

**EVOLUTIONARY EPISTEMOLOGY
AND THE CONCEPT OF IGNORANCE**

By

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EVOLUTIONARY EPISTEMOLOGY AND THE CONCEPT OF IGNORANCE

ABSTRACT

The purpose of this dissertation is to consider what evolutionary epistemology can tell us about the concept of ignorance. The procedure for this consideration involves an examination of six central issues in evolutionary epistemology:

1. Establishing a solid account of evolutionary theory.
2. Identifying and examining the distinctions between the two main schools of thought in evolutionary epistemology: the EET Program (those who maintain that scientific theories develop and compete *analogously* to biological organisms) and the EEM Program (those who maintain that the evolution of our cognitive mechanisms contributes *literally* to our survival).
3. Identifying and examining the distinctions between 'blind' and goal-directed variation in biology and science.
4. Consider how culture has transcended biology i.e. how has biology produced a single species which has generated a mode of evolution (culture/science) which does not operate through natural selection but yet contributes to the survival of this species?
5. Consider the relationship between evolutionary epistemology and the problem of realism.
6. Consider how evolutionary epistemology responds to skepticism and how skepticism applies to evolutionary epistemology.

In Chapter One I address the first central issue, above, and argue for a neo-Darwinian or New Synthetic theory of evolution. In Chapter Two, I examine the works most representative of the central issues in evolutionary epistemology i.e. Karl Popper, Donald T. Campbell, Michael Bradie, Franz Wuketits, etc. In Chapter Three, I examine each of the five remaining central issues of evolutionary epistemology in order to determine what they can tell us about the concept of ignorance. In Chapter Four, I formalize the concept of ignorance in evolutionary epistemology by

further defining and examining the implications of the neo-Darwinian model of knowledge. And finally, in Chapter Five, I synthesize the formal components of the concept of ignorance with the main issues in evolutionary epistemology.

Examining the concept of ignorance in reference to these six issues of evolutionary epistemology satisfies two tasks:

1. It establishes a clear understanding of what evolutionary epistemology can tell us about the concept of ignorance.
2. This understanding clarifies aspects concerning the six central issues of evolutionary epistemology. In this way, the procedure or methodology of this dissertation is symbiotic.

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1. Always do the best job you can possibly do.
2. Be happy.

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INTRODUCTION

As a student of philosophy, I have always been intrigued by the fundamental questions of epistemology: 'What are the necessary and sufficient conditions for knowledge?', 'Is justified true belief knowledge?', 'When, if ever, are beliefs justified?', etc. But I have also been interested in skepticism--the formal procedure which questions whether knowledge, however defined, is possible at all. As an undergraduate, I can recall reading Peter Unger's book *Ignorance: A Case For Scepticism*. Unger held an extremely radical unmitigated form of skepticism which questioned practically all knowledge claims. Were we really as ignorant as Unger claimed? I became fascinated with the concept of ignorance. I wanted to examine what it meant to say that S is ignorant of p. I was also intrigued to see that Unger had proposed a (cursory) causal explanation for our ignorance: it was language itself. That is, language was developed imprecisely in ancestry and this led to the establishment of epistemic criteria (such as certainty) which are impossible to fulfil. Hence, there are very few things we can claim to know. Although I shall argue against Unger's ancient language hypothesis (ALH) and much of his form of linguistic skepticism later in the dissertation, this suggestion led me to consider a natural explanation for how we come to know--and especially how we do not know: evolutionary epistemology.

And so the purpose of this dissertation gradually developed into a consideration of what evolutionary epistemology can tell us about the concept of ignorance. Immediately, one might ask two important questions:

1. What is epistemically significant about the concept of ignorance?
2. Why should we care what evolutionary epistemology has to say about it?

Let me respond to the first question by stating that an examination of the concept of ignorance will provide three epistemically significant insights:

(i) We can understand that ignorance as a lack of knowledge relative to a particular perspective is a necessary (but not a sufficient) condition for curiosity, inquisition, abduction, etc.

(ii) One's reflection of a lack of knowledge sharply distinguishes what is contained and what is not contained in a particular belief system i.e. it clarifies explanatory boundary conditions.

(iii) One's ignorance relative to a particular perspective allows for creativity in the growth of human knowledge. In this sense, ignorance is a form of conceptual emancipation.

In reference to (i), we can see that it necessarily follows that whenever a knowledge agent S, is curious, inquisitive, or abductive, he is ignorant relative to a particular perspective. But the state of ignorance itself is not a sufficient condition for curiosity, inquisition, etc., because one can be unreflectively ignorant of p (whatever we define p to be) and be neither curious, inquisitive, nor abductive. And this is because there are more conditions required which, when combined with a state of ignorance, are sufficient for curiosity, inquisition, etc. e.g. that about which one is ignorant--a particular state of affairs, the language used to represent the states of affairs, and so on. Immediately, then, we notice how states of ignorance are distinguished by reflective and non-reflective modes. Distinctions such as these provide a more comprehensive picture of a knowledge agent's epistemic framework.

In reference to (ii), we can see that in various branches of biology e.g. homology (comparative anatomy), embryology, etc., new insight is gained by comparing likenesses and differences of various species. Knowledge about a particular species can increase by determining what it is not like. There are definitions of qualities and characteristics which demarcate when an

organism either belongs or does not belong to a particular species. In this way, these fields broaden in their particular perspectives. Similarly, I think it is important to consider the opposite of knowledge (however defined). Knowing more about the concept of ignorance will sharpen theories of knowledge by forcing knowledge agents to recognize the explanatory boundaries and consider the causal factors responsible for these boundaries (the explanatory boundary conditions) which demarcates S's knowledge of p (according to a particular perspective), from his ignorance of p.

In reference to (iii), I maintain that the way in which we understand and define the concept of ignorance is important for epistemology and science because the cognizance of a lack of knowledge relative to one's current body of beliefs was an important epistemic development in the evolution of intelligence. Reflective awareness of one's ignorance regarding p improved the methods of categorization, it fostered curiosities, and it directed abduction. The acknowledgement of a lack of knowledge relative to a particular perspective, generated the creativity for explanation. In the recognition of gaps in one's perspective, one is relatively free to establish explanations which will fill in these gaps. The conscious direction of one's attention towards resolving or explaining a particular state of affairs, is the first step in the development of scientific knowledge. Naturally, this is a difficult hypothesis to confirm or falsify. I am, after all, taking guesses. However, my guesses will not be entirely unfounded. We shall see through a synthesis of neo-Darwinian evolutionary theory and the central issues of evolutionary epistemology, how this hypothesis may be warranted. And this leads us to an answer of question two, above.

Evolutionary epistemology is an appropriate field of study to inform us about the concept of ignorance because it is a naturalized epistemology. In other words, it considers the problems of epistemology from the view of the sciences which collectively produce the theory of evolution i.e.

paleontology, geology, botany, anthropology, biology: homology, embryology, molecular genetics, populations genetics, etc. Human knowledge, and, of course, human ignorance, evolved over thousands of generations. Their roots are biological. And so we have some responsibility to consider what biology and the other evolutionary sciences can tell us about them.

It is in [the area of epistemology] that an evolutionary perspective seems very likely to advance our understanding. This is because it is not unreasonable to expect that human knowledge [is] a function, in important respects, of our biology; after all, the capacity to formulate codes of right action and conceptions of the nature of the world around us is dependent, in part, on our neurobiology. And since our biology is a product of evolution, the nature of our knowledge can be expected to be influenced by our evolutionary development (Thompson, 1989, p. 19).

We should care what evolutionary epistemology has to say about the concept of ignorance because the evolutionary sciences offer us the best models currently available for explaining the causal mechanisms responsible for knowledge. I realize that this is question-begging but I agree with Donald T. Campbell that no non-presumptive knowledge or non-presumptive modes of knowing are possible to us (Campbell, 1974a, p. 418).

The first task at hand, then, is to establish a clear understanding of evolutionary theory. In this dissertation, I shall argue that a Neo-Darwinian or New Synthetic Theory of Evolution provides the best account of biological evolution, and hence, the best account of the causal mechanisms responsible for our current epistemological development. This is the task of Chapter One. This is by far the most technical of chapters, but necessarily so. If we are to seriously consider the relevance of evolutionary theory in relation to epistemology, it is imperative to initially establish a faithful interpretation of Darwinian and modern evolutionary theory. For this reason, Chapter One is divided into four sections. In the first section, I will discuss Darwinian evolutionary theory by examining Darwin's central work: *The Origin of Species*. This section will examine the historical influences

which led to Darwin's development of the central mechanism for evolution: natural selection. In the second section, I shall discuss the eventual scientific development in molecular and population genetics which led to the New Synthetic theory of evolution. Basically, the new synthesis combines the Darwinian mechanism of natural selection with Mendelian and later molecular and population genetics. This comprehensive picture defines evolution in terms of random genetic variability (genotypic influences e.g. DNA) with natural selection and retention of phenotypic characteristics which either allows a specific individual to flourish or perish. Again, I will stress that natural selection is the key evolutionary factor behind phenotypic change and that this change, when adaptatively advantageous, is gradual. In the third section, I shall examine the current debate between the pluralists (Gould, Eldredge, Lewontin, *et al*) and the Adaptationists (Mayr, Maynard-Smith, Dawkins, Dennett, Ruse, Thompson, *et al*). The debate centres around the exclusivity or pervasiveness of adaptation as the central mechanism in evolution. Gould *et al*, maintains that there are other factors such as punctuated equilibrium, genetic drift and natural catastrophes which explain the direction of evolution. As we shall see, the fact that there may be auxiliary processes at work in evolution is not contested by adaptationists provided that natural selection is considered to be the central evolutionary mechanism manifested in phyletic gradualism. The point of controversy rests on the importance the pluralists place on the auxiliary processes. That is, there are times when it is argued that such auxiliary processes are equal to or even more pervasive than natural selection. I shall argue against such a pluralist account and maintain that the adaptationist program, according to the new synthetic theory (or neo-Darwinism), still possesses the greatest explanatory power and properly remains as standard orthodoxy. The final section of chapter one is simply a summary of the central points of neo-Darwinism, and it is this orthodox view of evolutionary theory which I shall

refer to throughout the dissertation.

Having established a clear understanding of evolutionary theory as neo-Darwinian, the task of Chapter Two is to examine the works most representative of the central issues in evolutionary epistemology. Towards this end, in the first section, I shall look at D.T. Campbell's seminal paper "Evolutionary Epistemology" (1974a). Much influenced by Karl Popper, Campbell describes epistemology as a product of evolution in which language arose contingently due to natural selective pressures. Eschewing any belief in the *a priori* status of epistemic concepts such as 'certainty', Campbell sees knowledge as an accumulation of information according to a series of selective-retention processes. But Campbell describes scientific evolution as *analogous* to biological evolution. That is, ideas compete, and those providing the better fit within a scientific community survive while those that do not, perish. As well, Campbell maintains that, like organic evolution, science proceeds through 'blind' variation, selection and retention (of ideas). In the tradition of Popper, Campbell states that ideas describing the causal behaviour of objects and organisms, are thrown up as wild speculations and we try our best to prove them wrong or falsify them. I shall argue that Campbell is correct in stating the contingency of language, but is wrong in maintaining both that scientific evolution is analogous to organismic evolution and that science proceeds 'blindly'.

In the second section of Chapter Two, I shall look at Michael Bradie's paper: "Assessing Evolutionary Epistemology" (1986). Bradie's most important contribution to this branch of epistemology is to clearly define two specific programs: the evolution of cognitive mechanisms program (EEM) and the evolution of theories program (EET). This distinction divides up the various philosophers in each camp: Popper, Campbell, Toulmin, and Hull argue for the EET program while Bunge, Skagestad, and Ruse argue for the EEM program. My position is clearly with the latter

program and I shall discuss several disanalogies which reveal why the EET program breaks down.

In the third section of Chapter Two, I will discuss the current work of some of the evolutionary epistemologists from the Austro-German school such as Rupert Riedel, Gerhard Vollmer, and Franz Wuketits. This will bring us up to date regarding current trends in evolutionary epistemology and will focus especially on the problem of realism.

From the works in the previous three sections, I shall establish, in the final section of Chapter Two, six central issues in evolutionary epistemology. These issues represent the most common and most important issues that occupy the philosophers of evolutionary epistemology.

In Chapter Three, I shall examine how each of the six main issues of evolutionary epistemology provides insight into the concept of ignorance.

1. The first issue involves the task of securing a solid account of evolutionary theory. This task has already been completed in Chapter One but its importance cannot be over-stressed. In evolutionary epistemology, the manner in which one accounts for problems in epistemology is directly related to one's account of evolutionary theory. As we shall see, I argue for and shall defend the new synthetic or neo-Darwinian account of evolutionary theory. The remaining five issues and the concept of ignorance will be considered in light of this account.

The next three issues are related.

2. The second issue involves Michael Bradie's distinction between the EET and the EEM programs of evolutionary epistemology. This sharply divides evolutionary epistemologists into the analogical and literal camps. I shall argue against Popper and Campbell's account of the EET (analogical)

program and for the EEM (literal) program by showing a number of striking disanalogies which exist between conceptual (or scientific) and organic (or biological) evolution. The most significant of the disanalogies between the two gives rise to the next central issue.

3. The third issue involves the disanalogy between blind and goal-directed variation. It is an extremely important distinction because it is directly related to an evolutionary account of ignorance. Campbell, by way of Popper, argues that scientific inquiry is as 'blind' as the selective processes in organic evolution. Much like organisms, which do not know of any teleological benefit or disadvantage of a particular variation, so too, does Campbell argue that scientists throw up wild hypotheses without consciously knowing of any teleological or efficacious explanation. In this way, Campbell sees scientific development as analogous to organic evolution. But I shall argue against this view (of the EET Program) by maintaining that scientific inquiries are not 'blind' in this sense at all. The variations in science are significantly unlike the random genetic variations (and mutations) in organic evolution. The most obvious difference between the two is that we do exercise some control over scientific variants--that is, we can direct them towards specific goals. This disanalogy, I shall argue, gives us the first indication of how reflective awareness of one's state of ignorance was brought about by selective pressures. I shall argue that the very notion of goal-direction of variants in scientific and pre-scientific reasoning, was due to a cognizance of a need, want, or 'lack' of either information (propositional knowledge) or procedural technique (know-how knowledge). And that this 'lack' gradually led to an awareness of a distinction between knowledge and ignorance which sharpened the focus of inquiries.

We are naturally led to consider how the cognitive mechanisms responsible for science and culture evolved. We need to consider how and why natural selection favoured cognitive capabilities which would eventually produce beings capable of transcending such a biological constraint.

4. The fourth issue involves the cultural transcendence of biology. That is, we must consider and try to explain how biology has produced a species which has generated a mode of evolution (culture/science) which does not operate through natural selection but yet contributes to the survival of the species in question. This is related to the above two issues because it is the evolution of cognitive mechanisms which gradually led to the increase in common sense reasoning which eventually produced scientific theories. The point at which variation became directed signified a crucial turning point in the evolution of intelligence. I maintain that it is due to an understanding of a lack of knowledge (a 'reflective ignorance') relative to a particular perspective which greatly assisted in this transition.

The final two issues are also related.

5. The fifth central issue in evolutionary epistemology is the problem of realism. It would seem that any evolutionary epistemology must, at some level, presuppose realism. But there is a distinction between ontic realism (or realism about the relationship between things in the external world) and theoretic realism (realism about the relationship between our beliefs and the external world). We can recognize, of course, that evolutionary theory in general presupposes the continued existence of the external world. So the question, of course, is not whether one is a realist, but to what type of realism

does one subscribe e.g. naive realism, internal realism, direct realism, hypothetical convergent realism, hypothetical non-convergent realism, etc., and why? Again, I shall argue that the choice of realism by an evolutionary epistemologist depends largely on his understanding of the explanatory power and limitations of evolutionary theory. And this leads directly to the sixth main issue.

6. The final issue stems from the problem of realism and it is that which began this investigation, the problem of skepticism. How much can biology tell us about epistemology? If we assume that evolutionary theory will provide a good account for the concept of ignorance, we must also determine the explanatory boundaries of this field of science. And so we must consider both how evolutionary epistemology responds to skepticism and how skepticism applies to evolutionary epistemology. I shall argue against the Cartesian form of skepticism, both in its classic form and in the modernized linguistic form for which Peter Unger argues. But I shall show that there are striking parallels between neo-Darwinian epistemology and ancient--that is, Pyrrhonian--skepticism. These parallels will clarify not only our understanding of the concept of ignorance, but the position of the neo-Darwinian epistemologist.

Examining the concept of ignorance in reference to these six central issues of evolutionary epistemology will satisfy two tasks:

(i) First, it will satisfy the main task of the dissertation by providing a clear understanding of what evolutionary epistemology can tell us about the concept of ignorance.

(ii) But a second task will be accomplished because a better understanding of the concept of ignorance will clarify aspects of the six central issues of evolutionary epistemology.

In this way, the procedure or methodology of this dissertation is symbiotic.

In Chapter Four, I shall draw from our analysis of the main issues of evolutionary epistemology in Chapter Three and formalize some of the characteristics of the concept of ignorance. In the first section, I will draw a distinction between propositional and non-propositional knowledge and whether it is justified internally or externally. I shall argue that, according to a neo-Darwinian account of the concept of ignorance, the evolution of cognitive mechanisms suggests that our ancestors would have been concerned originally with know-how type knowledge i.e. the ability to do those activities, functions, etc., which would have promoted survival. I shall also argue that in gradually developing more sophisticated languages, our ancestors would have developed a survival-based use for propositional knowledge. This, I shall argue, is based on a common sense understanding of the world. Determining regularities in their environment and developing the means by which to manipulate, understand, and interact accordingly through 'epigenetic rules', would have given our ancestors a survival edge over those who did not adapt in this way.

I shall also argue that a neo-Darwinian epistemology is also a reliabilist epistemology based on external justification. That is, since neo-Darwinism presupposes a common sense understanding of the world, and science is understood to be an advanced understanding of common sense, then it follows that beliefs are reliably attained if they are produced by a law-governed procedure (some of my criticism of Cartesian skepticism in Chapter Three will be directed against internalist justification).

In the second section, I shall list a number of formal components of the concept of ignorance. This includes a distinction between two modes of ignorance: reflective and non-reflective ignorance-or awareness and unawareness that one is ignorant. I shall then discuss how the transition from blind

to goal-directed variation, know-how to propositional knowledge, and biology to culture, is better understood in terms of what I call the Lacunae Definition of Ignorance. If the notion of directing variants towards goals requires cognizance of a 'lack' or a gap, or hole, or 'lacuna' relative to a particular perspective, then we can consider, metaphorically, that remedying ignorance requires conceptual explanations which fill in these gaps. In this way, one's particular perspective becomes coherently expanded or enlarged. I will examine how this Lacunae Definition of Ignorance would have emerged according to a neo-Darwinian account by considering the *strategies* hominids would have used in overcoming instances of ignorance relative to their particular perspectives. This will involve a review of Soren Hallden's work on the notion of 'existence gambles'. In both blindly and reflectively directing our goals, Hallden believes the long run effect of evolution guards the survival of true belief concerning a common sense understanding of the world, and shortens the life-span of incorrect convictions.

And finally, I shall consider the various types of ignorance which emerge relative to particular perspectives. For example, there are remedial and undetermined types. The former is considered remediable according to established common sense and scientific criteria while the latter points out that there are various scientific goals which have yet been attained. There are many goals which can be articulated in each scientific field which are currently undetermined but nonetheless focused based on a reflective cognizance of a lack of information and technological ability. This leads us to realize the third and most significant type of ignorance which I call *factitious ignorance*. This simply involves the realization that our current theories, concepts, models, etc., and the lack of information or procedural technique that results in contrast to them, is due to a number of complex historical influences. And the result of these influences structures the way in which we can ask

questions about the world.

And finally, in the Fifth Chapter, I shall synthesize the formal components of the concept of ignorance with our examination of the main issues in order to draw some conclusions regarding not only the concept of ignorance, but the main issues of evolutionary epistemology as well. In this way, the symbiotic methodology of this dissertation will be complete.

CHAPTER I

GETTING THE EVOLUTIONARY THEORY RIGHT

INTRODUCTION

The main task of any project involving evolutionary theory is to produce a faithful interpretation of Darwin's work and to show how it is relevant with current work in biology today. It is for this reason that the purpose of this chapter is to argue for an adaptationist position according to the Neo-Darwinian or Modern Synthetic theory of evolution. I shall demonstrate that while this interpretation of Darwinian evolutionary theory stresses natural selection as the central mechanism in evolution, it is not inconsistent to consider the plausibility of secondary or auxiliary processes such as relatively rapid speciation following prolonged periods of stasis (punctuated equilibrium), neutral drift, natural catastrophes, etc. as processes which complement natural selection. However, we must not forget that these processes are, at best, auxiliary. That is, if they are considered plausible, they are only done so as complements to gradual adaptationism.

The first section of this chapter will concentrate on Darwin's theory as it is presented in the sixth edition of the *Origin of Species*. This will involve some discussion of the historical influences on Darwin such as the geological work of Charles Lyell, the social theory of Thomas Robert Malthus, etc. In this section I will cite passages which consistently demonstrate why it is important to understand Darwinian theory as strictly adaptationist (and not saltationist). In the second section, I will discuss some of the historical factors which led to the eventual synthesis between Darwinism and Mendelian genetics which produced the current Synthetic Theory. This will involve a brief account of the work of population geneticists Sir Ronald Fisher, J.B.S. Haldane, and Sewall Wright

in the 1920's. In the third section, I shall argue for neo-Darwinism by addressing current issues which have recently arisen between the pluralists (Gould, Lewontin, Eldredge, *et al*) and the adaptationists (Mayr, Maynard-Smith, Ruse, Dennett, Dawkins, *et al*). And in the final section, I will summarize my arguments.

I

WHAT DARWIN SAID: A BRIEF ACCOUNT OF *THE ORIGIN OF SPECIES*

By now, many people even remotely interested in scientific discovery are familiar with Darwin's five year excursion at sea aboard the H.M.S. Beagle (1831-1836). Even though there is good evidence to suggest that Darwin was already considering the theory of natural selection shortly after his return to England, it was over twenty years after his voyage that he first published the *Origin*. There is debate and controversy surrounding Darwin's hesitation for publishing his findings. Perhaps he feared the impact such a theory would have on the creationists of Victorian England. The fear of controversy, persecution and ridicule might seem obvious deterrents. Whatever the reasons for delay, on June 18th, 1858, Darwin received a letter from the naturalist Alfred Russell Wallace who had been working for some time in the Malay Archipelago. Wallace's natural observations and findings were strikingly similar to those of Darwin's. With the advice of Joseph Hooker and Sir Charles Lyell, on July 1st, 1858, Darwin and Wallace jointly published "On the Tendency of Species to Form Varieties: and On the Perpetuation of Varieties and Species by Natural Means of Selection" in the *Journal of the Linnean Society*. Perhaps realizing the inevitability of the discovery of the theory of natural selection, in November of 1859, the first edition of the *Origin* was published. This work ties

together much of Darwin's work not only aboard the Beagle but in England as well.

The first two chapters of the *Origin* deal with the variability which arises between individuals of a species (henceforth, *variation*) both under domestication and under nature. Having been a keen observer of cattle breeders, pig farmers, and himself belonging to two eminent Pigeon Clubs in London, Darwin was quite aware of the inheritability of specific traits from one generation of a species to the next. Although currently unfamiliar with the specific properties of inheritance (much of Mendel's work in particulate genetics was not 'rediscovered'¹ until the end of the nineteenth century), Darwin was able to determine that various particular species are descended from single progenitors. For example, the numerous varieties of domesticated pigeons were produced through intensive selection of man from the rock dove (*Colomba livia*). Darwin noticed this form of domesticated selection occurring in horticulture as well. Seed-raisers chose those plants which produced the highest yield and pulled up the 'rogues' which deviate from the proper (higher) standard. Darwin recognized that the principle of selection had been practised for thousands of years:

It may be objected that the principle of selection has been reduced to methodological practice for scarcely more than three-quarters of a century. But it is very far from true that the principle is a modern discovery. In rude and barbarous periods of English history choice animals were often imported, and laws were passed to prevent their exportation: the destruction of horses under a certain size was ordered. The principle of selection I find distinctly given in an ancient Chinese encyclopaedia. Explicit rules are laid down by some of the Roman classical writers...Savages now sometimes cross their dogs with wild canine animals to improve their breed, and they formerly did so, as is attested by passages in Pliny (Darwin, 1909, p. 48).

Darwin makes the very interesting point that savages (such as the natives of Tierra del Fuego) have selected animals favourably yet unconsciously. That is, they were aware of the properties which led

¹ Working independently in Europe, Hugo Devries, Erich von Tschermak, and Carl Correns had all duplicated Mendel's experiments and results.

to developed characteristics of a particular species (in this case, dogs) and so would be practising what Darwin called 'unconscious selection'.²

Darwin saw the same type of selection occurring in nature. However, variation and selection in nature occurs much more slowly than in domesticated situations. But he recognized that changes in the conditions of life are the most important in causing variability:

Over all these causes of Change, the accumulative action of Selection, whether applied methodically and quickly, or unconsciously and slowly but more efficiently, seems to have been the predominant Power (Darwin, 1906, p. 57)

It is in the third chapter of the *Origins* that Darwin sets out the theory of Natural Selection:

Owing to the struggle for life, variations, if they be in any degree profitable to the individuals of a species, in their infinitely complex relations to other organic beings and to their physical conditions of life, will tend to the preservation of such individuals, and will generally be inherited by the offspring. The offspring, also, will thus have a better chance of surviving, for, of the many individuals of any species which are born, but a small number can survive. I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection, in order to mark its relation to man's power of selection. But the expression often used by Mr. Herbert Spencer of the Survival of the Fittest is more accurate, and is sometimes equally convenient (Darwin, 1909, p. 77).

By 'fitness' we should never naively think that Darwin meant 'strongest'. Fitness simply means 'better adapted' to the conditions of a specific environment. As conditions change, those creatures possessing characteristics better adapted to the new conditions will be selected to survive. Thus there is a 'struggle' for existence. Darwin mentions that he owes much of his theory to Thomas Malthus's

² I found this passage particularly interesting because it relates to the functional utility of a case of 'know-how' knowledge. That is, the native may successfully select superior breeds without knowing why. This marks a unique transition point between blind variation and goal-directed variation and demonstrates external justification of beliefs.

work *An Essay on the Principle of Population*.³ Malthus was a member of the clergy and an economist of the early nineteenth century who was primarily concerned with (the growth of) human populations. He noticed that it is a general principle of nature that:

...living organisms produce more offspring than can normally be expected to survive to reproductive maturity. An oak produces hundreds of acorns annually, a bird can bring forth several dozen young in its lifetime, and a salmon lays thousands of eggs per year, each of which can potentially become an adult. Despite this massive reproductive capacity, adult populations tend to remain stable from generation to generation (Leakey, 1979, p. 9).

Natural selection could explain why some offspring survived and some perished. It was the characteristics which varied slightly between offspring which determined their 'fitness' or 'adaptability' to an environment. Whatever the variation, those offspring possessing the most adaptative characteristics will be selected for survival. The influence of Malthus on Darwin is captured in the following passage:

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied to the whole animal and vegetable kingdoms. Although some species may be now increasing in numbers, all cannot do so, for the world would not hold them (Darwin, 1909, p. 79)⁴

In this struggle for existence, Darwin acknowledged a balance between the complex relations of

³ Wallace, too was influenced by Malthus. See Leakey, 1979, p. 10.

⁴ Darwin also cites (Darwin, 1909, p. 79) that Linnaeus had calculated that if an annual plant produced only two seeds whose seedlings each produced two seeds, and so on, in about twenty years, there would be approximately twenty plants.

species (what we now call ecosystems): The structure of every organic being is related, in the most essential manner, to that of all other organic beings with which it comes into competition, from which it has to escape, or on which it preys (Darwin, 1909, p. 90). And so there is a geometrical rate of increase in which every species is trying to increase in numbers. The manner in which a species can vary its characteristics and adapt to a changing ecosystem will largely determine whether it survives or perishes. In the struggle for survival, the path of evolution is a descent (from a common progenitor) with modification through variation and natural selection.

Darwin also recognized forces other than natural selection such as climatic changes, sexual selection, and geographic isolation as having far-reaching effects on evolution.

Climate plays an important part in determining the average numbers of a species, and periodical seasons of extreme cold or drought seem to be the most effective of all checks. I estimated that the winter of 1854-5 destroyed four-fifths of the birds in my own grounds (Darwin, 1909, p. 83).

Both plants and animals are affected by climate and those which cannot endure sometimes drastic climatic changes will be selected against and perish.

Darwin also recognized sexual selection as less rigorous than natural selection (because the result of the unsuccessful competitor is not death), but nonetheless a guiding force in evolution.

