

Without Miracles

6 The Origin and Growth of Human Knowledge

- [Knowledge by Recollection](#)
 - [Knowledge Provided by a Benevolent God](#)
 - [Knowledge Instructed by the Senses](#)
 - [The Importance of Prior Knowledge](#)
-

Providence

Now, if the truth of things is always in our soul, the soul is immortal. So it is right to try boldly to inquire into and recollect what you do not happen to know at present--that is, what you do not remember.

--Plato[1]

Instruction

Let us then suppose the mind to be, as we say, white paper; void of all characters, without any ideas:-- How comes it to be furnished? Whence comes it by that vast store which the busy and boundless fancy of man has painted on it with an almost endless variety? Whence has it all the materials of reason and knowledge? To this I answer, in one word, from experience.

--John Locke[2]

Selection

Our categories and forms of perception, fixed prior to individual experience, are adapted to the external world for exactly the same reasons as the hoof of the horse is already adapted to the ground of the steppe before the horse is born and the fin of the fish is adapted to the water before the fish hatches.

--Konrad Lorenz[3]

Since the time of Socrates, the study of the origin, nature, validity, and limits of human knowledge has been of much interest to philosophers. This field of inquiry, referred to as epistemology,[4] continues to be a major focus of philosophy today. Here we will examine the major approaches that philosophers have taken to attempt to account for the puzzle of fit between knowledge and our universe, and explore the extent to which these approaches can be understood as providential, instructionist, and selectionist explanations for human knowledge.

Knowledge by Recollection

Plato, who lived in Athens during the fourth and fifth centuries b.c., provides us with the first written discussions concerning the origin of knowledge. His philosophy was very much influenced by his belief that knowledge seems to go well beyond what we can learn about the world through our senses. For example, we can imagine (and therefore must possess knowledge about) a perfect circle despite the fact that we have never seen one, since any

particular circle will, on close examination, reveal imperfections. Plato thus reasoned that the world we see, hear, smell, and touch cannot be the sole source of our knowledge, since although we can imagine perfect circularity, goodness, beauty, or justice, no particular object or event in our experience can ever be a perfect instance of such a quality. The problem of understanding how we can know so much, given our limited sensory experiences of particular objects and events, has been referred to as "Plato's problem" by the influential American linguist Noam Chomsky.[5]

A related problem concerning the source of knowledge appears in Plato's dialogue between Socrates and Meno. In their conversation concerning the nature of virtue, Socrates' friend begins to doubt the utility of their inquiry and presents an intriguing dilemma:

And how will you enquire, Socrates, into that which you do not know? What will you put forth as the subject of enquiry? And if you find what you want, how will you ever know that this is the thing which you did not know?[6]

Meno is in effect asking, if you don't already possess the knowledge you are looking for, how will you know when you have found it? And if you *do* know what knowledge you are seeking, then mustn't it be the case that you already possess the knowledge in question and therefore have no need to look for it? Socrates recognizes the essence and importance of Meno's question and paraphrases it thus:

I know, Meno, what you mean; but just see what a tiresome dispute you are introducing. You argue that a man cannot enquire either about that which he knows, or about that which he does not know; for if he knows, he has no need to enquire; and if not, he cannot; for he does not know the very subject about which he is to enquire.[7]

To appreciate fully Meno's dilemma, we have to make a distinction between two kinds of knowledge. Clearly, one can be ignorant of a certain fact or piece of information, make an attempt to find it out, and, if successful, be quite certain that what was found out was what one had wanted to know in the first place. For example, it is easy to imagine not knowing the telephone number of an acquaintance, looking it up in the telephone directory, and then knowing that the number so found is indeed what one wanted to know. In this case what we seem to be doing is simply filling in a specific piece of *factual* knowledge. However, since Meno's question arose in the context of discussing the nature of virtue, it is obviously not this kind of factual knowledge he and Socrates found troublesome. That problem has to do with *conceptual* knowledge.[8] If you do not already know what virtue is, how will you ever discover its meaning? Now, if virtue is simply some combination of other concepts already well understood, say a mix of one-third goodness, one-third fairness, and one-third moral strength, it may be the case that you could simply be told what virtue is with respect to these other concepts and thereby acquire a new concept. However if, as is usually the case for concepts, there is no generally agreed upon way to define a new concept as some easily understood combination of old ones, the full force of Meno's dilemma becomes apparent.

