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Some Precursors of Popper's Evolutionary Theory of Knowledge

Miles Groth

1. Introduction

In several ideas held by his predecessors Karl Popper found the elements of a radically new epistemology. In this paper, I will examine three of those ideas in the context of presenting the final form he gave his evolutionary epistemology. I will also offer some critical discussion of several of Popper's conjectures. He would have been pleased with that. I will pay special attention to the part played by language in Popper's epistemology.

Popper's account of organized intellectual activity, including science, includes the inevitability that any theory (hypothesis or conjecture) generated by means of it must be tentative. Accordingly, this characterization of knowing must also hold for Popper's own version of evolutionary epistemology. It is to be expected therefore that his theory of evolutionary epistemology changed and that the transformations and refinements of his theory are an example of the growth of knowledge.

The term "evolutionary epistemology" was applied to an aspect of Karl Popper's work in 1974. "So far as I know," wrote Popper, "the term 'evolutionary epistemology' is due to my friend Donald T. Campbell."[1] "Donald Campbell called my epistemology 'evolutionary' because I look upon human language, upon human knowledge, and upon human science, as a product of biological evolution, especially of Darwinian evolution through natural selection."[2] By 1989, however, Popper had rejected the term and favored instead the expression "evolutionary theory of knowledge": "I now feel that 'Evolutionary Epistemology' sounds pretentious, especially since there exists a less pretentious equivalent."[3] Yet even in 1974 he had entitled his response to Campbell's essay "Campbell on the Evolutionary Theory of Knowledge."[4] In his otherwise supportive response to what he terms Campbell's "beautiful essay," Popper notes that evidently Campbell does not share his "predilection for world 3."[5] As we will see, the biologist and scientist in Popper always deferred to Popper the philosopher because of the priority of world 3 entities in his cosmos. Campbell remains a thoroughgoing behaviorist of Skinnerian stripe, whose interests lie entirely in World 1 entities, even when they are being explored to explain World 2 entities, while Popper is, to use the now traditional term current since the middle of the 19th century, an epistemologist.[6]

Popper's conception of human *descriptive* language sets him apart from the theoretical biologists and psychologists.[7] He excuses Campbell's having missed his emphasis on the central place of language in his theory of knowledge by conjecturing that Campbell "may have been reluctant to say more," but I think Popper's graciousness hides an unwillingness to suggest that Campbell is no philosopher after all. Part of his response may be explained by

Popper's own gratitude for the recognition of his work by a man of Campbell's reputation and stature in the world of academic psychology and the social sciences. Of the theory of evolution itself, Popper wrote that he did "not think highly of the theoretical or explanatory power of the theory of evolution": "I have come to the conclusion that Darwinism is not a testable scientific theory, but a *metaphysical research programme* — a possible framework for testable scientific theories."[8] He uses the term 'Darwinism' "for the modern forms of this theory, called by various names, such as 'neo-Darwinism' or (by Julian Huxley) 'The Modern Synthesis'."[9]

With these considerations in mind, we may now ask why Popper nonetheless welcomed the suggestion that his epistemology is an evolutionary theory of knowledge. I will look for some answers to this question in two of Popper's late lectures: "Evolutionary Epistemology," which was given in conjunction with a conference on "Open Questions on Quantum Physics," held in 1983, in Bari, Italy, and "Towards an Evolutionary Theory of Knowledge," which was given to alumni of the London School of Economics in 1989. In these texts, we may expect to find Popper's most considered thoughts about his evolutionary theory of knowledge. When appropriate, I will refer back to earlier papers for clarification.

2. The Bari Lecture

In the Bari lecture, delivered on May 7, 1983, Popper outlined his evolutionary epistemology in the form of five theses. The fourth thesis constitutes his now familiar *responsio* to "the justificationist and observationist

philosophy of knowledge."[10] I will not consider it here and omit it from the following group.

> [1] The evolution of scientific knowledge, and also the ability to produce scientific knowledge, are the results of natural selection. They are closely connected with the evolution of a specifically human language.[11]
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> [2] The evolution of scientific knowledge is, in the main, the evolution of better theories ... through natural selection: [the theories] give us better and better information about reality. (They get nearer and nearer to the truth.)[12]
>
> [3] What enables a human scientist ... to go beyond the amoeba is the possession of ... the specific human language.[13]
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> . . .
>
> [5] ... in the evolution of man, the descriptive function of human language has been the pre-requisite for critical thinking: it is the descriptive function that makes critical thinking possible.[14]

To begin with, it seems clear to me that Popper understands natural selection as a strictly "biological" process in the evolution of scientific knowledge, although he admits that there are problems with the very concept of natural selection. These are due to the epistemological status of the theory of evolution itself.[15] When he says that theories are accepted and rejected in the way variations in a living organism are selected or rejected, he implies that some kind of "plastic" modification in the body of

knowledge human beings have has occurred. In other words, a quantitative change in knowledge can be ascertained, just as a quantitative change in tissue and tissue structure can be observed and measured as an organism evolves over time. While evolution and natural selection may be conceptual entities that cannot be measured the way a bodily organ can be measured, the results of the evolution of scientific knowledge have a kind of reality that is just as powerful and that can create effects which have consequences for the physical world (including human beings) that are as great as events such as earthquakes, tidal waves, or the proliferation of viruses. I think that, ultimately, Popper would judge the evolution of both physical structures and scientific knowledge in terms of its impact on living things. In short, while Popper has problems with the theory of evolution and natural selection, he assumes that it works in an analogical way in the physical world (what Popper calls World 1) as it does in the world of knowledge (what he calls World 3). I will discuss the meaning and importance of Popper's three world view (trialism) for his evolutionary epistemology in the next section of the paper.

