Popper versus Lorenz: An Exploration Into the Nature of Evolutionary Epistemology

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In 1941 Konrad Lorenz published a paper with the title "Kant's Doctrine of the A Priori in the light of Contemporary Biology". This essay stands as the foundation of the Austro-German School of Evolutionary Epistemology. As indicated by the title of the paper, the Lorenzians attempt to interpret Kantian transcendentalism along biological lines.

Lorenz was, however, by no means the first who attempted to biologise Kant. Philosophers and scientists such as Ernst Mach, Henri Poincare, Ludwig Boltzmann and Jean Piaget had made similar points previously. Nevertheless, it remains Lorenz's achievement to have formulated his thesis explicitly and provided ample empirical evidence in favour of it.

Lorenz's seminal paper remained largely unknown, and even his book on evolutionary epistemology published in 1973 raised little interest among philosophers, particularly in the English-speaking world. Meanwhile several other biologists and philosophers have joined Lorenz in his endeavour to elucidate epistemological issues through biological research. Among the many contributors let me name Rupert Riedl, Robert Kaspar, Franz Wuketis and Gerhardt Vollmer. Due to the effort of these and other researchers, a large body of literature has been created.

Whereas Lorenz's work remained largely unknown, the term "Evolutionary Epistemology" became attached to various attempts of English speaking philosophers to introduce concepts derived from biology into philosophy. The names of Donald Campbell, Stephen Toulmin and Gonzalo Munevar may stand for all those who in one way or another contributed to the development of this subject. However, the central figure in the realm of Evolutionary Epistemology remains Karl Popper, whose methodology of conjectures and refutations is generally identified with the evolutionary method.

In today's presentation I shall -- for the sake of clarity -- refer to the work of Popper, Campbell, Toulmin, and also to my own work as "evolutionary epistemology" whereas I shall use the term

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"bioepistemology" when speaking about the Austro-German school of evolutionary epistemology. This should, however, not be seen as a premature judgment of what evolutionary epistemology is all about about shall merely emphasise the fact that the thinkers of the Austro-German school are predominantly biologists who claim that their science can make a substantial contribution to the ancient philosophical subject matter of epistemology.

The topic I am addressing today is: What -- if anything -- can bioepistemology contribute to evolutionary epistemology? Are we here dealing with disjointed approaches to the same set of problems, do these approaches conflict with each other or can they be seen as supplementing each other? In other words, I am searching for a common framework which may allow us to talk meaningfully about both, bioepistemology and evolutionary epistemology.

In order to pursue this task it is necessary to outline the central tenets of both evolutionary epistemology and bioepistemology. Let me begin by briefly recapitulating the well known methodology of Karl Popper. Thereafter I will summarise bioepistemology.

Popper's evolutionary epistemology clearly grows out of his early work as expounded in The Logic of Scientific Discovery. There Popper dealt with the problems of scientific progress and with methodology. He argued against the then dominant empiricist tradition that scientific theories are not, in fact, arrived at by any sort of inductive process. Our mind is never, even at birth, a *tabula rasa*, an empty slate upon which experience leaves its impressions. There is always some kind of theory or theoretical preconception which guides our thoughts and actions. We can never know for sure if a theory is true because theories are not derived from experience. Rather, they are inventions of our own making. Our creative imagination may utilise any conceivable source for the construction of theories, including myth and metaphysics. How, then, can we be positive that science tells us something about the world, and is not a mere reflection of our deranged minds? The answer Popper gives is that, although we can never verify a theory, we can falsify it. We have to submit our hypotheses to the severest imaginable tests. A hypothesis which fails the test must be abandoned, one which passes it will be retained, but only temporarily; any day a new test may be designed which will topple it.

