluded without preventing the phenomenon, is the cause, or a condition, of that phenomenon" (CW, vol. VII, p. 391), respectively. As described above, the two methods work from cause to effect. However, in a similar way, both methods can, without loss of validity, work in the opposite direction, so from effect to cause. Furthermore, one might say that both methods are methods of elimination. For the Method of Agreement, everything that can be eliminated, stands in no causal relationship of any sort to the phenomenon. The Method of Difference stands on the foundation that everything that cannot be eliminated, is indeed connected with the phenomenon by a causal relationship.

The third method in Mill's *System of Logic* is called the *Joint Method of Agreement and Difference*. This method combines the two former methods. This may be needed when the Method of Difference is not available at all, or when the Method of Agreement has to be used in order to be able to use the Method of Difference. This may be the case when a particular phenomenon is caused by a combination of antecedents; and one is not capable of separating the different antecedents. This method uses a double employment of the Method of Agreement: one where the connection between the presence of A and the presence of a is shown, and one where the connection is shown between the absence of A and the absence of a. Then, one has the positive and the negative instances that the Method of Difference requires.

The last two methods that Mill describes are the results of previous inductions. First, Mill introduces the *Method of Residues*. The idea behind this method is as follows: given a phenomenon, subtract every portion which can be explained by virtue of previous inductions. Then, the remainder will be the effect of the antecedents that had been overlooked. What follows is a quote by Mill, to illustrate the Method of Residues.

> Suppose, as before, that we have the antecedents A B C, followed by the consequences a b c, and that by previous inductions (founded, we will suppose, on the Method of Difference) we have ascertained the causes of some of these effects, or the effects of some of these causes; and are "thence" apprised that the effect of A is a, and that the effect of B is b. Subtracting the sum of these effects from the total phenomenon, there remains c, which now, without any fresh experiments , we may know to be the effect of C.
> (CW, vol. VII, p. 397)

In fact, this method is, as Mill calls it, one of the most important among our instruments of discovery. This method provides people a tool to see the things that people often overlook.

The second method that uses previous inductions is called: the *Method of Concomitant Variations*. This method is specially designed to deal with, what Mill calls, the effects of Permanent Causes. These are causes that are impossible to exclude or isolate, therefore not applicable to any of the four methods that have been previously considered. Mill gives the example of Heat. One is unable to exhaust the heat of any body, therefore Body and Heat cannot be separated. By the methods above described, we cannot, determine "what portion of the phenomenon exhibited by any body is due to the heat contained in it" (CW, vol. VII, p. 399). This method uses a modification in the antecedent, which does not affect the consequences of the other antecedents, but rather results in a change of the corresponding consequence. Again, the same holds if one switches the places of causes and consequences. If this holds, we may conclude that the antecedent which is modified is wholly or in part a cause of the corresponding consequence. To illustrate, a quote from Mill.

> If some modification in the antecedent A is always followed by a change in the consequent a, the other consequences b and c remaining the same; or vice versa if every change in a is found to have been preceded by some modification in A, none being observable in any of the other antecedents; we may safely conclude that a is, wholly or in part, an effect traceable to A, or at least in some way connected with it through causation.

To continue with the former example, the heat of the body cannot be expelled completely. However, it can be adjusted. An increase or decrease of the heat in the body, is followed by expansion or contraction of the body, respectively. So, one of the effects of heat on a body is that it changes the space between particles within the body.

In the previous example, the modification used was with respect to the quantity of the instance investigated. However, there are multiple other techniques in which a modification can be made. The idea behind this method stays, nevertheless, the same and does not need any further explanation nor illustration.

According to Mill, these methods are the only possible ways to undertake an experimental inquiry, which is *a posteriori* and relies on induction. Moreover, except of the Method of Residues, all methods are independent from any deductive techniques. Although the fact that the Method of Residues is connected with deduction, one may say that even this method may be included in the methods of direct observation and experiment, because this deduction requires specific experience, according to Mill.