Taking the four theses together, Popper's basic idea seems to be that, like organisms evolving in nature, theories develop in the descriptions and arguments of language. To put the analogy more formally, theories are related to descriptive language as living organisms are related to the energy transformations of nature. Just as organisms evolve in nature, theories evolve in speech, that is to say, in sentences written in a natural language or in the expressions of formal languages such as mathematics and symbolic logic. In a certain sense, however, scientists themselves, in their relation to their theories, also occupy the position that nature has in its relation to organisms. In fact, the analogy would seem to hold only as long as being human

and having descriptive language at one's disposal are equivalent.

In Popper's epistemology, what occupies the position corresponding to nature in the process of evolution is thus an interaction of descriptive language and the people who use such language. But, surely, scientists do more than just speak, write, and work out equations when engaged in intellectual activity. All the same, Popper seems to be saying that this is all scientists must be doing when they "do science," and that this is all that the growth of knowledge requires. Just how new theories come to be *proposed* is more difficult to determine. I will return to this question in due course.

3. The Development of Theories

Theories, then, may be compared to variations in the evolution of an organism. If they are selected, they remain current in discussion and survive, but if they are not selected, they drop out as part of the currency circulating in scientific dialogue and debate. Such theories may seem to simply die away, but, in fact, they only enter a kind of suspended animation between the covers of a book or in the hyperspace of a computer chip until their usefulness at some point later on may be reanimated when reality has changed and they re-enter scientific discourse, having been brought back to life in the breath of a speaker or in the ether of being read. From the moment they are formulated, however, theories are permanent inhabitants of World 3.

According to Popper, a newly devised theory either fits what is real or cannot be accommodated by what is real. By "what is real" Popper seems to have in mind the

very same nature that figures in the evolution of living organisms. Critical discussion in a natural language determines what is fitting, but as an "organ" of the human being, language is itself part of nature and therefore part of what is real. Therefore, since any natural language is itself evolving, we may wonder what assurance there is that the fit it is describing can ever be adequate to what it describes. To answer this difficulty, Popper emphasizes the formal languages in which theories are usually expressed and ordinarily draws his examples from physics.

Discussion, however, finally sees fit to eliminate, one after the other, every theory proposed. Thus at the turn of the twentieth century, discussion led to the rejection of the basic physical theories of Newton that had been current for centuries. Popper would expect the same thing to eventually happen to Einstein's physical theories. In fact, he would predict that this must occur as knowledge grows.

For Popper, a theory works in ways that may be compared to the workings of a physical organ such as the eye, which has gradually evolved to accommodate its bearer organism's life in an illuminated, seeable environment. Such an organ would never develop where there is nothing to see, for example, at the bottom of an ocean. Theories appear in response to problems that arise as a result of unpredictable events and the vicissitudes of an ever-changing situation. Nature — that is to say, the characteristics of a given environment — evokes in the organism those adaptations that tend to make its fit more nearly complete. This is sometimes accomplished by a mutation in the organism, for example, by the evolution of an organ for seeing. A complete fit between the organism and the environment would mean that every organ and structure of the organism worked in harmony with the environment.

But since an environment is an ever-changing situation, even given long stretches of evolutionary time, perfection would seem to be unattainable. The inevitable changes of every environment and the serendipitous events occurring in nature preclude complete adaptation to it.

According to Popper, the logic of theory building is also situational. Just as confrontation with the environment produces organismic variation, critical discussion of a theory produces a new theory, which better fits that of which it is proposed to provide an account. A theory's greater approximation to the truth corresponds to the better fit and more complete adaptation of an organism to its environment. Truth would amount to a complete account of what is real, but like perfection in the adaptation of an organism to nature, it would appear to be precluded by the changing meaning of what is real, which is represented in science by the emergence of objections to prevailing theories.

Any single theory is part of the great body of all theories existing at any given time, all of which attempt to account for reality. That body of knowledge inhabits what Popper terms World 3. The body of scientific knowledge is an aggregate comparable to an organism, in which each theory may be compared to a structure of the organism as a whole. Like some organs (for example, the heart), some theories (the specific theory of relativity, for example) are more important than other theories.

For Popper, the evolution of knowledge is in one sense always progressive.[16] The growth of knowledge is a quantitative matter. Even truth, which every theory attempts to attain, is in the end a quantitative consideration. Truth is the characteristic of the extent to which a theory accounts for reality, and *how well* a theory fits reality (a qualitative consideration) is gauged in terms of *how many*

details of the theory correspond to what is real (a quantitative consideration). In another sense, however, the growth of knowledge is not progressive for Popper, since it does not lead anywhere. Nor is it regressive. Rather than thinking of the growth of knowledge in linear terms, Popper sees knowledge as expanding, as though from a single point, like a dilating sphere, although in an irregular way.[17]

In the end, for Popper, scientific knowledge is knowledge for its own sake, acquired in reply to an unending, ever-multiplying series of problems. The number of problems is always at least one more than the number of problems solved. It is as though knowledge, gained in response to the demands of such problems, increases for no other reason than to create (a) further problem(s). The successful and unsuccessful solutions to these problems comprise in part the universe of Popper's World 3.

The adaptations a living organism undergoes are endosomatic. That is to say, they become part of the flesh, for example, of an amoeba, a robin, or a human being. The growth of knowledge, however, occurs through the deployment of descriptive language, which is thought of as an exosomatic organ.[18] The importance of language in Popper's evolutionary epistemology is central. I turn to that topic now.

4. Descriptive Language

"Prior to human descriptive language, all theories could be said to be part of the structure of organisms which were their carriers."[19] In living things that do not have descriptive language at their disposal, which includes all

living things except human beings,[20] the organism literally embodies its theories. Whatever knowledge is produced in such creatures — and there is some of that kind of knowledge in human beings, too, of course — becomes part of the organism's neural mechanisms and morphology. In human beings, however, one organ has evolved that is exosomatic, and that is descriptive language. This organ has the advantage of mutating without directly endangering the life of the organism as it changes.