This form of selection depends not on a struggle for existence in relation to other organic beings or external conditions, but on a struggle between the individuals of one sex, generally the males, for the possession of the other sex. The result is not death to the unsuccessful competitor, but few or no offspring. Sexual selection is, therefore, less rigorous than natural selection. Generally, the most vigorous males, those which are best fitted for their places in nature, will leave most progeny. But in many cases victory depends not so much on general vigour as on having special weapons confined to the male sex. A hornless stag or spurless cock would have a poor chance of leaving numerous offspring. Sexual selection, by always allowing the victor to breed, might surely give indomitable courage, length to the spur, and strength to the wing to strike with the spurred leg, in nearly the same manner as does the brutal cockfighter by the careful selection of his best cocks (Darwin, 1909, p.

101).

Males displaying the most adaptive characteristics—either through combative strength or physical attractiveness—would stand the best chance of ensuring that such characteristics were passed on to the next generation. And, of course, there are more subtle means of competing. Strength and beauty (however defined) are wonderful attributes ensuring reproduction, but they do not mean very much if you are not fertile. There is little point in being Superman if Kryptonite has reduced your sperm-count to zero (Ruse, 1986, p. 16). Darwin recognized that the struggle for sexual reproduction was perhaps more strongly motivated than the struggle for existence e.g. the male black widow spider, the preying mantis, the sockeye salmon, etc. are just a few of the species which risk life and limb in order to reproduce.

Darwin also mentions species isolation as an important element in modification through natural selection.

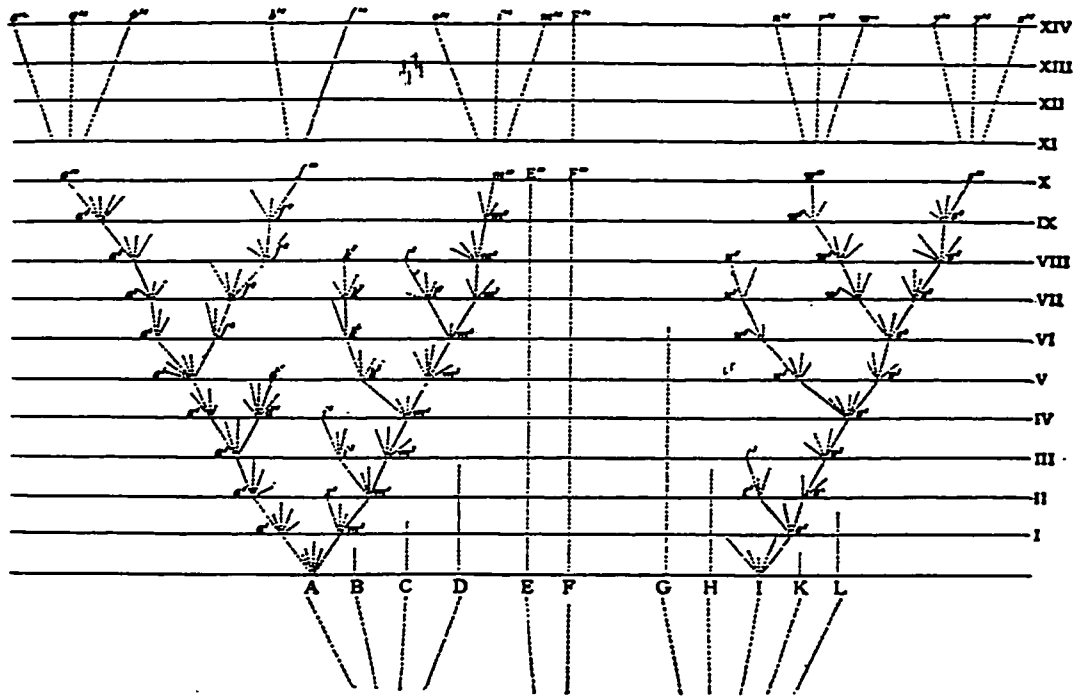
In a confined or isolated area, if not very large, the organic and inorganic conditions of life will generally be almost uniform; so that natural selection will tend to modify all the varying individuals of the same species in the same manner. Intercrossing with inhabitants of the surrounding districts will be prevented (Darwin, 1909, p. 116).

This can have either favourable or deleterious effects. The isolation may allow a species to stabilize. However, if the group is quite small, variations will be limited and the number of emerging species too, will be limited.

Isolation likewise prevents, after any physical change, as of climate, elevation, etc., the immigration of better adapted organisms; and thus new places in the natural economy will be filled up by modification of the old inhabitants. Lastly, isolation will give time for a new variety to be improved at a slow rate. If, however, an isolated area be very small, the total number of inhabitants will be small, and this will retard the production of new species by decreasing the chances of favourable variations arising (Darwin, 1909, pp. 116-117).

Darwin concludes that although small isolated areas (such as oceanic islands) have been highly favourable in the production of new species, this type of modification has been far more rapid on large areas where species can flourish, become victorious over their competitors, and give rise to the greatest number of new varieties and species.

The modified descendants of any species will succeed better than its competitors as they become more diversified in structure. Darwin presents an evolutionary tree as the only diagram in the *Origin*. His demonstration begins with eleven hypothetical species (A to L). Each horizontal line represents approximately one thousand generations. The small dotted lines trace the descendants of each particular species. And the small letters indicate 'well-marked varieties'.



(From Darwin, 1909, pp. 128-129)

Species B, C, D, H, K, and L, all have relatively short generational life spans and perish quite quickly. Both G and E have significantly longer durations, but eventually perish as well. A, I, and

F all survive the longest. F experiences no variation and maintains a regular stasis. A and I however, branch off into a variety of new species. It is interesting to note that Darwin states that he does not "suppose that the process ever goes on so regularly as is represented in the diagram, nor that it goes on continuously; it is far more probable that each form remains for long periods unaltered, and then again undergoes modification" (Darwin, 1909, p. 128). It appears that Darwin had been considering speciation change which in some ways, anticipates punctuated equilibrium but accounts for this change through phyletic gradualism. As we shall see in the third section, gradual adaptation through natural selection should always be considered the primary mechanism guiding evolution.

Why should all the parts and organs of many independent beings, each supposed to have been separately created for its proper place in nature, be so commonly linked together by graduated steps? Why should not Nature take a sudden leap from structure to structure? On the theory of natural selection, we can clearly understand why she should not; for natural selection acts only by taking advantage of slight successive variations; she can never take a great and sudden leap, but must advance by short and sure, though slow steps (Darwin, 1909, p. 206).

One of the first opponents to the theory of natural selection was Mr. St. George Mivart, a distinguished zoologist who was perhaps the first advocate of what we now know as punctuated equilibrium. Mivart claimed that new species could manifest themselves 'with suddenness and by modifications appearing at once': "He thinks it difficult to believe that the wing of a bird 'was developed in any other way than by a comparatively sudden modification of a marked and important kind'" (Darwin, 1909, p. 261). Darwin states that such a conclusion is improbable in the highest degree because it leaves the realm of science and enters into the realm of miracles.

That many species have been evolved in an extremely gradual manner, there can hardly be any doubt...Many large groups of facts are intelligible only on the principle that species have been evolved by very small steps. For instance, the fact that species included in the larger genera are more closely related to each other, and present a greater number of varieties, than do species in the smaller genera...Against the belief

in such abrupt changes embryology enters a strong protest. It is notorious that the wings of birds and bats, and the legs of horses or other quadrupeds are indistinguishable at an early embryonic period, and that they become differentiated by fine steps (Darwin, 1909, p. 261).

Although abrupt changes may appear in the geological record, Darwin states that such a record is imperfect and fragmentary and that there is nothing strange in new forms appearing as if suddenly developed (Darwin devotes Chapter 10 entirely to this problem).

It is historically and scientifically important that we interpret Darwinian evolutionary theory as closely to Darwin's intentions as possible. And this means understanding Darwin as primarily a strict adaptationist. Naturally, he was limited in understanding the finer details of genetic inheritance; however, we can clearly see the dominant role natural selection plays in evolution while acknowledging, as did Darwin, the auxiliary process at work such as geographic isolation, sexual selection, and climatic changes. Darwin could not have been more clear in stressing the gradual adaptations which species undergo while nature selects and retains those characteristics which are best adapted to a particular environment. Against any rapid form of speciation, Darwin anticipates the theory of punctuated equilibrium by over a century and responds quite candidly by stating: *Natura non facit saltum*.⁵

Evolution, as Darwin describes it, involves gradual phylogenetic change. And it is important to understand his evolutionary theory in terms of this gradual process. He looked at organisms in much the same way as most natural theologians of the day did. That is, as though they were somehow *designed*. In other words, organisms seemed to have been made very well for the functions and tasks which befell them in their daily routines. But instead of adopting some unseen (and unscientific)

⁵ 'Nature does not make leaps'.

causal agent such as God as the force behind the production of such helpful adaptative features like eyes, leaves, antennae, etc., Darwin produced a perfectly consistent natural explanation. But adaptation by natural selection not only rids us of Divine teleology, it proposes that adaptation is altogether blind. Variation, selection and retention do not operate according to a map or blue print. Selection chooses a winner who has adapted to the particular environment better than any other competitors. This is exactly where Lamarkian progressionism breaks down. Selection cares not a whit about perfect functioning; only better functioning. Many adaptations could easily have been better designed e.g. our eyes, spinal columns, internal organs, etc. But the point to note is that these adaptations evolved gradually according to various selective pressures.

Another reason why it is important to understand Darwin's theory as adaptationist, is to consider what would happen if new variations did not constantly occur. We would find a stagnant species which would be rigid to a changing environment and would perish quite quickly. Again, we must understand that variation is 'blind'. That is, variations of individual species occur 'randomly'. This randomness does not arise due to an organism's present needs; new variations will just as likely be detrimental to a species as beneficial. The truly creative aspect of evolution is selection. This is why Darwin believed variations must be small; otherwise large changes (or saltations, 'spurts', etc.) would invariably move an organism too far out of adaptive focus (Ruse, 1986, p. 17).

We have established the main ideas behind Darwin's evolutionary theory. Hopefully, these ideas will sufficiently convince the reader of a strictly adaptationist interpretation. In the next section, we shall see the final components needed to complete the adaptationist picture of Darwinism: molecular and population genetics.

II THE NEO-DARWINIAN SYNTHESIS

While Darwin was busy compiling and assessing data while writing the *Origin* in England, Gregor Mendel was busy cross-pollinating pea plants in (what was then) the Austro-Hungarian Empire.

There are several places in the *Origin* where Darwin admits his ignorance of inheritance:

I have hitherto sometimes spoken as if variations were due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of variation...Such considerations incline me to lay less weight on the direct action of the surrounding conditions than on a tendency to vary, due to causes of which we are quite ignorant (Darwin, 1909, pp. 145-147).

The causes of variation we now know arises from gene recombination and mutation. And the early studies in gene research and particulate inheritance were developed by Mendel. By distinguishing pea plants in an all or nothing fashion i.e. smooth/wrinkled peas, purple/yellow flowers, plump/pinched pods, tall/short plants, etc., Mendel was able to observe the dominant and recessive traits in hybrids. By identifying the dominant and recessive traits (or genes, specifically, alleles) of pea plants, Mendel was able to produce a mathematical model for inheritance.

Mendel himself developed the concepts of dominance and recessiveness, and his work embodies a clear distinction between genotype and phenotype. We observe the phenotype (like seed shape or eye colour), whereas our knowledge of the underlying genotype has had to be arrived at by subtler means (Leakey, 1979, p.25).

Although Mendel's ideas were known to the scientific community--he presented a paper to the Brunn Society of Natural Science in 1865 and published his work in 1866--as noted, above, the significance of his ideas was not rediscovered until the very end of the nineteenth century. Much of the development of modern genetics came about from the work of the German biologist August Weismann who, from the late 1870's onward, did much to convince the scientific world that the

hereditary substance, or 'germ plasm' as he called it, is passed from generation to generation without being influenced by bodily changes acquired through exercise, or lack of it, injury or disease (Leakey, 1979, p. 17). While Darwin was wrongly convinced of a Lamarckian notion of a 'use-or-disuse' understanding that phenotypic characteristics could be genetically inherited and blended (his theory of pangenesis), Weismann was developing what was to become known as the Central Dogma of molecular genetics: That *somatic* (bodily) events cannot be translated into changes in the individual's genetic information (Leakey, 1979, p. 19). In other words, the flow of genetic information is unidirectional--that is, from the DNA outward.

By this point in time, technology improved the development of microscopes and cellular analysis (cytology) advanced ideas concerning chromosomes, cellular division e.g. mitosis and meiosis, and the concept of gene mutation arose i.e. abrupt changes in the genotype could bring about correspondingly large changes in the phenotype. During the first three decades of the twentieth century, there existed a rivalry between geneticists who maintained that evolution occurs through a series of drastic mutations (genotypic variation) and naturalists who maintained that evolution occurs according to the Darwinian notion of (phenotypic) variation. It is now obvious that something was occurring at both levels. During the 1920's, population geneticists Ronald Fisher and J.B.S. Haldane in England, Sewall Wright in the U.S., and Sergei Chetverikov in Russia, were examining plants and animals in terms of entire populations. They had shown that:

...previous work had underestimated both the frequency and utility of small mutations. Even the slightest selective advantage would lead to the rapid spread and permanent establishment of an otherwise inconspicuous novelty. From these and other observations, it gradually became apparent that natural selection was unremittingly active (Miller, 1982, p. 160).

Where Mendelian genetics deals primarily with molecular changes within the individual, Darwinism

is concerned with evolution as a function of population change. Although every individual is affected by variation, natural selection is best illustrated amongst a group--where some members succeed or 'fit' better than others. In an effort to synthesize Mendelian genetics with Darwinian evolutionary theory, population genetics was born. As Ruse points out, it was not long before a veritable flood of evolutionists started to produce work based on a Darwin-Mendel synthesis and the synthetic theory was born:

In North America, undoubtedly, the crucial catalyzing work was that of the Russian-born, U.S.-residing biologist, Theodosius Dobzhansky: *Genetics and the Origin of Species* (1937, third edition 1951, revised and retitled 1970). This influenced the systematist Ernst Mayr, author of *Systematics and the Origin of Species* (1942, much augmented 1963); the paleontologist G.G. Simpson, author of *Tempo and Mode in Evolution* (1944, revised and retitled 1953); and the botanist, G. Ledyard Stebbins, author of *Variation and Evolution in Plants* (1950) (Ruse, 1982, p. 75).

In the development of population genetics, Mendel's first law (of segregation)--which states that it is entirely a matter of chance which paired allele of a parent at a given locus is copied and passed on to the offspring--needed to be applied to an entire population. Thus, the Hardy-Weinberg Law was developed:

Assume a very large population of organisms (i.e. a populations that is effectively infinite), evenly distributed between males and females and with random interbreeding. Assume also that at some locus one has alternative alleles A and a, in proportion p:q. Assume that there are no externally disruptive factors (e.g., no mutation). Then, whatever the initial distribution of genotypes, in the next and all succeeding generations the distribution of genotypes will be

$$p^2AA + 2pqAa + q^2aa$$

Moreover, in each generation the ratio of A to a alleles will stay constant at p:q (Ruse, 1982, p. 78).

This law seems to be a mere truism i.e. "if nothing happens, then nothing happens" (See Ruse, 1982, p. 78). That is, if there is no selection or mutation, then gene ratios remain the same. But Ruse maintains that it is similar in type to Newton's first law of motion (i.e. if there are no forces, then

motion or rest remains unchanged). The importance of this law is the way in which it provides a background of stability, against which geneticists can introduce disruptive factors and measure them: If the law did not hold, then anything could go any which way, and one would have neither control nor explanation (Ruse, 1982, p. 78). Against the background of this law, we can formulate limited causal models (or what Richard Lewontin (1980) has called "as if" statements). If we presuppose a Hardy-Weinberg equilibrium, then, all things being equal, population geneticists could introduce factors which could be expected to bring about changes in gene ratios in populations which lead to evolutionary change. Ruse notes a common pattern to these models:

...in the Darwinian tradition, two causal factors above all others are taken to be of importance and analyzed as to their potential effects. On the one hand, we have the constant introduction of new genes into populations; that is, through *mutation* we have a process that leads ultimately to new kinds of phenotypes. This provides the Darwinian component of random variation. On the other hand, we have the fact that, because of their phenotypes, some genes can be expected to increase their representation in populations, at the expense of other genes; that is, we have a differential reproduction, or Darwinian *selection*. And, because of the quantificational precision that the Mendelian approach to genetics offers, evolutionists are in a position to examine this selection in controlled detail, seeing how quickly a selectively favored or "fitter" allele might be expected to spread through a population, when for instance other factors affecting gene ratios (like mutation) might oppose or aid the selection, and so forth (Ruse, 1982, pp. 79-80).

New species are formed by the gradual accumulation of changed genotypes through the combination of genetic variation and natural selection: through 'chance and necessity', as the French microbiologist Jacques Monod has summed it up (Leakey, 1979, p. 26). Ernst Mayr recognized this marriage of both chance and necessity in the Synthetic Theory and stated that:

...natural selection permits an escape from the dilemma of the alternative "chance or necessity" that had bedeviled philosophers from the Greeks on. Natural selection is a two step process: The production of gametes and zygotes is preceded by a whole series of chance events, but survival and successful reproduction are largely determined by anti-chance properties of genotypes. By accepting natural selection

one no longer must make the unpalatable choice between chance or necessity. They are both represented in the process of natural selection (Ruse, 1982, p. xii).

So the physical features which makes up any phenotype is simply the product of the totality of genes which makes up the genotype which is modified and fashioned by the interacting effects of the environment on the growing developing organism (See Ruse, 1982, p. 66). There are just a few more characteristics we need to discuss in order to complete our picture of the new synthetic theory of evolution.

According to Paul Thompson (1983, p. 433), it is generally assumed that the synthetic theory is capable of explaining three major aspects of evolution: changes in local populations (e.g., the change of colour of the peppered moth in England), species formation, and macroevolutionary trends (e.g., increasing body size, increasing neurological material and capabilities).

According to the most common general characterization of the synthetic theory...all of these changes are a function of natural selection acting upon genetic variability in populations and resulting in a change in the relative frequency of alleles (genes at a particular location--a locus--on a chromosome) in populations (Thompson, 1983, p. 43).

In reference to Mayr's definition (1963) that synthetic theorists maintain that all evolution is due to the accumulation of small genetic changes which are guided by natural selection and that transspecific evolution is nothing but an extrapolation and magnification of the events that take place within populations of species, Thompson states that there are three aspects of such a general characterization of the new synthesis which is relevant to the current debate over the mode and tempo in evolution (a debate which we shall consider in detail in the next section). The first aspect is, as we have seen above, genetic variability. The loci of alleles can be polymorphic--that is, points at which two or more different alleles exist. Genetic variability then, is a function of the number of

polymorphic loci in a particular population.

Consider for example, a population of organisms which have only one pair of chromosomes, only two loci and only one form of allele at each locus. Only one genotype is possible in such a population (i.e., AABB). On the other hand, in a population in which more than one form of allele exists at a large number of loci, there will be a large variety of genotypes possible. For example, in a population of organisms which have only one pair of chromosomes with only two loci but at each of which two different forms of alleles exist, nine different genotypes are possible (AAbb, AABb, ABbb, Aabb, AaBb, aabb, AaBB, aaBb, aaBB). Hence, there is a greater degree of potential genetic variability (Thompson, 1983, p. 433).

It would seem to follow that if selection favours superior heterozygote fitness, eventually the frequency of organisms which are homozygous for the fitter allele will gradually increase, eliminate other allele forms, and reduce polymorphism and genetic variability. But as Thompson points out (1983, p. 434), this is not the case; i.e. there are high levels of polymorphism in large outbreeding populations (see also Lewontin, 1974).

Synthetic theorists have provided a number of complementary mechanisms to account for these high levels of polymorphism. For example, polymorphism is, to some extent, maintained by the continual mutation of alleles as well as, though far less significantly, chromosomal changes, (e.g., inversions). Considerably more significant as a mechanism for maintaining polymorphism are particular kinds of selections. For example, balancing selection is selection which favors a heterozygote over a homozygote. In cases where balancing selection occurs, polymorphism will be maintained because the heterozygote which is favored carries two different forms of allele at a locus (Thompson, 1983, p. 434).

We should also consider the balance hypothesis (as inspired by Dobzhansky) as a good account for genetic variability. If there are two or more alleles represented at many loci, held in population by selection, then there is no such thing as a 'standard' genotype. Excepting twins, all genotypes and many phenotypes would differ. According to the balance hypothesis, selection is not wholly dependent upon the occasional mutation. Because any given population would carry considerable variation, if selection were to demand it, for instance, as the result of moving into a new ecological

niche, it would be there ready for use (Ruse, 1982, pp. 86-87).

I hardly need say that this consequence of the balance hypothesis gives a whole new perspective on the evolutionary process. Darwinism becomes a much more flexible, dynamic, opportunistic process than one might otherwise have imagined. In particular, the plausibility of natural selection as *the* creative process in evolution, as *the* cause of organic adaptation, is much enhanced. Rather than waiting for the solitary, rare, useful mutation, and building features up, step by laborious step, virtually all the time selection has a huge inventory of materials to draw on and can get to work at once should the need arise (Ruse, 1982, p. 87).

The second characteristic of the synthetic theory Thompson notes is that, in relation to species formation, most supporters of the synthetic theory accept that evolutionary change is gradual. Based on this assumption, two predominant types or patterns of species formation are accepted: phyletic evolution and splitting.

Phyletic evolution is the result of a gradual accumulation, under the direction of selection, of allelic substitutions. The result of this accumulation of allelic substitutions is, eventually, a new species. In terms of pattern, this process will produce a temporal sequence of populations of organisms which manifests a gradual change in morphology, physiology, etc. (Thompson, 1983, p. 434).

The other mode of species formation is the splitting of populations:

In this way, a single population can give rise to two species. The population splits and the two subgroups diverge genetically to the point where successful interbreeding is not possible. While there are a considerable number of modes of speciation by splitting (see White, 1978), the one that has played the most significant role in current discussion of tempo and mode in evolution is allopatric speciation. According to this mode of species formation, an original population becomes geographically separated into two groups. This geographic separation prevents the members of one subgroup from interbreeding with the members of the other subgroup. Under these conditions, the two populations diverge genetically over time to the point where successful interbreeding will no longer be possible even if the two descendent subgroups are reunited geographically--they have become genetically isolated. At this point, the two descendent groups are two separate species. In terms of pattern, this process will produce a temporal sequence of diverging populations of organisms (Thompson, 1983, p. 435).

The third relevant aspect of the synthetic theory is selection. As we noted above, this is the creative

force in evolution, for it directs the evolutionary process in the development of new species. Selective pressure adds up small changes in a particular direction with the result that new species come into existence. Random factors in species formation, if considered at all, are considered secondary to the pervasive role of selection (Thompson, 1983, p. 436). We have now considered some of the central characteristics of the synthetic theory of evolution.

In these past two sections, I have shown the historical relationship and transition from Darwin's theory of evolution to the synthetic theory. And it should be abundantly clear by now that Darwinism must be understood in terms of adaptation by natural selection. It should also be clear that selection takes place because it confers an adaptative advantage to its possessors. Having established a sufficient amount of historical information concerning the development of Darwinian and Neo-Darwinian evolutionary theory, I shall, in the next section, examine the current debate between the Pluralists: Gould, Eldredge, Lewontin *et al*, and the Adaptationists: Mayr, Maynard Smith, Dawkins, Dennett, *et al*. By examining both sides of this debate, I hope to establish why neo-Darwinism or the New Synthetic Theory of Evolution provides the best account of biological evolution and hence, the best account of the causal mechanisms responsible for our current epistemological development.

III

PLURALISM VS. ADAPTATIONISM

What has become a rather lively and heated debate concerning adaptationism vs. pluralism arose recently between Daniel C. Dennett and Stephen Jay Gould in the *New York Review of Books*.⁶ In evolutionary theory, strict adaptationism (or what Gould would call "ultra-Darwinism" or "constructionism" or "Darwinian fundamentalism") is described as follows:

The generally accepted result of natural selection is adaptation--the shaping of an organism's form, function, and behavior to achieve the Darwinian *summum bonum* or enhanced reproductive success. We must therefore study natural selection primarily from its results--that is, by concentrating on the putative adaptations of organisms. If we can interpret all relevant attributes of organisms as adaptations for reproductive success, then we may infer that natural selection has been the cause of evolutionary change. This strategy of research--the so-called adaptationist program--is the heart of Darwinian biology, and the fervent, singular credo of the ultras (Gould, 1997a, p. 34).

As we noted, above, adaptationists such as Mayr, Maynard Smith, Ruse, Dawkins, Thompson and Dennett see natural selection as being the central mechanism guiding the way in which organisms have evolved.

Pluralists like Gould, Lewontin and Eldredge, however, maintain that, aside from natural selection, and perhaps in some cases, in place of natural selection, there are other factors involved in evolution.

The pluralists...including Darwin himself...accept natural selection as a paramount

⁶ See first Maynard Smith's review of Dennett's *Darwin's Dangerous Idea* in *The New York Review of Books*: November 30, 1995 pp. 46-48. Then see Gould's two-part article in June 12, 1997 pp. 34-37 and June 26, 1997 pp. 47-52. Then see Dennett's reply to Gould in August 14, 1997, pp. 64-65; and Gould's final response in the same issue on p. 65. As well, one could also look at Steven Pinker's response to the debate concerning evolutionary psychology and Gould's response to Pinker in the October 9, 1997 issue pp. 55-58.

principle (truly *primus inter pares*), but then argue that a set of additional laws, as well as a large role for history's unpredictable contingencies, must also be invoked to explain the basic patterns and regularities of the evolutionary pathways of life...[the] pluralists seek to identify a set of interacting explanatory modes, all fully intelligible, although not reducible to a single grand principle like natural selection (Gould, 1997b, p. 47).

Gould further qualifies this definition by stating that:

...selection cannot suffice as a full explanation for many aspects of evolution; for other types and styles of causes become relevant, or even prevalent, in domains both far above and far below the traditional Darwinian locus of the organism. These other causes are not, as the ultras often claim, the product of thinly veiled attempts to smuggle purpose back into biology. These additional principles are as directionless, non-teleological, and materialistic as natural selection itself—but they operate differently from Darwin's central mechanism (Gould, 1997a, p. 65).

These other types of auxiliary processes or intermediary complexities come in the form of spandrels, spurts and jerks, contingencies and neutral drift. According to Gould, ultra-Darwinian fundamentalists pursue one true way while pluralists seek to identify a set of interacting explanatory modes, all fully intelligible, although not reducible to a single grand principle like natural selection (Gould, 1997b, p. 47). There are interesting cases on both sides of the debate. However, I believe that the auxiliary processes which Gould stresses are complementary rather than oppositional to adaptationism. Perhaps the best way to illustrate and somehow resolve the tensions on both sides of this debate is to first state the adaptationist position (as espoused by Dennett), and then the pluralist position (of Gould), and then demonstrate why adaptationism is still preferable to pluralism (when properly understood).

(i) Daniel C. Dennett: *Darwin's Dangerous Idea*

While at a cognitive science symposium at MIT in 1989, Daniel Dennett noticed how little knowledge and agreement there was concerning the interpretation of Darwin's evolutionary theory.

The level of hostility and ignorance about evolution that was unabashedly expressed by eminent cognitive scientists on that occasion shocked me (Dennett, 1995, pp. 391-392).

The shock, Dennett believes, stems from the fact that "People ache to believe that we human beings are vastly different from all other species".⁷ It appears that Dennett is saying that some scientists refuse to admit that our culture, our technology, our art, religion, science, in essence: all that makes us who we are, is simply a by-product of biological evolution. And he maintains that it is difficult for people to accept that we are, in fact, simply another animal--albeit, a rather advanced one. The danger in Darwin's idea of natural selection is that "it cuts deeply into the fabric of our most fundamental beliefs". Dennett refers to natural selection as a 'universal acid' which cuts through our most cherished thoughts concerning mind, meaning, and our place in the universe. He maintains that some of the scientific community may still be resisting the ramifications of Darwinian theory because:

We are terrified that if Darwin is correct and if we apply his thinking to ourselves, there can be nothing sacred, there can be no point to our existence, there is no assurance that everything will "be all right", and there is no content to "goodness" or even any reason to think that goodness matters. In Dennett's opinion, the results of this fear, both within and without the scientific community, are self-deception about the true nature and implications of evolution, unfounded and unnecessary controversy about the overall picture and the details of the process, and the above-noted resistance to considering human culture and human behavior in an evolutionary light (Clayton, 1996, p. 289).

This fundamental misconception is one of the main reasons why Dennett set out to get the Darwin right in his 1995 book *Darwin's Dangerous Idea*.

As an adaptationist, Dennett defines natural selection as a blind, algorithmic process which

⁷ See *New Scientist*, September 23, 1995, p. 44.

has three key features:

1) Substrate neutrality: the power of the procedure is due to its *logical* structure, not the causal powers of the materials used in its instantiation e.g. the procedure for long division works equally well whether you use pencil, pen, paper, brick, neon lights, skywriting, etc.