4 Mill-Whewell Debate

The Mill-Whewell debate is indisputably one of the most important debates that Mill had during his lifetime. William Whewell (1794-1866), being a pre-eminent historian of science and holder of a chair in moral philosophy at Cambridge, showed to be an excellent opponent to Mill. Indeed, the writings of Whewell were an inspiration, or rather an inducement, for Mill to respond to the criticisms' in Whewell's works. In the preface of the first edition of *System of Logic* Mill states: "without the aid derived from the facts and ideas contained in...[the History], the corresponding portion of this work would probably not have been written" (CW, vol. VII, p. cxiii). Furthermore, Mill found in Whewell's Philosophy of the Inductive Sciences (vol. I, 1840) a fine counterpart of his own empiricist views, as Whewell presented in his work an *a priori* view of human knowledge and its knowing faculties based on German Idealism. In his turn, Whewell responded to Mill in his *Of Induction, with special reference to Mr. J. Stuart Mill's System of Logic* (1849). This was, again, reason for Mill to respond to Whewell, in his third edition of *System of Logic*. In short, the debate between these two philosophers can be summarized in two points. First, Whewell maintained that induction involves the so-called *colligation of facts*. Second, Whewell pointed out that the experimental methods which Mill advocates are absent in the history of science.

To understand the argument between these two philosophers better, one ought to know Whewell's stance as good as Mill's. For that reason, a brief description of Whewell's view on induction and the essential parts within it, will follow first. Subsequently, Mill's criticism on Whewell will be presented.

4.1 Whewell on Induction

As stated by Snyder (2019), Whewell considered himself to be a follower of Francis Bacon, who sought to find a middle way between rationalism and ultra-empiricism. To support this, he argued that all knowledge has both an objective and an ideal or subjective dimension. This is what he called the "fundamental antithesis" of knowledge. Whewell criticized Kant (and the German Idealists) and Locke (and the Sensationalists) for being too narrow-minded; while the former had an exclusive focus on the subjective dimension of knowledge, the latter exclusively focused on the objective dimension. For Whewell, one ought to focus on both dimensions to be able to deepen our understanding. An important concept in Whewell's philosophy is his "Fundamental Ideas". In theorizing, scientists seek intelligible relations between the facts that need to be connected. These intelligible relations are the Fundamental Ideas. For instance, Space, Time, Symmetry and Motion are examples of Fundamental Ideas. Whewell claims that the Fundamental Ideas are "supplied by the mind itself". This, being an idealist claim, triggered Mill to reply. There will be a further elaboration on Mill's critics on this matter in Section 4.2. As these Ideas are supplied by the mind, it means that the mind is an active participant in acquiring knowledge. As Whewell states in his *History of Scientific Ideas*, Fundamental Ideas are "not a consequence of experience, but a result of the particular constitution and activity of the mind, which is independent of all experience in its origin, though constantly combined with experience in its exercise" (1858, vol. I, p. 91). This activity of the mind will be described now.

For Whewell, in induction there is an act of thought which he calls "colligation". Colligation is the act of thought that bundles all observational facts together by "superinducing" a conception upon them. This conception unites the individual observations, such that they may fall under a general (natural) law. The conception at hand must provide a property that is shared by all observations, in order to be able to fall under this conception. As an example, Whewell uses the motion of Mars, which was discovered by Kepler. However, Kepler did not observe the new data points of the position of Mars in the universe, which was Tycho Brahe's accomplishment, yet it was Kepler who assigned the conception of an ellipse to the aggregated positions and data points. Only after the assignment of the conception, the true orbit of Mars was discovered. According to Whewell, Kepler could assign the conception of an ellipse to the observational data, because he had a clear notion of the very conception itself. This clear notion of the conception is essential, because the conception and Ideas are provided by our minds, but not applicable in their innate form. Discoveries in science helped to illuminate the conceptions that were already in our minds, as Whewell claims. This is what he calls the "explication of conceptions".

For Whewell, scientists ought to try to fit the found observations under a certain conception. If the conception is applicable to this set of observations, the conception can colligate the facts into a law and no further action is needed. If it is not possible to unite the observations under this certain conception, the scientist ought to use this experience to refine the ventured conception.