At this point in the discussion, we should look more closely at one of four major ideas that Popper puts to use in his evolutionary epistemology. One is, of course, Darwin's idea of evolution by natural selection. The other three are the idea of a descriptive language, the idea of a world of propositions in themselves, and the idea of the *a priori* as an organ. The idea of a descriptive language originates with Karl Bühler and the idea of a world of propositions in themselves originates with Bernard Bolzano. Konrad Lorenz seems to have been the first to think of Kant's *a priori* as a biological organ. Since the idea of descriptive language is central to the first and third theses Popper lays down in the Bari lecture, before concluding the discussion of what he says there, I will briefly present Bühler's ideas. Later, I will trace Popper's idea of World 3 back to Bolzano (*via* Frege and Heinrich Gomperz). I will conclude with a discussion of Lorenz's interpretation of the Kantian *a priori* in the context of considering Popper's account of objective knowledge as expectation and adaptation.

Popper often discusses Karl Bühler's theory of language.[21] He returns to it in the Bari lecture, where he gives it fuller treatment than anywhere else in his published writings. "The most important contribution to the evolutionary theory of language known to me lies buried in

a little paper published in 1918 by my former teacher Karl Bühler."[22] According to Bühler, language has a biological function in all of its forms, that is, when it expresses, signals, or describes. When language is symptomatic, "the only biological function of language is to *express* outwardly the inner state of an organism; perhaps by certain noises, or by certain gestures."[23] Other creatures *may adapt* themselves to such expressions. That means they will find ways of including the first organism's expressions as "stimuli of their environment to which they may respond with advantage."[24] What, up to that time, has been for the first organism mere "self-expression" (for example, a cat's meow) may now function as a "warning" to another animal (for example, to a squirrel) upon which the cat might prey. The same sound (originally only symptomatic or expressive) now functions linguistically as a signal or "sign."[25] It has acquired a more highly evolved function, thanks to its capacity for evoking in the responding animal (our squirrel) a standard reaction (fleeing from a predator to save its little neck).[26] The expressive (or symptomatic) sound as a signalling sound effects something new between the two creatures: communication. When the cat becomes part of the squirrel's environment in this way, they are said to communicate with one another. According to Bühler, such communication need be only unidirectional. An evolutionary process — a process of organism-environment interaction approaching greater and greater fit between the two — has elevated the function of a sound from random expression to deadly serious com-munication. There is communication because the message has survival value. Yet further evolution leads to the use of language to describe "*a situation that may or may not be present or biologically relevant.*"[27] But how did this function evolve?[28]

The autonomy of descriptive language from any signalling function is essential. A signal implies the need for an immediate response of some kind which is useful, which may even save the organism's life. Description, however, "may not be immediately useful at all. It may not be useful at all, or useful only years later and in a totally different situation."[29] It is *playful*. Popper believes that descriptive language evolved under conditions of freedom, apart from the constraints that ordinarily dominate the processes of evolution by natural selection, in which survival is typically at stake when some particular organism-environment fit is being tried out.

Popper sees evidence for his conjecture about how descriptive language evolves in the play-acting observed among young children. He proposes that the spontaneous invention of a pretend situation "may create the *need* for something like a descriptive or explanatory comment."[30] He hypothesizes that descriptive language, including story-telling (and ultimately myth and fiction), "may have been first invented by children playing or play-acting, perhaps as a secret gang language."[31] A child playing make believe with his friends is called upon to reveal what his imagined drama is about, probably first of all by the other children with whom he is playing. The inventive child's language is then adopted by the children's mothers and, finally, by the adult males in the social group to which the children belong. The explanatory stories of children, Popper thinks, evolve into the explanatory theories of the scientist, and only then does descriptive language become useful. This is a highly novel and provocative conjecture. It is also a conjecture that, by Popper's own admission, is not testable, yet a great deal depends on its plausibility.[32] This is one of those proposals (which Popper often refers to), the full

meaning of which may not be graspable even to those who has put them into words.

Popper concludes: "Human [descriptive] language is, I suggest, the product of human inventiveness. It is a product of the human mind, of our mental experience and dispositions. And the human mind, in its turn, is the product of its products ...."[33] According to Popper, reason, the pursuit of Kant's first critique, is ultimately the product of child's play, not the quantum leap of genius beyond efforts to merely communicate, as some theories of language may suggest. One of the characteristics of playfulness, as any observer of children can confirm, is its serendipitousness, but the turning up of problems in everyday life also has this quality.

In the Bari lecture, Popper also says that theory making corresponds to the trial moment or phase of trial and error learning and that error elimination in theory development parallels the selection moment in Darwinian evolution. Trial and error learning is, of course, one of the basic types of animal learning, along with habituation, insight learning, and conditioning.[34] At this point, the question naturally arises of how Popper's theory of knowledge growth is different from psychological learning theories. The basic difference lies, of course, in the introduction of World 3 entities. Learning theories deal only with World 1 and World 2 entities. In the Bari lecture, Popper neatly summarizes his idea of the three worlds. It will be even clearer why and how his epistemology is not a psychological learning theory[35] when the differences among the three worlds are made explicit. Language is, again, the key notion. I turn now to Popper's idea of a trialistic universe. I will follow that with a look at its precursors in the work of Gottlob Frege and Bernard Bolzano.

5. Popper's Trialism

"About twenty years ago I introduced a theory that divides the universe into three sub-universes which I will call World 1, World 2, and World 3."[36] World 1 is the sub-universe of "all physical bodies and forces, and fields of forces; also of organisms ... and all physical, chemical, and biological processes."[37] World 2 is the sub-universe of "our mind: of conscious experiences of our thoughts."[38] Is also the world of moods ("our feelings of elation or depression,"[39] for example). World 2 is the world that interacts with language. The mind's "dispositions are due to a feedback effect" in relation to language. World 3 is the sub-universe of "the products of the human mind, and especially the world of our human language ... the world of human creation in art, in architecture and in music."[40] This is the world of "all books, all libraries, all theories, including, of course, false theories, and even inconsistent theories."[41] World 2 interacts with this world (as it does with World 1 objects). Some World 3 objects are "abstract," however, and thus do not interact with World 1. These include, for example, theories, symphonies, and mathematical and logical proofs. All of these abstract World 3 objects are potentially performative, although it may not always be possible to "play out" some of them at a given time. An example of this kind of World 3 entity would be some of John Cage's compositions, which rewrite themselves with each performance.