Let us look at another example in what is perhaps the more familiar context of a child learning to add.

Children in the preschool years have been found to make a transition, without any instruction, from a crude addition algorithm to a more efficient one. . . . According to the earlier algorithm, the problem of $4 + 3 = ?$ is solved by a procedure analogous to counting out four blocks, then three blocks, and then counting the combined set. A more advanced algorithm consists of starting with four and counting three more. A key step in this transition is eliminating the counting out of the first

addend. To attribute this step to some kind of insight--to "realizing" or "seeing" that counting is unnecessary because the resulting number is already given--is, of course, to tumble right into the learning paradox [that is, Meno's dilemma]. *For such an insight presupposes an understanding of the more sophisticated procedure in advance of discovering it.*[\[9\]](#)

This pattern of behavior was demonstrated by my son when he was about four years old in his interaction with a computer program designed to teach addition. To teach $4 + 3 = 7$, the computer program would display images of four objects (say, puppies) in a box on the left side of the screen with three like objects in a box on the right side. Above the images was the equation " $4 + 3 = ?$ " with the number "4" directly above the box containing the four puppies and the number "3" directly above the box containing the three puppies. Although my son had no difficulty counting all the puppies and coming up with the right answer, he initially used the first, inefficient procedure described above of counting all the puppies instead of just looking at the first "4" of the equation and then continuing to count the three objects on the right as "5, 6, 7." After a few such solutions, I could not resist pointing out to him that there was no need to count the first set of objects since he could just use the number provided. I was initially pleased to see that my son was able to make use of this more efficient strategy, but then quickly dismayed to discover that he didn't seem to realize that the answer obtained using this new method was the same as that obtained by counting all the objects! So left on his own he returned to the less efficient method he understood, only to move back spontaneously within a few days to the more efficient method, this time with an understanding of the correspondence between ordinality and cardinality that he somehow managed to acquire on his own. Just how he was able to acquire this new knowledge constitutes the crux of Meno's dilemma.

Bereiter's dismissal of *insight* in the quotation above as a solution to the problem is of particular interest here, and we will consider in chapter 9 how this word raises important issues concerning the origin and growth of knowledge. Let us for now simply note that making an appeal to insight as a type of foresight, foreknowledge, prescience ("to know before") or clairvoyance does nothing to solve Meno's dilemma. It would imply that the knowledge in question was somehow already available to the child, and therefore what seemed to be *new* knowledge was instead actually *old* knowledge.

But this is exactly the unsatisfactory answer that Plato (through the character of Socrates) offers. Since Socrates was devoted to the pursuit of knowledge, he could not leave Meno unanswered. He provides not only a response, but first a demonstration of how Meno's slave boy, having never been educated in geometry, is nonetheless able to solve a problem concerning the area of a square by answering a series of questions. Socrates takes the results of this demonstration as evidence that the slave boy *must already have known* the fundamentals of geometry, and that since these were not learned during his present life as an uneducated slave, they must have been acquired during some previous existence of the boy's soul. Thus Plato, through Socrates' demonstration and response, argues that all knowledge is in essence remembered or *recollected*, a view that is known in philosophy as the doctrine of recollection, or to use the Greek word, *anamnesis*. As Plato explains:

Now, if the truth of things is always in our soul, the soul is immortal. So it is right to try boldly to inquire into and recollect what you do not happen to know at present--that is, what you do not remember.[\[10\]](#)

Plato's view that all knowledge is simply recollected may have seemed reasonable at the time. We see today, however, that it is seriously deficient in a number of important respects, of which we will consider just two. First, the doctrine of recollection does not adequately address the core of Meno's original question, since substituting the words *recollect* and *recollection* for *inquire* and *inquiry* in the original shows that the essence of the original

dilemma remains. In other words, if you don't already know what you are trying to remember, how will you know when you have indeed remembered it? And if you *do* know what you are trying to remember, then it must be the case that you already have access to the knowledge in question and therefore have no need to remember it!