In Darwinian selection only the fittest organisms survive. Popperian falsification lets only the fittest theories pass muster. There is, however, no assurance that the survivors will make it through the next test; at any time they may succumb to the onslaught of a hostile environment or a severe test respectively. Adaptation can be compared to truth. No organism is ever perfectly adapted, no theory can ever claim to be absolutely true. There is no direct feedback connection between the environment and the organism. The surroundings cannot induce mutations which would help the animals to survive in that very environment. Lamarckism does not work. New mutations appear randomly, which is to say, without regard to possible success in a given environment. Our hypotheses are likewise not induced by experience, but rather are inventions of our minds which have to stand on their own in the hostile world of experimental testing.

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All organisms are successors of previous generations, all theories are successors of previous theories. Going back into the past we are led from sophisticated to rather crude scientific theories, moving further back we arrive at ancient mythological and metaphysical beliefs, and even further backward in time we reach the bedrock of our inborn biological theories. There is, however, progress not only with respect to improving the content of our theories, but also in becoming increasingly aware of what we are doing. The methodology is always the same, and may be described as the method of trial-and-error, but increasingly we become aware of the importance of critically assessing our theories, of doing consciously what in the past happened inadvertently. So much for a brief recapitulation of Popper's evolutionary method.

Turning now to Lorenz and bioepistemology we are confronted with an entirely different problem constellation. Bioepistemology is primarily concerned with the evolution of the mechanisms of cognition. It can be seen as an attempt to base epistemology on results derived from scientific investigations into the nature of knowledge acquisition. In this methodological respect it is akin to Piaget's genetic epistemology. Whereas Popper is interested in the evolution of human knowledge, bioepistemology is concerned with the evolution of cognitive mechanisms. Cognitive mechanisms are first of all the processes of perception and conception. But for Lorenz this definition doesn't reach far enough. Indeed, for him, life itself is to be characterised as a cognitive process.

How are we to understand from a philosophical perspective this rather strange sounding definition of cognition? Lorenz points out that the structural features which characterise living things mirror the nature of the world within which the creatures dwell. In the very form, structure, and chemical composition of the eye, for example, the laws of optics are codified. The shape and lubricity of a fish indicates the nature of the watery environment within which it lives. The architecture of our bones, the shape and texture of a bird's wing, all these structures bear witness of the relation of an organism to its environing world. Even the non-living world mirrors in its very structure the nature of its environment. The diamond bears witness to the forces of nature which out of soft graphite created its hardness and brilliance. The giant sandstone cliffs we find in the deserts of the world depict in their very structure the direction of wind current existing millions of years ago, at a time when what is now a crumbling mountain was a soft sand dune being shaped by the forces of wind and water. Whole sciences such as palaeontology and archaeology rely on the truthfulness of the functional relationships between a remnant of ancient times and the physical or cultural situation at this time.

Why, however, should we call the physical codification of environmental conditions "knowledge"? I believe, indeed, that this term is inappropriate. The ancient rocks do know nothing; there is, however, information contained in their structure. And this information can be unearthed by a knowing subject. In my view the central question of bioepistemology is not how to biologise human knowledge, rather how to explain the genesis of knowing subjects out of systems which merely store information. This question requires answers from different fields. On the one hand it is a question to be addressed by anatomists, ethologists and evolutionary theorists. On the other it is a philosophical issue for it implies questions such as: what is language, what are concepts, how do our categories of thought develop? Within this wide array of problems ethologists have eked out a niche where they can make an intellectual living. They are investigating the nature of instincts and their evolutionary development leading from closed quasi-mechanical instinctual reactions to systems of increasing openness, that is, systems which can learn from the environmental situation and in doing so modify their own responses.

For philosophers the kind of research ethologists are performing may appear far fetched and irrelevant to philosophical issues. Yet, as we all know it is out of patiently collected, often minute details that great science develops. A great unifying theory will only come once the ground work has been done. The major synthesis attempted by scientists such as Konrad Lorenz and Rupert Riedl may not yet have been arrived at but interesting beginnings have been made.