It is very significant, it seems to me, that Popper explicitly denies that World 3 objects are "identical with human experiences or memories."[42] This is the basis for his criticism of induction as an explanation of how we gain knowledge. Objective knowledge is, precisely, not at all

subjective. Processes of knowing, which are World 2 phenomena, are subjective, but the products of these processes are not. In other words, knowledge considered from a psychological point of view is subjective. From a philosophical point of view, i.e. from an epistemological perspective, however, it is objective. For Popper, the two fields consider knowledge of two different kinds. Psychologists and epistemologists are not merely looking at the same data from two different angles. Nor is it just a matter of redefining the word 'knowledge'. Popper's point is that objective knowledge occupies a universe all of its own, and since memories are psychological phenomena, they should not be confused with the occupants of World 3.[43] An epistemological object is transmuted by means of the "critical process of improving upon it, again and again, at different periods" in the life of its producer.[44]

What is most remarkable about World 3 entities, however, is that their meaning may not be grasped by their maker. Having created a theory, it may happen that certain facts are only implied by the theory. These facts are subsequently *discovered* by the deviser of the theory, or by someone else. It is conceivable that certain facts implied by the theory may never be discovered. Such facts are "unintended and unforeseeable and [yet] inescapable consequences of the invention ...."[45] It would seem, then, that in this sense there are two kinds of objective knowledge: (a) facts that have actually been made explicit by someone, and (b) facts that are implied in a theory devised by someone but that have not yet been "thought out" and made explicit.

How are World 3 objects related to World 1 and World 2 objects? For Popper, we recall, all knowing occurs in response to problems that confront us nonstop. Ordinarily, we solve a problem that we come up against.

In some cases, however, we are faced with what Popper calls "open problems," which have a decided effect on the researcher. We are bothered, bemused, perhaps even harried by such problems, so much so that our mood changes. It may happen that pronounced physiological changes occur and, for example, our blood pressure becomes elevated from the anxiety generated by the problem. In other words, World 3 objects may affect both World 2 objects (moods) and World 1 objects (the scientist's body). World 2 knowledge is knowledge we can recall. It is "information carried by us in our heads; knowledge in the subjective sense."[46] By contrast, World 3 knowledge (knowledge in the objective sense) is there for us to know as knowledge in the subjective sense (i.e., as a World 2 object), even if it is only implicit.

What is the origin of this idea of objective knowledge and World 3 entities? In several places, Popper gives credit to Frege and Bolzano. In "Epistemology Without a Knowing Subject," for example, Popper writes: "My third world resembles most closely the universe of Frege's objective contents of thought." He quotes Frege: "I understand by a *thought* not the subjective act of thinking but its *objective* content ...."[47] In 1978, Popper added a note of considerable interest.[48] There he suggests that Frege probably got the idea of his *dritte Reich* from Heinrich Gomperz, who, like Bühler, had been one of Popper's teachers at the University of Vienna.[49] Edmund Husserl, and thus phenomenology, in its inception was influenced by this same idea of Frege's, Popper adds.[50] Popper's idea of an objective realm of knowledge, then, appears to have been inspired by Frege. But what of the inhabitants of that realm? For that, I turn to Bolzano.

In § 5.3 of "Epistemology Without a Knowing Subject," Popper is critical of Bolzano, but the great

mathematician and social reformer's notion of propositions in themselves is clearly a ground-breaking conjecture that influenced Popper. The critical passages in Bolzano's *Wissenschaftslehre* run:

> I understand by a *proposition in itself [Satz an sich]* any statement that something is or is not, indifferently whether this statement is true or false, whether or not anyone has put it into words, whether or not it has even been thought .... We do not have to think of a proposition in itself as something propounded by someone; no more may we confuse it with an *idea* present in the consciousness of a thinking being, nor with an affirmation or *judgment*.[51]

What is critical here, and what distinguishes Popper's World 3 from Plato's world of forms or ideas and Hegel's Objective Spirit or Mind, as Popper himself emphasizes, is that World 3 inhabitants have syntactic qualities, which means they must also have a grammar, since syntax implies a grammar.[52] By contrast, a Platonic ἰδέα or an Hegelian *Begriff* is a singularity, as is Kant's *Ding an sich*. Bolzano's *Satz an sich*, like a Popperian theory, on the other hand, is a proposition. This is undoubtedly why Popper likes to speak of theories as being *proposed* and also speaks of them as being mediated and criticized linguistically. Being like Bolzano's propositions in themselves would also account for the performative characteristic of Popperian theories. A theory — like any spoken or written statement, or a musical composition or work of plastic art — takes time to be manifested. Yet Popper (again following Bolzano) also says that theories have a certain timeless, eternal quality, like Plato's forms.

This is required so that theories may remain somehow "alive" and yet only potentially active. Theories and other World 3 inhabitants remain dormant in hibernation, so to speak, until they are reanimated by discussion.

Language, then, is responsible both for making theories, which become timeless, and for subsequently temporalizing these timeless entities. Once a theory is reanimated by the work of criticism and argumentation, the theory is transformed, a new theory is produced, and something more is added to World 3. Superseded and rejected theories continue to be World 3 entities. Like unworkable experiments of nature, wrong theories disappear, but unlike failed experiments of nature, wrong theories are not lost forever, even if the long forgotten books which contain a record of them are destroyed. It is not entirely clear from what Popper says, however, whether a World 3 entity remains if there is no record of it at all in any World 1 form and no one is alive who can recall it from memory as a World 2 object. This seems to be an important consideration for the ontological status of Popper's World 3 entities.