If the conceptions have been explicated, one is able to choose whether a certain conception is appropriate to colligate phenomena. Determining whether a conception is appropriate to a set of observations, is merely a matter of observation. As Whewell explains, finding the right conception is dependent on a series of inferences. In this series of inferences, one is able to use any type of inference, such as enumerative, analogical and eliminative. For example, Kepler used various sorts of inferences to reach the conception of an ellipse, according to Snyder (1997).

After the known observations are colligated by an appropriate conception, it is often trivial to generalize the shared property over the complete class, thus including the non-observed facts. When Kepler found that the set of positions of Mars fell under the conception of an ellipse, he extrapolated it to every other position Mars would take, but had not been observed yet. Now he could conclude that "all the points of Mars' orbit lie on an ellipse with the sun at one focus".

Furthermore, it is good to remark that Fundamental Ideas are the structures or the foundation that exist between the observational data that we perceive. Therefore, observation is "idea-laden"; in all observation there might be an unconscious inference (or conscious inference). Finally, Whewell's view on "conceptions" is that they fall under the corresponding Fundamental Ideas; the conceptions are included in the Ideas. For example, the concept of a rectangle falls under the Idea of Space.

Thus far, it seems that Whewell's Fundamental ideas correspond highly with Kant's forms of intuition, which he defines in his *Critique of Pure Reason* (1787). Highlighting this, it would seem that Whewell's epistemology is of a Kantian sort, as also claimed by different commentators (Buchdahl, 1971; Butts, 1993). However, as already said before, Whewell criticized German Idealists, including Kant, for focusing exclusively on the ideal or subjective dimension of knowledge. In finding a middle way between the rationalists and the empiricists, Whewell distinguishes himself from Kant in certain ways, as Snyder (2019) states. First, Kant defines a hard distinction between his "forms of intuition", such as Time and Space, and his "forms of thought", or Categories, such as Substance and Cause.

Whewell, in his turn, does not make this sharp distinction. Furthermore, in his Fundamental Ideas, Whewell included Ideas which function as conditions of knowledge in their respective branch of science, apart from the Ideas that function as conditions of experience. Thus, for Whewell it may be possible to have certain experiences in the world; but without a distinct Idea, it is impossible to have knowledge about it. Finally, Whewell disagrees with Kant's notion that the only knowledge that is possible for mankind is of our "categorized experience". Whewell, on the contrary, claims that the Fundamental Ideas accurately represent facts in the world, being independent of the processes in the mind. So, using the Fundamental Ideas, one might acquire knowledge about these objective features in the world.

As shown above, there are similarities between the views of Whewell and Kant. However, as Whewell tries to find a middle ground between empiricism and rationalism, one can say that Whewell's epistemology is not a direct follow-up of Kant's.

4.2 Mill on Whewell's View on Conceptions

Now as both Mill's and Whewell's view on induction have been explicated in sufficient degree, it is time to elaborate on the debate between the two philosophers. As E.W. Strong (1955) states, the biggest difference between the views of Whewell and Mill is about "the nature and role of conceptions in scientific discoveries" (Strong, 1955, p. 215). To summarize this matter in one sentence: Whewell believes that conceptions are in the mind *a priori*, while Mill believes that conceptions are, just like any other kind of knowledge, born from experience and observation. With that having said, one might turn one's attention to the arguments supporting the statements of both men.