What, then, is it that philosophers can learn from observations made on animals as lowly as amoeba, but mostly on fish, birds, dogs, cats, monkeys and humans? For ethologists the most outstanding feature of the evolutionary hierarchy is the development from closed to open cognitive systems. On the lower end of the evolutionary scale we find instinctual reactions which quasi-mechanically occur in a non-modifiable pattern of reflex action. For exampie a male stickleback will fight its rival by attacking its red belly. It will, however, also attack any other object as long as it exhibits a red spot of approximately the same size. The fish never learns to distinguish between the fake and the genuine red belly. These cognitive reactions are indeed very close to purely physiological mechanisms in that they are not modifiable by the organism which exhibits them.

On the upper end of the evolutionary scale we find the human animal who can -- if he wants -- act rationally, suppress instinctual drives and regulate his behaviour according to artificially contrived social norms. In between both extremes we can observe the genesis of mental structure. Many birds, for example, can be imprinted. This means that if a newborn chick sees not its natural parents during its first hours of life but a different kind of object, the bird will for the rest of its life consider this object to be its parent. Even the most absurd entities such as a toy car or a bearded man are accepted as a mother ersatz. A case like this reveals that there are innate cognitive structures which give direction to cognition without determining its content. Here in this comparatively simple case, we find a demonstration of what we may want to call the categories of experience. They are being present before all experience, thus they form the foundations of all experience. In this respect they correspond to Kant's definition of the <u>a priori</u>. The constructive features of experience are absolutely necessary in order that an organism can learn something, that is give content to the inbuilt framework which guides its processes of learning. Their cognitive structures have arisen through the selection pressure of survival functions. This means that they are not arbitrary, that they direct the animals' perception and conception in such a way that it can operate successfully in its ecological niche. This is to say that not only the physical characteristics of an organism store information about its environing world, but the mental, the categorical are also mirroring the true nature of the environment. Lorenz puts the point in the following way:

> But just as the hoof of the horse is adapted to the ground of the steppe which it copes with, so our central nervous apparatus for organizing the image of the world is adapted to the real world with which man has to cope. Just like any organ, this apparatus has attained its expedient species-preserving form through this coping of real with the real during a species history many eons long. (Lorenz 1941, pp. 103-104).

During many millions of years of biological evolution our nervous systems and our sense organs were formed so as to have a true image of reality. If, say, an organism was endowed with a space-time framework which did not lead to a truthful representation of the environment, then this organism would not survive and leave no offspring. Only creatures whose perceptual systems let them act successfully in their respective environment would survive and leave progeny. A fish's fin is adapted to life in the water, a bird's wing to flight and our perceptual system is adapted to the environment within which our ancestors developed. In a similar vein, the embryologist Waddington writes:

> The faculties by which we arrive at a world view have been selected so as to be, at least, efficient in dealing with other existents. They may, in Kantian terms, not give us direct contact with the thing-in-itself, but they have been moulded by things-in-themselves so as to be competent in coping with them. (Waddington 1961, pp. 123-125).

Our experience is coloured by inbuilt spectacles. But those spectacles are not there for nothing. They help us to see better. They developed during eons of evolutionary history. Thus, they, too, are a result of experience, albeit not the result of an individual's experience but that of its whole species. In Kantian terminology we may say that space and time as forms of intuition, and the categories are _a priori_ for the individual but _a posteriori_ for the species. Thus, those spectacles represent the accumulated experience of our predecessors. Perception and conception have been shaped by evolutionary forces ever since the dawn of time.

Yet, the knowledge we gain through these spectacles is, indeed, limited. Only the kind of environment experienced by our ancestors shaped those cognitive structures. In a different kind of environment they lose their reliability. This, of course, becomes evident once we begin exploring areas of reality not accessible to man's everyday experience. The conceptual problems resulting from the advance of modern physics, particularly in quantum mechanics and relativity theory, provide ample evidence of the limits of our in-wired conceptual hardware. Lorenz addresses this problem in the following way:

> The realization 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, on the one hand shakes our confidence in the laws of pure reason and on the other hand substantially raises our confidence in them. Kant's statement that the laws of pure reason have absolute