Bolzano's propositions in themselves are thus the progenitors of Popper's World 3 inhabitants. As noted above, according to Bolzano, the idea of the proposition in itself was not new with him but had its inception with Aristotle. In that case, Popper's World 3 would be but a further transmutation of the theory that there is a world of objective knowledge and that it is a world mediated by language.[53]

6. The Belated "Inaugural" Lecture

In 1990, Popper published *A World of Propensities*, a small volume containing two lectures. One of these lectures is "Towards an Evolutionary Theory of Knowledge." It was what he called his "slightly belated Inaugural Address" at the London School of Economics. Delivered on June 9, 1989, it may be his last published statement of his views on the subject. I will mention only what is new here which supplements the Bari lecture.

Popper begins with the "proposition *that animals can know something: that they can have knowledge.*"[54] This might sound unusual coming from a philosopher, since most philosophers have held that only human beings know in any meaningful sense. Popper's view that gaining or "growing" knowledge is an evolutionary process depends on his attribution of knowledge to all living things, beginning with unicellular animals. All of this makes sense if we always hear *objective knowledge* when Popper uses the word 'knowledge' in the lecture. The idea is not new coming from Popper, but the spin he gives to the theme is bolder in this lecture. He claims that "we ourselves possess knowledge of which we are not aware, not conscious."[55] *All* knowledge which animals possess is of this kind. The knowledge of this kind in us, i.e. objective knowledge, "has often the character of unconscious *expectations*."[56] Once again, we may be surprised by what Popper says here, since we have heard about unconscious knowledge in Freud's metapsychology, a "research programme" like Darwinism that Popper had long since dismissed as not being a theory at all, since like all metaphysical systems, it is not falsifiable. He obviously means something very different than Freud had meant.

Objective knowledge is a kind of expectation. Popper had already suggested this in the Bari lecture: "Theories are (in fact all knowledge is) from the

evolutionary point of view, part of our tentative *adaptations* to our environment. They are like expectations or anticipations. This is indeed their function: the biological function of all knowledge is to try to anticipate what will happen in our environment."[57] In his belated "inaugural address," Popper emphasizes the unconscious nature of this knowledge. The meaning of the term 'unconscious' is now clear: without consciousness. Popper is suggesting that consciousness need not be a characteristic of knowledge. While there must be consciousness for subjective knowledge (a World 2 phenomenon), a decisive feature of *some* objective knowledge (namely, the knowledge that guides adaptation) is that consciousness does *not* accompany it. Nor is there subjective consciousness of it in the psychological sense. Such objective knowledge is the theoretical content of every act of observation we employ in recognizing problems that need solving.

After delivering up a number of examples that illustrate how plants as well as animals know in the sense he has in mind, Popper proposes that adaptation itself has the nature of "long-term knowledge about the environment." We have eyes, for example, because we *know to see* in an environment. The eyes, for example, "could never have evolved without an unconscious and very rich knowledge about long-term environmental conditions."[58] The eyes are thus an embodiment of objective knowledge, and "the knowledge of the pre-conditions of [an organ's] use [for example, the eye] are built into the organ [eye]."[59] In the same way, language, the exosomatic organ *par excellance*, is also an embodiment of knowledge. Finally, says Popper, unconscious objective knowledge *precedes* each step in the evolutionary process. Therefore, adaptation, which is none other than long-term objective knowledge, *is* expectation. But what is expectation? It is

not based on observation.[60] Nor, again, is it based on any kind of subjective knowledge, i.e. what one might be able to remember at any given moment. Popper's claim here is that the long-term knowledge of expectation is not based on World 2 knowledge and cannot be derived from it. So where does this knowledge come from? It is *a priori* knowledge of a Kantian kind. "In my opinion," writes Popper, "Kant anticipated the most important results of the evolutionary theory of knowledge. But I am going much further than Kant."[61]

Although he does not make the acknowledgement here, this idea is first worked out in a paper by Konrad Lorenz, and just how Lorenz understands the meaning of the Kantian *a priori* sheds light on Popper's formulation of objective knowledge as expectation.[62] Popper and Lorenz were boyhood friends. In later life, Popper valued Lorenz's work on imprinting in animals and noted the compatibility of his idea of objective knowledge and Lorenz's findings in animal psychology, but it appears to have been a 1941 paper by Lorenz that provided him with the germ of the idea of objective knowledge as adaptation.[63] Lorenz's paper contains a remarkable conjecture, the gist of which is that the Kantian *a priori* functions as a biological organ. The classical categories — especially cause (which favors making associations) and quantity (which favors mathematical explanations) — work for us because they have survival value, says Lorenz. But it need not have been this way. In fact, other concepts — for example, the *Gestalt* function of perception, rarely used by scientists but commonly called upon by artists — may yet supersede the basic *a priori* categories, which, because of their adaptive value, now dominate our thinking and characterize our reason.[64] Kant's *a priori* categories lead us to see things in a certain way. Adaptation has produced

the categories that now comprise the instruments of human reason and currently function in an expectational way. In Popper's theory, objective knowledge is *a priori* in just this sense. It anticipates or expects, i.e. hypothesizes, "partly unknown" states of affairs. Unlike Kant's *a priori* categories, however, the contents of objective knowledge are not eternally valid, although they *seem* to be because they have served us so well in describing what is real.

> Organisms and their organs incorporate expectations about their environment; and expectations — as we have seen — are homologous with our theories .... So I suggest the hypothesis that adaptation and expectations are homologous even with *scientific theories* (and *vice versa* theories with adaptations and expectations.)

7. Conclusion

In this paper I have attempted to unravel several strands of Popper's evolutionary epistemology in its most evolved form. I have not done this in order to find priority for his ideas in Bolzano, Frege, and Lorenz. In most cases he has already done this. I have intended rather to present their ideas in the context of the final version of Popper's evolutionary epistemology, with the hope of bringing some further clarity to it. Although Popper had serious philosophical questions about neo-Darwinism and the notion of natural selection, he found the biological theory of evolution congenial in accounting for the reality of progress in science and the growth of scientific knowledge.