As Strong (1955) states, Mill thinks it's necessary to reply to Whewell, because Whewell rests his theory upon "ideological" (i.e. epistemological) considerations, while he tried to abstain from ideological discussions (as they do not advance the topic of *System of Logic*, as Mill argues). So, Mill had to reply to Whewell, and does so in the chapter "Of Abstraction, or the Formation of Conception" (Book IV, chapter II). In this chapter Mill presents three theses; using them to obtain conclusions that criticize Whewell's views. The first main thesis that Mill proposes is as follows: Ideas or conceptions, which are denoted by a general name, "represent in our minds the whole class of things to which the name is applied" (CW, vol. VIII, p. 650). Mill's second thesis is: general conceptions do not develop from within, but are the result of comparison of the specific objects and/or have evolved by abstraction from the very phenomena under investigation. To illustrate this Mill gives the example of comparing several objects, and agreeing that some of them agree in being white, and, thus, having the conception of "a white thing". This simple example shows, Mill argues, that the very act of comparison, leading to connecting the facts by means of the conception, may be the source of the conception itself. The same accounts for the example about Mars' motion, discovered by Kepler. Mill agrees that Kepler had to superinduce the conception (of an ellipse), which he already acquired, onto the observations. However, Kepler being unable to extract the concept from his observations, was a mere accident. If the planetary orbit would be visible, Kepler could have extracted the conception of the ellipse out of Mars' orbit. This leads to Mill's final thesis: "a conception is a conception of something; and that which it is a conception of, is really *in* the facts, and might, under supposable circumstances, or by some supposable extension of the faculties we actually possess, have been detected in them" (CW, vol. VIII, p. 651). It is clear that with these three theses, Mill criticizes Whewell's view on the source of conceptions. First, he questions the *a priori* principle of the ideal dimension of knowledge by stating that conceptions are always obtained from abstraction and comparison of the facts themselves. Furthermore, Mill continuous to criticize other points in Whewell's philosophy. For example, Mill claims in this chapter that the facts are not *connected*, as Whewell would put it. We may think of them together, because the *ideas* of the facts may become connected. However, this is nothing more than what happens at any casual association. Having said this, Mill is now ready to elaborate on the clearness and the appropriateness of conceptions, these notions being an essential point in Whewell's view of conceptions.

For Mill, a conception is appropriate whenever the conception corresponds to a real agreement among the phenomena. Moreover, if the comparison has led to real differences and resemblances, a conception cannot fail to be appropriate. Furthermore, appropriateness is relative to the particular object at hand. In other words, the agreements can be of various degrees of importance. For example, animals may be characterized by the conception "color". This can lead to a proper induction. Although, this conception will not guide us to any knowledge of the laws of any other property of the animals. If one takes, for example, the structure of the skeleton, one could derive far more knowledge of other properties of the animals within this characterization. The latter may be thus more "appropriate" than the former, if one wants to investigate the mode of life of the animals, for instance. Therefore, Mill claims that appropriateness comes in degrees and is dependent on the particular scientific goals.

Next, Mill elaborates on the clearness of conceptions. For Mill, the main requisite for a clear conception is that one exactly knows in what the agreement consists; it has been observed with care and precisely remembered. Furthermore, a clear conception means a determinate conception. This entails that the conception does not fluctuate, except when the progress of knowledge or the rectification of an error forces one to consciously change the conception. In order to have a determinate conception, one ought to have *accurate* and *careful* observing and comparing faculties. Thus, the clearness of a conception hugely depends on the scientist having "habits of attentive observation, an extensive experience, and a memory which receives and retains an exact image of what is observed" (CW, vol. VIII, p. 659), according to Mill.

Finally, it is important to state some minor remarks about clearness and appropriateness. As one might expect, these two notions are strongly interdependent. Once a conception is not appropriate, it cannot be clear, because there is no real agreement involved, so there is nothing to be clear about. Furthermore, a conception might be clear, but it will not be appropriate if the properties of that conception do not help someone towards what this person wants to understand.

4.3 Mill on Whewell's Historical Question

As stated before, Mill and Whewell differ in two matters. First, and yet considered, their views on the constitution of conceptions. Second, Whewell questions the historical value of Mill's methods. Whewell claimed that Mill had not enough historical evidence to state that his experimental methods were (historically) valid. In other words, Mill did not have evidence that the methods which he had presented, were really used in practice. Saying this, one may infer, as Mill did, that Whewell criticized the validness of the Canons of Induction. Furthermore, as Snyder (2019) argues, Whewell's opinion on the philosophy of science did not depend on whether it was inferred from a study of the history of science; rather, it was important that the philosophy of science was inferable from the historical study of science.