2) Underlying mindlessness: Each constituent step in the algorithm is utterly simple. Algorithms are recipes designed to be followed by novice cooks. Each step is extremely simple requiring "no wise decisions or delicate judgments or intuitions on the part of the recipe-reader" (Dennett, 1995, p. 51).

3) Guaranteed results: An algorithm will accomplish the same results every time if executed in the same way. In this sense, it is a foolproof recipe.

By explaining natural selection in this way i.e. as a blind, algorithmic procedure, Dennett maintains that this best accounts for Darwin's explanation of how and why an organism's anatomy and behaviour seem to fit so well with its environment. As we noted, above, prior to Darwin, fitness could be explained in terms of a benevolent God i.e. organisms are adapted by divine design.

Dennett uses the metaphor of skyhooks and cranes to illustrate this point.

The skyhook concept is perhaps a descendant of the *deus ex machina* of ancient Greek dramaturgy: when second-rate playwrights found their plots leading their heroes into inescapable difficulties, they were often tempted to crank down a god onto the scene, like Superman, to save the situation supernaturally. Or skyhooks may be an entirely independent creation of convergent folkloric evolution. Skyhooks would be wonderful things to have, great for lifting unwieldy objects out of difficult circumstances, and speeding up all sorts of construction projects. Sad to say, they are impossible (Dennett, 1995, p. 74).

The notion of any god to explain how life got started requires the use of such 'skyhooks'. They are foundationless accounts which lack explanatory power. Cranes, on the other hand, do not fall from the sky as supernatural accounts, but build from the ground up on solid foundations.

Cranes can do the lifting work our imaginary skyhooks might do, and they do it in an honest, non-question-begging fashion. They are expensive, however. They have to be designed and built, from everyday parts already on hand, and they have to be located on a firm base of existing ground. Skyhooks are miraculous lifters, unsupported and insupportable. Cranes are no less excellent as lifters, and they have

the decided advantage of being real. Anyone who is, like me, a lifelong onlooker at construction sites will have noticed with some satisfaction that it sometimes takes a small crane to set up a big crane. And it must have occurred to many other onlookers that in principle this big crane could be used to enable or speed up the building of a still more spectacular crane. Cascading cranes is a tactic that seldom if ever gets used more than once in real-world construction projects, but in principle there is no limit to the number of cranes that could be organized in series to accomplish some mighty end (Dennett, 1995, p. 75).

We can see where Dennett is going here. He is using the crane metaphor to explain how simple compounds at the molecular level could have, according to fundamental laws of chemistry and the physics of self-organizing systems, bonded billions of years ago to form the first complex organisms. From here, it is simply a matter of further construction and replication to greater and greater complexity and an increase in diversity. Once the right combination of basic molecular matter was in place (the eukaryotic revolution)--in accordance to other forces of course, such as gravity, inertia, fluid mechanics, electro-magnetism, strong/weak nuclear forces, etc.--the intermediary force of natural selection could take over. And so order arises from chaos through a gradual building up of simple inanimate compounds to complex animate organisms. And all of this can be done without the use of skyhooks such as a benevolent god. Dennett admits to being a reductionist but not a "greedy" one. Instead, he considers himself a "good" reductionist because he recognizes the intermediary forces or "cranes" such as natural selection which is the central mechanism for biological evolution. A "greedy" reductionist descends past the intermediary level directly to physics and ignores the fact that cranes enable us to transcend our genes.

Among several important cranes in our evolution are two addressed by John Maynard Smith.⁸

⁸ See John Maynard Smith's "Genes, Memes, and Minds", a review of Dennett's *Darwin's Dangerous Idea* in *The New York Review of Books*, November 30, 1995 pp. 46-48.

He states that the first populations of replicating entities lacked sex: that is, there was no way in which different replicators could unite to form a new individual (Smith, 1995, p. 46). But once sex did arise, it greatly accelerated the evolutionary process. But sex did not arise with the intentions of developing or progressing the evolution of an organism towards a specific end. We must remember Darwin's insistence that natural selection is blind. How and why reproduction arose as it did is still somewhat of a mystery. But that it did, greatly assisted in the evolution of species.

A second crane which greatly aided evolution is the development of the brain and the ability to learn by experience i.e. by trial and error.

The brain is as much a product of natural selection as the liver and kidney. In the simplest animals it serves mainly to generate fixed responses to external stimuli. Once, however, the connectivity of the neurons in an individual can be modified by experience, an animal will alter its behavior in a useful way as a result of that experience. It is also possible to program a computer so that the strength of the internal connections alter with experience; such computers are surprisingly good at learning. As B.F. Skinner pointed out, trial-and-error learning is an exact analogue of evolution by natural selection. Dennett agrees with Skinner about this, although rejecting much else that he said. The important point is that the brain is, in Dennett's words, a crane. It evolved by natural selection, but, once evolved, it made the evolution of further complexity possible (Maynard Smith, 1995, p. 46).

Dennett maintains that there are those in the scientific community who do not wish to understand natural selection in terms of its 'craneness'. In the largest chapter of his book Dennett recognizes that some, like Stephen Jay Gould, are reluctant to accept that we, as humans, could have been produced by such a blind, algorithmic process.

(ii) Stephen Jay Gould: Spandrels, Punctuated Equilibria, Neutral Drift and Historical Contingencies

As a pluralist, Gould maintains that there are other factors responsible for our evolution aside from natural selection.

In 1972, Niles Eldredge and Stephen Jay Gould published a paper entitled 'Punctuated

Equilibria: An Alternative to Phyletic Gradualism'. In this paper, they stated that fossil records of various species do not indicate a smooth gradual process of evolution but instead, new species emerge in brief periods of rapid change: as punctuations, each representing a "geological moment" (a period which may represent thousands of years). As well, they also maintained that species maintain a "stasis" or equilibrium and do not change in any substantial or directional way--usually long periods of five to ten million years for fossil invertebrate species. Instead of the Darwinian model of gradualism, a new model of saltationism was developed ("saltation" meaning "leap" or "jump" and coming from the same Latin root as "somersault"). It is difficult to determine precisely whether or not Gould and Eldredge intended to show an alternative to the orthodox view of Darwinian gradualism or whether the theory of punctuated equilibria is simply complimentary to or an extension of adaptation by natural selection. For on the one hand, Gould recognizes the importance of adaptation:

...may I state for the record that I (along with all other Darwinian pluralists) do not deny either the existence and central importance of adaptation, or the production of adaptation by natural selection. Yes, eyes are for seeing and feet are for moving. And, yes again, I know of no scientific mechanism other than natural selection with the proven power to build structures of such eminently workable design (Gould, 1997a, p. 35).

But just a few paragraphs later he cites:

My own field of paleontology has strongly challenged the Darwinian premise that life's major transformations can be explained by adding up, through the immensity of geological time, the successive tiny changes produced generation after generation by natural selection. The extended stability of most species, and the branching off of new species in geological moments (however slow by the irrelevant scale of a human life)--the pattern known as punctuated equilibrium--requires that long-term evolutionary trends be explained as the distinctive success of some species versus others, and not as a gradual accumulation of adaptations generated by organisms within a continuously evolving population. A trend may be set by high rates of branching in certain species within a larger group. But individual organisms do not

branch; only populations do—and the causes of a population's branching can rarely be reduced to the adaptive improvement of the individual (Gould, 1997a, p. 35)

We shall consider the precise status of Gould's (and Eldredge's) position in a moment.

In 1979, at a symposium on adaptation in London (organized by John Maynard Smith), Gould read a paper he had co-written with Richard Lewontin entitled: "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme". This paper criticised adaptationist thinking on two counts. First, adaptationists were accused of seeing all organismic characteristics as purely adaptational i.e. functional. Secondly, some adaptationist accounts of various characteristics were considered to be "just-so" stories⁹ i.e. adaptationist flights of imagination as explanations for the physical and behavioral traits of organisms. Certainly we must stand on guard against actual "just-so" stories; e.g. that flamingos are pink to camouflage themselves against the setting sun. John Maynard Smith praised the paper because it forced adaptationists to clean up one's act and provide evidence for one's stories. But he also maintains that adaptationist thinking is still the mainstay of evolutionary thought.

In their paper, Gould and Lewontin set out to offer an alternative explanation to organismic features other than as functional adaptations. Such features are compared to the spandrels of San Marco as being accidental and unselected consequences of a particular architectural design. A spandrel is the tapering triangular space formed by the intersection of two rounded arches at right

⁹ The term "Panglossian" comes from Voltaire's *Candide*, a satirical comedy directed at Leibniz because of his belief that this is the best of all possible worlds. Dr. Pangloss is the learned fool who "could rationalize any calamity or deformity—from the Lisbon earthquake to venereal disease—and show how, no doubt, it was all for the best. Nothing *in principle* could prove that this was not the best of all possible worlds" (Dennett, 1995, p. 239). Dennett notes that Gould and Lewontin were not the first to coin this phrase: the evolutionary biologist J.B.S. Haldane used the term Pangloss's Theorem to refer that all (in nature) is for the best in this best of all possible worlds.

angles...they are necessary by-products of mounting a dome on rounded arches (Gould, 1993, pp. 147-49).



(From Dennett, 1995, p. 269)

Gould maintains that the iconography depicted on these spaces are secondary and that the spandrels themselves emerge as a necessary architectural constraint. Since these spaces must exist, they are often used for ornamental effect. Because evolutionary biologists focus exclusively on immediate adaptation to local conditions, they tend to ignore the basic structural or architectural constraints and invert the explanation placing primacy on the secondary characteristics.

Every fan vaulted ceiling must have a series of open spaces along the mid-line of the vault, where the sides of the fans intersect between the pillars. Since the spaces must exist, they are often used for ingenious ornamental effect. In King's College Chapel in Cambridge, for example, the spaces contain bosses alternately embellished with the Tudor rose and portcullis. In a sense, this design represents an 'adaptation', but the architectural constraint is clearly primary. The spaces arise as a necessary by-product of fan vaulting; their appropriate use is a secondary effect. Anyone who tried

to argue that the structure exists because the alternation of the rose and portcullis makes so much sense in a Tudor chapel would be inviting the same ridicule that Voltaire heaped on Dr. Pangloss... Yet evolutionary biologists, in their tendency to focus exclusively on immediate adaptation to local conditions, do tend to ignore architectural constraints and perform just such an inversion of explanation (Gould, 1993, pp. 147-49).

There are, according to Gould (and Lewontin), important nonadaptive consequences which emerge as side consequences for later use.

Since organisms are complex and highly integrated entities, any adaptive change must automatically "throw off" a series of structural by-products--like the mold marks of an old bottle or, in the case of an architectural spandrel itself, the triangular space "left over" between a rounded arch and the rectangular frame of wall and ceiling. Such by-products may later be co-opted for useful purposes, but they didn't arise as adaptations. Reading and writing are now highly adaptive for humans, but the mental machinery for these crucial capacities must have originated as spandrels that were co-opted later, for the brain reached its current size and conformation tens of thousands of years before any human invented reading or writing (Gould, 1997b, p. 47).

The spandrel metaphor is but one auxiliary process which illustrates an alternative force to natural selection in the explanation of species evolution.

Let us now examine the third auxiliary process of Gould's pluralist arsenal: neutral drift. Gould considers this an odd time to be a Darwinian fundamentalist because each of the major subdisciplines of evolutionary biology have been discovering other mechanisms as adjuncts to natural selection:

Population genetics has worked out in theory, and validated in practice, an elegant, mathematical account of the large role that neutral, and therefore nonadaptive, changes play in the evolution of nucleotides, or individual units of DNA programs. Eyes may be adaptations, but most substitutions of one nucleotide for another within population genetics may not be adaptive (Gould, 1997a, p. 35)

Gould states that natural selection does not explain why many evolutionary transitions from one nucleotide to another are neutral and hence, nonadaptive. The mathematical population geneticist

Motoo Kimura has founded the neutral theory of molecular evolution which claims that most evolution at the molecular level is *not* caused by natural selection, but by "genetic drift", the random replacement of one gene by another, functionally equivalent gene (Orr, 1997a, p. 4). It appears that on the molecular level, biological differences do not seem to affect fitness.

The fourth and final auxiliary process to natural selection is what Gould refers to as historical contingencies or catastrophes. He maintains that the study of mass extinctions has disturbed the ultra-Darwinian consensus for adaptation:

We now know, at least for the terminal Cretaceous event some 65 million years ago that wiped out dinosaurs along with about 50 percent of marine invertebrate species, that some episodes of mass extinction are both truly catastrophic and set off by extraterrestrial impact. The death of some groups (like dinosaurs) in mass extinctions and the survival of others (like mammals), while surely not random, probably bears little relationship to the evolved, adaptive reasons for success of lineages in normal Darwinian times dominated by competition. Perhaps mammals survived (and humans ultimately evolved) because small creatures are more resistant to catastrophic extinction. And perhaps Cretaceous mammals were small primarily because they could not compete successfully in the larger size ranges of dominant dinosaurs. Immediate adaptation may bear no relationship to success over immensely long periods of geological change (Gould, 1997a, pp. 35-36).

No matter how great the explanatory power of natural selection as adaptation, it cannot account for the impact of such world historical catastrophes:

Crank your algorithm of natural selection to your heart's content, and you cannot grind out the contingent patterns built during the earth's geological history. You will get predictable pieces here and there (convergent evolution of wings in flying creatures), but you will also encounter too much randomness from a plethora of sources, too many additional principles from within biological theory, and too many unpredictable impacts from environmental histories beyond biology (including those occasional meteors)--all showing that the theory of natural selection must work in concert with several other principles of change to explain the observed pattern of evolution (Gould, 1997b, pp. 47-48).

We have now reviewed four of the auxiliary processes of the pluralist program which Gould

recognizes as in some ways contributing, and in other ways, opposing the strict adaptationist program. The purpose of the next section is to demonstrate why, in several ways, the pluralist position of evolution (according to Gould) is misguided and the adaptationist position of the synthetic theory is the better interpretation.

(iii) Problems with Pluralism

There are three aspects of pluralism that I shall criticize:

- (a) Gould (and Eldredge's) theory of punctuated equilibrium as oppositional to phyletic gradualism.
- (b) The trouble with spandrels. Gould (and Lewontin's) attack of the adaptationist programme based on non-adaptive features.
- (c) Gould's contingency thesis; or the non-repeatability of evolution.

(a) Punctuated Equilibrium

As we have seen, above, it is difficult to determine exactly whether or not Gould believes the theory of punctuated equilibrium to be an auxiliary mechanism compatible with natural selection, or a mechanism which counters gradualism altogether (and stands, as Benton Stidd (1985) maintains, as a new 'paradigm'). And this is due, at least in part, to the various stages this theory has gone through since its inception. Biologists Jerry A. Coyne and Brian Charlesworth from the Department of Ecology and Evolution at the University of Chicago noticed that:

In the past 25 years, Eldredge and Gould have proposed so many different versions of their theory that it is difficult to describe it with any accuracy...Punctuated equilibrium originally attracted great attention because it invoked distinctly non-Darwinian mechanisms for stasis and change...leading to Gould's pronouncement that 'if Mayr's characterization of the synthetic theory [of evolution] is accurate, then that theory as a general proposition is effectively dead, despite its persistence as textbook orthodoxy' .¹⁰

¹⁰ See Jerry A. Coyne and Brian Charlesworth, letter in *Science*, April 18, 1997, pp. 338-341.

From 1972 to the present, we can identify at least three distinct stages of Gould's concept of punctuated equilibrium (See Ruse, 1989, pp. 118-145).¹¹ The first phase was represented in the jointly-written first paper in 1972. Here, the theory was considered a straightforward extension of adaptationism (i.e. neo-Darwinism or the synthetic theory of evolution). The second phase came in 1980 with Gould's paper: 'Is A New and General Theory of Evolution Emerging?' Here Gould was considering that macromutations could have occurred (due to chromosomal rearrangements) with species' changes occurring in just one or a few generations.

Significantly, the father figure had changed from Charles Darwin to Richard Goldschmidt (1940), one of the few English-speaking saltationists of the past half-century, and intellectual rival to the synthetic theory's greatest living exponent, Ernst Mayr (Ruse, 1989, p. 122).

Although Gould denies that he was ever a saltationist in Goldschmidt's sense, Dennett points out that he did choose to dub his denial of gradualism as "the Goldschmidt break" (Dennett, 1995, p. 289). At this point, Gould may have been highlighting the essential abruptness of evolution as opposed to its continuity.

...just as (say), a man falling in love might start to regard a woman in a new light, as a person of sexual attraction rather than as a lawyer or professor. Neither the continuity nor the profession is denied absolutely. They just no longer seem so important (Ruse, 1989, p. 122)

The third phase of Gould's punctuated equilibrium theory is the current form. Gould has pulled back from extremism (particularly with respect to the formation of new species) and his notion of macromutation declines. However, Gould does not retreat entirely:

Now we are presented with a *hierarchical* view of the evolutionary process. Down

¹¹ Ruse is careful to distinguish Gould's development of the theory from that of Eldredge. The two differ in a number of ways.

at the level of the individual organism we have natural selection working away, although much of its emphasis seems to be that of keeping things in line. (Below the level of the individual, at the level of the gene, we may have drift, working in ways that Japanese evolutionists suggest). Adaptation counts, although it is only one thing, along with a lot of constraints on development and adult form. Change generally comes at time of speciation, and although full-scale mutations are out, there is a feeling that changes in rates of development could have significant and fairly instant effects (Ruse, 1989, p. 13).

Gould maintains that Dennett's account of his theory of punctuated equilibrium is "a farrago of false charges" (Gould, 1997b, p. 48). Dennett has accused Gould (and Eldredge) of "flimflam and backpeddling" because their theory has gone through so many changes since 1972. But Gould maintains that he (and Eldredge) have simply recognized further implications and dropped untenable corollaries but that the basic principles have remained in tact and even gained strength. Gould has admired Dennett's crane analogy but insists that although natural selection may be the largest crane with the largest set of auxiliaries, punctuated equilibrium (along with neutral drift and evolutionary change by developmental constraints i.e. catastrophes) are also cranes (Gould, 1997a, p. 36).

Today, Gould defines punctuated equilibrium in the following way:

Punctuated equilibrium requires that substantial evolutionary trends over geological time, the primary phenomenon of macroevolution, be explained by the greater long-term success of some species versus others within a group of species descended from a common ancestor. Such trends cannot be explained, as Darwinian fundamentalists would prefer, as the adaptive success of individual organisms in conventional competition, extrapolated through geological time as the slow and steady transformation of populations by natural selection (Gould, 1997b, p. 47).

What is at the heart of this matter seems to be the extent of Gould's saltationism. And this leads us to ask a number of crucial questions about the theory of punctuated equilibrium:

- (1) How well substantiated is the motivation for punctuated equilibrium? In other words, how complete is the fossil record at both the micro and macroevolutionary levels?
- (2) How does the theory of punctuated equilibrium compare to competing theories of species

formation such as phyletic gradualism and the splitting of populations evidenced in Mayr's notion of founder populations and allopatric speciation which itself is a process of population genetics--the very heart of the new synthesis?

(3) How 'punctuated' is the 'equilibria'? That is, how extreme is the rapid reorganization of the genome? And how often would this occur relative to gradual, adaptive allelic substitution?

(4) In what sense is punctuated equilibrium complimentary or oppositional to adaptationism? And to what extent does the theory of punctuated equilibrium stand as a new 'paradigm' or an assimilation in the theory of evolution?

(1) First of all, one of the main reasons for the emergence of the theory of punctuated equilibrium was due to the gap in the fossil records. That is, paleontologists (like Gould) had noticed that the transition between species was not as smooth as one might expect if gradualism were as pervasive as some adaptationists proposed. Immediately, we find a number of problems with this motivation for punctuated equilibrium. As we saw in the first section of this chapter, Darwin was already dealing with proto-punctuacionists (like Mivart) long before Gould and Eldredge came on the scene. And Darwin's point then, was as salient as it is today. The fossil record may very well be incomplete (for current corroboration, see Kellogg, 1975, 1983; Gingerich, 1976, 1977). In most of the literature concerning the adaptationist/punctuacionist debate, little attention is given to the process of fossilization (or permineralization) itself. And this is surprising, since Gould is a paleontologist. And, as such, he should know and educate others that fossilization is a rare occurrence. And this is because:

...natural processes tend to recycle as much as possible. Almost all animals and plants that die are eaten or decompose. Even hard parts such as wood, shells and bones eventually break down; and their nutrients are recycled by the action of carrion-feeders, insects, molds and bacteria. The sun, the air we breathe and chemicals in the soil also help the gradual processes of breakdown and composition (Parker, 1990, p. 32).

Most fossils are found in ancient lakes or sea beds. And this is because sedimentation and a lack of

oxygen are conducive to good cast or mold fossilization. Land organisms are less likely to be preserved but may fossilize if buried quickly after death in dry sand, mud, volcanic ash, peat, natural tar, inland waters, etc. So to begin with, the odds are stacked against our favour that we shall find a complete fossil record indicating smooth gradual links of all species.

Secondly, although there are gaps due to an incomplete fossil record (remember, in piecing together the past, we are often unsure whether or not all the evidence is in), there are cases where these gaps have been convincingly filled in.¹² The most famous case, of course, is the fossil of *Archaeopteryx* linking reptiles and birds. But this is often overlooked by punctuationists (and for good reason). Thompson (1983, p. 437) has pointed out that there is considerable controversy about whether or not the fossil record actually does manifest patterns indicating long periods of stasis punctuated by brief periods of change (see Cronin *et al*, and Williamson 1981) while others (see Levinton and Simon, 1980) have stated that this pattern represents a specific meaning of 'species' which the punctuationists employ.

And thirdly, Darwin also realized that even though there may be gaps in the fossil record, there are obvious trends in the development of adaptative characteristics. For example, the trend witnessed from the possession of rudimentary eyes to more sophisticated eyes (See Ruse, 1982, p. 220). These are just a few examples we must review when we consider the motivation behind punctuated equilibrium.

¹² We can consider Kellog's work (1975) in which she argues that there is a long-term gradient (two million years) towards increased size of the microfossil radiolarian *Pseudocubus vema*, thus indicating a long term phyletic trend. Ozawa's studies (1975) of the Permian verbeekinoid foraminifer *Lepidolina multiseptata* shows continual change particularly in prolocular diameter. And Gingerich (1976, 1977), has studied trends in higher organisms such as the primate *Pelycodus* showing gradual change. (All examples cited were found in Ruse, 1982, p. 218).

(2) I do applaud Gould *et al* for considering alternative explanations to gradual adaptation based on gaps in the fossil record (for there is nothing like abductive hypotheses to get the conversation going and force orthodoxy to defend itself). However, there may be equally plausible explanations which account for the rarity of transitional fossil forms which is quite consistent with adaptationism. As punctuationists note, fairly rapid evolution may be accounted for if there is a small founder population for a new group. Gould and Eldredge state that if any large group has considerable variation held within it by selection, then a small number of founders will necessarily be somewhat atypical which could cause rapid and significant biological change (Eldredge and Gould, 1972). But this notion of founder populations was worked out by Mayr back in 1963 and recapitulated again in 1988:

Almost every careful analysis of fossil sequences has revealed that a multiplication of species does not take place through a gradual splitting of single lineages into two and their subsequent divergence but rather through the sudden appearance of a new species. Early paleontologists interpreted this as evidence for instantaneous sympatric speciation (speciation over a single area), but it is now rather generally recognized that the new species had originated somewhere in a peripheral isolate and had subsequently spread to the area where it is suddenly found in the fossil record. The parental species which had budded off the neospecies showed virtually no change during this period. The punctuation is thus caused by a localized event in an isolated founder population, while the main species displays no significant change (Mayr, 1988, p. 415).

It has been noted that the theory of allopatric speciation (speciation involving a second--in this case a geographically isolated but adjoining--territory) allows Mayr to modify the gradualism of the original Darwinian proposal, while retaining the basic Darwinian mode of explanation and avoiding the "punctual" events of the Gould-Eldredge scenario (events that in his view are objectionable) (McMullin, 1993, p. 316). But even though the founder principle proposes an explanation for rather rapid speciation, the proposed speed of speciation and the new forms of plants and animals produced

are not as Gould proposes.

Take something presumably formed (in part) by the action of the founder principle, for instance the finches of the Galapagos or...the fruitflies of South America. These organisms hardly give rise to thoughts of drastic change, even if the founder principle is effective. Certainly there is no question here of organisms with fundamentally modified ground plans: four wings and the like. Again, if one looks at some of the proposed chromosome species mechanisms that so excite Gould, one suspects that orthodox evolutionists would like more proof as to their universal nature. Gould never mentions Darwin's finches, the paradigm of the Darwinians. Do they not fit his theory? (Ruse, 1982, p. 218).

And Thompson has noted the populational genetic basis for the founder effect i.e. that the changes in the genotype of founding populations are heightened by the fact that genes interact in complex ways (e.g., the alleles at one locus can suppress the expression of alleles at another locus, or the alleles of several loci can work to modify the individual effect of alleles at other loci): Hence, changes at a few loci have the potential for effecting radical changes in the genetic composition of the population by altering the phenotypic expression of the alleles at numerous loci and thereby most likely altering the fitness values of a large number of loci (Thompson, 1983, p. 445). And so we can consider the founder effect as a process of speciation to be a function of population genetical processes. To further Thompson's point, one can see the connection between the founder effect and population genetics in Sewall Wright's shifting balance theory of evolution (1969, 1977, 1978). Wright envisions an adaptive landscape in which populations containing alleles that improve fitness are more adapted and live at higher elevations and those populations which do not possess these alleles will live at lower elevations. As a result of random genetic variability, a population on the landscape will move and alter its position on the adaptive landscape:

Mutation and migration will provide a population with genetic variation. Natural selection will sift through this variation, preserving the beneficial mutations and eliminating the harmful ones. As it does this, selection will tend to drive the

population uphill. By contrast, random genetic drift will move the population in an unpredictable fashion. The effect of all these forces--mutation, migration, selection, and random genetic drift--will bring the population to a state of genetic equilibrium, corresponding to a point near a peak on the adaptive landscape (Gardner *et al.*, 1991, p. 584).

I agree with Thompson that the founder effect, as a function of population genetics, follows from processes described by the new synthesis.¹³ Enough has been said in defense of the synthetic theory. We should now move on to consider what punctuacionists mean by 'rapid changes' occurring in 'geological instants'.

(3) There are a number of problems which surface when we consider exactly how 'punctuated' a period of stasis is. If we consider the possibility of 'macromutations' i.e. sudden phylogenetic changes producing instantaneous variations, we must ask a number of crucial questions. First of all, as Dobzhansky (1951) pointed out, if speciation occurs as rapidly as punctuated equilibrium suggests, would this not severely limit an organism's chances of finding a suitable mate? One of the main reasons why adaptationism explains evolution more adequately than punctuated equilibrium theory is because gradual phylogenetic changes are small enough to allow an organism to fit with its environment. A large change (or saltation) would severely limit an organism's chances for reproduction thereby moving it to the periphery of adaptive focus. Although the new synthesis recognizes the importance of genotypic changes, it is still natural selection which is the dominant factor in causing change at the phenotypic level. And change at the phenotypic level is what ultimately sets up new selection pressures. Far more than not, a mutation causing significant

¹³ Thompson's interpretation of the synthetic theory, however, does differ somewhat from standard orthodoxy. Although his views that the modern synthesis does not entail gradualism or extrapolationism are provoking and offer interesting insight into the structure of biological theories, I shall maintain, for the sake of argument, the standard orthodox view of the modern synthesis.

phenotypic change is selected against, and for good reason. The random change in the DNA's sequence of nucleotides is far more likely to reduce the fitness of an organism than improve it because mutations expressed at the phenotypic level cannot adapt quickly enough to current environmental conditions. If we can recall Wright's adaptive landscape, any saltation or leap from a fitness peak will invariably be to one's disadvantage. Any random jump from a peak is going to land you further down the hill. And so macromutations far more often than not, will produce 'hopeful monsters' which stand little chance of reproducing. Although mutations can, on rare occasions, improve an organism's fitness and add to the genetic variability of evolution, they are far more commonly selected out.

A related problem we must consider is the length of the saltationary period. Early in the development of Gould's theory, large scale change could occur in a relatively short time period. By 1982, however, jumps in the fossil record could last 50,000 years. Does change occurring in 50,000 years count as punctuated? This may be a 'geological instant' but not an instant in terms of genetics. Many generations can come and go in such a large time span. We are now led to ask to what extent does punctuationism centre around the semantic issue of what is meant by 'gradual' and 'rapid'? If stasis is 'interrupted' by change occurring in a time span of 50,000 years, then this is perfectly consistent with neo-Darwinism. For it would allow for speciation and gradual morphological change. If, on the other hand, change is held to take place much more rapidly--such as in a few generations--then this would indeed be counter to neo-Darwinian accounts of phyletic gradualism. Would we then venture to state that such a theory is, say, revolutionary?