Miles Groth
Wagner College
Staten Island, New York

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100, 1892, pp. 25-50. Frege's seminal essay has been translated twice: (1) "On Sense and Nominatum," in Herbert Feigl and Wilfrid Sellars (eds.), *Readings in Philosophical Analysis* (1949) New York: Appleton-Century-Crofts, pp. 85-102. Feigl's version was based on the translation decisions of Rudolf Carnap (1947); (2) "On Sense and Reference," in *Translations from the Writings on Gottlob Frege* (1952) New York: Philosophical Library, pp. 56-78. Translated by Peter Geach. See pp. ix-x, "Glossary," for the editors' comments on their translation decisions.

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Notes

1. OK, p. 67. Codes to the references to Popper's texts are given in the bibliography. The title of an individual essay cited is not always given when a collection is referred to. The essay in which this acknowledgement appears, "Two Faces of Common Sense: An Argument for Commonsense Realism and Against the Commonsense Theory of Knowledge," was first published in 1972, though the material on which it is based was prepared for a seminar given by Popper in 1970. Campbell's essay was written in 1965-66, but was not published until 1974. Evidently, the application of the term "evolutionary epistemology" to Popper's work was in the air and known to Popper before Campbell's essay was published. Campbell's essay is "Evolutionary Epistemology," which was first published in Paul Schilpp's *The Philosophy of Karl Popper* (1974) LaSalle: Open Court, Volume 2, pp. 413-463, and reprinted in Gerard Radnitsky and W.W. Bartley, III (eds.), *Evolutionary Epistemology, Rationality, and the Sociology of Knowledge* (1987) LaSalle: Open Court, pp. 47-89. Campbell also terms Popper's view "a natural selection epistemology" or "descriptive epistemology" (p. 47). Popper notes (EE, p. 242) that Campbell had based his view of Popper's position on Popper's first book, *Die beiden Grundproblemen der Erkenntnistheorie*, which had already spelled out the basic ideas of his evolutionary epistemology. This text was not published in German, however, until 1979 (Tübingen: Mohr). Parts of the manuscript were reworked and published in 1935 as *Logik der Forschung*. Written in 1930-32, *The Two Problems of the Theory of Knowledge*, which was inspired by the problems of the logical positivists, is discussed in UQ, pp. 83-87: "The book was meant to provide a theory of knowledge and, at the same time, to be a treatise on method–the method of science. . . . I looked on human knowledge as consisting of our theories, our hypotheses, our conjectures: as the *product* of our intellectual activities" (p. 85). See also Campbell's essay "Reintroducing Konrad Lorenz to Psychology," in Richard I. Evans (ed.), *Konrad Lorenz. The Man and His Ideas* (1975) New York: Harcourt Brace Jovanovich, pp. 88-118 (especially pp. 93-97, "Evolutionary Epistemology").

2. EE, p. 239.

3. TE, p. 29.

4. CET, pp. 115-120.

5. CET, p. 120.

6. Campbell himself is known in the academic world as a psychologist. Elected president of the American Psychological Association (1975), he began as a behaviorist in the tradition of John Broadus Watson, publishing some of his early papers in *The Psychological Review*, the journal founded by Watson and his colleagues to disseminate their ideas. Ron Amundsen has compared the conclusions of Campbell's work to some of those of Skinner, a psychologist who denied any meaning to the notions of "freedom" and "dignity," but who nonetheless has had enormous influence in areas such as teacher education and the treatment of mentally retarded and deteriorated patients undergoing "milieu therapy" (institutionalization in mental hospitals). See Amundsen's "Trials and Tribulations," in Kai Hahlweg and C.A. Hooker (eds.) *Issues in Evolutionary Epistemology* (1989) Albany: SUNY Press, p. 420.

7. Popper relies heavily on the distinction between the expressive, signalling, and descriptive functions of language formulated in 1918 by Karl Bühler, who was one of Popper's teachers in the Psychology Department at the University of Vienna when Popper was still working on "the psychology of thought and discovery" (UQ, pp. 73-74, 78). See also EE, pp. 245-247. I will return to Bühler's ideas.

8. UQ, p. 189, 168; cf. § 37, pp. 167-180.

9. UQ, 170.

10. EE, p. 242.

11. EE, p. 239.

12. EE, p. 239.

13. EE, p. 240.

14. EE, p. 250.

15. See, for example, "Of Clouds and Clocks" (OK pp. 241-242) and the passage cited from Popper's intellectual biography cited in note 8, above.

16. Popper's view of evolution is in a sense one-sided, however, since as the early evolutionists pointed out, evolution may be progressive, regressive, or mixed. A classic statement of this is found in Alfred Lotka's "The Law of Evolution as a Maximal Principle," *Human Biology. A Record of Research* 17 (3), 1945, pp. 167-194. This paper, which followed Lotka's *Elements of Physical Biology* (1925) (retitled *Elements of Mathematical Biology* in 1956 [New York: Dover Books]), influenced the evolutionary