Second, and perhaps of greater importance, the doctrine of recollection does not address the issue of the *origin* of knowledge. If Meno had wished to continue his discussion with Socrates, he might have asked where the soul obtained its knowledge in the first place. From Plato's other writings, it is quite clear that Socrates would have answered that the soul is immortal and therefore its knowledge simply has no beginning and no end. So we see that Plato's proposed solution to the question of the origin of knowledge is a providential one, with no beginning and no end in much the same way that religions view the existence of God.

Knowledge Provided by a Benevolent God

The scientific revolution that began in Europe at the end of the Middle Ages was accompanied by increasing interest in the problem of knowledge, particularly the problem of the reliability of our perceptions of our surroundings. Is the universe actually as it appears to be? Can we trust our senses that fire is hot, that water is wet, and that rocks are hard? Or are these impressions merely illusions, perhaps in the way that our dreams appear to be? Although science was beginning to make remarkable progress at this time, its achievements were accompanied by a fair amount of philosophical skepticism concerning the truth and accuracy of the laws of nature being discovered. Are these scientific laws to be completely trusted, or are they illusions or at best only *likely* to be true or only *approximately* true? The first person in Renaissance Europe to consider these issues seriously was René Descartes, who lived from 1596 to 1650.

Descartes began with a skeptical view of human knowledge and hoped to prove by his "method of doubt" that we can indeed trust our impressions of the physical world. His thinking on this matter can be summarized as follows. First, he realized that all his knowledge was subject to doubt, *except* the knowledge that, to doubt in the first place, there must certainly be a doubter. From this reasoning arose his famous dictum, *cogito, ergo sum* ("I think, therefore I am"). Second, Descartes convinced himself that something external to himself exists. He reasoned that the cause of anything must have as much perfection as what it has caused. Therefore, since he was able to imagine an entity that is the perfect instantiation of all that is good, such an entity (that is, a perfectly good God) must truly exist. The third and final step in Descartes's method was to conclude that a benevolent God would not deceive. Therefore we can be confident that our impressions of the world do indeed correspond to what is really there.

Descartes consequently believed that God played an indispensable role in human knowledge. Not only does God provide assurance that the world we experience corresponds to the world that truly exists, He also provides us with certain innate ideas that are not in any way based on experience, for example, the very idea of God itself, and other abstract concepts such as beauty, goodness, justice, and virtue. Because Descartes's epistemology depends crucially on the knowledge and assurance provided by an all-knowing and benevolent God, it is, like Plato's, a providential view. But to the extent that our knowledge also depends on information gathered by our senses, it is also an instructionist view in which the reliability and validity of sensory instruction are certified and guaranteed by God Himself.[\[11\]](#)

Descartes's arguments have since been much criticized, especially his proof of the existence of a benevolent and all-knowing God, but they are widely regarded as marking the beginning of modern philosophical thought. The

belief that the basis of human knowledge cannot reside solely in sensory experience is still considered a key insight. And the quest to provide a justifiable and rational basis for knowledge is very much alive in philosophy today.

Knowledge Instructed by the Senses

Three British philosophers who lived during the seventeenth and eighteenth centuries developed theories that are in striking contrast to the providential epistemologies of Plato and Descartes. Since they all emphasized the role of sensory experience in the acquisition of knowledge, they are referred to as the British empiricists.[\[12\]](#)

The first of these, Englishman John Locke (1632-1704), completely rejected the concept of preexisting innate ideas and argued that all knowledge has its origin in sensory experience. To him the mind at birth was like a blank slate, a *tabula rasa*. To repeat part of Locke's epigraph used at the beginning of this chapter:

Let us then suppose the mind to be, as we say, white paper, void of all characters, without any ideas:--How comes it to be furnished? . . . Whence has it all the materials of reason and knowledge? To this I answer, in one word, from experience.