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validity, nay that every imaginable rational being, even if it were an angel, must obey the same laws of thought appears as an anthropocentric presumption. Surely the "keyboard" provided by the forms of intuition and categories -- Kant himself calls it that -- is something definitely located on the physico-structural side of the psychophysical unity of the human organism.... But surely these clumsy categorical boxes into which we have to pack our external world "in order to be able to spell them as experiences" (Kant) can claim no autonomous and absolute validity whatsoever. This is certain for us the moment we conceive them as evolutionary adaptations... At the same time, however, the nature of their adaptation shows that the categorical forms of intuition and categories have proved themselves as working hypotheses in the coping of our species with the absolute reality of the environment in spite of their validity being only approximate and relative). Thus is clarified the paradoxical fact that the laws of "pure reason" which break down at every step in modern theoretical science, nonetheless have stood (and still stand) the test in the practical biological matters of the struggle for the preservation of the species.

The "dots" produced by the coarse "screens" used in the reproductions of photographs in our daily papers are satisfactory representations when looked at superficially, but cannot stand closer inspection with a magnifying glass. So, too the reproductions of the world by our forms of intuition and categories break down as soon as they are required to give a somewhat closer representation of their objects, as in the case in wave mechanics and nuclear physics. All the knowledge an individual can wrest from the empirical reality of the "physical world-picture" is essentially only a working hypothesis. And, as far as their species-preserving function goes, all those innate structures of the mind which we call "a priori" are likewise only working hypotheses. Nothing is absolute except that which hides in and behind the phenomena. Nothing that our brain can think has absolute, a priori validity in the true sense of the word, not even mathematics with all its laws. (Lorenz 1941, pp. 98-99).

Both bioepistemology and evolutionary epistemology are essentially non-foundational. They agree that there is no hope for infallible knowledge. The two approaches are indeed complementary. Bioepistemology describes the genesis of cognitive structures from the most primitive to the most sophisticated organisms. Its realm ends, however, where science begins. Because science extends into areas of reality not accessible to common sense.

In moving up the evolutionary ladder, we move from the physiological to the instinctual to ever wider open cognitive structures, to myth and metaphysics and eventually to science. And here, it seems, there is a break in evolution. The ancient mechanisms which unconsciously directed our thought and actions are not good enough any more. They do their service in our everyday experience but fall once we probe into realms of reality for which our cognitive apparatus was not selected.

Thus, bioepistemology provides philosophers with a tool for criticism. The message is: don't trust your perceptual and conceptual structures once you leave the safe grounds of everyday experience. Criticise even the most basic presupposition such as our concepts of causation, of induction, our space-time framework and even our logic. Therefore the main function of bioepistemology is to assist us in freeing ourselves from anthropocentric preconceptions which we may not be aware of because they are part of the hardware with which we were born.

We have seen so far that with respect to epistemology bioepistemology has primarily a remedial function. It can help us to step back a little and relieve us from some of the anthropocentric presumptions which are inevitably present in the very structure of human thought. But it does not have any positive function, in particular it does not contribute to scientific methodology. It can explain why common sense is successful but it cannot direct our thoughts once we leave the realm of everyday experience. This conclusion is disappointing. Should it really be the case that the evolutionary process which shaped the cognitive structures of all species including our own, cannot provide further guidance once we reach the highest level of cognition as exemplified in science?

One member of the Austro-German school is here of different opinion. It is Rupert Riedl who has developed his own thoughts on methodology which are in conflict with Popper's. Riedl emphasises the universality and necessity of induction in all cogitive processes. We are all familiar with Popper's harangue against induction. Is there anything that bioepistemology could add to his arguments? Is induction indeed merely a habit without any possible rational justification?