(4) If punctuated equilibrium were to take place over relatively long periods of time (50,000 years), then it is an extension of neo-Darwinism (a view which Gould maintained in the first stage

of the theory in 1972). However, some (Stidd, 1980, 1985) have maintained (though Gould has come out against it) that punctuated equilibrium is a 'paradigm'--a revolution in evolutionary thinking. I shall forego the usual queries surrounding what Kuhn really meant by the term 'paradigm' and instead choose that offered by Thompson (1988, p. 81) as a new disciplinary matrix incommensurable with the old matrix. If we accept this definition, then it becomes obvious that punctuated equilibrium does not stand as a new paradigm to phyletic gradualism. For we have already seen in (b), above, how rapid changes in speciation are accountable by population genetics. And, according to Thompson,

If punctuated equilibria is a new disciplinary matrix one would not expect this agreement [between it and the synthetic theory]. This sounds more like a case of increased exemplars rather than a gestalt switch resulting in a new disciplinary matrix which is incommensurable with the old matrix. In the latter case one would expect no agreement between the two theories due to incommensurability resulting from radical meaning change (Thompson, 1988, p. 81).

That punctuated equilibrium theory is complementary to the synthetic theory is echoed also in Ruse:

One might also say that twentieth-century punctuated equilibria theory is more a modern incarnation of an old tradition than a proven way of nature...The whole point about punctuated equilibria theory when it was first introduced was that it was an extension, or rather, correct application of an *already-existing* paradigm, namely orthodox neo-Darwinism (Ruse, 1989, p. 139).

We may safely conclude that punctuated equilibrium is not an alternative theory to the synthetic theory but represents a modification of the standard neo-Darwinian picture of phyletic gradualism.

(b) The Trouble With Spandrels

As we saw, above, Gould (and Lewontin) developed the spandrel analogy to convince us that adaptation is not "pervasive". Those biological features which are not adaptations are called "spandrels". Like the spandrels of San Marco, various biological features may serve no immediate

biological purpose but are simply by-products of the underlying architectural structure (the *bauplan* or 'floor-plan'). They argue that the adaptationists believe the decoration of the spandrels is their primary purpose. And so they argue that adaptationists generally maintain that all biological features of an organism are functionally adaptative. I shall discuss three problems with Gould (and Lewontin's) argument which demonstrates how their analogy is weak and upon closer inspection, breaks down.

First, the effectiveness of the spandrel analogy is questionable because it is possible to conceive, based on historical architectural information, that the display of iconography may have been a motivating factor governing the choice of architectural supports. At the very least, it can be demonstrated that both functions--support and decoration--were highly valued at the time of construction. Dennett does not believe Gould has proven that the space created by spandrels was secondary i.e. as a use for the depiction of religious icons. At least one reason for the construction of the Basilica of San Marco was to provide a showcase for mosaic images and, as such, are adaptations chosen from a set of equipossible alternatives for aesthetic purposes: "They were designed to have the shape they have precisely in order to provide suitable surfaces for the display of Christian iconography" (Dennett, 1995, p. 274).

Otto Demus, the great authority on the San Marco mosaics, shows in four magnificent volumes that the mosaics are the *raison d'etre* of San Marco, and hence of many of its architectural details. In other words, there wouldn't be any such pendentives in Venice if the "environmental problem" of how to display Byzantine mosaic images of Christian iconography had not been posed and this solution found. If you look closely at the pendentives...as I did on a recent visit to Venice, you will see that care has been taken to round off the transition between the pendentive proper and the arches it connects, the better to provide a continuous surface for the application of mosaics (Dennett, 1995, p. 274).

It is questionable whether spandrels were designed primarily to display iconography. This may have

been important, but I think primacy must be given to figuring out how one is going to support a dome on top of four arches.

Recently in the *Boston Review*¹⁴, H. Allen Orr (a population geneticist) states that Gould and Lewontin's spandrel analogy is quite sound. In claiming that adaptationism is flawed, Lewontin and Gould maintain that:

Although natural selection is an important force driving evolution, it does not follow that each arbitrary character one can point to has an adaptive purpose. Instead, some features of organisms are like "spandrels"...although spandrels are often decked out with mosaics, no one would seriously argue that spandrels are there *because* they provide such swell surfaces for mosaics. Instead, spandrels are there because they *have to be*--they are, it turns out, an inevitable by-product of putting a dome on rounded arches. Gould and Lewontin's warning was obvious: Organisms may also sport spandrels. Some traits have no adaptive tale to tell, but reflect structural constraints imposed by an organism's development or by its quirky evolutionary history (Orr, *Boston Review*, 1998, 21.3, p. 3).¹⁵

In claiming that spandrels were designed to showcase mosaics, Orr believes Dennett has inverted the proper path of analysis i.e. that the biological system begins with an architectural constraint. To conclude that spandrels (in this case, of San Marco) are adaptations chosen for aesthetic rather than structural reasons is silly according to Orr. And now we enter into the realm of the *pro homine*. Dennett quoted Otto Demus (the great authority on San Marco mosaics) to strengthen the adaptationist viewpoint. And to support the pluralist account, Orr quotes the engineer Robert Mark as saying:

Dennett's critique of the architectural basis of the analogy goes even further astray

¹⁴ The first appearance of Orr's critique of Dennett was entitled "Dennett's Dangerous Idea" and appeared in the professional journal *Evolution*.

¹⁵The complete citation for this reference is: <http://www-polisci.mit.edu/BostonReview/br21.3/Orr.html>

because he slights the technical rationale of the [pendentives]...his treatment of crucial structural elements as a kind of surface decoration that can be altered at will...ignores the...centuries of construction experience that led to their incorporation (Orr, br 21.5, 1998, p. 2).

Mark stresses that, for large structures, pendentives (or spandrels) "are necessary structural elements" and that Dennett's alternatives (i.e. squinches, pendentives) might well collapse. Dennett's suggestion that spandrels may have been adapted (according to Otto Demus) is, to Orr, a perfect example of the peculiar excesses of adaptationism:

Adaptationist culture encourages wild story-telling just where Design is least obvious. The problem is sociology: nobody ever got famous for speculating on why birds have wings ("So they can fly?"). The road to glory instead demands ingenious stories that are far from obvious, and the whole business can degenerate into a display of cleverness (Orr, br 21.5, 1998, p. 3).

People worried about holding up a 42 foot dome are not worried about mosaics, says Orr. Arches are simply a cheap and effective way of getting the job done. And when they are finished, you can paint the spaces between them.

Orr provides an interesting example of a biological spandrel (something Gould should have provided in spades). Orr asks us to consider the blind spot in our visual field:

The blindspot is a maladaptive legacy of our evolutionary past. Early in vertebrate evolution, light sensitive tissue folded up in such a way that our proto-eye was left with its neuronal wiring *on the inside*. Once evolution veered off in this direction, a blind spot was a structural inevitability. If the wiring starts on the inside of the eyeball, some wire somewhere must plunge through the back of the eye to reach the brain. One makes up adaptive stories about the resulting blind spot at some peril (Orr, 1998, br 21.3, p. 3).

But in the next sentence Orr admits that many biologists suspect that Gould and Lewontin overstated their warning. And then he states that although Dennett pays lip service to the notion that any adapted system suffers from "undesigned" features, he [Dennett] is hot under the collar about Gould

and Lewontin and their nefarious spandrels. Orr believes that any attempt to undercut the importance of adaptationism is, according to Dennett, the attempt to bring in a skyhook as an explanation. But I am not convinced that this is the case. Any good adaptationist is going to expect that designs have by-products, flaws, etc. And this is because variation is random and selection is blind. There is no advanced foreknowledge of a planned design. Natural selection works with what it has. And if that means that there are by-products and flaws, then so be it. Nobody--especially adaptationists--said nature was perfect, just adaptatively functional. There is no need to make up adaptive stories about the blind spot because this is perfectly consistent with adaptationism.

Orr states that biologists do not feel uneasy about adaptationism because they fall for some alternative cause of biological "design", but because they are just not sure that a feature is designed by natural selection. And one such cause for uneasiness is the notion of "neutrality" i.e. the possibility that the biological differences we see don't affect fitness much one way or the other (Orr, 2001, p. 21.5, 1998, p. 3). Orr is perhaps justified to mention that Dennett disregards the neutral theory of genetic drift (championed by Motoo Kimura) i.e. the random replacement of one gene by another, functionally equivalent gene. But Orr ridicules Dennett for his lack of intelligence in molecular genetics by stating that Kimura's work is "a tad harder to read than the pop biology Dennett appears to devour". Is Maynard Smith "pop biology"? Is Ernst Mayr? Do any of the over two dozen population geneticists, developmental biologists, and paleontologists whose work Dennett mentions in his book contribute to the field of "pop biology"? When is biology not "pop"? The very person Orr is defending and towards whom Dennett directs much of his criticism--Stephen Jay Gould--could rightfully be considered the grand-daddy of all pop biologists. This type of abusive *ad hominem* is

uncalled for and simply illustrates a lack of focused criticism.¹⁶

In fairness, however, I must give Orr credit for eventually addressing more relevant and interesting problems concerning the neutralist/selectionist debate. Orr agrees that, evolutionists are unanimous that, where there is apparent "Design" in organisms, it is caused by natural selection. The problem he is stressing is that in many adaptive stories, the protagonist does not show dead-obvious signs of design.

Is it obvious that the recessivity of most genetic diseases is adaptive? Evolutionists used to think so, but we now know they were almost surely wrong. Is it obvious that flower color differences in plants are adaptive? Many evolutionary biologists have begged to differ. Is it obvious that most molecular differences between species need adaptive explanation? The neutralists and selectionists give very different answers. And, last, is it obvious that the neural wiring that allows human language evolved as an adaptation *for* language? Different linguists reach different conclusions. The fact is we often have enormous difficulty distinguishing what is and is not "Designed"-- what does and does not require its very own adaptive story (Orr, 1998, br, 21.3, p. 4).

And it is true that, currently, any undergraduate textbook in physical anthropology, biology, or genetics, will mention genetic drift and the neutral theory of molecular evolution as having had significant impact on our thinking about the evolutionary process.

Genetic drift has most probably played an important role in human evolution, influencing genetic changes in small groups. From studies of recent hunter-gatherers in Australia, we know that the range of available mates was restricted to within the linguistic tribe, usually consisting of about 500 individuals. In groups of this size,

¹⁶ I should not find it necessary to inform Mr. Orr, but since he is a geneticist, he might not know of specific informal fallacies--critical reasoning being a tad bit harder than the usual banter in critical reviews (see how easy it is to attack the man abusively?). The term *ad hominem* is latin for "against the man". It can be used properly e.g. in cases in which a person is shown to be lacking in knowledge, is untrustworthy, or unduly biased. But it can easily be used abusively by focusing on irrelevant characteristics of a particular individual. Mr. Orr appears to comment on Dennett's lack of knowledge in a particular field e.g. molecular genetics. But the way he raises this point is tinged with ridicule at Dennett's intellectual shortcomings. And this is unfair for Dennett is a philosopher, not a geneticist.

drift can have significant effects, particularly if drought, disease, and so on should temporarily reduce the population still further (Nelson, *et al*, 1992, p. 93).

However, most texts will qualify the relative importance of such auxiliary processes as being secondary and complementary to natural selection.

While drift has been a factor over the long term, the effects have been irregular and nondirectional (for drift is *random* in nature). Certainly, the pace of evolutionary change could have been accelerated if many small populations were isolated and thus subject to drift. However, by modifying such populations, drift only provides fodder for the truly directional force in evolution—natural selection (Nelson, *et al*, 1992, p. 93).

I think Orr is quite right to ask such questions as: How seriously should we take these endless adaptive explanations of features whose alleged Design may be illusory? Isn't there a difference between those cases where we recognize Design *before* we understand its cause and those cases where we try to make Design manifest *by* concocting a story? And isn't it worrisome that we can make up adaptive stories (and pen wildly speculative papers) faster than we can make up experimental tests? (Orr, 1998, br, 21.3, p. 5). Orr is right in his concern for caution that too much adaptationism may be too much of a good thing. But as we noted earlier, this is what any sensible evolutionist should be on guard against i.e. excessive Panglossism. It is all too easy to drum up "just-so" stories which explain or justify all possible adaptations. But if we are cautious, we can limit these excesses. And I think all neo-Darwinians would agree.

A second reason why Gould's spandrel analogy breaks down is due to teleology. That is, variation, selection and retention is blind or random in natural selection. However, in architecture, the choices for structure are conscious and goal-directed. Dennett notes that instead of spandrels, other architectural techniques for dome support could be used e.g. squinches, pendentives, etc. There are architectural or engineering constraints on all organisms. But the mode in which such creatures

come naturally to be and the mode in which such architectural structures come to be are entirely different.

However, even if we accept that the mode of development of both structures--organismic and architectural--is radically different, we can still talk about by-products. And this is the third problem with Gould's analogy. There is no neo-Darwinian who would maintain such a position of panadaptationism as to insist that every feature of every organism has some adaptive, functional purpose. Dennett proposes that the by-products to which Gould and Lewontin refer are really dead-obvious solutions to design problems without requiring much thinking at all i.e. "no-brainers" or what engineers call a "don't-care". If something has to be one way or another but neither way makes the function any better, then design does not interrupt function.

Are there many features in the biosphere that exist for no reason? It all depends on what counts as a feature. Trivially, there are indefinitely many properties (e.g. the elephant's property of having more legs than eyes, the daisy's property of buoyancy) that are not themselves adaptations, but no adaptationist would deny this. Presumably, there is a more interesting doctrine that Gould and Lewontin are urging us to abandon (Dennett, 1995, p. 276).

Dennett questions which form of "pervasive" or Panglossian adaptationism Gould is intending to overthrow with the spandrel analogy. Dennett admits that no matter how extreme one's form of adaptationism, there will always be undesigned features as by-products. No adaptationist's account would be so "pervasive" as to deny this:

The thesis that every property of every feature of everything in the living world is an adaptation is not a thesis anybody has ever taken seriously, or implied by what anybody has taken seriously, so far as I know. If I am wrong, there are some serious loonies out there, but Gould has never show us one (Dennett, 1995, p. 276).

Even though there may be many features of organisms which are not adaptations, this does not rule out natural selection as the "exclusive agent" of evolutionary change. To think it does, commits one

to the caricature that is panadaptationism. Dennett does acknowledge that Gould (and Lewontin) may have provided an interesting development to adaptation. However, Dennett, along with Maynard Smith, does not believe the spandrel analogy in any way replaces adaptation: "The effect of the Gould-Lewontin paper has been considerable, and on the whole welcome. I doubt if many people have stopped trying to tell adaptive stories. Certainly I have not done so myself" (Maynard Smith, 1991, p. 6). Dennett maintains that the inflammatory rhetoric of Gould (and Lewontin) suggesting that spandrels constitute an alternative to adaptationism opened the floodgates to a lot of wishful thinking by Darwin-dreaders who would prefer that there *not* be an adaptationist explanation of one precious phenomenon or another (Dennett, 1995, p. 278). If we interpret the spandrel definition charitably i.e. as dead obvious solutions to design problems--"no-brainers" or "don't-cares"--it still becomes rather obvious that no matter how Panglossian or "pervasive" one's adaptationist account is, there will always be undesigned features as by-products. If this is all Gould and Lewontin were saying, then the spandrel analogy, however metaphorically weak, is perfectly consistent with neo-Darwinian adaptationism. If, on the other hand, Gould and Lewontin are suggesting that the spandrel analogy might, in some way, overthrow adaptationism; if, instead of enlarging adaptationism, the spandrel analogy is intended to oppose it: "They call for a 'pluralism' in evolutionary biology of which adaptationism is to be just one element, its influence diminished by the other elements, if not utterly suppressed" (Dennett, 1995, p. 271); and if they do not know that the emergence of by-products is an integral part of any neo-Darwinian adaptationist position, then they are sadly mistaken.

(c) The Non-Repeatability of Evolution

The final aspect of the pluralist position which I wish to criticize is the theoretical importance placed

on the roles of contingency and chance in the evolution of organisms. Gould maintains that natural selection "does not explain why a meteor crashed into the earth 65 million years ago, setting in motion the extinction of half the world's species...if this contingent event had not occurred, and imparted a distinctive pattern to the evolution of life, we would not be here to wonder about anything at all!" (Gould, 1997a, p. 36). As we saw earlier, Gould believes that the study of mass extinction has disturbed the ultra-Darwinian consensus e.g. the extinction of dinosaurs and survival of other species bears little relationship to the evolved, adaptive reasons for success of lineages in normal Darwinian times dominated by competition (Gould, 1997a, pp. 35-36).

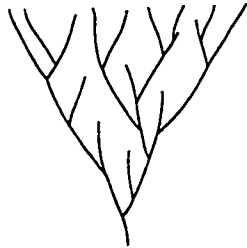
Much of Gould's views on contingency come from his work *Wonderful Life: The Burgess Shale and the Nature of History*. It is in this work that Gould states that if the tape of life were rewound and played again and again, the chances of life emerging as we now know it are quite slim.

There are a number of problems with this account. The first problem is with Gould's account of the Cambrian explosion of flora and fauna. Fossils in the Burgess Shale (a mountainside quarry in British Columbia) have revealed an explosive increase in the number of organisms during the Cambrian time period (between 535 and 530 million years ago).¹⁷ Gould maintains that this sudden

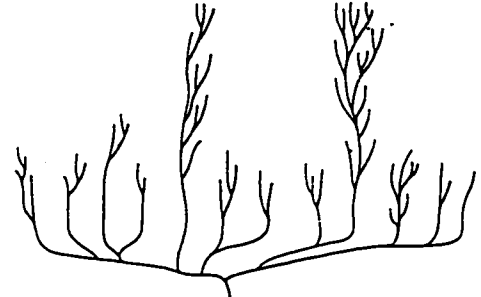
¹⁷ I want to stop right here for a second to display briefly, a rather unsavoury aspect of Gould's style of intellectual criticism. We have already seen how Orr used abusive *ad hominem*s in attacking Dennett. We shall now see a similar, but more cunning form of implicit abusive *ad hominem* used by Gould. Dennett states on page 300 of his book, that the Cambrian Explosion of multicellular organisms really took off "around six hundred million years ago". In his response, Gould states that Dennett "misstates the date of the Cambrian explosion by 70 million years...the actual date is 530 million years ago" (Gould, 1997b, p. 49). Gould accuses Dennett of lacking the ability to grasp scientific material and this shows in a frequency of such factual errors in his descriptions of technical work. There are two problems here. First, we could assume that Dennett was only giving a rough estimate for the Cambrian explosion. And second, if Gould really wishes to press this matter, it will undoubtedly backfire on him. For only five pages later in Dennett's book do we see where Dennett may have come across such a rough estimate-- in Gould's own writings! From a talk Gould gave at

increase in biological diversity creates tensions for the adaptationist. This tension is revealed in what Gould calls 'the fallacy of the cone of increasing diversity'. As we saw, above, Darwin's only diagram in the *Origin* is of a tree of life depicting the gradual morphological changes in various species. When these fan-like generations are looked at over a period of thousands of years, a cone increases in diversity as species gradually evolve in fanlike patterns representing the divergence of populations. This type of slow divergence is challenged by Gould who opts for a model of decimation and diversification--that is, a branching which stems from a broader vertical scale.

The Cone of Increasing Diversity



Decimation and Diversification



(From Dennett, 1995, p. 302)

Gould rightly believes that species become extinct all the time and since perhaps over 90 percent of all species that have ever existed are now extinct, there must be plenty of decimation to balance the diversification. But Dennett points out that Gould's new model is simply a squashed-down version of the cone of increasing diversity. The types of decimation which occurred naturally and in large

the Edinburgh International Festival of Science and Technology entitled: "The Individual in Darwin's World" (1990, p. 12), Gould states that "...almost all the major anatomical designs of organisms appear in one great whoosh called the Cambrian Explosion about 600 million years ago". This may be an isolated incident but it is indicative of the types of trivialities which should be avoided when focusing on important issues.

scale, are not enough to weaken the mechanism of natural selection. In fact, they support it even further. Although mass extinctions would surely play a major role in pruning the tree of life, the mechanism takes over with any and all surviving species. As Maynard Smith points out, "The non-repeatability of evolution--the idea that if evolution were to happen again from the same starting point, it would not repeat itself--is true, but not new; it is what most scientists have always thought" (Maynard Smith, 1995, p. 47). The notion of "extrapolationism"--that all evolutionary change is gradual and predictable--would never be endorsed today by an adaptationist in its "pure" form. As Dennett stated in an earlier work,

I cannot see why any adaptationist would be so foolish as to endorse anything like "extrapolationism" in a form so "pure" as to deny the possibility or even likelihood that mass extinction would play a major role in pruning the tree of life, as Gould puts it. It has always been obvious that the most perfect dinosaur will succumb if a comet strikes its homeland with a force hundreds of times greater than all the hydrogen bombs ever made (Dennett, 1993, p. 43).

I do not believe Gould's radical contingency or Lady Luck hypothesis counters adaptationism at all because he has not offered any evidence that such population explosions would never happen again if we replayed the tape of life. Dennett wisely suggests that computer simulations in Artificial Life may provide some insight into what might happen were we to replay the tape repeatedly.

It is surprising that Gould has overlooked the possibility that he might find some evidence for (or against) his main conclusion by looking at the field of Artificial Life, but he never mentions the prospect. Why not? I don't know, but I do know Gould is not fond of computers, and to this day does not even use a computer for word-processing; that might have something to do with it.

A much more important clue, surely, is the fact that when you do rerun the tape of life, you find all sorts of evidence of repetition. We already knew that, of course, because convergent evolution is nature's own way of replaying the tape (Dennett, 1995, p. 306).

Whichever lineage happens to survive--after a contingency of mass extinction--the winners are those

which happen to gravitate towards the good moves in design space (Dennett) or the peaks in the adaptive landscape (Wright). Although we might never see humans again emerge from the primordial soup (after a long process of change and diversification); and although we may never see global pathways of progress we could see similar local patterns of development e.g. air-breathing, land-inhabiting vertebrates, etc.

...local improvement...seeks out the best designs with such great reliability that it can often be predicted by adaptationist reasoning. Replay the tape a thousand times, and the Good Tricks will be found again and again, by one lineage or another. Convergent evolution is not evidence of global progress, but it is overwhelmingly good evidence of the power of processes of natural selection. This is the power of the underlying algorithms, mindless all the way down, but, thanks to the cranes it has built along the way, wonderfully capable of discovery, recognition, and wise decision. There is no room, and no need, for skyhooks (Dennett, 1995, p. 308).

The second problem with Gould's treatment of the non-repeatability of evolution has to do with his motivation for proposing biological contingency. I recognize, of course, that in considering the motivation behind any academic or scientific proposal, one must be wary of misrepresentation. However, I believe there is a strong enough case to render a plausible account for Gould's motivation against adaptationism. First of all, Dennett draws the tentative conclusion that the reason why Gould is so adamant about fostering his thesis of radical contingency, is because it may put into question the fact that Darwinian evolution is an algorithmic process. Dennett believes that the motivation for Gould's reluctance of the algorithmic description may stem from his politics i.e. his leftist/Marxist sympathies (although Dennett admits this is simply a superficially plausible reading of Gould). But more importantly, it may also stem from his religious beliefs (i.e. Secular Humanism) which attempts to protect or restore the Mind-first or top-down vision of John Locke to secure our place

in the universe with a skyhook.¹⁸

Gould maintains that natural contingencies are not another principle in addition to natural selection but is merely a pluralistic corrective which stresses the limits "faced by *any* set of general principles in our quest to explain the actual patterns of life's history" (Gould, 1997b, p. 47). And he has taken offense at Dennett's gratuitous speculation of his motives claiming that "Dennett has no clue about my political or religious views, and he has never bothered to ask me--but did lack of data ever derail the ultra-Darwinian game of adaptationist storytelling?" (Gould, 1997b, p. 49). Although Dennett admits that his conjecture of Gould's political affiliations may be superficial, it may not be entirely unwarranted. For, as Ruse points out, Gould has stated that he has thought it pertinent to bring Marxism into his scientific work (on the nature of paleontological theories), and that he has admitted to seeing the world as functioning according to the laws of dialectical materialism, and that he has praised punctuated equilibria theory precisely because it fits with such a dialectical world-picture (Ruse, 1989, pp. 130-131). Ruse informs us also that we should remember that Gould was a leader in the fight against human sociobiology--a fight which was carried on most strenuously by left-wing groups like the Cambridge (Mass.) Science for the People collective. But Ruse also warns us not to misunderstand what he (and later, Dennett) is saying.

I am *not* saying that punctuated equilibria theory is part of a communist plot. Most of its supporters (like Eldredge) are not Marxists...All I am saying is that there is a complex set of threads which bind people's motives to their support for scientific theories, and some of those motives I have just been detailing may have lain--may still lie--behind the support that some people have for punctuated equilibria theory (Ruse, 1989, p. 132)

¹⁸ John Maynard Smith (1995, p. 47), agrees with Dennett that Gould may be trying to escape from an algorithmic explanation of life.

So not only are we justified in considering the connections between Gould's politics and religion, much of Gould's politics and religion are public knowledge. And it is not unreasonable to consider that one's political and religious views influence one's scientific views.

IV CONCLUSIONS

I have mentioned in the Introduction that before we can proceed to consider what evolutionary epistemology can tell us about the concept of ignorance, it is paramount to establish a good, clear understanding of evolutionary theory. It is for this reason that the purpose of this chapter was to examine the historical and current scientific literature in evolutionary theory in order to 'get the Darwin right'. And I have argued that the neo-Darwinian or synthetic theory of evolution provides the best account of the mechanisms of evolution so far. As we have seen, Darwinism, properly understood, sees natural selection as the primary mechanism responsible for phyletic change. And this change does not occur in spurts. We have seen how vocal Darwin was in his insistence that evolution is gradual and not saltational. And we have also seen the eventual synthesis between Darwinian evolutionary theory and genetics. It is through a combination of blind or random genetic variation of the genotype and natural selection and gradual change according to selective pressures, that the phenotype changes. The physical features of the phenotype is the product of the genes comprising the genotype which is modified and fashioned by the interacting effects of the environment on any developing organism.

I have recognized the pluralist arguments (most notably from Gould), for what they are-- namely, auxiliary factors which complement the central mechanism of evolution: natural selection. For example, in reference to punctuated equilibrium, it is not unreasonable to admit that in some

cases, upon closer inspection of gradual lines in the cone of increasing diversity, there are staircases indicating a period of stasis until some new selection pressure arose. But as I have shown, above, this simply clarifies what orthodox Darwinians already knew. Gould and Eldredge have not so much presented a revolutionary idea as an interesting observation about the variability in tempo of evolutionary processes and its predictable effects on the fossil record (Dennett, 1995, p. 285).

Secondly, if we consider spandrels in light of natural selection--that is, as enlarging rather than opposing adaptationism--then spandrels, as unselected by-products or consequences of particular architectural/structural design, are acceptable. If, as Dennett suggests, spandrels are just "no-brainers"--i.e. dead obvious solutions to design problems, then only the most foolish panadaptationist would maintain that there are no functional by-products. However, the spandrel analogy does not in any way replace natural selection as the exclusive causal mechanism in evolution. It is complementary to it. But very few adaptationists would have any qualms about such a description. If Gould (or any pluralist) steadfastly maintains that spandrels in any way replace natural selection, he is simply wrong.

And thirdly, when Gould states that "Natural selection does not explain why a meteor crashed into the earth 65 million years ago, setting in motion the extinction of half the world's species", does he really expect it to account for such natural contingencies? Would *any* adaptationist? Again there is a common ground in which natural selection can be considered the central mechanism of evolution but that the intermediary mechanism of adaptation works only when there are sufficient conditions in place e.g. complex organisms, replication potential, sexual selection, etc. It is simply obvious that any major change in a local environment is going to have ramifications on the evolution of particular species. But this is not a disputable point for adaptationists. And this is because whatever survives

such major catastrophes, continues to adapt or perish according to natural selection. As Gould himself, so aptly states: "...variation proposes and selection disposes" (Gould, 1997a, p. 36). Enough said.

Now that we have a good understanding of evolutionary theory, we can move on to examine in what ways biology can enlighten us concerning some problems in epistemology--particularly, the concept of ignorance.

CHAPTER TWO

AN ASSESSMENT OF EVOLUTIONARY EPISTEMOLOGY

Now that we have a clear understanding of neo-Darwinian evolutionary theory, we can examine how some of its mechanisms apply to epistemology. And so the purpose of this chapter is relatively simple. I shall examine the major influences in evolutionary epistemology over the last twenty-five years in order to show how this relatively new and unique branch of epistemology has developed. I shall focus mainly on the two most influential works in this field: Donald T. Campbell's "Evolutionary Epistemology"¹⁹ and Michael Bradie's "Assessing Evolutionary Epistemology". Along the way, I shall also mention the works of several others who have contributed to this field in important ways.