It was therefore the sensory experiences provided by vision, hearing, smell, and touch that wrote on the mind, leaving impressions that would then be our knowledge of the world. Since Locke saw the role of sensory experience as that of transmitting knowledge to the mind from the outside world, his epistemology is essentially nonprovidential and instructionist.

But although he believed that the senses were the origin of all human knowledge, he did not assume that they provide accurate knowledge concerning all aspects of the external world. He made a distinction between what he called the *primary* and *secondary* qualities of things, the primary including shape, weight, number, and movement, and the secondary including color, taste, smell, texture, and temperature. He believed that our senses provide accurate knowledge about the primary qualities so that, for example, if we see or feel a round object, it is the case that the object actually is round. But this is not the case for the secondary qualities (such as the taste or color of a lemon) since these are sensations produced by an object and do not reflect the properties of the object itself.

Locke's idea of secondary qualities was an important recognition that not all our perceptions of the external world necessarily indicate the actual state of the world. But in making this admission, he opened the way for others to doubt that our perceptions correspond to anything in a real, material world at all. One such philosopher was the Irish-born Anglican Bishop George Berkeley, who lived from 1685 to 1753. Like Locke, he believed that all knowledge was based on sensory experience. However, whereas Locke insisted that our perceptions of primary qualities provide knowledge about what the external, physical world is really like, Berkeley logically concluded that it is not possible to check whether any of our perceptions accurately correspond to a real world. If all we can ever know about the world are our perceptions of it, how can we ever know whether any of our perceptions actually do correspond to physical objects and events?

Berkeley's conclusion was simply to deny that an independently existing, physical world exists. This was in some respects a quite logical continuation of the train of thought begun by Locke, and this immaterialist, idealist philosophy makes even more sense when it is realized that the primary purpose of the bishop's writings was to argue against "skepticism, atheism, and irreligion." According to Berkeley, what we experience through our senses is due to the direct action of God, and so it is through the senses that God communicates with us and

informs us as to what things are good for us and what are harmful. As one contemporary critic of Berkeley put it, "Roughly speaking, [Berkeley's] immaterialism is what you get if you start off with Locke's picture and replace matter by God."[\[13\]](#) We therefore see that Berkeley's epistemology is both providential, in that all knowledge is provided by God, and instructionist, in that all knowledge is transmitted to us through the senses.

Scottish philosopher David Hume (1711-1776) was the last of the three British empiricists and arguably the most interesting, troubling, and influential. He was very much impressed by Newton's success in discovering laws of physics, and attempted to apply Newton's experimental method to understand the content and abilities of the human mind and to create a method for discovering truth.

However, Hume's attempt to be scientific and empirical in his search for truth led him to an inescapable and distressing conclusion. Locke believed that from our experience of the world we can know that an external world exists and know at least some of its actual characteristics. Berkeley concluded that we can know only that our ideas and God exist. Hume, almost in spite of himself, reasoned that we cannot claim to know anything about an external world (or even if it exists), about God, or about our own mind.

Like Berkeley, Hume recognized that we can never know the external world directly since all that we know of such a world are our sensory perceptions of it and the ideas that these perceptions generate. But unlike Berkeley who consequently rejected belief in a material world, Hume insisted that by our very nature we are *compelled* to believe that external objects exist despite the fact that such belief is clearly irrational. His conclusion is therefore essentially that humans are at the core irrational in their beliefs that sensory experiences can reveal to them anything of an external, material world.[\[14\]](#)