epistemologists, and he is often cited by them. His work also influenced a whole generation of natural scientists inspired by neo-Darwinian ideas. In *Elements of Mathematical Biology*, Lotka defines evolution as "the history of a system undergoing irreversible changes" (p. 24). His innovation was to have brought evolutionary theory and physical chemistry, which underlies biology, into coherent interface with each other, so that the formal physical and mathematical principles of biology could be employed to explain evolution. In the paper that started it all, "Studies on the Mode of Growth of Material Aggregates" (*American Journal of Science*, 26, 1907), Lotka is interested in "the quantitative formulation of the problem of evolution in its most general form." Evolution is, in his characterization there, "the study of the laws governing the distribution of matter among complexes of any specific kind, as determined by their general physical characteristics" (p. 216). These complexes or aggregates are precursors of the systems of cybernetic servomechanisms. For Lotka, chemical dynamism is an exemplification of the laws of evolution and an expression of its tendency. Foreshadowing his *Elements*, Lotka mentions the factors analogous to chemical dynamism that determine the origin of a new member of a population of organisms and set the life span of an individual member of the population. Thanks to Lotka, physical chemistry was modelled on evolutionary theory. What went on in the organism — including consciousness, which discovered the laws of evolution — could be understood in terms of what went on between the organism and the environment. It is apparent that Lotka was impressed by Freud's version of the concept of the dynamic unconscious. In "The Law of Evolution as a Maximal Principle," he uses the Freudian term 'ego': "It is not consciousness that has been evolved–an elementary flash of consciousness may be a natural property of matter–but a particular kind of integrated consciousness, a consciousness spun into a continuous thread by a faculty of memory, a consciousness embroidered upon a canvas, whose function is to hold in place and in their proper relation the components of the picture. This background, this reference frame, is the state of development in which we observe it in ourselves, is the *ego*, to whom all experiences are referred. The material organ to which this integrating function is entrusted is the nervous system, including the brain" (p. 404). On the idea of the "material organ," Lotka's refers to Sir Charles Sherrington, who in 1922 had conceptualized the brain and central nervous system as a integrated structure, but for his psychological model, Lotka refers the reader to Arthur Tansley's *The New Psychology and Its Relation to Life* (1916), for whom the motor nervous system had been incorrectly identified with Freud's concept of the wish, then a very popular idea. (Freud had been translated into English as early as 1910). The deed had been done, says Tansley, by Edwin Bissell Holt, an important Watsonisn behaviorist, in his book *The Freudian Wish and Its Place in Ethics* (1915). Watson had questioned Holt on his possible Freudian leanings ("Does Holt Follow Freud?") in an article in the *Journal of Philosophy, Psychology, and Scientific Method* 14, 1917.

17. The image I form is of a polyhedron surrounding a circle. The greater the number of sides of the polyhedron (theories), the more points at which it touches the circle (truth) it tends to approximate and encompass.

18. "Without the development of an exosomatic descriptive language — a language which, like a tool, develops outside the body — there can be *no object* for our critical discussion. But with the development of a descriptive language (and further, of a written language), a linguistic third world can emerge; and it is only in this way, and only in this third world, that the problems and standards of rational criticism can develop" (OK, p. 120). The term "exosomatic organ" was originated by Lotka (1945, p. 192).

19. EE, p. 250.

20. Popper conjectures that bees might also have something like a descriptive language at their disposal. EE, p. 247.

21. "Toward a Rational Theory of Tradition" (1949 [1948]), CR, pp. 134-135; "Language and the Body Mind Problem" (1953), CR, p. 295; "Of Clouds and Clocks" (1965), OK, § XIV, pp. 235-238; "Epistemology Without a Knowing Subject" (1968 [1967], OK, pp. 119-120; and in his autobiography (1974), UQ, p. 74.

22. EE, p. 245.

23. EE, p. 245.

24. EE, p. 245.

25. EE, p. 246.

26. In the language of Ivan Pavlov's classical conditioning learning theory, this reaction is termed an unconditional response (often mistranslated as "unconditioned response").

27. EE, p. 247. In "Of Clouds and Clocks" (1965), Popper had already made explicit the importance of descriptive language for the generation of new theories. There he refers to the "the description of conjectured states of affairs, which we formulate in the form of theories or hypotheses" (OK, p. 236).

28. Popper notes that apart from its descriptive function, distinctively *human language* can have other sorts of higher functions, including those that are "advisory, hortative, fictional" (OK, p. 120, n. 7), and, of course, argumentative.

29. EE, p. 247.

30. EE, p. 249.

31. EE, p. 249.

32. EE, p. 249.

33. EE, p. 251.

34. For this, see an article by the British zoologist J.W.S. Pringle (1951). This text is often referred to by Donald Campbell in his discussions of natural selection epistemology and may be considered a important background text for understanding how Popper formulated the trial and error elimination schema he first introduced in "Of Clouds and Clocks" (1965). See OK, pp. 243-44 and 119. Cf. also "Epistemology Without a Knowing Subject" (1967).

35. In "Epistemology Without a Knowing Subject," Popper equates the growth of knowledge with "the learning process" (OK, p. 144), but he does not have in mind learning in the sense of a psychological process.

36. EE, p. 252. Before 1970, Popper had termed these the First World, Second World, and Third World. His colleague in New Zealand, Sir John Eccles (1970), had suggested the alternative. UQ, 21, 198 (n. 7a), 235 (n. 293).

37. EE, p. 254.

38. EE, p. 252.

39. EE, p. 252.

40. EE, p. 252.

41. EE, p. 252.

42. EE, p. 252.

43. Popper playfully personalizes theories and their cohorts by referring to them variously as inhabitants and inmates of World 3.

44. EE, p. 253. Popper's example at this point in the text is of Newton working on his theory of gravity.

45. EE, pp. 253-254.

46. EE, p. 254.

47. OK, pp. 106, 109. Gottlob Frege, "Uber Sinn und Bedeutung" [1892], *Kleine Schriften* (1967) Hildesheim: Olms, pp. 143-162. The key sentence is a footnote (p. 148, n. 5): "Ich verstehe unter Gedanken nicht das subjektive Tun des Denkens, sondern dessen objektiven Inhalt, der fähig ist, gemeinsames Eigentum von vielen zu sein." See References for the translations. Cf. Michael Dummett's "Frege's Myth of a Third Realm," in *Frege and Other Philosophers* (1991) Oxford: Oxford University Press, pp.

249-262, and Tyler Burge, "Frege on Knowing the Third Realm," *Mind* 101, 1992, pp. 633-649.

48.OK, p. 152. This appears only in editions from 1979 on.

49. Heinrich Gomperz, *Weltanschauungslehre* (Jena: Diederich, 1905), Volume II, Part 1. Gomperz called this volume of his unfinished work *Noölogie*. This book has never been translated into English. Gomperz's influence on Popper was significant in many other ways. See UQ, §§ 7, 15, 16, 38, and n. 89 (pp. 209-210).