The format of this chapter is relatively simple. The first section will deal with Campbell's paper from 1974. The second section will refer to Bradie's paper of 1986. And the third section will focus on recent work which will bring us up to date. Finally, in the fourth section, I shall compile a list of what I believe to be the most common and significant issues in evolutionary epistemology. It is from this list of issues, combined with a neo-Darwinian understanding of evolutionary theory, which will provide us with a basis from which to examine the concept of ignorance.

¹⁹ Some consideration will also be given to Campbell's paper "Unjustified Variation and Selective Retention in Scientific Discovery" in F.J. Ayala and T. Dobzhansky, eds. *Studies in the Philosophy of Biology* (London: Macmillan Press Ltd., 1974). I shall refer to this work at various times throughout the text as Campbell, 1974b.

I

DONALD T. CAMPBELL'S "EVOLUTIONARY EPISTEMOLOGY"

From the very first paragraph of this seminal paper, we are made aware of the intimate relationship between knowledge and biology:

An evolutionary epistemology would be at minimum an epistemology taking cognizance of and compatible with man's status as a product of biological and social evolution. In the present essay it is also argued that evolution--even in its biological aspects--is a knowledge process, and that the natural selection paradigm for such knowledge increments can be generalized to other epistemic activities, such as learning, thought, and science (Campbell, 1974a, p. 413).

Campbell divides his paper into six sections dealing with:

1. Popper's contributions to evolutionary epistemology.
2. The way in which common sense leads to science viz. trial and error.
3. The hierarchy of selective-retention processes.
4. Historical perspectives.
5. The manner in which Kant's categories can be explained in biological terms.
6. Pragmatism, utilitarianism and objectivity i.e. arguing for a critical realism.

These sections are prefaced with a recognition and detachment from any supposed *a priori* status that language and concepts may have in epistemology. Campbell rejects any notions of direct realism and certainty and opts for a pragmatic stance maintaining that language is purely contingent and has developed according to selective pressures. Concepts like 'certainty' are not entirely empty but do not have any special ontological status in our vocabulary. Language developed functionally in the same manner in which vision developed i.e. to allow organisms to adapt better to a specific environment:

...an epistemology...not compatible with the evolutionary model...would be a direct realism, an epistemology assuming veridical visual perception, unless that epistemology were also compatible with the evolution of the eye from a series of less adequate prior stages back to a light-sensitive granule of pigment. Also incompatible would be a founding of certainty on the obviously great efficacy of ordinary language. In the evolutionary perspective, this would either commit one to a comparable faith in the evolutionary prestiges to modern language, or to a discontinuity and point of special creation. Better to recognize the approximate and only pragmatic character of language at all stages, including the best...In all of this opportunistic exploitation of coincidence in vision there is no logical necessity, no absolute ground for certainty, but instead a most back-handed indirectness. From this perspective, Hume's achievement in showing that the best of scientific laws have neither analytic truth nor any other kind of absolute truth seems quite reasonable and appropriate (Campbell, 1974a, p. 414).

This is an important point for us to keep in mind, for later in this dissertation, I shall examine the work of Peter Unger who maintains that concepts like 'certainty' reveal our epistemic ignorance. The first point we should acknowledge, then, is that language, according to the evolutionary epistemologist, is an adaptative tool which has considerable survival value.

Much of Campbell's treatment of evolutionary epistemology centres around the problem of fit: the fitness between vision and the world, the fitness between an organism and its environment, and the fitness between science or scientific theories and the world they describe. For Campbell, these problems can be answered through natural selection i.e., viz. a series of trials and errors. In biology, there are essentially three main components of the model of natural selection: variation, selection and retention. The model itself, is well described by Stein and Lipton:

In the modern Darwinian theory of biological evolution, genetic mutations provide the variations, the environment provides the selection, and reproduction provides the retention. The variations are not pre-designed. Rather, fit is achieved only through the hindsight of the selection process. In biological evolution, this amounts to saying that the mechanism of variation is not influenced by the effects the variations would have. The likelihood of a mutation is not correlated with the benefits or liabilities that mutation would confer on the organism. Rather, those organisms with features which make them less fit for survival do not survive in competition with other organisms

in the environment which have features that are more fit. Evolutionary epistemology attempts to apply this blind variation and selective retention model to the growth of scientific knowledge and to human thought processes in general (Stein E. and Lipton, P., 1989, p. 34).

In the first section of his paper, (*The Selective Elimination Model*), Campbell echoes this definition stating that natural selection operates:

...upon the pool of self-perpetuating variations which the genetics of the breeding group provide, and from within this pool, differentially propagating some variations at the expense of others. The supply of variations comes both from mutations providing new semistable molecular arrangements of the genetic material and from new combinations of existing genes. (Campbell, 1974a, p. 415)

But Campbell again stresses that:

Considered as improvements or solutions, none of these variations has any *a priori* validity. None has the status of revealed truth nor of analytic deduction. Whatever degree of validation emerges comes from the differential surviving of a winnowing, weeding-out, process (Campbell, 1974a, p. 415).

It is in this section that Campbell mentions Popper's contribution to evolutionary epistemology by recognizing how the process of the succession of scientific theories is similar to the natural selective elimination process. In *Logik der Forschung*, Popper states that we choose the theory which best holds its own in competition with other theories; the one which, by natural selection, proves itself the fittest to survive (Popper, 1959, p. 108). The logic of discovery is, for Popper, (and for Campbell), a system of trial and error or, what Popper eventually termed *conjectures and refutations*.

Assume that we have deliberately made it our task to live in this unknown world of ours; to adjust ourselves to it as well as we can; to take advantage of the opportunities we can find in it; and to explain it, if possible (we need not assume that it is), and as far as possible, with the help of laws and explanatory theories. *If we have made this our task, then there is no more rational procedure than the method of trial and error--of conjecture and refutation: of boldly proposing theories; of trying our best to show that these are erroneous; and of accepting them tentatively if our critical efforts are unsuccessful* (Popper, 1963, p. 52).

This method of trial and error is applied not only by people like Einstein but by the amoeba as well. It is a method practised by all animals at all levels.

In the second section, (*Locating the Problem of Knowledge*), Campbell again mentions Popper's contributions to evolutionary epistemology by stating that the central problem of epistemology has always been and still is the problem of the growth of knowledge:

...the most important way in which common-sense knowledge grows is, precisely, by turning into scientific knowledge. Moreover, it seems clear that the growth of scientific knowledge is the most important and interesting case of the growth of knowledge (Popper, 1959, pp. 17-19).

I agree with Popper, here, who states that many philosophers and scientists, (such as Kant, Whewell, Mill, Peirce, Duhem, Poincare, Meyerson, Russell, etc.) maintained that scientific knowledge is the result of common sense knowledge and that its problems are simply enlargements of the problems of common sense knowledge. Although Popper confined his discussion to the growth of knowledge in science, he maintained that his remarks were applicable:

...to the growth of pre-scientific knowledge also--that is to say, to the general way in which men, and even animals, acquire new factual knowledge about the world. The method of learning by trial and error--of learning from our mistakes--seems to be fundamentally the same whether it is practised by lower or by higher animals, by chimpanzees or by men of science...the study of the growth of scientific knowledge is, I believe, the most fruitful way of studying the growth of knowledge in general. For the growth of scientific knowledge may be said to be the growth of ordinary knowledge *writ large* (Popper, 1963, p. 216).

Campbell applauds Popper's connection with biology and epistemology and claims that we can give up the notion of holding all knowledge in abeyance until the possibility of knowledge is first logically established, or until indubitable first principles of incorrigible sense data are established upon which to build (Campbell, 1974a, p. 418). Rather, logical analysis is looked upon as an accumulative achievement in which no nonpresumptive knowledge or modes of knowledge are

possible to us. Knowledge, then, is rationally justified and well-grounded belief brought about through the outcome of systematic tests. But the tests, according to Popper, as is well known by most philosophers of science, do not verify or confirm hypotheses, but attempt to falsify them. Using all the weapons of our logical, mathematical, and technical armoury, we try to prove that our anticipations were false--in order to put forward, in their stead, new unjustified and unjustifiable anticipations, new 'rash and premature prejudices' (Popper, 1959, pp. 278-279).

In the third section, (*A Nested Hierarchy of Selective-Retention Processes*), Campbell elaborates and expands on Popper's position by listing a selective retention program to *all* knowledge processes:

1. A blind-variation-and-selective-retention process is fundamental to all inductive achievements, to all genuine increases in knowledge, to all increases in fit of system to environment.
2. In such a process there are three essentials: (a) Mechanisms for introducing variation; (b) Consistent selection processes; and (c) Mechanisms for preserving and/or propagating the selected variations.
3. The many processes which shortcut a more full blind-variation-and-selective-retention process are in themselves inductive achievements, containing wisdom about the environment achieved originally by blind variation and selective retention.
4. In addition, such shortcut processes contain in their own operation a blind-variation-and-selective-retention process at some level, substituting for overt locomotor exploration or the life-and-death winnowing of organic evolution (Campbell, 1974a, p. 421).

Campbell emphasizes that variations are 'blind'-- stating that variations are produced without prior knowledge of which ones will furnish a selectworthy encounter.

An essential connotation of blind is that the variations emitted be independent of the environmental conditions of the occasion of their occurrence. A second important connotation is that the occurrence of trials individually be uncorrelated with the solution, in that specific correct trials are no more likely to occur at any one point in a series of trials than another, nor than specific incorrect trials. A third essential connotation of blind is rejection of the notion that a variation subsequent to an

incorrect trial is a "correction" of the previous trial or makes use of the direction of error of the previous one (Campbell, 1974a, p. 422).

Campbell stresses the point that a blind-variation-and-selective-retention process is fundamental to all inductive achievements, to all genuine increases in knowledge, to all increases in fit of system to environment (Campbell, 1974a, p. 421). And elsewhere, Campbell has mentioned that for the three problems of fit that began this enquiry (i.e. vision/world, organism/environment, science/world described), there is only one explanatory paradigm: blind variation and selective retention (Campbell, 1974b, p. 142). 'Blindness', then, is opposed to terms like "wise, designed, prescient, informed, foresighted, clairvoyant, intelligent, preadapted" and the essential requirement for 'blindness' is that the variations have a "relative independence, relative to the eventual fit or structured order that is to be explained" (Campbell, 1974b, p. 147). The 'blind' variation in biology is far easier to accept than Campbell's belief that variation is blind in science. For the type of blindness in biology is, as we have seen, random genetic variation. The blindness in epistemology that Campbell is referring to is guesswork due to ignorance. This is evident in the way he describes variation as analytic:

In going beyond what is already known, one cannot go but blindly. If one can go wisely, this indicates already achieved wisdom of some sort (Campbell, 1974a, p. 422).

And elsewhere, Campbell states:

If one is expanding knowledge beyond what one knows, one has no choice but to explore without the benefit of wisdom (gropingly, blindly, stupidly, haphazardly). This is an analytic truth central to all descriptive epistemologies of the natural selection variety (Campbell, 1974b, p. 142).

There are two dominant areas in which I disagree with the Campbell and Popper's account of evolutionary epistemology. On the one hand, I do not believe knowledge grows purely by trial

and error. It also grows by trial and confirmation. And secondly, there are several disanalogies between conceptual and organic evolution.

First, fitness between an organism and an environment is accomplished not only by trial and error but through trial and confirmation. There are reasons why an organism repeats favourable actions, habits, instincts, etc., while avoiding actions producing deleterious effects. And this is due to a reliance, however unconscious, on induction that future similar circumstances will yield similar results. Skagestad raises an interesting criticism against this notion of scientific blind variation by maintaining that:

...no scientific progress would be possible if hypotheses were to be proposed 'blindly', in this sense: independently of the problems for which they eventually provide solutions, the way biological variations are independent of the adaptive needs of the organism. This impossibility was clearly recognized and cogently argued already by Charles Sanders Peirce. Having learnt from De Morgan that, given any finite body of data, there will be an infinite number of theories which will account for them, Peirce concluded that it was wildly improbable that man, during the relatively short time-span of his cultural development, could have hit upon a single true theory by chance guessing (Skagestad, 1978, p. 614).

Peirce asks:

How was it that man was ever led to entertain a true theory? You cannot say it happened by chance, because the possible theories, if not strictly innumerable, at any rate exceed a trillion--or the third power of a million; and therefore the chances are too overwhelmingly against the single true theory in the twenty or thirty thousand years during which man has been a thinking animal, ever having come into any man's head (Peirce, 1931-35, p. 591).

Organisms 'learn' so to speak, not only by understanding what does not work--trial and error, but with what does work--trial and confirmation.

Secondly, we can see that on one level (a trivial level, to be sure), Campbell's tautology holds true. It is the case that when I want to know more information about something, I must do so without

wisdom or, in other words, in ignorance. And this is similar to the way in which genetic variation proceeds i.e. without knowing in advance what the effects of the selections will be. However, on another level, we must ask ourselves *how* blind we really are. Scientists may possess little information to which their current hypotheses refer; however, this does not mean they do not possess numerous models, theories, concepts, etc., in their armament by which to develop and test these new ideas in a goal-directed fashion. Although biological evolution appears to be non-goal directed, scientific theories are, at least apparently so. To Campbell, blind variation is, in so many words, teleological ignorance. That is,

...knowledge grows through variations which are blind in the precise sense in which biological variations are blind, i.e., which occur independently of their eventual utility in producing an increase of fit. With regards to science, this would mean that scientific hypotheses arise quite independently of their eventual contribution to solving problems or explaining puzzling phenomena. Scientific progress, like biological evolution, opportunistically selects what it can use from among the variations which happen to occur (Skagestad, 1978, p. 613).

Unlike biology, science appears to be goal-directed. Campbell accounts for this by stating that blind variation is both in a stage of unconscious thought and by appealing to 'preadaptation'. Our current explorations in science, then, are blind variations built upon over years of heuristical trial and error. And so preadaptations of blind trial and error have influenced our current methods of blindly choosing hypotheses describing the world. But the evolution and survival of organisms is markedly disanalogous to the evolution and survival of scientific theories. We do not just boldly throw up theories as wild speculations and then attempt to falsify them. Although science, like organic evolution, also accumulates information through both trial and error and trial and confirmation, it is generally a goal-directed procedure which progresses unlike organic evolution. In science, we have an idea of where we are going. We have already seen that variation in organisms is blind.

Naturally, there are times when discoveries are serendipitous. But this has occurred and will continue to occur in both the organic and scientific world. The important point to remember, here, is that science is characterized by goal-directed progress whereas organic evolution is blindly non-progressive.

Skagestad believes that there is a sharp disanalogy between biological preadaptation and scientific preadaptation. In biology, natural selection guides evolution through a proliferation of favorable variations at the expense of unfavorable ones. The sheer numbers of variations-to-success ratio is extremely high. In science, however, guesses are narrowed and exclude a wide range of guesses. Although Peirce maintained that scientific method proceeded through non-adaptative steps,

...scientific progress through trial and error would be impossible unless the range of possible guesses were drastically narrowed down by the possession of correct rudimentary ideas of force, space, etc. Such ideas could not themselves have been arrived at by chance guessing, but they could have been arrived at during man's pre-scientific mental evolution, because correct rudimentary ideas of physics would have immediate survival value (which the further refinement of these ideas would not have) (Skagestad, 1978, p. 616).²⁰

Skagestad further mentions that biology and science are also different in the modes of selection each uses. In biology, there is blindness before the fact and wisdom after the fact whereas in science, one is not wholly blind before the fact but not wholly wise after the fact either. Whatever blindness is inherent in the original hypothesis-formation is carried over to the stage of selection:

We propose a theory because we think it may account for the facts, and we retain it, after testing, because we think it does account for the facts. Both stages of the process are motivated by a fallible belief in a correspondence between theory and facts; this belief is strictly speaking 'unjustified', not only at the stage of hypothesis-formation, but also at the stage of selection (Skagestad, 1978, p. 617).

²⁰ This notion is similar to E.O. Wilson's, C. Lumsden's, and Michael Ruse's references to epigenetic rules.

It is apparent that the distinction between blind and goal-directed variation is a central issue to evolutionary epistemology. I shall consider this and other disanalogies in detail in the next chapter.

To return to Campbell's paper, I do not believe it necessary to list Campbell's ten level hierarchy of selective-retention processes in great detail. However, I do believe these processes are interesting enough as biological explanations for epistemology to warrant some consideration. Simply stated, Campbell moves from the first, *nonmnemonic problem solving* with blindly initiated locomotor activity to the second, *vicarious locomotor devices* such as the use of a blind man's cane in a vicarious search process which eliminates some wasted movements by the entire body, removing costly search from the full locomotor effort, making that seem smooth, purposeful, insightful (Campbell, 1974a, pp. 424-425). The third and fourth processes are *habit* and *instinct*. Habit, Campbell maintains, is prior to instinct because learned adaptive patterns developed initially by continuous trial-and-error learning.

In the habit-to-instinct evolution, the once-learned goals and subgoals become innate at a more and more specific response-fragment level. For such an evolutionary development to take place, very stable environments over long evolutionary periods are required (Campbell, 1974a, p. 426).

The fifth process is *visually supported thought* in which locomotor activity is reduced when an environment is represented vicariously through visual search. In this case, the 'successful' locomotions at this substitute level can be put into overt locomotion and will be put into further editing when in direct contact with the environment. The sixth process is *mnemonically supported thought*. At this level, the environment can be searched and vicariously represented in memory or "knowledge" rather than visually. The seventh process involves socially *vicarious exploration: observational learning and imitation*. This involves the use of trial and error by single members of

social systems in which, for example, a scout may be used in order for others to observe the consequences of its behaviour:

The aversion which apes show to dismembered ape bodies, and their avoidance of the associated locations, illustrates such a process. In ants and termites the back tracking on the tracks of foragers who have come back heavy laden illustrates such a process for knowledge of attractive goal objects. The presumptions involved in this epistemology include the belief that the model, the vicar, is exploring the same world in which the observer is living and locomoting, as well as those assumptions about the lawfulness of that world which underlie all learning (Campbell, 1974a, p. 431).

Campbell is careful to point out that even in imitation, there is no "direct" infusion or transference of knowledge or habit, just as there is no "direct" acquisition of knowledge by observation or induction.

As Baldwin analyzes the process, what the child acquires is a criterion image, which he learns to match by a trial and error of matchings. He hears a tune, for example, and then learns to make that sound by a trial and error of vocalizations, which he checks against the memory of the sound pattern. Recent studies of the learning of bird song confirm and elaborate the same model (Campbell, 1974a, p. 432).

The eighth process to which Campbell refers is *language*. As he mentioned at the beginning of his paper, Campbell maintains that language is a contingent discovery, acquired through trial and error. Language among all animals has the social function of economy of cognition. In the dance of various types of bees,

The vicarious representabilities of geographical direction (relative to the sun and plane of polarization of sunlight), of distance, and of richness by features of the dance such as direction on a vertical wall, length of to-and-for movements, rapidity of movements, etc., are all invented and contingent equivalences, neither entailed nor perfect, but tremendously reductive of flight lengths on the part of the observing or listening worker bees (Campbell, 1974a, p. 432).

Ants and termites also communicate using pheromones to indicate when food has been found. The worker ants pick up on the scent and backtrack until food is found. As long as the food supply lasts,

the ants keep the pheromone track renewed. "Knowledge" is confirmed when the ant finds food as a result of the pheromone scent.

The ninth process is *cultural cumulation*. This involves selective borrowing of one species from another; or even amongst individual species. Finally, the tenth process is *science*.

The demarcation of science from other speculations is that the knowledge claims be testable, and that there be available mechanisms for testing or selecting which are more than social...What is characteristic of science is that the selective system which weeds out among the variety of conjectures involves deliberate contact with the environment through experiment and quantified prediction, designed so that outcomes quite independent of the preferences of the investigator are possible. It is preeminently this feature that gives science its greater objectivity and its claim to a cumulative increase in the accuracy with which it describes the world (Campbell, 1974a, p. 434).

Science, then is the most advanced and sophisticated form of selective-retention processes.

In the fourth section of the paper (*Historical Perspectives on Evolutionary Epistemology*), Campbell briefly discusses the various historical influences in this field. He accredits some early influence to Herbert Spencer claiming that by 1890, Spencer's view had become dominant; a view which was later opposed by William James in his pragmatist writings. As well, both C.S. Peirce and James Mark Baldwin contributed in various ways to the development of evolutionary epistemology.

What is of historical interest can be found in Campbell's fifth section (*Kant's Categories of Perception and Thought as Evolutionary Products*). Here, Campbell discusses the ways in which Kant's categories, though mistakenly thought to be necessarily synthetic *a priori*, can provide a descriptive contribution to psychological epistemology.

Though we reject Kant's claims of a necessary *a priori* validity for the categories, we can in evolutionary perspective see the categories as highly edited, much tested presumptions, "validated" only as scientific truth is validated, synthetic *a posteriori*

from the point of view of species-history, synthetic and in several ways *a priori* (but not in terms of necessary validity) from the point of view of an individual organism (Campbell, 1974a, p. 441).

Popper had recognized this aspect of the Kantian categories and states that:

...we are born with expectations; with 'knowledge' which, although not *valid a priori*, is *psychologically or genetically a priori*, i.e. prior to all observational experience. One of the most important of these expectations is the expectation of finding a regularity. It is connected with an inborn propensity to look out for regularities, or with a *need to find* regularities, as we may see from the pleasure of the child who satisfies this need... When Kant said, "Our intellect does not draw its laws from nature but imposes its laws upon nature", he was right. But in thinking that these laws are necessarily true, or that we necessarily succeed in imposing them upon nature, he was wrong. Nature very often resists quite successfully, forcing us to discard our laws as refuted; but if we live we may try again (Popper, 1963, pp. 47-48).

Campbell notes that one of the earliest attempts to 'biologize' Kant's categories was in 1807 with Jacob Fries's interpretation of the categories as having only a psychological base, descriptive (rather than prescriptive) of human reason. And later, in 1902, Baldwin would state:

As Kant claimed, knowledge is a process of categorizing, and to know a thing is to say that it illustrates or stimulates, or functions as, a category. But a category is a mental habit; that is all a category can be allowed to be--a habit broadly defined as a disposition, whether congenital or acquired, to act upon or to treat, items of any sort in certain general ways. These habits or categories arise either from actual accommodations with 'functional' or some other form of utility selection, or by natural endowment secured by selection from variations (Baldwin, 1902, p. 309).

Campbell cites an impressive list of scholars who, in some way or another, have provided an evolutionary interpretation to Kant's categories.²¹ But of all these, he credits the ethologist, Konrad

²¹ In chronological order, the list includes James, Morgan, Mach, Poincare, Boltzmann, Fouille, Cassirer, Shelton, Reichenbach, R.W. Sellars, Uexkull, Meyerson, Northrop, Magnus, Lorenz, Piaget, Waddington, Bertalanffy, Whitrow, Platt, Pepper, Merleau-Ponty, Simpson, W.S. Sellars, Hawkins, Barr, Toulmin, Wartofsky, Watanabe. Campbell also states that to some degree, Quine, Maxwell, Shimony, Yilmaz and Stemmer have made similar points without explicit reference to the Kantian categories. See Campbell's Appendix IV for a complete list of sources.

Lorenz, with having done the most thorough job (see Lorenz, 1962).²² To Lorenz,

Kant's statement that the laws of pure reason have absolute 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 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...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, 1962, pp. 26-27).

The *ding an sich*, for Lorenz, cannot be expressed in its own terms. Objectivity becomes relativised to a species' developed abilities guided by natural selection. A horse's hoof develops according to the ground of the steppe on which it must cope and our nervous system adapts according to the environment in which it must cope.

Our visual, tactual, and several modes of scientific knowledge of the steppe are each expressed in quite different languages, but are comparably objective. The hydrodynamics of sea water, plus the ecological value of locomotion, have independently shaped fish, whale, and walrus in a quite similar fashion. Their shapes represent independent discoveries of this same "knowledge," expressed in this case in similar principles in a quite different, but perhaps equally "accurate" and "objective" shape. The *Ding an sich* is always known indirectly, always in the language of the knower's posits, be these mutations governing bodily form, or visual percepts, or scientific theories. In this sense it is unknowable. But there is an objectivity in the reflection, however indirect, an objectivity in the selection from innumerable less adequate posits (Campbell, 1974a, p. 447).

²² There is an interesting reference to Lorenz's paper in Raphael Falk's "Evolutionary Epistemology: What Phenotype is Selected and which Genotype Evolves?" (*Biology and Philosophy*, 1993, 8, 153-172, p. 153). Falk states, in a rather cursory manner, that Lorenz's paper of 1941 was published in a journal heavily loaded with Nazi philosophical papers. Given that Falk is from the Hebrew University of Jerusalem, I have been left wondering if there is more to this observation than mere fact. Is Falk suggesting that Lorenz's ideas in some way express Nazi ideology? Or is this purely a coincidence? I do not know because Falk has left this issue hanging, so to speak. And it would be of some historical interest for Falk to have pursued this issue further.

At this point, Campbell begins the sixth and final section of his paper (*Pragmatism, Utilitarianism, and Objectivity*). Agreeing with Popper that the *goal of objectivity* in science is a noble one, which is to be dearly cherished, Campbell admits that our current views of reality are partial and imperfect.

We recoil at a view of science which recommends we give up the search for ultimate truth and settle for practical computational recipes making no pretence at truly describing the real world. Thus our sentiment is to reject pragmatism, utilitarian nominalism, utilitarian subjectivism, utilitarian conventionalism, or instrumentalism, in favor of a critical hypothetical realism (Campbell, 1974a, p. 447).

Campbell admits that, according to critical realism, presumptions must be made which go beyond the data. But he recalls Hume's insight that nonpresumptive knowledge is impossible. And so it is a question of which presumptions as opposed to whether or not there are presumptions. The assumption of a real world is assumed not only by scientists but by anyone who wishes to examine the relationship between evolution and epistemology.

The problem of realism is prevalent in evolutionary epistemology as it is in other types of epistemology. It is fair to say that if we hope to extract any relevance from biology to epistemology, we must make some assumptions about the world i.e. that there is a world which has existed for millions of years prior to our conscious existence; that this world is, in some ways understandable through the development of laws, however fallible, which explain the regularity of specific behaviour, etc. But the question of the extent to which our interpretations of phenomena in the external world accurately represent that world, is and may forever remain questionable. Nonetheless, Campbell has assumed that fitness occurs between scientific theories and the world they describe because they are on the right track so to speak i.e. that the world is, in some ways, similar to the way in which science describes it. Elsewhere (Campbell, 1974b, p. 139)), Campbell has asked the reader whether he is awed and puzzled by the fitness between scientific studies and the world they describe.

As Skagestad notes, Campbell acknowledges that there may be no fit to be explained or marvelled at:

It may well be held that what our perceptions or theories seem to fit is just a shadow world of our own making, requiring no explanation. Campbell has no logically compelling evidence to the contrary, and he has no quarrel with those who are not 'awed' by these instances of fit. He simply appeals to those who are awed, and seeks to explain the sense of awe by presuming a hypothetical, realistic ontology, for which there is no compelling evidence (Skagestad, 1978, p. 618).

Skagestad makes the very good point that although we can acquire evidence supporting fitness between visual perception and the physical world as well as fitness between an organism and its environment, we *do not* have independent evidence of what our scientific knowledge is, and what the physical world is like.

Now, on the one hand, we may presume that our scientific knowledge is true, i.e., that it fits the physical world. This seems to be Campbell's approach. We may still wish to explain how science comes to fit the world, if it fits, and the assumption that it does fit seems to licence us to use scientific knowledge as evidence for or against a proposed explanation of the fit. This appearance is, however, illusory. Once we take 'the world' to be the world as described by science, then the presumed fact of the truth of science is not a fact in the world, since science does not assert its own truth. Once we presume the truth of science as a datum for explanation, we move to a level of explanation where scientific evidence does not count (Skagestad, 1978, p. 618).

Skagestad does not reject the idea of hypothetical realism--in fact, as a Peircean, he believes a convergence towards truth best explains scientific change. However, he considers hypothetical realism to be part of the explanation of scientific change, not part of the phenomena to be explained.

To Skagestad,

...the objection is not against realism *per se*, but against treating the approach of scientific knowledge towards the truth as an empirical phenomenon on the same epistemological level as biological evolution and visual perception, requiring the same sort of explanation. Once the disanalogy between these various *explananda* is recognized, the enterprise of looking for analogous explanations appear futile (Skagestad, 1978, p. 619).