Let us be a bit less skeptical for at least a moment and accept for the sake of argument our intuitions that a world of real objects exists independent of our experience of them, and that our perceptions provide generally accurate information about the world. If we grant this much, can we not establish an empirical basis for knowledge? Unfortunately not, as Hume demonstrated in pointing out the problem of induction. Induction refers to the process by which we derive general knowledge based on observations of a limited number of instances. For example, after having eaten bread a few times, one might be expected to believe that bread is an edible and nourishing substance, and not hesitate to eat it in the future. That is, if the bread that one has eaten so far has been nourishing, one might well conclude that *all* bread is nourishing. This seems reasonable enough until one realizes that no matter how much nourishing bread one eats, this can in no way guarantee (or even make it probable) that some bread somewhere is *not* nourishing. Indeed, the bread baked by the local baker tomorrow could possibly be contaminated with the ergot fungus, resulting in bread that could cause illness.

The problem of induction as raised by Hume had, and continues to have, a significant impact on epistemology, particularly on the philosophy of science. In essence, Hume realized the impossibility of an instruction-dependent explanation of knowledge in that no amount or kind of sensory experience (which, even if trustworthy is always limited to a particular time, place, and context) could ever result in certain, justifiable knowledge in the form of universal generalizations or laws of nature. In essence, he could not escape from the conclusion that all human knowledge must be *fallible*, and that no kind or amount of experience, logic, or reasoning could be trusted to eliminate the possibility of error. In this sense, he effectively destroyed empiricism by revealing the irrationality of human belief based on sensory experience and reflections on this experience. As Bertrand Russell, British philosopher, mathematician, social reformer and Nobel laureate in literature noted, "the growth of unreason throughout the nineteenth century and what has passed of the twentieth century is a natural sequel to Hume's destruction of empiricism."[\[15\]](#)

Although this chapter is meant to be philosophical, it should be noted before leaving this section that much psychological research has revealed the inadequacy of the empiricist view that our senses provide us with trustworthy information about the world. Perceptions of the same object can vary from person to person, and even within the same person. The chemical phenylthiocarbamide (PTC) has an unpleasant taste for some people and no taste at all for others. Plunge your right hand into a container of hot water and your left hand into one of cold water. After 15 seconds or so, place them both into the same container of warm water and the very same water will feel simultaneously cold (by the right hand) and warm (by the left hand). Observe an oar that has been placed at an angle in water and it will appear bent, although you know that it is straight. The three visual illusions in figure 6.1 show objects that appear to be of different lengths and sizes although a ruler indicates they are actually the same. Many other examples of how we can be fooled by our senses could be given, and of course a magician's livelihood depends on such misperceptions. We will also see in chapter 11 how our understanding of spoken and printed words may depend as much on our expectations and prior knowledge as on the actual words themselves. Add to this the problem of induction raised by Hume, and it should not be surprising that few philosophers consider sensory experience to be an absolutely reliable source of knowledge of the external world.



The Importance of Prior Knowledge

Prussian philosopher Immanuel Kant (1724-1804) was also concerned with the problem of human knowledge and attempted to show how human reason could lead to objectively valid knowledge despite the problems raised by Hume. Kant admitted that it was Hume who caused him to awaken from his "dogmatic slumber."[\[16\]](#) He came to the conclusion that neither coherent experience nor knowledge of the world would be possible without prior ("a priori") possession of certain types of knowledge.

This preexperiential knowledge includes concepts of space, time, and causality. Kant concluded that we cannot possibly gain knowledge about the world without at least some guiding prior knowledge about what to expect. Accordingly, we naturally expect that events take time, that objects take up space, and that if event A always precedes event B (and A and B are irreversible), A is the cause of B. Because these are concepts that we cannot gain from experience, since our very experience of the world depends on them in the first place, and since Kant knew nothing about how a selectionist process can generate new knowledge, he could not and so did not attempt to explain the origin of such a priori knowledge. In this respect, his view of knowledge can also be considered both providential and instructionist since knowledge of the world results from the interaction of mysteriously provided a priori knowledge with instructionist sensory experiences.[\[17\]](#)