In Mill's reply to this criticism by Whewell, he uses a similar strategy, as the one he used to reply to Whewell's similar criticism regarding ratiocinative logic. Critics posed that obtaining the syllogism itself is treated as a trivial enterprise, while this might be the most difficult part of the entire process. Mill agrees that the greatest difficulty lies in obtaining the evidence, and, more importantly, reducing it to the form in which its conclusiveness may be tested. However, if one tries to reduce it, without knowing *what it is to be reduced to*, any progress is very unlikely. Therefore, Mill claims, the business of Inductive Logic is to provide rules, to which inductive arguments have to conform. The arguments that conform to these rules, are conclusive. This, and only this, is what the Canons of Inductions are and ought to be, according to Mill. So, Mill does not directly reply to the apparent lack of evidence, as Whewell would put it. Rather, Mill redirects the attention to what in his eyes, is the proper function of the Canons of Induction. For Mill the Methods of Induction are related to practice normatively, not descriptively. By maintaining this, Mill implicitly says that there is no lack of evidence, but a "no-need" of evidence, because illustrating is not the proper function of the Methods of Induction.

Mill's second argument is a response to Whewell's claim that no discovery is ever made by the four Methods of Induction. Here again, Mill uses an already-used argument to react to the criticism. In the case of syllogisms, Archbishop Whately concluded, that if their argument was right, it was right against the reasoning process as a whole. Because, whatever cannot be reduced to a syllogism, cannot be reasoning. In Mill's case, if Whewell's argument is correct, it is correct against all inferences from experience. This would mean that not a single discovery has been made by observation and experiment, which is obviously not the case. In this way Mill claims that experimental practices are separate from, and prior to the Methods of Induction.

Mill confesses that the illustrations that were given in his work about the Methods of Induction, were solely based on "facilitating the conception of the Methods by concrete instances" (CW, vol. VII, p. 431). However, he does not agree with Whewell that there are no historical examples of the Methods of Induction to be given. After giving a certain example of the Methods of Induction, Mill finishes with a counterattack:

> If discoveries are ever made by observation and experiment without Deduction, the four methods are methods of discovery; but even if they were not methods of discovery, it would not be the less true that they are the sole methods of Proof ... Now it is with Proof, as such, that Logic is principally concerned. This distinction has indeed no chance of finding favour with Dr. Whewell; for it is the peculiarity of his system not to recognize, in cases of induction, any necessity for proof. If, after assuming an hypothesis and carefully collating it with facts, nothing is brought to light inconsistent with it, that is, if experience does

> not disprove it, he is content: at least until a simpler hypothesis, equally consistent with experience, presents itself. If this be Induction, doubtless there is no necessity for the four methods. But to suppose that it is so, appears to me a radical misconception of the nature of evidence of physical truths.
> (CW, vol. VII, p. 432)

As Strong (1955) aptly remarks, Mill shifts the argument from how discoveries are made to what constitutes proof in induction. In my opinion, Mill is justified in doing this, because he has given examples of important cases of scientific inquiry. After showing that there are historical examples where the Canons of Induction are exemplified, Mill may, if he wishes, move to another point in the argument.

This closes the discussion between the two philosophers. To summarize, the Mill-Whewell debate mainly consisted of two points. First, Whewell argued that conceptions, which are used in order to produce a generalization within the process of induction, are *a priori* in the mind. Knowledge, therefore, consists out of an objective and an ideal or subjective dimension. To the contrary, Mill argued that concepts are merely found in the facts that are present in the world. Conceptions *an sich* come to the mind by previous experience, the act of abstraction or the act of comparison of the facts themselves. The second point of discussion between the two gentlemen may be characterized as follows: Whewell questioned whether the four Methods of Induction, as Mill had proposed them, were historically valid. In other words, were there any discoveries of natural laws that might have been characterized as found using one of those methods. Mill replied forcefully, stating several examples of great scientific importance, in which one can detect the certain appearance of one of the Methods of Induction. Therefore, Mill claimed that experimental practices are separate from, and prior to, the Canons of Induction. Furthermore, Mill claims that the Canons are not related to practice in a descriptive manner, but rather a normative manner. The Canons articulate a set of rules to which the practices are obliged to.