I am in agreement with Skagestad here because we both share the belief that the connection between biology and epistemology is not merely analogical, but literal, and that Campbell is misguided in treating the relationship analogically. We must literally treat man as an animal ('cousin to the amoeba' as Campbell states) and as such, subject to biological evolution in the literal sense. Through selective pressures, a novel mode of evolution has developed--that of culture and science which proceeds by means of mechanisms differing from that of natural selection, and yet reacting back on man's biological survival and, hence, affecting the course of his biological evolution (Skagestad, 1978, p. 620). To Skagestad, the crucial question of evolutionary epistemology is the question of how evolution by natural selection was able to generate, in one biological species, a mode of evolution not operating through natural selection, and yet contributing to the survival of the species in question (Skagestad, *ibid*). He is not alone in his suggestion that we are far from understanding the mechanisms involved in this 'self-transcendence' of evolution, but we can better understand these by clearly distinguishing the features peculiar to cultural evolution which are not found in biological evolution. It is for this reason that we must resist the temptation to exploit the theory of evolution in broad analogies which Campbell has done, which break down upon closer scrutiny (Skagestad, 1978, *ibid*). The distinction between literal and analogical versions of evolutionary epistemology has emerged as another central issue in evolutionary epistemology and it becomes one of the main areas of focus in Michael Bradie's assessment in the following section.

II

MICHAEL BRADIE'S "ASSESSING EVOLUTIONARY EPISTEMOLOGY"

It is perhaps appropriate that we now turn to Bradie's assessment of evolutionary epistemology. For we have just left off with a criticism of Campbell and Popper's analogical version. Bradie's contribution to this field takes up and clearly defines the distinction between the literal and the analogical versions.

There are two interrelated but distinct programs which go by the name "evolutionary epistemology". One is the attempt to account for the characteristics of cognitive mechanisms in animals and humans by a straight-forward extension of the biological theory of evolution to those aspects or traits of animals which are the biological substrates of cognitive activity, e.g., their brains, sensory systems, motor systems, etc. (Bradie, 1986, p. 403).

Bradie refers to this attempt to extend evolutionary theory to the explanation of the development of cognitive structures as the evolution of cognitive mechanisms program (EEM).

The other program attempts to account for the evolution of ideas, scientific theories and culture in general by using models and metaphors drawn from evolutionary biology (Bradie, 1986, p. 403).

Bradie refers to this program, the attempt to analyze the growth of knowledge using evolutionary models drawn from biology, as the evolution of theories program (EET).

A good characterization of the EEM program can be found in Vollmer:

Our cognitive apparatus is a result of evolution. The subjective cognitive structures are adapted to the world because they have evolved, in the course of evolution, in adaptation to that world. And they match (partially) the real structures because only such matching has made such survival possible (Vollmer, 1975, p. 102).

As we saw in the previous section, Lorenz's biologizing of Kant would fall under the EEM category.

And generally speaking, both Popper's and Campbell's treatment would fall under the EET category

(even though both, in some ways, endorse the EEM program). For Popper,

The evolution of scientific knowledge is, in the main, the evolution of better theories. This is, again, a Darwinian process. The theories become better adapted through natural selection: they give us better and better information about reality (they get nearer and nearer to the truth). All organisms are problem solvers: problems arise together with life (Popper, 1984, p. 239).

Stephen Toulmin is yet another advocate of the EET program claiming that science develops in a two-step process analogous to biological evolution. At each stage in the historical development of science, a pool of competing intellectual variants exists along with a selection process which determines which variants survive and which die out (Toulmin, 1967, p. 465). Bradie also adds David Hull and Nicholas Rescher to the list of EET advocates stating that Hull prefers to develop a general analysis of "evolution through selection processes which applies equally to biological, social and conceptual evolution" (Hull, 1982, p. 275) while Rescher gives the program a methodological twist concentrating more on the evolution of thoughts rather than thinkers (Rescher, 1977, p. 128). Both the EET and EEM programs are distinct but are interrelated. They are not, says Bradie, identical.

I can well imagine that the EEM program will turn out to be true, while the EET program may never turn out anything more than programmatic notes. Indeed, there is a sense in which some version of the EEM program must be true if our current understanding of evolutionary process is anywhere near correct (Bradie, 1986, p. 408).

An important question to consider is how, exactly, these two distinct programs are connected. Bradie cites a passage from E.O. Wilson which combines biological evolution with neurophysiological development:

The biologist, who is concerned with questions of physiology and evolutionary history, realizes that self-knowledge is constrained and shaped by the emotional control centers in the hypothalamus and limbic system of the brain. These centers

flood our consciousness with all the emotions--hate, love, guilt, fear, and others--that are consulted by ethical philosophers who wish to intuit the standards of good and evil. What, we are then compelled to ask, made the hypothalamus and limbic system? They evolved by natural selection. That simple biological statement must be pursued to explain ethics and ethical philosophers, if not epistemology and epistemologists, at all depths (Wilson, 1978, see also Bradie, 1986, pp. 408-409).

Bradie claims that an evolutionary explanation of the brain and its functions as an explanation of knowledge is not logically persuasive but he does not say why this is so. And this is somewhat discouraging. For what could be more relevant to the EEM program than considering the mechanisms at work which have contributed to the development of the brain which is necessary for the acquisition of knowledge? In fact this is exactly what Stephen Pinker has undertaken in his latest work (Pinker, 1997). Understanding the evolution of the brain from brainstem, to the cerebellum, to the limbic system, to the cerebrum, and finally the neocortex, will not specifically answer *why* we develop scientific theories, but it will provide a basis for understanding the necessary components involved in their development. And this is a crucial step. And so I am puzzled by Bradie's statement that Wilson's treatment is not logically persuasive especially since he earlier mentioned that there is a sense in which the EEM program must be true if our current understanding of evolutionary process is anywhere near correct.

What Bradie has found is that there are two distinct schools of thought--the EEM and EET--each maintaining that their side should be considered "genuine" evolutionary epistemology. We have seen how Popper, Campbell, Toulmin, Hull, and Rescher are members of the EET camp. Bradie now mentions champions from the EEM camp such as Bunge, Skagestad, and Ruse. Mario Bunge claims that the attempt to develop analogies between biological evolution and scientific theories is ill-conceived because the analogies are superficial and the disanalogies loom large. For Bunge,

Genuine evolutionary epistemology takes organic evolution seriously, deals with the evolution of cognitive abilities as an aspect of brain evolution, and takes the social matrix into account (Bunge, 1983, p. 58).

Skagestad, as we saw above, maintains that by taking evolution seriously, we recognize humans as animals subject to biological evolution who have developed a novel means of evolution--culture, which proceeds by mechanisms other than natural selection (Bradie, 1986, p. 410). And Ruse, maintains that culture developed naturally from selective pressures. In the next chapter, I shall discuss several disanalogies which throw the EET program into question. Bradie concludes this section of his paper by stating that both programs are worth pursuing if only for the reason that by recasting old problems in new ways we cannot help but learn something of interest whether we succeed or fail (Bradie, 1986, p. 411). And it is precisely for reasons similar to this, that I have chosen to examine the concept of ignorance in light of evolutionary epistemology.

Aside from the distinctions of the EET and EEM programs, Bradie makes two further less important, but interesting distinctions. The first identifies the distinction between ontogenetic (or individual) and phylogenetic (or group) processes of knowledge growth. Bradie sees at present, a *prima facie* difference between the two types of biological processes. And so, to the extent that we are inclined to use biology as our guide to understand knowledge in all its aspects we should be somewhat wary of the glib assumption that the phylogenesis of knowledge and the ontogenesis of knowledge should be amenable to the same model adapted from phylogenetic considerations in biology (Bradie, 1986, pp. 412-413). The final distinction Bradie mentions involves the consideration of whether evolutionary epistemology, in either form of EET or EEM, should be considered 'epistemology' at all. Since both forms are purely descriptive, and epistemology is a normative discipline, it can be argued that very little can be gained from causal and genetic models

of biology (Bradie deals with this problem later in the paper). Aside from trying to derive norms from facts (which sociobiologists sometimes attempt), Bradie states that the standard way out is to distinguish between descriptive and normative epistemology and argue that evolutionary epistemology is relevant to the former but not the latter (Bradie, 1986, p. 413). For now, Bradie asks us to consider Reidl's characterization of evolutionary epistemology:

In contrast to the various philosophical epistemologies, evolutionary epistemology attempts to investigate the mechanism of cognition from the point of view of its phylogeny. It is mainly distinguished from the traditional positions in that it adopts a point of view outside the subject and examines different cognitive mechanisms comparatively. It is thus able to present objectively a series of problems (including the problems of traditional epistemology) that are not soluble on the level of reason alone (but, which are soluble from the phylogenetic point of view) (Reidl, 1984, p. 220).

It appears that Reidl is claiming that traditional problems in epistemology are solvable by appealing to "ultimate" evolutionary explanations rather than "proximate" traditional analyses (Bradie, 1986, p. 413). On the other hand, Hull maintains that a purely descriptive epistemology is "epistemology in name only" (Hull, 1982, p. 273). He maintains that all such efforts, including his own, should be seen not as an attempt to understand epistemology from an evolutionary point of view, but rather to produce a "scientific theory of socio-cultural evolution" (Bradie, 1986, p. 413).

In the third section of his paper, Bradie explores the metaphor of the evolution of species and concepts and identifies some common problems. These problems involve the notions of blind variation, selective retention and the problem of progress. He states that Bunge (siding with Piaget), Simon, Skagestad, and Rescher all maintain that science is markedly different from biology in the way in which selection occurs. That is, in science, selection is not blind but goal-directed. This is linked to the problem of scientific progress. Where we can see that biological evolution is blind in

the selective-retention process--and as such, has no particular goal in mind--science does proceed as though progress is being made. Whether science does actually "progress" is, itself, debatable. We would need to consider in what ways we believe progress is taking place: Toward some convergent objectivity? Relative to local or regional contextual rationality? To Elster (1979), Thagard (1980), and Blackwell (1973), the progress of science implies that there are "global" criteria; natural selection does not imply such criteria and therefore a strong disanalogy emerges between the two. On the other hand, Hull (1982) and Bechtel (1984) have argued that scientific progress need not involve a commitment of global criteria if it is recognized that the regularities of nature and the 'laws of nature' exert a transcontextual constraint on the development of scientific theories (Bradie, 1986, p. 427). And Bradie's position on this matter is as follows:

The fact of the matter is that judgments of progress in science are always "local" judgments. This is because even if "global" criteria do exist we are never in a position to know what they are, except by a local presumption or fiat. The history of science and the history of ideas gives almost all of us pause when we contemplate reifying a contemporary standard as an inviolable canon. Rather than assume progress does or does not exist, a more useful exercise for those interested in constructing evolutionary models would be to take alleged cases of indisputable progress and see to what extent they can be 'explained away' as the vicissitudes of historical fortune and changing local fashions (Bradie, 1986, p. 427).

This latter suggestion of Bradie's sounds a lot like what Kuhn has already said.

In the fourth section of his paper, Bradie asks what evolutionary epistemology is supposed to do for us. And this, he answers by addressing two related questions:

1. What is the relationship between evolutionary epistemology and traditional epistemology?
2. What is biology supposed to tell us about knowledge and knowing?

In response to the first question, Bradie considers the locus of the epistemological problem by contrasting Campbell's descriptive epistemology with Dretske's analytic epistemology. As we

have seen above, Campbell maintains that a descriptive epistemology is more a branch of science than of philosophy; for it describes the ways in which language, phylogenetic and ontogenetic development, etc., evolved according to various selective-retention processes. As such, Campbell rejects any views maintaining that truth is divinely revealed to humans, direct realism, and any epistemologies based on ordinary language analysis. Our language, philosophy, and science are all considered to be hypothetical and contingent (Bradie, p. 435). Dretske, on the other hand, states that although members of a well-adapted species may be right in their perceptual judgements about their surroundings (Dretske, 1971, p. 586), this has no particular significance, just as rats who successfully find their way through mazes cannot be said to 'know' their way through the maze. Unlike rats, humans make judgements and ask significant epistemological questions concerning the right to be sure, the question of what counts as adequate evidence, what counts as a good or the best explanation, and how to distinguish between conclusive and inconclusive reasons (Dretske, 1971, p. 586). While Campbell does not disagree with this view, he maintains that instead of seeing descriptive epistemology as either a competitor to or a successor of traditional epistemology, it can be complementary to it. And he realizes that within the framework of contingent knowledge, he does make presumptions about the world and begs the traditional epistemologist's question.

With respect to the traditional epistemological question (how is knowledge possible?), descriptive epistemology must, Campbell says, be what he calls an "epistemology of the other one". Such a perspective abandons the justification of first person knowledge and works instead "on the problem of how people in general, or other organisms, come to know" (as quoted in Bradie, 1986, p. 437)

Dretske sincerely doubts that any evolutionary view of man's perceptual powers will ever satisfy the skeptic (Dretske, 1971, p. 588). Stroud as well, in criticizing Quine mentions that such descriptive accounts simply add up to an "epistemology of the other" leaving the question of how knowledge

is possible at all unanswered (Stroud, 1981, pp.463-466). Bradie points out that, in response to Stroud, Quine argues that "this projection [of ourselves] into the other's place must be seen not transcendently but as a routine matter of analogies and causal hypotheses within our scientific theories" (Quine, 1981, p. 474). Although Bradie recognizes that evolutionary epistemology may never satisfy the skeptic's objections based on "logical possibilities" which can, in principle, be raised forever, he suggests that we simply forget about them and move on; life is too short to deal with such people (Bradie, 1986, p. 438).

At this point, Bradie proceeds to answer the second question (What is biology supposed to tell us about knowledge and knowing?), by considering some of the virtues of evolutionary epistemology. Evolutionary theory can provide a biological account of such things as rationality, the historical development of science, the disappearance of the demarcation between pure and applied science, the mind-body problem and other metaphysical issues. The important point Bradie stresses is the distinction accredited to Ernst Mayr between *proximate* and *ultimate* solutions to these problems. For example, in considering the relationship between nonmaterial aims and purposes on material organisms, one could easily adopt a "just-so" account and state that this is simply a function for which these aims and purposes evolved. We may still be dissatisfied with this account however because although it offers an ultimate account of the relationship between mind and body, we are left without any proximate account:

A complete understanding of biological phenomena (in the light of evolutionary theory) requires both a proximate and an ultimate analysis...It remains an open question whether socio-cultural considerations in problems such as these wash out any but the barest biological considerations. After all, one can just as easily argue, as many do, that 'consciousness' is an evolutionary adaptation which enhances the survival and reproductive prospects of organisms which possess it. This hardly "solves" the problem of consciousness. All the difficult questions, how it works, etc.,

are proximate and remain to be solved (Bradie, 1986, p. 443).

Although proximate questions remain unanswered, Bradie does admit that the evolutionary point of view can, at least at the ultimate level, demystify consciousness to the extent that it is plausible to construe it as just another handy adaptive organ (Bradie, 1986, *ibid*). This is also the position taken up and well argued by evolutionary psychologist Stephen Pinker (Cf. Pinker, 1997). Bradie concludes this section by stating that:

Although I am not convinced of the merits of all of these claims, neither am I convinced by the claim (e.g. by Dretske) that an evolutionary approach to epistemology is not relevant at *all* to basic epistemological issues. But, evolutionary explanations should not be expected to do everything or condemned if they do not. Here, the distinction introduced by Mayr between ultimate and proximate accounts of biological questions can be fruitfully extended to epistemological questions as well. For the present, this remains a program, awaiting its Darwin (Bradie, 1986, pp. 443-444).

The last section of Bradie's paper that I shall examine considers evolutionary epistemology in light of the problem of realism. And, once again, he considers Campbell's views on this. Campbell claims that although descriptive epistemology can debunk the value of 'hard facts', the ideology of 'stubborn facts' has a functional truth. There is a goal of truth even though we must abandon literal truth. This 'goal' refers only to the way in which individual organisms interact with their environments to produce knowledge. And this can lead us to "epistemological relativity".

Amoebas know what they know, frogs know other things, humans still more. Each kind comes to know what it does through processing by cognitive structures which are the product of evolutionary development. We may know more things than other creatures or different things but each kind of organism constructs, as it were, an image of reality based on its own needs and capacities (Bradie, 1986, p. 444).

This epistemological relativism is never pushed to an ontological relativism, however. The language of science is subjective and metaphoric and never the language of reality itself (Campbell, 1975, p.

1120). Campbell presumes that reality has a language in a view he calls 'hypothetical realism'.

The basic postulate of hypothetical realism is that there is an objective world of objects and relations which exists independently of any knowing and perceiving organisms. The organisms which inhabit and interact with this world, however, have only indirect, fallible knowledge, which is "edited" by the "objective referent" (Bradie, 1986, *ibid*).

Skagestad objects to Campbell's realism stating that biology and ontology are not on the same level in terms of "matching" data and creating "fits" (Bradie, 1986, p. 446).

Campbell, Skagestad argues, although in the tradition of epistemological naturalism, departs from the mainstream of that tradition by his insistence on the *objectivity* of truth as *correspondence*. The mainstream, as exemplified by James, e.g., sees truth as a relation between experiences. This mainstream tradition leads to a form of epistemological relativism (which Campbell calls "ontological nihilism") to the effect that..."Once we have ascertained the economic, sociological, or psychological *causes* of the origin of a belief, as well as the *functions* through which it is maintained, there is no further question to be asked about truth or validity; we can at most ask how well the belief fulfils its particular function within its social and cultural context" (Skagestad, 1981, p. 30 in Bradie, 1986, pp. 446-447).

Campbell, though realizing that current scientific theories are fallible, nonetheless maintains that there is an objective final truth to which our current theories approximate. And although Campbell's notion of hypothetical realism may allay some forms of instrumentalism or pragmatism, some form of ontological relativism is still possible: that our theories change and may even converge locally, in itself, does not entail the Campbellian conclusion that an ultimate consensus as the limit goal of inquiry is legitimate (Bradie, 1986, p. 447).

It seems clear to me that an evolutionary epistemologist would have realist presumptions of some sort. That is, that a world does indeed exist independently of the mind and has so for some time, that there are ways to 'carve up' the world into categories in order to better understand it, etc. But I am not sure if it is necessary to make the move into metaphysical realism. And in some ways,

I am puzzled at Campbell's insistence on this. Is there some inherent fear of ontological relativism? Why is it necessary to postulate an objective world of fixed objects and relations? Is it simply to escape relativism? If that is the case, then why is it necessary to go either way? It appears to me, that the safest move for any evolutionary epistemologist is to simply suspend judgement on this matter. Since we cannot say one way or the other, why would we say anything other than that it currently lies beyond the scope and ken of reasoning, scientific or otherwise? It is for precisely this reason (but not this reason alone) that I have found Ruse's work so illuminating. As we shall see in the following chapter, Ruse recognizes this problem but makes no commitment to either ontological relativism or ontological realism. And for good reason: this is an area in epistemology in which we simply cannot clearly articulate. Although the world seems to be knowable according to some type of correspondence, our beliefs can only currently cohere. Ruse does not move beyond what evolutionary epistemology itself maintains; his view is quite consistent in this regard. And, as Shimony maintains, we cannot use evolutionary theory to establish epistemological claims including realism because our use of evolutionary theory in such a way would presuppose the truth of realism (Shimony, 1981, p. 117).

Bradie concludes this section on realism by stating that he believes some form of realism is correct. However, he is not sure which one. That is, he is not convinced that hypothetical realism can be maintained in a convergence-free version. He asks the reader to consider hypothetical convergence-free realism in this sense:

Biological evolution, we are constantly reminded, is opportunistic. Organisms not only exploit their local environments, but the longevity of lineages is contingent upon historical accidents. Imagine a laboratory of many worlds, each of which is essentially the same. Evolutionary theory predicts that even if life starts in them all, we should not expect either the organisms or the lineage to be identical or even

closely similar. There is, in the biological world, no convergence to an ultimately perfect form. Most evolutionary epistemologists (Toulmin excepted) are unwilling to accept the implications of this for cognitive or conceptual evolution. They will admit that the local, intellectual, social, and cultural background out of which new ideas emerge is a relevant factor in forming the selective forces which determine which of those ideas will survive and which will not, but they are unwilling to accept the radical implication that the direction of conceptual evolution and change need not be leading anywhere in particular. They are unwilling to abandon the eschatological vision of a terminal-consensus "in the long run" (Bradie, 1986, p. 451).

According to Bradie, although there may be philosophical motives for maintaining the virtues of objectivity and truth, there is no biological rationale for convergence to consensus.

Hypothetical realism, in and of itself, does not guarantee or even suggest convergence. There is a long inferential leap from general coping with the environment, which all successful lineages must develop, to consensus of structure, content and function of knowledge. The appeal to laws or regularities of nature to force convergence assumes that the constraint 'reality' imposes on how and what we think are sufficient, in the long run, to wash out the social and cultural differences, which, for all we know, operate to induce divergence. Even if a global or galactic community eventually reached consensus, shared bias and mutual reinforcement could not be ruled out as major contributory causes (Bradie, 1986, p. 451).

I think it is safe to say that in evolutionary epistemology, we can maintain some form of realism insofar as we assume the existence of a world existing independently of our consciousness. But we cannot justify the further assumption that this independent world comes complete with fixed objective facts waiting for us to converge upon. To do so is to go beyond what reason, as a product of evolution, allows.

III
CURRENT DISCUSSIONS
IN
EVOLUTIONARY EPISTEMOLOGY

In a relatively current paper, Franz M. Wuketits (Wuketits, 1995) discusses some recent arguments and counterarguments in evolutionary epistemology. In reference to Raphael Falk's "Evolutionary Epistemology: What Phenotype is Selected and which Genotype Evolves?", Wuketits states that the main concern and one of the most vexing problems is the question of how evolutionary epistemologists conceive "reality" and how they cope with "realism" (Wuketits, 1995, p. 358). Falk responds to members of the EEM program of the Austro-German school, led by zoologist Rupert Riedel, and whose advocates include Gerhard Vollmer and Franz Wuketits. To Falk, such members "conceive epistemology not only as taking cognizance of and compatible with man's status as a product of a biological process, but actually wish to establish epistemology as a branch of biological science (Falk, 1993, p. 163). In specific reference to Wuketits, Falk has this to say:

Taking a reductional realist position Wuketits formulates what he calls the fourth postulate of evolutionary epistemology (which, to my mind, should have been the first one): "The naturalist has to adopt the postulate of objectivity: nature is objective; it has existed before and independently of an observing subject" (Wuketits, 1984a, p. 14). Wuketits claims that once one adopts this postulate, it follows automatically that modelling reality or, at least, certain parts of it, is vital for any organism. Information-processing, therefore, serves as a mechanism for the sake of survival: the better the model of reality, the better the chance of survival" (Wuketits 1986, p. 193). Even though evolutionary epistemologists by and large progressed beyond such a naive-realist position, its impact is still there. According to it our models of the mind represent the world because our brains have evolved to respond to 'the environment'-as if there exists such an entity, which is distinct and essentially independent of the organism--so as to increase our adaptation. Our mental models 'fit' reality (Falk, 1993, p. 163).

Wuketits responds by claiming that although this may have painted an accurate picture of his views

several years ago, he has since changed his position and now follows one of the central claims of evolutionary epistemology--namely, that life in general and the life of any individual is a process of learning (Wuketits, 1995, p. 358). He agrees with Ruse (Ruse, 1989) that "we still have the real world, but it is the world as we interpret it". And further, that each organism interprets, to a certain extent "reality" and does not simply *portray* it by its perceiving apparatus. Wuketits states that the crucial question is not, how animals and humans have evolved through adaptation to a given environment, but rather how the interactions between organisms and their environment(s) have evolved (Wuketits, 1995, p. 359). In opposition to Falk's claim that he is a naive realist, Wuketits illustrates why, in fact, he is a coherentist:

Like some other evolutionary epistemologists, I argue for a *coherence theory* which replaces the view of the "correspondence between cognition and the external world" that, if taken in a strict sense, could indeed be regarded as a kind of naive realism. The advocates of a coherence theory, on the other hand, will not be so naive to think that what we (or other organisms) perceive is a "picture" of something in the outer world, a necessarily "objective" image of external reality. Rather, they suppose that reality--and our (or other organisms') views of reality--rest on coherence and success in life (Wuketitis, 1995, p. 359).

The next point which Falk takes issue involves to what extent evolutionary epistemology is, in fact, epistemology. Since Falk accuses Wuketits *et al* of biologizing propositional knowledge, this reduces hypothesizing to nothing but trial and error strategy and contributing no new insights to the analysis of concepts like "consciousness", "rationality", "self-awareness", etc., which is what he (and Dretske) believe epistemology is all about. To Falk,

...it may be asserted that attempts to conceive evolutionary epistemology as "a challenge to science and philosophy" has not yet contributed anything new to philosophy. It has, however, rather depreciated the efforts to conceive biological theories as constructive means for empirical examination and interpretation of our subjective world. The EEM program, far from resolving any epistemological questions, rather evaded them by presenting them as facts, only the biological history

of which must be unravelled. No progress has been accomplished through it toward any insight into the basic question of the meaning of the assertions of knowledge (Falk, 1993, p. 167).

Falk likens the problem of reifying the concept of knowledge with innate structures of cognition to similar problems encountered in sociobiology.

The central problem of sociobiology is the construction of a theory that will provide a biological explanation of the social behaviors, social processes, and social structure characteristic of species' populations...The problem starts when authors "biologize" the system of socially transmissible information that encodes behaviour and cognitive characteristics of social groups, namely culture. When epigenetic rules have been formulated which "reshape" the "substance of culture" and "build the mind and its contents," we witness how the objectification of social concepts and the description of the processes in terms analogous to those of organic epigenesis were introduced in an attempt to overcome the hurdles of the unresolvable reduction of the concepts of human intentional behaviour to causal material explanations. Yet, as put by Hanna (1985, pp. 32-33), "we neither have empirical evidence that decides the issue of genetic determinism, nor do we have a clear idea of the sort of evidence that would in principle decide the issue...in this respect, we do not have an adequate epistemology within which to frame the fundamental thesis of sociobiology" (Falk, 1993, p. 168).

The final issue which Falk takes up is the inherent danger in objectively allocating deterministic descriptive epistemology as an arbitrator between possible epistemologies which may eventually provide justification for biological "is's" to become normative "ought's" (Falk, 1993, p. 169).

Wuketits responds to this notion of genetic determinism by stating that evolutionary epistemologists argue for genetic propensities for an organism's particular ways of information processing and coping with different objects of the environment. As Gray Hardcastle points out, there is an actual relation of mutual dependence (Gray Hardcastle, 1993, p. 190) between any organism and its environment(s). To Wuketits, an animal's coherent view of its surroundings comes from--and is constrained by--this continuous mutual relation.

Any epistemic activity, no matter how complex it is , starts from somewhere and

cannot emerge from nothing. Cognition gaining has--and always had--in first instance a significant "survival value". Sure, human *knowledge* goes beyond this, but it is based on all those mechanisms that have a particular meaning for survival. Nobody will seriously argue that, for example, Einstein's formula is vital and serving our survival in a strict biological sense. However, this does not count as an argument against the assumption that all types of cognition/knowledge have basically the same structure and start with processing of relevant--indeed, biologically relevant--information (Wuketits, 1995, p. 361).

There is no miracle to human epistemic knowledge, says Wuketits. It should not come as a surprise if, as it turns out, the specifically human type of cognition appears to be one, though the most sophisticated of "cognitive phenotypes" which has developed in the course of evolution thus increasing the fitness of its "carriers" (Wuketits, 1995, p. 361). The human cognitive phenotype is simply the most complex and sophisticated type. It depends on elementary biological mechanisms of cognition gaining as, by its results, it transcends them, as it were (Wuketits, 1995, p. 362). Wuketits closes his paper by quoting Barham: The very reason for why philosophical problems actually *cannot* be resolved without biology might seem astonishing, though it is in fact trivial: "The problems of philosophy are the problems of a biological organism" (Barham, 1992, p. 267).

Falk seems unconsciously unsympathetic towards the very difficult task of trying to explain in bio-historical terms, the phylogenetic and ontogenetic development of conceptual knowledge. To what degree do we need empirical evidence to support the influence of biology on culture? How could and how should this be done? (a question which, itself, is *both* descriptive and prescriptive). Falk has failed to realize that many questions in epistemology are of an extremely conjectural nature, and, left purely in the conceptual realm, either lead to divisions of schools of thought or elude resolution entirely. Why should he demand more from the EEM program than it can possibly offer? Simply because it is an empirical program? He seems to have missed the point that the EEM

program is trying to provide a plausible biological account for the origin and development of knowledge because we have reached a level in our current conceptual development by which to formulate viable hypotheses concerning the very bio-historical origin of our ideas. Since we cannot simply go back in time to observe the origin and development of modern man as he interacted with his environment, we are, to a degree, taking guesses. But this is the very nature of the project at hand. The big question is whether or not biological science can provide any further basis for our current conceptual guesses. And I think it has. Although it is still in its infancy, evolutionary epistemology has contributed interesting new perspectives to the field of epistemology if not only by raising more questions concerning the development of intelligence (viz. bipedalism, enlarged brain size, sophistication of language, etc.). We have reached a point in our conceptual development whereby no responsible epistemologist can turn a blind eye to the importance of biology to epistemology. Biology may not answer all our questions concerning epistemology, but then again, as Bradie said, why should it?

IV

A SUMMARY OF THE CENTRAL ISSUES IN EVOLUTIONARY EPISTEMOLOGY

Although the branch of evolutionary epistemology is still quite young, we can see a number of common themes which have emerged as central points of controversy. The following list is not meant to be exhaustive but illustrative of the issues in evolutionary epistemology which I believe to be fundamental.