In our pursuit of a naturalistic, nonmiraculous account of the knowledge that appears to be prior to sensory experience, we once again meet Konrad Lorenz, who, in addition to his important contribution to the understanding of the evolution of animal behavior, made an important contribution to epistemology. In a paper first published in 1941, he argued that the necessary a priori knowledge, including concepts of space, time, and causation, is actually the product of the biological evolution of the human nervous system.[\[18\]](#) As such, this knowledge does not result from the limited experience of an individual but rather is the hard-won product of the long and arduous evolution of our species. Thus Lorenz states that "all laws of 'pure reason' are based on highly physical or mechanical structures of the human central nervous system which have developed through many eons like any other organ."[\[19\]](#)

This use of biological evolution as an explanation for human knowledge has three important consequences. First,

Lorenz is able to account for the fit of human knowledge to its environment without falling back on the providential and instructionist explanations of the philosophers who preceded him. Second, an evolutionary perspective responds to the challenge of Plato's problem, that is, how is it that we are able to know so much despite our limited personal experiences of the world. According to Lorenz, this is possible since biological evolution endows us with a central nervous system that reflects past knowledge obtained through the natural selection of our ancestors, and that is consequently not limited to the experience of the individual. Finally, Lorenz concludes that since human knowledge evolves from an interaction of the species with its environment, it must, at least in some important respects, reflect the environment in which it evolved. In this way he stands opposed to those who assert that what we seem to know of the world may in fact be simply an illusion bearing no resemblance to reality. To repeat another chapter epigraph:

Our categories and forms of perception, fixed prior to individual experience, are adapted to the external world for exactly the same reasons as the hoof of the horse is already adapted to the ground of the steppe before the horse is born and the fin of the fish is adapted to the water before the fish hatches. [20]

Lorenz's evolutionary account of the fit of human knowledge to its environment relies on Darwinian selection operating between organisms, and thus leads to a primarily innatist view. But others have extended Darwinian cumulative variation and selection to knowledge processes occurring *within* humans. It is in this framework that the evolutionary epistemologies of Sir Karl Popper and Donald T. Campbell are found. Discussion of their ideas will be saved for chapters 9 and 10 where thoroughly selectionist views of knowledge, thought, and science are presented.

This admittedly cursory discussion of how philosophy has dealt with the puzzle of fit of human knowledge to its environment cannot pretend to do justice to the vast amount of thought devoted to this issue. Nevertheless, we have touched on the major themes and approaches since Plato's time, and detected a trend from providential to instructionist to selectionist epistemologies. Before Darwin, philosophy had essentially two ways of accounting for human knowledge--providence and instruction. Plato's doctrine of recollection is a rather pure providential epistemology. Locke's and Hume's empiricism emphasizes sensory-based instruction of knowledge from the environment to the individual. Hume recognized the essential irrationality of such knowledge. And the epistemologies of Descartes, Berkeley, and Kant are based on a mixture of both providentialism and sensory instruction.

It was only after Darwin's revolutionary theory became known that a third perspective was imaginable; namely, that human knowledge owed its origin and development to something other than providence or instructive sensory experience. Although certainly no philosopher himself, Darwin made possible a reconceptualization of knowledge as a type of adaptation of the brain to its environment, an adaptation resulting from the same processes of cumulative blind variation and selection that underlie the adaptation of other biological structures and behaviors. Both Lorenz and Popper present such an evolutionary epistemology, although this Darwinian perspective is embraced by only a small minority of philosophers today. As evolutionary biologist Ernst Mayr observed:

No one resented Darwin's independence of thought more than the philosophers. How could anyone dare to change our concept of the universe and man's position in it without arguing for or against Plato, for or against Descartes, for or against Kant? Darwin had violated all the rules of the game by placing his argument entirely outside the traditional framework of classical philosophical

concepts and terminologies. . . . No other work advertised to the world the emancipation of science from philosophy as blatantly as did Darwin's *Origin*. For this he has not been forgiven to this day by some traditional schools of philosophy. To them, Darwin is still incomprehensible, "unphilosophical," and a *bête noire*.[\[21\]](#)

Mayr makes an interesting point here, but he goes too far in implying that many philosophers find Darwin's selectionist theory of evolution incomprehensible. Instead, the philosophers who take the time to reject explicitly an evolutionary epistemology are invariably well acquainted with Darwinian selectionism. However, they advance reasons why they believe that the processes underlying the growth of human knowledge are very different from the those underlying adaptive organic evolution (some of their reasons will be considered in the last two chapters).