One might see this as the classic debate between an Idealist and an Empiricist, corresponding to Whewell and Mill, respectively. However, Whewell is not an Idealist *pur sang*, as he argues for a system of induction which depends on both *a priori* conceptions and *a posteriori* observations and facts. Having said that, this elaboration on the Mill-Whewell debate has been of sufficient length and profoundness to advance to the next topic, which will be a critical, skeptical stance towards *System of Logic.*

5 A Skeptical Stance towards System of Logic

In order to be able to claim its validness as proper knowledge, induction relies, as stated above in this thesis, on generalization of single instances. The English philosopher David Hume (1711-1776) raises the important question whether induction can be justified by reason. In other words, can we, by reason, be certain that one is justified to infer unobserved experiences from observed experiences. Hume concludes that this question will inevitably lead to a dilemma, which is unsolvable. The justification of induction cannot be proved deductively, nor by induction itself. By posing this question, Hume is widely seen as the greatest skeptical philosopher of all time.

5.1 Hume's Problem

As Henderson (2019) states, the central point in the problem of induction that Hume poses in his *Treatise* (1739) and *Enquiry* (1748), is that inductive inference cannot be justified by understanding or reason alone. The problem arises because of the fact that induction's foundation rests on the assumption of the uniformity of nature. As stated before, this means that similar causes, result in similar effects, independent from the point in time one finds oneself in. Rather, Hume argues, induction is made possible, because one *assumes* the regularity of nature. Hence, induction is not justified by reason, but is accepted because one assumes that nature follows a habit or a custom.

In order to understand Hume's argument, what will follow is a brief description of Hume's distinction between different kinds of propositions, *relations of ideas* and *matters of fact*, as they are of utter importance in his argument. In fact, these two types of propositions are the only types of propositions that can contain any proper knowledge, according to Hume. Relations of ideas may be characterized as *a priori*, indestructible connections between ideas. These ideas are intuitively and demonstrably certain. An example of a propositions that may be characterized as a relation of ideas is: "all bachelors are unmarried". Hence, to ascertain the truth of relations of ideas, one only has to "look for the meaning of the ideas involved", as prof. dr. Wiep van Bunge puts it. Furthermore, a denial of these propositions leads by definition to a contradiction. One cannot, indeed, deny that bachelors are unmarried, because by definition, bachelors are unmarried men. By contrast, matters of fact are *a posteriori* propositions. To verify the truthfulness of the following statement: "this bachelor is bald", one needs to know about which bachelor one is speaking and whether he is, indeed, bald. So, these propositions can, and must, be checked to verify their truthfulness, and may be denied without fear of contradiction.

This distinction is used by Hume to show that neither of these two types of reasoning can be used to justify induction. More specifically, Hume shows that the uniformity of nature cannot be verified by these two types of reasoning. He treats first relations of ideas. As stated above, relations of ideas cannot be denied, because this would inevitably lead to a contradiction. Hume uses this property to show that relations of ideas cannot be used for his cause. It is clearly and distinctively conceivable, as Hume maintains, that the course of nature may change. One might, for instance, believe that tomorrow the sun will not come up anymore or that rivers flow from the sea to the mountains. In addition, if something is intelligible and can be distinctly conceived, it may be denied, and thus, implies no contradiction. Therefore, relations of ideas cannot be used to justify the uniformity of nature.

Secondly, Hume also finds no resort in his matters of fact. The propositions that can be characterized as matters of fact are purely empirical, thus the knowledge derived from these statements presuppose that the future will be in line with the past. This, however, is exactly what one wants to prove, when one tries to prove the uniformity of nature. Therefore, arguments that use matters of fact will be circular, without exception. So, Hume must conclude that matters of fact cannot be used to prove the uniformity of nature by reason either.