1. Since this branch of epistemology has its origins in biological theory, it is essential that, initially, the evolutionary theory must be faithfully represented. At first sight, this seems an obvious necessity.

However, as we have seen, it is quite clear that there are differing perspectives within evolutionary theory e.g. gradualism vs. saltationism, progressionism vs. non-progressionism, pluralism vs. adaptationism, etc. And I believe that in the first chapter, I have satisfied this initial task in evolutionary epistemology by clearly establishing the explanatory power of the neo-Darwinian or synthetic theory of evolutionary theory.

2. The next three central issues in evolutionary epistemology are related. The second central issue is Bradie's distinction between the EET and the EEM programs. This issue is divisive among evolutionary epistemologists. One needs to assess the importance of each program, whether or not there is a connection between the two, and to decide whether or not it is better to argue for an analogical or literal interpretation of the relationship between evolution and knowledge. An analogical version is tempting at first glance, but there are several convincing disanalogies which gives one serious grounds for pause.

3. The third central issue involves perhaps the most significant disanalogy between organic and scientific evolution: the distinction between blind and goal-directed variation. One of the central issues which emerged from Campbell's treatment is the problem of 'blind' variation. Campbell maintains that just as organisms select and retain variations blindly without the foreknowledge of specific goals, so too, do scientists propose theories blindly in the understanding of various aspects of the world. Campbell maintains that when we go beyond what is already known, we cannot but go blindly. To go wisely implies that we already have achieved wisdom of some general sort (Campbell, 1974a, p. 422). I have referred to this, above, as 'Campbell's tautology'. And I believe it is a central problem for evolutionary epistemology for the simple reason that science obviously appears to be goal-directed. Organic and scientific evolution may be analogous on some levels but

they are disanalogous in several ways (a detailed analysis of the disanalogies follows in the next chapter).

4. The fourth central issue of evolutionary epistemology has been raised by Toulmin, Dawkins, and Skagestad (among others). And this involves the connection between biology and culture. In some ways, this is a generalization of Campbell's tautology i.e. the move from blind to goal-directed selection and Bradie's distinction of the EET and EEM programs. Culture and science somehow transcends natural selection, yet nonetheless contributes to the survival of our species. Skagestad states the problem well by considering: "How evolution by natural selection was able to generate, in one biological species, a mode of evolution not operating through natural selection, and yet contributing to the survival of the species in question" (Skagestad, 1978, p. 620, see also Dawkins, 1976 and Lumsden and Wilson, 1981). Toulmin refers to this as 'Mach's error' i.e. that the failure to recognize the possibility that the "intellectual selection-criteria" of science need not be the same as those operating in biology (Toulmin, 1972, p. 321).

The final two issues are also related.

5. The fifth issue which emerges in evolutionary epistemology is a very old and very familiar one: the problem of realism. But there must be a distinction between what we can call ontic realism and theoretic realism. The former is concerned with the physical relationship between objects in the external world whereas the latter considers what stance we are to take concerning the relationship between our beliefs and the so-called 'real world'. We have seen that many of the evolutionary epistemologists are ontic realists of some sort and/or to some degree. And for obvious reasons, the acceptance of biology as an explanation for the development of knowledge assumes a type of realism i.e. insofar as one maintains that physical objects exist and have existed independently of an

observer. The question of realism in evolutionary epistemology seems not to be whether or not to maintain realism, anti-realism, or some form of agnosticism, but what *type* of realism? And there is considerable diversity in choosing a realist perspective e.g. naive realism, internal realism, direct realism, hypothetical convergent realism, hypothetical non-convergent realism, etc. Much of the concern about theoretic realism seems to have come from the biologizing of Kantian categories and propositional knowledge. In reference to Lorenz's 1941 paper, the notion of categorizing the world in *a posteriori* ways, is quite consistent with a biological understanding of organismic interaction within an environment. The problem, however, emerges when we consider to what degree, if any, our concepts describe the world. How much biology can say about the problem of realism is itself dependent upon one's presumptions about the efficacy of evolutionary theory. Many, such as Campbell, have realized that since there are no presuppositionless or non-presumptive starting points, biology provides a reasonable and rational starting point. Although I agree, again we must exercise caution regarding the extent of biological explanation in epistemology (remember Mayr's ultimate/proximate distinction).

6. A problem related to realism in evolutionary epistemology is the problem of skepticism. Dretske and Stroud have stated that evolutionary epistemology simply amounts to "an epistemology of the other" and that it does not address central epistemic issues. Others such as Plantinga and, especially Unger, maintain that the old familiar Cartesian problem of deception casts much of our current knowledge claims in doubt.

As I have mentioned, above, these are not the only issues in evolutionary epistemology. However, I do believe they are among the most important and controversial. No matter what problems of epistemology an evolutionist examines, he will find himself needing to address at least

some of these issues. As I mentioned above, I believe I have sufficiently satisfied the conditions of the first central issue. It is through a combination of a neo-Darwinian understanding of evolutionary theory and the remaining five central issues of evolutionary epistemology, that I intend to examine the concept of ignorance. We shall see that this task is, by nature, symbiotic--that is, as much as we can learn about this concept from these central issues, our understanding of the concept of ignorance will answer some important questions concerning these five central issues.

CHAPTER THREE
THE CENTRAL ISSUES OF EVOLUTIONARY EPISTEMOLOGY
AND THE CONCEPT OF IGNORANCE

Introduction

In Chapter One, I responded to the first central issue of evolutionary epistemology by establishing a neo-Darwinian position of evolutionary theory, arguing for an adaptationist position and stressing the importance of natural selection and phyletic gradualism. In this chapter, I shall examine the remaining five central issues of evolutionary epistemology set out in Chapter Two in order to determine what they can tell us about the concept of ignorance. Although there are several works to which I shall refer, by far the most influential is Michael Ruse's *Taking Darwin Seriously*.²³ I have found Ruse's work to be not only compatible with many of my own views but it is one of the clearest accounts of the central issues of evolutionary epistemology I have come across.

After having sufficiently established a clear account of evolutionary theory (neo-Darwinism), the next step is to consider whether the biological mechanisms literally influence our cognitive abilities and hence, the manner in which we acquire and revise beliefs--in short, how we do science; or whether one considers the competition for scientific theories to be analogous to the type of

²³ Although I shall consider Ruse's works: *The Philosophy of Biology Today* (1989), *The Darwinian Paradigm* (1989), and *Evolutionary Naturalism* (1995), I shall focus mainly on *Taking Darwin Seriously* (1986). Most of my reference to this work will be from the 1986 edition. There will be times, however, when I will refer to the recent, forthcoming second edition in Prometheus, 1998.

competition which results from natural selection. In other words, is one arguing for an EEM or an EET program? I shall argue for the former because I believe an understanding of evolution as adaptational through natural selection reveals a number of dissimilarities in the EET program and provides an appropriate account of the development of cognitive mechanisms. This is based on the conditional that IF we understand man to be just another animal, THEN we must maintain that those factors responsible for the development of science--language, consciousness, reasoning, etc.--developed gradually *because* of their survival value or they were necessary concomitants of something that was adaptatively advantageous. If these cognitive mechanisms were not conducive to the survival of *Homo sapiens* then they would not have been selected for. At first sight, this sounds like a tautology. That is, whatever 'fits' survives, and whatever survives must have fit. However, I shall present a plausible case demonstrating how the cognitive mechanisms responsible for culture and science would have gradually developed. This rests, of course, on a neo-Darwinian understanding of evolutionary theory which stresses the importance of natural selection and adaptation.

No set of equations applicable to everything from galaxies to Bosnia can explain why teeth are found in the mouth rather than in the ear. And since organisms are collections of digestive tracts, eyes, and other systems organized to attain goals, general laws of complex systems will not suffice. Matter simply does not have an innate tendency to organize itself into broccoli, wombats, and ladybugs. Natural selection remains the only theory that explains how *adaptive* complexity, not just any old complexity, can arise, because it is the only nonmiraculous, forward-direction theory in which *how well something works* plays a causal role in *how it came to be* (Pinker, 1997, p. 162).

The manner in which I shall argue for the EEM program draws on two other central issues in evolutionary epistemology: the distinction between blind and goal-directed variation, and the manner in which culture transcends biology.

First, I shall argue against the EET program by discussing three dissimilarities between organic and scientific evolution. The first two have been discussed by Ruse (1986) and deal with the manner in which science and biology differ in terms of hybridization and extinction. The third dissimilarity is perhaps the most important and involves the method of change. The way in which organisms change (or evolve) is markedly different in process from the change which occurs in science. The most obvious dissimilarity introduces the next central issue of evolutionary epistemology--the distinction between blind and goal-directed variation. I shall show the dissimilarity between scientific and organic evolution by arguing against Popper's and Campbell's notion of scientific blindness. I shall maintain that scientific, unlike organic evolution, is progressive and goal-directed. I shall also argue that the direction of one's queries towards a specific goal is the result of consciously reflecting upon a lack (of information) relative to a particular perspective. Our queries are not 'blind' in the same sense as 'random' genetic variation. The fact that we can direct our scientific enterprises indicates not only a great dissimilarity between organic and scientific evolution (and thus the EET program), it gives us the first indication of how reflective awareness of one's state of ignorance was brought about by selective pressures.

This leads us naturally to consider how the cognitive mechanisms responsible for science and culture evolved--that is, how and why natural selection favoured capabilities which would eventually allow a species to transcend its biological constraints. If we maintain a neo-Darwinian position, then biological processes must have gradually led to this development. I believe Wilson's and Lumsden's 'epigenetic rules' have convincingly accounted for this transition. Generally speaking, an epigenetic rule is simply a diversified process of perception and cognition which influences the learning and transmission of ideas in a particular culture e.g. the classification of colours, the development of

human incest barriers, logic, mathematics, etc. Ruse also accepts this notion of epigenetic rules. mentioning that the list of such rules is ever-expanding. I shall add to this list the conscious awareness of a lack of information--reflective ignorance--as yet another but extremely important epigenetic rule which gradually played a prominent role in the emergence of science and culture.

The final two main issues of evolutionary epistemology that I shall consider--realism and skepticism--are also related. I shall examine what type of ontic and theoretic realism a neo-Darwinian is committed to e.g. naive realism, direct realism, internal realism, etc. In this way we can more sharply determine the explanatory boundaries of this evolutionary epistemology. Does it try to say too much, and spill over into metaphysics? Or is it cautious and careful and leaves too many crucial questions unconsidered? And this will lead us to consider the topic of skepticism--not only what the evolutionary epistemologist (as neo-Darwinian) has to say about it, but especially what type is relevant to his position. Any responsible epistemologist--Darwinian or otherwise--must, at some point, address the problem of skepticism in order to seriously consider the scope, breadth and explanatory power of his epistemology. A Darwinian epistemologist must ask himself: "When does evolutionary theory become too much of a good thing?" "What are its cut-off points?" "How do the explanatory boundary conditions described by this evolutionary theory apply to itself?" We are led to consider not only what evolutionary epistemology says in response to skepticism but how skepticism applies to evolutionary epistemology. From a neo-Darwinian perspective, I shall argue against Cartesian skepticism--not only what I call 'classic' Cartesian skepticism, but the modernized linguistic version popularized by Peter Unger. This is by far the longest section of the chapter but for good reason. Since my inquiry into the concept of ignorance originated with Peter Unger's *Ignorance: A Case For Scepticism*, it is fitting that I should consider it most thoroughly. The purpose

of this critical examination is not so much to determine what the Cartesian (or Ungerian) skeptic believes the concept of ignorance to be, but to determine, according to neo-Darwinian epistemology, that it is significantly unlike the Cartesian/Ungerian skeptic's account. The most striking differences between the two involve the way in which each understands the origin and function of language. Whereas evolutionary epistemology maintains that language is contingent, emerged and developed according to selective pressures, and has no *a priori* status whatsoever, Unger believes that language is necessary and has *a priori* status. But Unger's linguistic skepticism departs from mainstream skepticism in its one similarity with evolutionary epistemology. As I mentioned in the Introduction, Unger believes it may be possible to establish a natural cause for our current state(s) of ignorance. Whereas most linguistic skeptics use language as a conventional tool by which to develop a skeptical position and then ignore or abandon the efficacy of such a commonly used language (tipping over one's ladder after one has climbed up, so to speak), Unger considers a possible reason for such ladder-building may have been imprecise concepts developed in ancestry. I shall argue not only against Unger's particular type of linguistic skepticism, but against what he believes to be the reason for ignorance--the ancestral language hypothesis (ALH).

By rejecting Unger's form of skepticism, however, I am in no way committed to the belief that no form of skepticism can offer clarification to our understanding of this concept. On the contrary, I maintain that there are striking parallels between neo-Darwinian epistemology and Pyrrhonian skepticism such as the 'acquiescence of appearances' (or a common sense understanding of the world), the distinction between regionally utilitarian and ontologically ultimate beliefs, and the avoidance of highly stringent (metaphysical) criteria and the establishment and (tentative) acceptance of practical--albeit, fallible--epistemic criteria. Identifying these parallels will contribute

significantly to our understanding of the concept of ignorance.

I

THE DISTINCTION BETWEEN ORGANIC AND SCIENTIFIC EVOLUTION: ARGUING FOR THE EEM AND AGAINST THE EET PROGRAM

As we noted above, the central mechanism of evolution is natural selection i.e. organisms change because they: 1) Adapt in order to promote survival (and reproduction); 2) Genetic variations are 'blind'--that is random i.e. they occur without respect for an organism's present needs. A new variation, as like as not, will harm its possessor, rather than help it (it is selection which is the creative element in evolution; and 3) It is the individual, not the group that wins or loses the struggle for survival.²⁴ Although there is some connection between organic constraints and the development of scientific knowledge, there are striking dissimilarities in many of the accounts of the EET program which attempt to draw this parallel (such as Popper's, Campbell's, etc.). First of all, science is progressive--at least, comparatively so. There is a teleological and progressive aspect to scientific evolution which is absent in organic evolution. Unless you are a Spencerian, you must see evolution as opportunistic, not progressive. Spencer believed that:

...in organic nature, and indeed everywhere else, we see a 'law of progress', which takes the form of complexity arising from simplicity, or more precisely (as he put it) of heterogeneity arising from homogeneity. Simple organic forms are forever evolving into diverse, complex forms. We go from a uniform sameness to a set of inter-connected but different components (Ruse, 1986, p. 37).

Analogously, Spencer argued that we progress from the simple to the complex in other areas such

²⁴ The familiar 'ontogeny recapitulates phylogeny' has long been discarded in its original form and, according to Ruse, was always kept at arm's length by Darwin. See Ruse, 1986, pp. 4-16.

as scientific inquiry. Although Spencer may be correct in claiming that science is evolutionary, he was wrong in thinking that evolution passes from the simple to the complex. There are many counter examples to Spencer's 'law of progress' e.g. the reduction of toes on horses, sexual to asexual reproduction in various species, etc. And in terms of scientific theories, one can understand progress as identifying simplicity out of complexity (homogeneity out of heterogeneity). William Whewell's notion of unification or consilience of theories plays very prominently in science i.e. the ability to explain several disparate elements under one theory or hypothesis. Evolution is opportunistic, not progressive--if the simpler will do, then so be it (Ruse, 1986, p. 40). Science, on the other hand, seems to be progressive:

I do not pretend to have established, in some God-guaranteed way, that progress does actually occur in science. My point is that, as we commonly think, progress has occurred in science. Indeed, I would say that scientific development is our touchstone for progress. Furthermore, 'progress' signifies that our beliefs are getting closer to a true mapping of a real, objective world 'out there', independent of our whims and wishes. This may all be a pipe-dream. The crux is that this is what we think. Perhaps we are all caught in an illusion. At some stage we shall have to consider this possibility. For now, I will rest with appearances, although in fairness I would suggest that if you think that the progress of science is illusory, there is some obligation upon you to show why this is so (Ruse, 1986, p. 43).

By 'progress', here, Ruse is referring to an advancement of knowledge which seems to move closer to the truth--a real, independent, objective mapping of the world. For example, Copernicus was a little closer to the truth than Ptolemy and his supporters because he was able to determine that the planets really do revolve around the sun (Ruse, 1986, p. 42). It is important to point out that Ruse is describing scientific progress according to how it appears and how we describe it i.e. he is not explicitly committing himself to any metaphysical claims about the function or stature of science.

In arguing against the current EET program we can see a number of striking dissimilarities.

Ruse has mentioned two: *hybridism* and *extinction*. In the organic world, two separately evolving lines can only come together i.e. reproductive barriers collapse, between closely related lines. Beyond a certain point, hybridism is impossible (Ruse, 1986, p. 51). The chromosomal make up of disparate species is simply not compatible for radical hybridization. In science, however, the notion of hybridization has a very different status;

Scientific blending occurs when disparate subjects are brought together in one consistent theory. Sometimes the thus-joined subjects are not that far apart. But sometimes, as in great revolutions, the connected areas come from widely separated parts of science. Joining embryology and biogeography, as Darwin did in the *Origin*, is the scientific equivalent of hybridizing elephants and mice. The difference is that Darwin did it, whereas nature does not and cannot (Ruse, 1986, p. 51).

Ruse believes the notion of hybridization is so central to the field of science that it casts doubt on the analogist's argument.

The great emphasis in the path of Darwinian organic evolution is on fanning out, like branches of a tree. That is a major reason why talk of progression fails. The great emphasis in the path of scientific evolution is on bringing together, like roots of a tree. That is a major reason why talk of progression seems appropriate, and why we think that such progression is directed towards an understanding of objective reality (Ruse, 1986, p. 51).

The second dissimilarity between organic and scientific evolution is *extinction*. We can see how in organic evolution, extinction is the invariable fate of every group. But in science, theories rarely entirely become extinct (although there will always be exceptions e.g. Ptolemaic astronomy,²⁵ static pre-plate tectonics, pre-Darwinian Creationism, etc.). But it is rare for any scientific theory which has had moderate success to vanish without a trace.

²⁵ Here, I am referring to the extinction or abandonment of the geo-centric concept of the planetary system. I realize, of course, that Ptolemaic calculations can still apply to navigation with sextants, chronographs, etc.

Rather than total extinction, we find that parts tend to get incorporated into the successors. These incorporations obviously are the facts on which we have made the case for scientific evolution. However, more than this. The incorporated parts then tend to get incorporated into the successors' successors, and so on *ad infinitum*. I do not assert that theories never vanish entirely. Nevertheless, it does seem that science is cumulative in a way that the organic world is not. There are no trilobite genes today. There are important elements of pre-evolutionary biology in modern Darwinian theory (Ruse, 1986, p. 52).

It is difficult to imagine that any major scientific theory e.g. Einsteinian astronomy, quantum mechanics, molecular biology, etc. will ever become extinct in the sense in which natural organisms become extinct. Such theories are the cumulative products of earlier theories (factual or theoretical). As we noted in Chapter One, modern molecular biology and genetics owes its current status to the work of earlier Mendelian genetics. And future work will result from current models of DNA research. But will the model of the double helix ever totally be scrapped? The paths of organic and scientific change seem to be quite far apart, the former showing no signs of progression while the latter does.

II

BLIND AND GOAL-DIRECTED VARIATION

We are now led to the third and most significant dissimilarity between biological and conceptual evolution: the method of change. There are good reasons why change occurs in both but each is quite distinct.

A population of insects (say) is suddenly faced with a new predator. This sets off selection pressures and (one hopes) an adaptive response. The population must find a 'solution', for instance new camouflaging coloration or a distinctively unpleasant odour or taste. Analogously in science. Its practitioners do not go into their laboratories on Monday mornings and then explain the world--any part of the world. Science is stimulated by problems--Why are there homologies?--and this sets up intellectual responses which attempt to solve them. The winners thus are 'adapted'

to the problems set before them. Fish are adapted to the problems of a watery environment. Comparative anatomy is adapted to the problems of homology (Ruse, 1986, pp. 53-54).

Something quite different is going on in the case of the insects and the scientists. The former must adapt or perish. Their adaptation is makeshift and unpredictable—that is to say, 'blind' in any teleological sense due to random genetic variation. The scientists, however, can mould or direct their theories towards a specified projected end. Science originated as a systematized method the aim of which was a true reflection of objective reality.

Heuristically insightful though the organic change/scientific change analogy may be, because of the difference in variations it collapses at the level of justification. Scientific evolution is not Darwinian. There is no warrant for concluding that the status of science is the status of organisms. We do not have to accept as proven fact that scientific theories exist only in so far as they have beaten out all others...Contrary to all of this Darwinism, the picture which is starting to emerge, and for which a number of plausible arguments have now been adduced, is that science is progressive. It moves towards an understanding of reality. 'Unfashionable as it may be to say so, we really do have a better grasp of biology today than any generation before us, and if further progress is to be made it will have to start from where we now stand' (Maynard Smith, 1982, p. 42). This means, therefore, that inasmuch as a scientific theory is 'adapted' to the problems before it, this must be understood in terms of right and wrong, rather than simply in terms of the relative notion of doing better than any other (Ruse, 1986, pp. 57-58).

It may be possible to remedy the disanalogy between scientific and organic variation. It has been suggested that one could show that the new elements of science do not really constitute a counter-example to Darwinism. This is what D.T. Campbell attempted to do by arguing that by the time an idea develops in the scientific community, it is already directed (or quasi-directed). It is the process by which the idea was produced which required randomness and selection. As we saw in the second chapter, Campbell maintains that, although most discoveries are not random today, the guiding principles themselves developed through random variation.

If one is expanding knowledge beyond what one knows, one has no choice but to explore without the benefit of wisdom (gropingly, blindly, stupidly, haphazardly) (Campbell, 1974b. p. 142).

I have referred to this earlier as 'Campbell's tautology' i.e. we do not know p because we lack knowledge of p. And in our attempts to know p, we must do so blindly. I disagree with this approach because the ideas in science are not developed haphazardly. That is, they were attained gradually through countless revisions based on prior information. This process is cumulative and gradual and must necessarily be influenced by prior and more vague concepts.

Another way in which one may try to remedy the disanalogy between scientific and organic variation, is to show that organic variations simulate directed variations. This is the approach of Karl Popper. As we saw in Chapter Two, Popper believed science is deductive and, unlike pseudo-sciences e.g. religion, astrology, etc., is open to check against the empirical world. Real science is falsifiable:

Falsifiability is a deductive form of reasoning. A general statement can be disproved by a particular negative instance, even though no number of positive instances will ever inductively confirm it.²⁶

To Popper, science is Darwinian insofar as it throws up wild hypotheses about the world (bold conjectures) and then tries to refute them or knock them down in light of empirical evidence. This process is never-ending and has only fleeting, transient success. I disagree with Popper for the simple reason that although there is no absolute proof, science at least seems to be cumulative, and comparatively progressive. And it is notions such as hybridization, non-extinction, simplicity, consilience, etc., which indicates that science is directed and not blind.

²⁶ From Ruse, 1986, p. 61. But also see Popper's *Objective Knowledge: An Evolutionary Approach* (Oxford: Oxford University Press), 1972, p. 261.

Think for a moment of what made scientific change different from organic change. More than anything, we came up against the facts of variation. Scientific variants are directed. Organic variants are not. But what does this difference mean? It means that Nicholas Copernicus or Charles Darwin or James Watson had a goal in mind--understanding nature--and that this governed and regulated the science they produced. In other words, the *scientist* had an active role in the course of science (Ruse, 1986, p. 66).

We have seen a number of striking dissimilarities between organic and scientific evolution which places the EET program in question. I shall now discuss why the EEM program is the appropriate program for evolutionary epistemology by examining how neo-Darwinism accounts for the development of cognitive mechanisms responsible for the transcendence of culture over biology.

III

BIOLOGY AND THE EMERGENCE OF CULTURE

Once we acknowledge that mankind is as much a part of the process of evolution as the amoeba, worker bee, wombat, or salmon, we will understand that *homo sapiens* have no special status in the animal kingdom. A neo-Darwinian epistemologist must abandon the Cartesian notion that the distinctive element which separates humans from other animals is our rational faculty which enables us to see the truth about the world. Neo-Darwinism obliterates this concept of humankind.

According to neo-Darwinism, we share a common heritage and striking similarities with higher apes and this is amply demonstrated by fossil records, experimental evidence, homology, embryology, bio-geology, etc. as well as the astounding genetic/chromosomal overlap which also shows a common origin. The main constraint responsible for the evolution of *homo sapiens* is natural selection which led to bipedalism and larger brain size. As brain size increased, tool development increased, tooth size decreased, diet changed (to more protein-based), etc. Gradually, it became more

advantageous (survival-wise) to establish groups with central depots and a cooperative division of labour. About 30,000 years ago, Neanderthal man was replaced by modern man. We see evidence of more complex tools, art, ornaments, etc. In other words, we see the emergence of culture.

...the critic will probably note that the arrival of culture is clearly bound up with the development of recognizably human language. Also, no doubt, as we entered this new realm, the conscious self-awareness that is the unique possession of our species came into full being--at least, consciousness was probably either cause or consequence of such entry (Ruse, 1986, p.123).

The development of language, culture, and the notion of consciousness, may seem to present problems to the Darwinian:

...in understanding humans today, biology is quite unimportant...when it comes to understanding science or morality, not to mention religion or music or anything else which makes humans truly human, natural selection and the genes tell us nothing...humans--as rational cultural beings--are autonomous. Thus, in the assessment of truth--whether it be in the scientific realm or in the moral realm or wherever--we can and must work, as cultural beings, by the standards of reason and evidence. Biological advantage has nothing to tell us about '2+2=4', Mendel's laws or the Greatest Happiness Principle (Ruse, 1986, p. 124).

On first sight, this may appear to be a powerful argument against natural selection. However, one need simply reflect for a moment on the brief period of time in which modern man developed culture and science (30,000 years) compared to the vast amount of time it took to produce such a being in the first place (several billion years). We must never lose sight of the fact that IF neo-Darwinism is, as I believe, an accurate account of the mechanisms and conditions responsible for the development and survival of various species--of which man is but a part--THEN it follows that these same processes are responsible for his epistemic development as well. Cognitive mechanisms capable of producing science and culture do not come into being *ex nihilo*. They develop through a gradual process of trial, error, and confirmation. Undoubtedly, the two most important developments in

man's cultural evolution were language and consciousness. The development of language was likely connected to the development in brain size.

The evidence from brain growth and tool use and the like is that more complex and sophisticated language abilities were probably part of a package deal, as our ancestors increased the general power of their intellectual capacities. The increase was gradual, not saltationary...culture was contingent on the development of modern speech (Ruse, 1986, p. 139).

There is general consensus in this belief. And more and more reverse engineering is being done by neurologists and human biologists to support this model of brain development. Ornstein and Thompson state that:

The brain evolved faster than any other organ in history: it took hundreds of millions of years to create the 400cc brain of *Australopithecus* four million years ago in Africa, yet in only a few million more years the brain had grown to 1250 to 1500 cc, and had developed the capacity for abstract thought...it is not just the size of the brain that matters. What is especially important is *where* the brain is large. Our cerebral cortex, the upper-most part of the brain, is much larger and more intricate than in any other animal. It is the most distinctive part of being human. It enables us to carry ourselves beyond our inheritance, and to create our own environment--again and again (Ornstein and Thompson, 1984, pp. 39-40).

After the development of the cerebral cortex, language need not have been singularly responsible for the development of culture. I believe that Wilson's and Lumsden's 'epigenetic rules' provide interesting insights into the development of culture. An epigenetic rule is:

...a constraint which obtains on some facet of human development, having its origin in evolutionary needs, and channelling the way in which the growing or grown human thinks and acts (Ruse, 1986, p. 143).

Elsewhere, Wilson characterizes an epigenetic rule as:

Any regularity during epigenesis that channels the development of an anatomical, physiological, cognitive, or behavioral trait in a particular direction. Epigenetic rules are ultimately genetic in basis, in the sense that their particular nature depends on the DNA development blueprint...In cognitive development, the epigenetic rules are expressed in any one of the many processes of perception and cognition to influence

the form of learning and the transmission of (units of culture) (Lumsden/Wilson, 1981, p. 320).

There are primary rules at the receiving end i.e. as raw information coming into to the human organism e.g. the classification of colours into blue, green, yellow and red. This colour processing is evident in the languages of all cultures and reveals how human organisms process this type of input according to specific channelling constraints (Ruse, 1986, p. 144). And there are secondary rules which process the information in ways which are adaptatively advantageous to the biological being such as human incest barriers between siblings--there are good evolutionary reasons why inbreeding is bad e.g. progeny from close unions tend to be horrendously physically handicapped (Ruse, 1986, p. 146). There is an ever-growing list of such epigenetic rules which show that human culture is informed and structured according to biological factors. And I shall argue that a cognizance of a lack of information (relative to a particular perspective) is particularly responsible for the goal-directedness of both common sense and eventually, scientific inquiry. Epigenetic rules, then, are mediating factors between the non-progressiveness of biological evolution and the apparent progressiveness of science. Among the most important are the secondary epigenetic rules of induction and deduction.