Let us recall that bioepistemology alleges that our cognitive structures have been selected by the real in such a way that we can cope with this very reality. There is a close functional relationship between the structural features of an organism and the world within which the organism dwells. There is information encoded in the very structure of our bodily organs as well as in our organs of cognition. Induction is universally adopted in the animal kingdom and it is part of our everyday behaviour. Without using induction we hardly could survive. This means, however, that the nature of reality, that the thing in itself must exhibit regularities, for otherwise natural selection would not have fostered our capacities to use induction. If we were to live in a completely chaotic environment induction could not work. If, on the other hand, we would live in an environment with complete regularity, each event following the next in absolutely predictable fashion, then induction could be used universally. We would need no other method, this, would be the only rational one. There would be no Humean or Popperian problem and philosophers would be unemployed. Thus, methodology itself depends not only on rules of logic but on the nature of the world. Riedl emphasises that induction can also be used fallibilistically and probabilistically. The problem of method for Riedl is how to improve the reliability of induction rather than to abandon it as a method. He claims that natural selection will favour cognitive organisation which not merely lends itself to induction but more importantly uses induction in the proper circumstances. The more primitive the cognitive system of an organism, the more machine-like will it react. It cannot learn from its experience, it does not know when its inductions will fail. Higher developed animals can learn when to use induction and they can also learn when not to use it. The very fact that we can condition and decondition an intelligent animal such as a dog proves the point.

Organisms are born with inbuilt expectations. If the cognitive system is closed as in the case of the stickleback mentioned above, those expectations cannot be modified. Increasing openness of the cognitive system means, however, that the animal can learn when its inductions are wrong and modify them according to experience. Once we reach the realm of the human animal it becomes obvious that we can learn how to modify our expectations and improve our inductive capabilities. The better we know the conditions under which an induction may hold the more reliable it will be. Arriving in a foreign country we may be awakened by a train passing by our hotel every morning. After a few days we are expecting the train at a certain time and we will be astonished when our induction fails because the train doesn't run on Sundays. Doubtlessly, however, once we know the peculiarities of a country, its public holidays, its propensities for strikes or other delays, we become quite good in our inductions.

According to Riedl the evolution of our cognitive capacities can be interpreted as an improvement in the organism's capacities to induce, that is, to judge when particular observations warrant generalisation. The more closed the cognitive system, the more fallible the induction. The more open the system the better the chances of learning whereby learning means to comprehend the conditions under which an induction may hold.

Turning to science, Riedl contends that here, too, induction plays a crucial role. He realises, of course, Hume's problem but believes that a theory of probabilistic induction adequately describes scientific procedures. By using induction fallibilistically, he believes he can, reconcile his theory with Popper's. But in this view he is mistaken. Popper has made it very clear that any kind of inductive methodology is not acceptable to him.

At this stage I would like to introduce a framework within which both, Riedl's and Popper's ideas, find a place. I do not claim that either of those authors would be happy with my attempted solution, but I feel that it may help to clarify the issue. The concept which I want to introduce is the concept of control. I will argue that during their cognitive evolution living things increasingly learn how to control the conditions of their own experience. Scientific progress can be seen as but a further step in the same direction.

Let us see what the concept of control amounts to, and how it can help us to understand why, indeed, induction is an important part of scientific methodology. Let me further show you that this does not mean that we have to abandon Popperian trial-and-error methodology. In my view, both methods are complementary. In other words, I will argue that you can have your Popper and your Riedl too. In order to make my point I will present a few examples which may help to elucidate the concept of control.