Hume concludes:

> Thus, not only our reason fails us in the discovery of the *ultimate connexion* of causes and effects, but even after experience has inform'd us of their *constant conjunction*, 'tis impossible for us to satisfy ourselves by our reason, why we shou'd extend that experience beyond those particular instances, which have fallen under our observation.
> (T, 1.3.6.11, p. 91-92)

Hume states that reason is not and cannot be the foundation for inductive inference. By concluding this, Hume undermines the validness of all knowledge obtained by induction. However, it was not Hume's mission to undermine the scientific progress which has been made thus far. He admits that it is naturally logical to expect similar effects when given similar causes. In the *Enquiry*, Hume seeks a motive of "equal weight and authority" as reason to justify the use of the assumption, which the uniformity of nature seems to be. Hume concludes, then, that this motive is "custom" or "habit". The mind is inclined to expect regularity in the future, when one has seen similar objects or events constantly conjoined.

Therefore, one may conclude that we may never know whether the causes of nature will have the same effects over time. The only thing one does when assuming the regularity of nature, is following a habit or custom.

5.2 Mill on Hume's Problem

In Mill's *System of Logic* there is a brief reference to Hume's problem. This is written in Book III, chapter III (Of the Ground of Induction), paragraph 1. Moreover, in the Introduction written by R.F. McRea (CW, vol. VII) there is also a short analysis of Mill's response to Hume's problem. In this paragraph, there will be a brief description of what McRea has written about Mill's account of Hume's problem.

According to McRea (CW, vol. VII), it is widely thought that Mill was not too bothered about arguing in a circle, as happens when one tries to prove the uniformity of nature by induction. For Mill, the uniformity of nature is, just as Hume claims, the general axiom of induction. However, Mill adds that this principle itself is an instance of induction. He argues that the uniformity of nature is a great generalization founded by prior generalizations of inferior magnitude. Mill, moreover, argues that one will not attain general laws before discovering a multitude of phenomena that affirm corresponding, particular laws. Finally, and most importantly, Mill states that the principle is not something within induction that helps to prove the thing in question; rather it is a necessary condition of it being proved. For Mill, the uniformity of nature is the "ultimate major premise of all induction" when transforming an induction to the form of a syllogism. Therefore, the principle stands as the major premise stands to the conclusion of a syllogism and, as a result, the principle is solely a necessary condition. Mill ends his argument with stating that not a single conclusion may be proved, for which the major premise is false.

The key notion, McRea argues, is that for Mill an induction is made valid by the evidence from the particular facts alone. Hence, the validness of the syllogism is not dependent on the major premise. For example: "All men are mortal" (major premise) and "Socrates is a man" (minor premise). In this example, detecting the attributes of being a man is sufficient to make the inference to mortality. Moreover, past experiences of mortality "authorizes" us to infer both the major and the minor premise. The mortality of Socrates is not an inference from the mortality of all men; it is an inference from the experience that proves the mortality of all men. This shows that the evidence in the minor premise alone, not together with the major premise, accounts for the validness of the inference. This will also hold for the induction where the major premise is that of the uniformity of nature, according to McRea. Therefore, McRea claims, there is no circularity in Mill's argument.

In my honest opinion, I feel like Mill missed a chance to really address Hume's problem. McRea argues that, indeed, Mill's argument does not contain any circularity. However, stating that the major premise, in this case the uniformity of nature, is not of any influence on the validness of the induction, is a rather convenient way to not address the real question at hand. It is true that an induction *an sich* may be valid, although the major premise is not true. This, however, does not mean that the induction as a whole would be of any value in acquiring proper knowledge. Hence, Mill missed an opportunity to solve Hume's problem and one may remain skeptical about the very foundation of induction as an adequate instrument to acquire certain, proper knowledge.

This stance is supported by Goddon (2014). As Goddon claims, it seems that Mill finds its rescue in a naive naturalism. Instead of looking for a deeper justification of induction as a proper form of logic and reasoning, Mill claims that induction is nevertheless a primitive source of justification. Therefore, a logician should concern himself with the supply of a set of criteria or tests that can determine the difference between good and bad inductive inferences, according to Mill. He asks himself the question why some inductions suffice with just a single instance, while others need myriads of instances and do not move towards establishing a universal proposition. Mill felt that the answer to this question was of upmost importance for a logician, and for that reason, he felt it was necessary to search for the answer to this question, rather than seeking the justification of the uniformity principle.