It does appear that an evolution-inspired epistemology is resisted by many philosophers because it is inconsistent with their attempts to establish an infallible, justifiable foundation for human knowledge. In this sense, the continually reappearing themes of providentialist rationalism and instructionist empiricism can be seen as attempts to find some bedrock, some firm base on which to base our knowledge, whether it be infallible prior knowledge, God, or completely trustworthy sensory experience. An evolutionary, selectionist epistemology cannot provide such a foundation since selectionist processes are not foresighted and give no guarantee of errorless fit, especially not with future environments not yet encountered.

Yet just such a selectionist perspective is the basis for an alternative epistemology that avoids the problems of providential and instructionist epistemologies while at the same time accounting for the increasingly better fit of our knowledge to the world. Because of this, a selectionist, Darwin-inspired epistemology has gained many proponents over the last century.[\[22\]](#) This trend toward a selectionist account of knowledge growth will likely continue as philosophers become more interested in and familiar with the evolution and development of the human brain and the selection of synapses that, as discussed in the previous chapter, is now believed to underlie all memory and learning.[\[23\]](#) Such complementary selectionist perspectives on learning and thinking are presented in the next three chapters.

[\[1\]](#)Plato, Meno dialogue (1952, p. 183).

[\[2\]](#)Locke (1690/1952, p. 121).

[\[3\]](#)Lorenz (1941/1982, pp. 124-125).

[\[4\]](#)The word *epistemology* is derived from the Greek word for knowledge, *episteme*.

[\[5\]](#)Chomsky (1988b, p. 34).

[\[6\]](#)Plato (1952, p. 179).

[\[7\]](#)Plato (1952, p. 179).

[\[8\]](#)See Petrie (1981, pp. 12-15).

[\[9\]](#)Bereiter (1985, p. 203; emphasis added).

[\[10\]](#)Plato (1952, p. 183).

[11]Descartes's philosophy is often referred to as rationalist epistemology (from the Latin *ratio*, "reason"). Rationalist epistemology stresses the ability of the mind to come to knowledge about the world without the need for (or indeed, despite misleading) sensory experience. It thus stresses the role of reasoning and innate ideas that according to Descartes's preevolutionary philosophy, could be provided only by God.

[12]The word *empiricism* has its roots in the Greek word *empeiria*, which was translated as *experientia* in Latin, and from which is derived the French and English word *experience*. In philosophy, empiricism is the view that we can obtain knowledge of the world through direct sensory experience of it. As such, it can be considered an instructionist epistemology.

[13]Thomson (1964, p. 240).

[14]See Musgrave (1993, chapter 8) for a more detailed discussion of Hume's irrationalism.

[15]Russell (quoted in Popper, 1979, p. 1).

[16]Walsh (1967, p. 306).

[17]Although Kant did not make explicit use of divine providence in his epistemology, he wrote, "When we speak of the totality of nature, we must inevitably conclude that there is Divine regulation" (quoted in Lorenz, 1941/1982, p. 142).

[18]Lorenz (1941/1982).

[19]Lorenz (1941/1982, p. 127).

[20]Lorenz (1941/1982, pp. 124-125).

[21]Mayr (1966, pp. ix-x).

[22]See Cziko & Campbell (1990) for nearly 1000 references related to evolutionary epistemology.

[23]Munz (1993) and Plotkin (1994) provide additional arguments for a selectionist, Darwin-inspired epistemology.