Scientific experimentation takes place in a tightly controlled environment. By applying a variety of instruments and techniques the scientist attempts to exclude possible disturbing factors. For example, he may create an artificial vacuum, keep the temperature constantly optimal, or isolate the apparatus from undesirable radiation. All these techniques serve a single purpose, namely to create conditions which can be repeated if necessary, and which ensure that a new phenomenon is not due to experimental failure but a genuine occurrence worthy of further exploration. The very fact that experiments must be repeatable shows that induction plays a central role in science. Even as basic a procedure as the reading of a thermometer is based upon the reliability of induction, for whenever the scientist observes the rising of mercury in his thermometer he induces that the temperature surrounding the instrument has risen. This usage of induction is usually referred to in the philosophical literature as the ceteris paribus clause. It assumes that everything else being equal the scientist can concentrate on the phenomenon under consideration. Yet, to give a procedure a name does not mean one has solved the problem. A complete rejection of induction as proposed by Popper would make scientific activity impossible. We cannot test all our theories at once, we have to rely on the older well tested theories and the reliance means nothing else but the reliance on the principle of induction. In other words, experimental control is a means that enables us to use induction reliably. This, however, does not mean that we should use induction as a means of discovery, as Riedl would want us to do. Here I want to side with Popper. New phenomena do not carry with themselves their theoretical explanation. The fact that the same phenomenon may always appear under identical circumstances does not give us a theory or even a hypothesis.

That experimental control is of crucial importance in natural science and that its main function is to create conditions under which we can use induction reliably may not be controversial. But it may be asked whether the concept of control is also applicable to the descriptive sciences, such as astronomy. And, indeed, it is as important a method there as anywhere else. The giant telescopes which scan the evening sky have encoded in their very motion our theories of the universe. A new astronomical phenomenon can only be discovered if all other phenomena remain invariant. Thus, by controlling the motions of the telescope we control our experience. We ensure that the ceteris paribus clause applies. We induce that the movements of our planet have not changed from yesterday and that we therefore can concentrate on this new occurrence which arouses our interest. But once this stage has been reached induction loses its value. The fact that we have been observing the feature under consideration for the past two years does not of course imply that it will be visible tomorrow. Only a new theory which enables us to make testable predictions can assist us in our search for new knowledge. Such a theory is, indeed, arrived at by trial and error, by the creative imagination, by bold conjectures and attempted refutations.

The concept of control is by no means restricted to science or even human knowledge. It is, indeed, central to all cognitive and even physiological processes. For example, the well known phenomena of colour and size constancy in vision make it possible for us to use induction reliably. Under different light conditions objects may look the same, although objectively speaking they ought to look very different indeed. But recognition of the same object under different circumstances can have great survival value. Therefore our perceptual

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system abstracts those features away which are not relevant in a particular situation.

We are now in the position to interpret the Kantian categories and forms of intuition as means of control which enable us to function reliably in our everyday circumstances. Once we penetrate into different areas of reality we need different kinds of controls. I have mentioned so far only experimental control, but, as it is clear that experimentation is derived from scientific theories, the latter, too, ought to be seen as devices of conceptual control.

Induction is perfectly acceptable, indeed, necessary, as long as it is used in certain, well-defined, that is, controlled circumstances. New occurrences, however, we do not understand. We do not know their regularities, nor do we know the occasions under which they will manifest themselves. Therefore, induction is no method to lead us into new and unknown territories. Here we will have to fall back on the oldest of all methods, the method of trial and error, of throwing out randomly new ideas, hoping that they may capture an essential feature of the world and may tether our fantasies to reality.

I have been arguing that the concept of control lends itself as a unifying theme for both, evolutionary epistemology and bioepistemology. I have shown how the methods of induction and of trial and error supplement each other and are both necessary in order to explain how cognitive systems operate. Using both methods means, however, creating a new one. Popper proclaimed a method true for eternity and for all living systems. The new method may better be called a metamethod because it proclaims that methodology itself changes and improves. That, indeed, at the beginning of life and cognition there was nothing but trial and error, but during the course of evolutionary history living things learned to use induction in an ever more successful manner. The improvement of the cognitive apparatus can then be understood as a means of creating stable structures which make induction possible. Science constitutes the most advanced stage of the cognitve development on earth. The processes of experimental and conceptual control have been perfected and many stunning results of modern science provide ample evidence for its power. But once we reach the stage where our powers of control fail, we have to resort to the oldest of all methods, to trial and error. For, as Donald Campbell has said, "in going beyond what is already known, one cannot but go blindly." (Campbell 1974, p. 422)

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