6 Conclusion

Briefly summarizing, first there has been a short overview of the state of scientific philosophy before John Stuart Mill's book *System of Logic* was published. Subsequently, the core of *System of Logic* has been summarized. This consists of a brief introduction in ratiocinative logic and what induction in general is. Moreover, the most important techniques that John Stuart Mill presented in his book *System of Logic* have been displayed. In Section 4 the famous Mill-Whewell debate has been elaborated on. First the stance of Whewell is explained, whereas Mill's reaction to Whewell's point of view is presented in the last part of this Section. The last Section of this thesis may be regarded as the most critical towards Mill's System of Logic. In this Section a critical, skeptical stance is introduced. This skeptical stance, in particular Hume's problem, is not accounted for by Mill, as shown by this thesis. More specifically, for skeptics, Mill has not solved Hume's problem, and therefore, the question if induction can lead to certain, proper knowledge was still open after the *System of Logic*. Nevertheless, one could say that Mill did an outstanding job in formalizing the Inductive methods of scientific inquiry.

In my opinion, I think that Mill missed an opportunity to really address Hume's problem in his book. By not properly addressing such a great point, which is the foundation of the adequacy of induction, is in my eyes either ignorance or it shows that Mill was seeking to avoid the problem. Either way, it would have strengthened the *System of Logic* if Mill had addressed the problem in an adequate manner, or had stated that he did not want to elaborate on it, because he, frankly, did not know the solution to the problem.

7 References

Buchdahl, G. (1971). Inductivist versus deductivist approaches in the philosophy of science as illustrated by some controversies between Whewell and Mill. The Monist, 55(3), 343-367.

Butts, R. E. (1993). Whewell's logic of induction. In Historical Pragmatics (pp. 235-267). Springer, Dordrecht.

Goddon, D. M. (2014). Mill's System of Logic, The Oxford Handbook of British Philosophy in the Nineteeth Century.

Henderson, L. (2019). "The Problem of Induction", The Stanford Encyclopedia of Philosophy (Winter 2019 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2019/entries/induction-problem/>.

Hume, D. (1739). A Treatise of Human Nature (T), Oxford: Oxford University Press.

Hume, D. (1748). An Enquiry Concerning Human Understanding, Oxford: Oxford University Press.

Kant, I. (1787). Critique of pure reason.

Mill, J. S. (1963–91). The Collected Works of John Stuart Mill (CW), 33 vols., J. M. Robson (ed.), Toronto: University of Toronto Press. Retrieved 9-12-2019 from the World Wide Web: https://oll.libertyfund.org/titles/165

SparkNotes Editors. (2005). SparkNote on John Stuart Mill (1806–1873). Retrieved 3-12-2019, from the World Wide Web: http://www.sparknotes.com/philosophy/mill/

Snyder, L. J. (1997). Discoverers' induction. Philosophy of Science, 64(4), 580-604.

Snyder, L. J. (2019). William Whewell, The Stanford Encyclopedia of Philosophy (Spring 2019 Edition), Edward N. Zalta (ed.). Retrieved 16-12-2019 from the World Wide Web: https://plato.stanford.edu/archives/spr2019/entries/whewell/

Stewart, D. (1821). Elements of the Philosophy of the Human Mind, vol. ii, Boston: Wells Lilly

Strong, E. W. (1955). William Whewell and John Stuart Mill: their controversy about scientific knowledge. Journal of the History of Ideas, 209-231.

Whately, R., (1870). Elements of logic. Longmans, Green, Reader and Dyer.

Whewell, W., (1849). Of Induction: With Especial Reference to Mr. J. Stuart Mill's System of Logic. JW Parker.

Whewell, W. (1858). History of scientific ideas (Vol. 1). JW Parker and son.

Whewell, W., (1858). Novum Organon Renovatum (Being the Second Part of the Philosophy of the Inductive Sciences), 3rd edn., London: John W. Parker Son.