50. "The whole history [of Gomperz's influence on Frege and the latter's influence on Husserl] would be worth a careful re-examination . . .." And for several reasons. For example, it is well-known that Heinrich Gomperz studied Freud's psychoanalytic method with Freud in 1899. There is correspondence from this period between the two men. See Jeffrey Masson (ed.), *The Complete Letters of Sigmund Freud to Wilhelm Fliess, 1887-1904* (1985) Cambridge: Belknap Press, pp. 386-388. I have also wondered whether Frege's "third world" may have been indirectly influenced by the realm of the unconscious in one or more of the three senses Freud gave the concept around the same time that Gomperz was at work on his *Weltanschauungslehre*.

51. " ... unter einem *Satze an sich* verstehe ich nur irgend eine Aussage, daß etwas ist oder nicht ist; gleichviel, ob diese Aussage wahr oder falsch ist; ob sie von irgend Jemand in Worte gefaßt, ja auch im Geiste nur gedacht oder nicht gedacht worden ist. ... Eben so wenig, als man sich vorzustellen hat, daß ein Satz an sich etwas von Jemand Gesetztes ist, darf man ihn auch mit einer in dem Bewußtseyn eines denkenden Wesens vorhandenen Vorstellung, *ingleichen mit einem* Fürwahrhalten, *oder* Urtheile *verwechseln*" (p. 104). *Gesamtausgabe*, Volume 11,1, edited by Jan Berg (1985) Stuttgart: Frommann, pp. 104. Cf. a translation, by Burnham Terrell, of selections from the *Wissenschaftslehre*, published as *Theory of Science* (1973) Boston: Reidel, pp. 48. The text in question, "What the Author Understands by a Proposition in Itself," appears in § 19 of the work. Bolzano traces his idea of the *Satz an sich* to the *Versuch einer vollständigen analytische Denklehre als Vorphilosophie und im Geiste der Philosophie* (1803) by Gottfried Mehmel, the *Handbuch der Logik* (1802) by Andreas Metz, Gottlieb Wilhelm Gerlach's *Grundriss der Logik* (1817), and indirectly to Johann Friedrich Herbart's *Lehrbuch zur Einleitung in die Philosophie* (1813), Leibniz's *Dialogus de connexione inter verba et res* (1677) and Aristotle's *Posterior Analytics*, I.x (76 b24-26). (For the text by Leibniz, see his "Dialogue" with Hobbes, in a translation by Roger Ariew and Daniel Garber, of Leibniz's *Philosophical Essays* [1989] Indianapolis: Hackett, pp. 268-272.) It is worth remarking that the idea of a *Satz an sich* is quite unrelated to Kant's *Ding an sich*.

52. Cf. "On the Theory of the Objective Mind" (OK, p. 154).

53. For Aristotle (*Posterior Analytics*, I.x, 76 b24-26), the matter begins with a distinction between outer and inner speech. Bolzano writes: "Man vergleiche hiemit die Unterscheidung des *Aristoteles* . . . zwischen *äußerer* und *innerer* Rede λόγος

ἔξω und λόγος ἔσω oder ἐν τῇ ψυχῇ" (p. 110, n.; translation, p. 51). Hugh Tredennick translates the term "internal discourse." *Posterior Analytics* (1969) Cambridge: Loeb Classical Library, pp. 72-73. Aristotle is here defining an αἴτημα or postulate (assumption), which he distinguishes from an ὑπόθεσις (hypothesis).

54. ET, p. 30.

55. ET, p. 31.

56. ET, p. 31.

57. EE, p. 243.

58. ET, p. 36.

59. ET, p. 37.

60. Popper would want to steer clear here of any suggestion of something like a mood of expectancy. On the other hand, I do not think prescience (which, in any case, would be a psychological datum) is what he has in mind.

61. ET, p. 46.

62. Konrad Lorenz, "Kant's Doctrine of the A Priori in the Light of Contemporary Biology," in Ludwig Bertalanffy (ed.), *General Systems. Yearbook of the Society for General Systems Research* (Ann Arbor: Society for General Systems Research, 1962), pp. 23-35. First published in the *Blätter für deutsche Philosophie* 15, 1941, pp. 94-125, as "Kants Lehre vom apriorischen im Lichte gegenwärtiger Biologie." The translation, by Charlotte Ghurye, was edited for publication by Donald Campbell, William A. Reupke, and Lorenz. It has been reprinted at least two times, in Richard I. Evans (ed.), *Konrad Lorenz: The Man and His Ideas* (1975) New York: Harcourt Brace Jovanovich, pp. 181-217, and in H.C. Plotkin (ed.), *Learning, Development, and Culture* (1982) New York: John Wiley, pp. 121-143. In his paper, Lorenz says that "all our forms of intuition and categories are thoroughly natural. Like every other organ, they are evolutionarily developed receptacles . . ." (p. 26). "Working hypotheses" in science are "functional organs" (p. 27), and "all human thought is only a working hypothesis" (p. 28). Human knowledge, says Lorenz, "is only a working hypothesis for us, it is true that we are ready at any moment to throw overboard our favorite theories when new facts demand this" (p. 29). The thing itself is approached only by means of the categories, which change as what is real (the facts) changes. "The forms of perception and categories are not the mind, but rather are the tools of the mind" (p. 34).

63. UQ, pp. 44-45, 192-193, 203 (n. 44). While I have not seen a reference to this paper by Popper, it is often cited by other evolutionary epistemologists, including Donald Campbell.

64. See Lorenz's paper other seminal paper for evolutionary epistemology, "Gestalt Perception as Fundamental to Scientific Knowledge," in Ludwig Bertalanffy (ed.), *General Systems. Yearbook of the Society for General Systems Research* (Ann Arbor: Society for General Systems Research, 1962), pp. 37-56, first published in the *Zeitschrift für experimentelle und angewandte Psychologie* 6, 1959, pp. 118-165, as "Gestaltwahrnehmung als Quelle wissenschaftlicher Erkenntnis." The translation, by Charlotte Ghurye, was edited for publication by Donald Campbell, William A. Reupke, and Lorenz.

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