In reference to the latter, it has been noted that the scientist is constrained and guided by inference of a formal kind where conclusions follow necessarily from premisses e.g. laws of excluded middle ($p \vee \neg p$) and non-contradiction ($\neg(p \ \& \ \neg p)$). Logic constrains and guides the scientists' work by setting up boundary conditions within which the scientists must work. A scientist cannot afford to be illogical lest his claims become contradictory.

Anything which seems to be leading to contradiction has to be side-tracked and eliminated in some way. If the evidence is that a species went extinct, then you

cannot permit it to be still living. If an area of the globe is not volcanic, then you cannot have volcanoes in that spot (Ruse, 1986, p. 157).

As equally important and vital to the scientist is mathematics.

Arithmetic, algebra, geometry, calculus, and much more--are all absolutely crucial to science, particularly the well-articulated, sophisticated parts of modern science...One is tempted, indeed, to say that progress is a direct function of mathematization. Certainly, the two go hand in hand. We see this very clearly in the development of evolutionary theory itself...population genetics--the very heart of the modern evolutionary enterprise--relies very heavily on algebra, calculus, statistics, and other tools of the mathematician's kit-bag. There can be no doubt that, without such a form of reasoning, little could be done in science (Ruse, 1986, pp. 157-158).

There are also inductive arguments from analogy, generalizing particular instances into laws, simplicity, elegance, and consilience as means by which to draw conclusions about the physical world.

Scientists aim to gather their ideas beneath one or two sweeping, all-powerful hypotheses. When they can do this, they feel happy. And when they can do this between widely disparate areas, perhaps even using the new theory to push into new and surprising areas--making predictions which might have been thought false, but which prove to be true--they feel satisfied that they have captured some important facet of reality. Even though that of which they talk may be unseen, scientists think they are describing an objective world in the way that it really is. In short, they have made progress (Ruse, 1986, p. 159).

Ruse believes there is a biological explanation for the ways in which science has developed and progressed. Much of what we know has come about through natural selection and the epigenetic rules. He states that it is reasonable to presume that Darwinian advantage reaches through science like bones through a vertebrate.

...there is already some evidence that apes transmit extragenetic or cultural information. Jane Goodall observed baby chimps in the wild emulating the behavior of their mothers and learning the reasonably complex task of finding an appropriate twig and using it to prod into a termite's nest so as to acquire some of these tasty delicacies (Sagan, 1977, p. 125).

But there is an easy way to consider how important such rules and constraints were to early hominids. Epigenetic rules demand the directives which one expects to find valuable in the ongoing struggle for survival and reproduction:

Consider two would-be human ancestors, one with elementary logical and mathematical skills, and the other without very much in that direction. One can think of countless situations, many of which must have happened in real life, where the former proto-human would have been at great selective advantage over the other. A tiger is seen entering a cave that you and your family usually use for sleeping. No one has seen the tiger emerge. Should you seek alternative accommodation for this night at least? How else does one achieve a happy end to this story, other than by an application of those laws of logic that we try to uncover for our students in elementary logic classes? (Ruse, 1986, p. 162).

The same is true for rudimentary mathematics i.e. if two tigers go into the cave and only one comes out, the hominid who can reason that it is not safe to enter has a greater chance for survival than his arithmetically inept cousin.

The proto-human who had an innate disposition to take seriously the law of excluded middle, and who avoided contradictions, survived and reproduced better than he/she who did not. The proto-human who innately preferred ' $2 + 2 = 4$ ' to ' $2 + 2 = 5$ ' was at a selective advantage over his/her less discriminating cousin (Ruse, 1986, p. 162).

This also holds true when considering the inductive side of reasoning. Quine has stated the importance regarding induction in matters of survival:

...why does our innate subjective spacing of qualities accord so well with the functionally relevant groupings in nature as to make our inductions tend to come out right? Why should our subjective spacing of qualities have a special purchase on nature and a lien on the future? There is some encouragement in Darwin. If people's innate spacing of qualities is a gene-linked trait, then the spacing that has made for the most successful inductions will have tended to predominate through natural selection. Creatures inveterately wrong in their inductions have a pathetic but praiseworthy tendency to die before reproducing their kind (Quine, 1969, p. 126).

As a final point in stating the plausibility of the role of epigenetic rules in attaining and revising beliefs, Ruse mentions the biological value of the notion of consilience.

One hominid arrives at the water-hole, finding tiger-like footprints at the edge, blood-stains on the ground, growls and snarls and shrieks in the nearby undergrowth, and no other animals in sight. She reasons: 'Tigers! Beware!' And she flees. The second hominid arrives at the water, notices all of the signs, but concludes that since all of the evidence is circumstantial nothing can be proven. 'Tigers are just a theory, not a fact'. He settles down for a good long drink. Which of these two hominids was your ancestor? (Ruse, 1986, p. 163)

Aside from these hypothetical scenarios, there is ample empirical evidence which supports the status of the epigenetic rules. For example, regardless of particular societies, there is a parallel or overlap of use in logic and mathematics. For all the variations between eastern and western cultures, there are underlying patterns similar in logic, mathematics, and inductive reasoning. As well, if we look at early childhood development, we can see how concepts of relations are learned in highly stylized ways i.e. with certain things being learned before other things. The learning of numbers, relations, etc., is also quite similar throughout different cultures. And there are animal studies which further supports the epigenetic rule theory. There is considerable evidence that higher primates have rudimentary notions of logic and mathematics and use these frequently in problem solving situations.

There may be those who claim that logic is a purely formal system but we must consider that the roots of logic and mathematics are grounded in biology because they were adaptatively advantageous. Before a reflective comprehension of the relationship between mathematics and any sort of objective reality could be formulated, utility (i.e. survival) and reproduction were the motivating factors. However, it is not unreasonable to see how science can and does develop above and beyond biological necessity. We see this constantly. But the point to note is that, originally, the rudimentary forms of logic, mathematics, inductive reasoning, consilience, etc., were developed according to their survival value viz. natural selection.

Natural selection simply does not care about giving us a meticulously true and

comprehensive insight into the nature of things. There is much that we find out, as in a philosophical enquiry which now engages us, despite selection...selection cares only about keeping us alive and our passing on of our genes (Ruse, 1986, p. 172).

A neo-Darwinian does not argue for any ultimate deductive validity to our formal reasoning. The epigenetic rules exist purely because they have proven their worth in the struggle to survive. This appears, on first sight, to be question-begging. And it is a case where Gould might simply slap a "just-so" label on this explanation or one might think that this reasoning is viciously circular i.e. that we have survived because (in part) epigenetic rules have proven their worth and since we are here, now surviving, they must have worked. But science is full of such circular reasoning (as is much philosophy). The ancients were quick to point out forms of reasoning which were circular (as well as infinitely regressive). But the point to note, here, is that there are "vicious" circles and there are "virtuous" circles. Gerhard Vollmer does an excellent job of distinguishing the two.²⁷ Vollmer states that circles are virtuous when they are consistent, fruitful, productive, and constitutive for rational enterprises. I believe the use of epigenetic rules to explain how hominids emerged from blind to goal-directed variation and developed culture through biological means is just such a "virtuous" circle. There is no deeper meaning beyond this. Causes, says Ruse, are not things, or metaphysical hooks but are projected into the world by us through our epigenetic rules. The human who believes in real connections has the biological edge over the human who sees only contingency.

And so we can see an historical connection between neo-Darwinian epistemology and the works of Hume. That is, the notions of cause and effect sets up a feeling of necessity e.g. Fire--Ouch!

²⁷ See Vollmer's "On Supposed Circularities in an Empirically Oriented Epistemology" in Radnitzky and Bartley's *Evolutionary Epistemology, Theory of Rationality, and the Sociology of Knowledge*, 1987, pp. 163-200.

Fire--Ouch!, etc. The mind has a *propensity* to see necessity in continuous successions which are given by nature itself. The mind (unconscious to itself) reads this necessity into nature thinking that it has found an objective fact of nature. 'If I warn you of fire, I am doing more than reporting on my own psychology. My aim is to persuade you that fires are objectively dangerous' (Ruse, 1986, p. 184). Hume's propensities correspond precisely to Wilson's epigenetic rules:

For Hume and Wilson, the mind thinks about nature in a causal fashion, believing that it is finding powers rather than creating them...for Hume and modern thinkers, the reason for such propensities seem the same, namely their value to us as functioning beings. Hume explicitly relates the utility of animal reason with 'their own presentation and the propagation of their species' (Ruse, 1986, p. 184).

Ruse considers Darwinian epistemology to be a natural growth from British empiricism.

So what have these last three sections on the virtues of the EEM program of evolutionary epistemology, the distinction between blind and goal-directed variation, and the manner in which culture and science developed according to biological mechanisms, told us about the concept of ignorance?

First of all, if we maintain a neo-Darwinian position, we can see how natural selection and various epigenetic rules would have led to the development of our cognitive abilities. We noted that language and consciousness would have played a significant role in this development. And we noticed further, that bipedalism, larger brain size, diet change, etc., all would have contributed to the emergence of (sophisticated) languages and consciousness.²⁸ And so, we have identified several

²⁸ The currently accepted understanding of hominid development goes something like this: Bipedalism preceded brain size increase; with an increased brain size, diet change was necessary to fuel such a large organ. So a change from a herbivorous to an omnivorous diet was required (meat protein provided the necessary energy). As Pinker states, 'neural tissue is metabolically greedy; our brains take up only two percent of our body weight but consume twenty percent of our energy and nutrients' (Pinker, 1997, p. 154).

important necessary conditions leading to the development of cognitive mechanisms in *homo sapiens*. We have also noted that nature would have selected those who best used these cognitive abilities. In other words, those who abided best to the epigenetic rules would have stood a greater chance of surviving and reproducing. The learning process would have been gradual at first. However with an increase in the sophistication of language, the acquisition, revision, and transmission of ideas would have developed quite rapidly.

Secondly, I believe that an important contribution to the ever-expanding list of epigenetic rules is the cognizance of a lack of information relative to one's particular perspective. It follows that if a significant aspect distinguishing cultural from biological evolution is the transition from blind to goal-directed variation, then we should consider what further rule(s) might be involved in such a transition. We have seen earlier that I disagree both with Popper's and Campbell's account of blindly throwing up wild hypotheses about the world and attempting to falsify them. I do not believe our cognitive mechanisms evolved by such a process. We do have some notion of progress, even if it is merely comparative and utilitarian. We simply know more about biology, chemistry, physics, etc., than we did 200 years ago. We have goals in mind and we can direct our efforts and plan strategies in the attempt to attain these goals. But we would not possess the desire to attain goals if we did not possess the ability to realize a lack of information relative to a particular perspective. In this respect, we are 'ignorant' but we are not 'blindly' ignorant in a Popperian sense. We are 'reflectively ignorant'. That is, we know that there is something for which a particular perspective cannot currently account. And so we speculate, hypothesize, theorize, etc., about how to account for this gap in a particular perspective. For example, Darwin had some idea, due no doubt, to his biological precursors (Erasmus Darwin, Lamarck, etc.) that there might be a biological mechanism

which could explain why various organisms exist as they do. His goal was to discover this mechanism. He knew that relative to the current biological perspectives, there was a lack of explanation; and so he did not venture into the biological world blindly but with a reflective ignorance. His theory of natural selection filled in one of the most profound gaps in human history. We are curious beings, to be sure. And what fuels this curiosity is a reflection on what it is that we do not know relative to what we currently know--regardless of what comprises our system of beliefs. We can confirm hypotheses relative to a belief system--say, a particular branch of science--and witness a comparative progression of ideas. An awareness of a lack of information would have been extremely important in focusing one's goals and objectives and narrowing the possible outcomes.

The notion of goal-directed variation presupposes a cognizance of a 'lack' of information relative to a particular perspective. This 'reflective ignorance' or awareness of a gap in one's beliefs prompts the motivation for curiosity and the incentive to fill in this gap. I thereby consider reflective ignorance--or cognizance of a lack of information--to be an epigenetic rule. Following this rule would have increased the likelihood for survival and reproduction. I believe this epigenetic rule would have been among the first developed because a cognizance of a lack of information or technique would have been felt more acutely and would be known prior to the development of a systematized set of beliefs. The 'lack' of information or technique would have been manifested in a want or desire or need. This need or lack would directly affect an early hominid's survival and would generate the drive for knowledge. In the effort to fulfil needs, a cognizance of a lack of information or technique would gradually inspire goal-direction. Prior to any conscious awareness of a body of beliefs--from which one uses analogical, deductive, inductive reasoning, etc.--there is the acute experience of a lack or a need. Understanding needs in terms of past trials, errors and

confirmations, and recognizing a comparative 'lack' relative to one's current belief system, would have been the first step in developing goal-direction.

Having secured an understanding of the concept of ignorance from a neo-Darwinian defence of the EEM program, an analysis of the distinctions and causes for the evolution of blind to goal-directed variation, and the emergence of culture from biological mechanisms, I shall now consider the final two (related) main issues of evolutionary epistemology: realism and skepticism.

IV

NEO-DARWINIAN EPISTEMOLOGY AND REALISM

We now must address the philosophical problem concerning what type of realism a neo-Darwinian subscribes to and why. This will provide some insight into the explanatory boundary conditions of evolutionary epistemology. And this will, in turn, demarcate what is known (or knowable) from what is not thereby expanding our understanding of the neo-Darwinian concept of ignorance.

To begin, we need to consider some distinctions between 'common sense realism' and 'naturalism'. I shall argue that the ontic form of realism that a neo-Darwinian maintains is derived from a common sense perception of the world. This is the basic level at which organisms perceive and respond to the world. Upon deeper reflection, however, the neo-Darwinian subscribes to what Vollmer and Bradie have called 'hypothetical realism'. This is a form of critical (ontic) realism which presupposes the existence of an external world independent of consciousness which is, in some ways, describable and hence, knowable. All knowledge, however, is hypothetical--that is, fallible, conjectural, tentative, and uncertain. At the theoretic level, a neo-Darwinian is a coherentist. He considers the information gathered about the world to be 'virtuously circular'. Without any means

to check the correspondence of our beliefs to some foundational criteria in order to determine their absolute objectivity, we have little choice in the matter but to try to get our beliefs to 'hang together'. But though coherence is circular, it is not viciously so. A coherent system of beliefs is virtuous if it expands and broadens explanation and provides reinforcement to the system. It is important to notice that the reason why a neo-Darwinian proposes a hypothetical/coherentist realism derived from common sense, is due, in part, because of an explicit recognition of an inability to secure knowledge defined according to a direct/correspondence form of realism. This distinguishes common sense from metaphysical realism. In order to get to the latter, one would need to establish objective criteria of the former. But we cannot do this. And for good reason. Our cognizance of a lack of cognitive ability is directly related to the neo-Darwinian's understanding of man as animal, influenced by the mechanisms of evolution. The cognizance of a lack of cognitive ability is a conscious acknowledgement of reflective ignorance. Since we do not know of any foundational criteria which could guarantee absolute knowledge, we must settle for what we have. And what we have is describable by a contingently developed language, which is the result of millions of years of evolution.

Whenever I use the term 'naturalism', it should be understood that I mean a hybrid both of the Humean definition that we cannot help but believe in something due to various propensities because 'Nature is too strong' and that our explanations in support of such beliefs are due to certain psychological predilections; **and** that the language of science offers the most unique model(s) (i.e., vocabulary) for discovering what there is. In a recent paper, Alan Rosenberg considers various types of naturalism which have developed since the early 1950's (see Quine [1951] and Nagel [1956]). He has noted a gradual influence of evolutionary biology over the last several decades:

A [reason] for the fascination which Darwin exercises in philosophy reflects advances in evolutionary biology which have dramatically increased its claim to explain aspects of human affairs. Of all the well-confirmed theories in modern science, it is the one with most direct relevance for the human condition, human behaviour, and its cognitive causes. If any well-established scientific theory can teach us about ourselves it is Darwin's. Other theories, which might teach us more, which might even limit the writ of Darwinian theory for understanding human affairs, are either so far not well confirmed, or even well formed. If naturalism is to replace a priori first philosophy with scientific theory, then at least for the present the theory in question will be Darwin's (Rosenberg, 1996, p. 4).

With the relatively recent influence of evolutionary theory in philosophy of science, Rosenberg characterizes naturalism in philosophy by stipulating three principles and one theorem (derived from one or more of these first principles):

1. The repudiation of 'first philosophy'. Epistemology is not to be treated as a propaedeutic to the acquisition of further knowledge.
2. Scientism. The sciences--from physics to psychology and even occasionally sociology, their methods and their findings--are to be the guide to epistemology and metaphysics. But the more well-established the finding and method the greater the reliance philosophy may place upon it. And physics embodies the most well-established methods and findings.
3. Darwinism. To a large extent Darwinian theory is to be both the model of scientific theorizing and the guide to philosophical theory because it maximally combines relevance to human affairs and well-foundedness.
4. Progressivity. Arguments from the history or sociology of science to the non-rationality, or non-cumulativity, or non-progressive character of science, are all either unsound and/or invalid (Rosenberg, 1996, p. 4).

The relationship between my use of common sense realism and naturalism is, to echo Quine, that science is really a more rigorous form of common sense. That is not to suggest that naturalism always follows common sense realism. It just so happens that my version of naturalized epistemology takes very seriously a common sense understanding of one's environment--an understanding *commonly* shared throughout much of the animal kingdom.

Among naturalists in the philosophy of science today, we see a division of at least three distinct schools: realists (such as Richard Boyd, Ronald Giere, etc.), anti-realists (such as Larry Laudan), and empirical agnostics (such as Bas van Fraassen). That some form of realism is presupposed by evolutionary epistemology is unquestionable. For it is commonly believed that the scientific descriptions of evolutionary theory naturally assume that there is an external world which exists separately from our own consciousness which has particular qualities describable in terms of concepts, theories and scientific law. The notions of unbroken empirical regularity, the repetition of inductive inferences, the efficacy of deduction, the success of prediction, etc., indicates that there is an external world about which one can in some way describe, understand, and communicate. Again, IF we consider *homo sapiens* to have evolved similarly to other species, THEN we presuppose that there is a commonly sensed world. Although each species will interact with its environment differently, we can say that there is a common-ness to the world--a world where fire burns, water drowns (air-breathing animals), a sufficient loss of blood or oxygen kills, etc. Nature is composed of various qualities and characteristics and cares not a whit how any of its species adapt or perish. If a lamb loses too much blood from the jaws of a wolf, it dies (and likely gets eaten). If a young child jumps out of an apartment balcony believing to be Superman, he will fall to the ground risking serious injury or death. Regardless of how science may carve up the qualities and characteristics of the world, many different species understand and respond to them at very basic, common sense levels. Neo-Darwinian epistemology, then, proposes a fairly robust common-sense realism:

Why is my world also your world? Why do we not get a fragmentation of realities?
For the Darwinian, the required universality follows on the unity of humankind.
Those humans who believed that $2+2=5$, or that fire causes orgasms rather than pain,

or ignored the virtues of consiliences, got wiped out in the struggle for existence. (Ruse, 1986, p. 189).

It seems that all organisms are adapted to the same objective world as we. It makes more sense to argue for a shared world with different (non-relativistic) ways of responding than for completely different existences for different organisms (Ruse, 1986, p. 190).

...the whole of life does not collapse into a morass of shifting, transient paradox. Consiliences do work. We do, historically, get a sense of real progress, as we push towards an understanding in terms of laws, predictions, testability, and, above all, the unification at the heart of great science. Here, at least nature does not let us down. Thus in this sense we get (and are justified in believing in) what I am characterizing as common-sense realism. Ultimately, it works (Ruse, 1986, p. 190).

We sense material objects e.g. lemons are football shaped, yellow, with a distinctive tartness. They are not like chocolate. Although we now know the lemon is composed of cells, the causal reason we sense them as we do is due to our own evolved natures i.e. it is important to acknowledge a lemon as a non-poisonous form of food (this is the level of the primary epigenetic rules).

The underlying particles are removed from immediate sensation, and given to us in consiliences. Because of this, and because of their causal role, such entities do not strike us as being so dependent upon the peculiarities of our nature. Indeed, they appear to us as part of a deeper, more profound side to reality. And so they are--DNA really is the key to the code of life (and, in another context going to the macroscopic, continents really did move). Science, as we know it, aided in its work by our skill with mathematics and the like, successfully progresses towards an ever stronger grasp of this reality. Nevertheless, this grasp is still one in which the enquiring mind plays its crucial part, as we use the secondary epigenetic rules to dig into and construct our experiences. Unfortunately for philosophy (but fortunately for real life), this work of the mind is normally concealed from us, for the success of the epigenetic rules lies in our taking them at face value. We think that mathematics talks of some world of eternal truths and that molecules exist quite independently of the observer (Ruse, 1986, p. 191).

I agree with Quine that 'science is self-conscious common sense'. At the level of common sense, the Darwinian epistemologist is no more a skeptic or a relativist than Hume. 'Like everyone else he/she

believes in a shared real world, towards a knowledge of which science progresses' (Ruse, 1986. p. 192).

However, like Hume, the Darwinian epistemologist cannot make the claim to know any ultimate stable reality. For if language is contingent and developed according to selective pressures, then how could we determine what criteria would provide us with metaphysically objective knowledge? We know what we know because of millions of years of gradual evolution; through processes which slowly churned out beings which developed languages sophisticated enough to comprehend how they came to be. Is there any necessary objective claim being made with a neo-Darwinian account of epistemology? Of course not. For it is as likely to be revised as past theories, models, etc. But any sophistication in philosophy or science originated from common sense perception. We may not observe any real necessary causal connections between events. However, we act *as though* there were such necessity. This was Hume's point. That is, we have propensities to act as though there is such causal necessity. And it is a good point. For if we did not act in such a way, we would, in all likelihood, be dead. The same holds true for our ancestors. Those who understood the world *as though* there were such connections between common sense qualities, characteristics, etc., adapted, survived and reproduced.

Adapting in the case of *homo sapiens* means understanding. Understanding in the early evolutionary stages of our ancestors would have been crude and markedly different from today. However, it would have involved a common sense understanding of the environment. This means that reasoning skills such as induction, analogy, deduction, etc., when properly undertaken and developed through countless trials, errors and confirmations, would have had high survival value. And so, a neo-Darwinian recognizes that understanding the world in this common sense fashion

would have led to a better chance of survival which in turn, would lead to the further development of ideas, which would eventually develop into scientific reasoning. To a neo-Darwinian, science is common sense writ large.

So at one level, the neo-Darwinian proposes realism in a common sense manner. This is the level of interpretation which, for millions of generations, resulted in the production of a single species capable of further reflection and inquisition. This reflection and inquiry led to the development of direct realism. That is, the belief that scientific methodology will eventually describe the world in an absolutely objective way. In this sense, the world is composed of a fixed set of 'facts' waiting for us to discover the appropriate means by which to uncover them. This form of realism presupposes a correspondence theory of truth i.e. that our concepts, models, theories, beliefs, etc., correspond to the way in which the world 'really' is. However, a problem with this form of realism emerges. The problem involves whether one can ever establish a foundational criterion (or set of criteria) by which to judge all knowledge claims. We simply have no way of knowing to what degree the world is as our concepts describe it. We must understand that any description of the world--scientific or otherwise--is a human process. And humans are as much a part of the evolutionary processes as any other organism. We impose human concepts onto the world. And we should always remember that evolution does not care about how we describe the world--just that we adapt, survive, and pass on our genes. As Ruse points out, if you see a chair and I see a chair, then there is nothing either of us can say about the 'real' existence of the chair other than what we get through our sense organs and the filtering effect of our epigenetic rules.

I may see the chair in finer and finer detail. Based on the evidence of the senses, I may spin theories incorporating ever more powerful consiliences, leading me to suppose that the chair is composed of sub-sensory particles like electrons.

Additionally, I may have no reason to doubt my senses or my consciences, because everything else meshes smoothly with my chair-awareness state. Other beings walk around the chair, rather than through it. But, at the bottom line, there is no perceiving of ultimate reality. What you see is what you get...common sense reality is all we have. This is quite enough (Ruse, 1986, pp. 198-199).

Alvin Plantinga has recently come out against evolutionary theory and naturalistic epistemology by stating that our reasoning powers may have nothing at all to do with survival, reproduction, or belief (see Plantinga, 1991, 1993). There is no reason why our cognitive abilities should tell us the truth about the world—they just tell us what we need to believe to survive and reproduce, which information could as easily be quite false (Ruse, 1998). In other words, many of the beliefs of our ancestors may have been false but simply brought about the appropriate behaviour which allowed them to survive:

The principal function or purpose, then, of our cognitive faculties is not that of producing true or verisimilitudinous beliefs, but instead that of contributing to survival by getting the body parts in the right place. What evolution underwrites is only (at most) that our *behavior* be reasonably adaptive to the circumstances in which our ancestors found themselves; hence (so far forth) it does not guarantee mostly true or verisimilitudinous beliefs. Of course, our beliefs *might* be mostly true or verisimilitudinous; but there is no particular reason to think they *would* be: natural selection is interested not in truth, but in appropriate behavior (Plantinga, 1993, p. 218).

Plantinga maintains that if an evolutionary account of our cognitive faculties is true, then such faculties are the result of blind mechanisms like natural selection, genetic variation, mutation, etc. And so evolution is interested only in survival or fitness, NOT true belief. So since everything we believe about evolution could be false (a *reductio* of naturalism) we need something to guarantee real truth. And this, to Plantinga, can be found in theism:

Naturalistic epistemology conjoined with naturalistic metaphysics leads *via* evolution to skepticism or to violation of canons of rationality; enjoined with theism it does not. The naturalistic epistemologist should therefore prefer theism to metaphysical

naturalism (Plantinga, 1993, p. 237).

Basically, we can divide Plantinga's argument into two distinct parts: First,

...if the neo-Darwinian account is true, then it is unlikely or at least not demonstrably likely that our cognitive faculties are reliable generators of true beliefs. Hence, if naturalism-plus-naturalized epistemology (hereafter NNE) is correct, then we could not be in a position to know that it is, and so could not know that our sensory faculties and inferential processes yield knowledge. In that case, NNE is an unstable position: it gives way to skepticism (Fales, 1996, p. 433).

And second,

On the other hand...theism plus naturalized epistemology is a stable position that can resist skepticism. For if God created us, either directly or indirectly through directed evolutionary means, then we have a guarantee that our cognitive faculties, when normal and properly used, are reliable (Fales, 1996, p. 433).

Evan Fales points out that Plantinga's argument hinges on three crucial claims: that naturalism is committed to a neo-Darwinian theory of our origins; that neo-Darwinian evolutionary processes would, for all we know, most likely yield cognitive processes which are unreliable in the relevant epistemic sense; and that theistic creation, in contrast, would yield reliable cognitive mechanisms (Fales, 1996, p. 433).

I believe we need to attack Plantinga's argument at the epistemological rather than the theological level. If, as any neo-Darwinian maintains, reasoning is adaptive, then you do not think that two plus two is four and not five just by chance. The recognition that we can be deceived, that our senses can mislead us, distinguishes between the world as we can in some sense discover (common sense reality), and the world in some absolute sense (metaphysical reality): the tree in the forest which we know is there even though it is dark and rainy and we have had a few beers and are seeing double, and the tree in the forest when no one is around (Ruse, 1998). Once this distinction is made, Plantinga's refutation of naturalism no longer seems as threatening. There is no doubt that

we are sometimes deceived (sometimes systematically so). But evolution can provide very good reasons for this deception.

Why, for example, do we believe in the objective necessity of causal connection, even though as Hume showed there really is nothing there? Simply because those proto-humans who associated fire with burning survived and reproduced, and those who thought it was all a matter of philosophy did not (Ruse, 1998).

But the key issue here is that we know that such and similar cases *are* cases of misconception and that they come from selection because we have reliable touch-stones against which to measure them—that falling trees hurt, for instance; that drinking arsenic kills; that other people's genitalia (factoring in sex and orientation) are a sexual turn-on; that grass really is green on a bright sunny day (Ruse, 1998). But these are not cases of misconception. Fales points out a purely biological explanation accounting for why reliable belief-forming processes are selected.

...having these capacities, as we clearly do, is an expensive proposition, biologically speaking. That gives the neoDarwinian a *prima facie* reason for assigning a low probability to the development of such mechanisms unless they confer a decided selective advantage. The selective advantage of intelligence, when linked in an appropriate way to action, can hardly be denied...Plantinga will agree that *Homo sapiens* has, more than any other species, specialized in intelligence as a survival strategy. We have few other biological advantages; most of our eggs are in that basket. Our heavy investment in big brains and otherwise mediocre bodies makes it all the more unlikely that resources would be wasted on elaborate belief-forming and processing mechanisms that have no practical utility (Fales, 1996, p. 440).

You can fool some of the people some of the time...but we cannot be fooled constantly or we would never have survived and reproduced.

I realize that there is much more to the debate of realism than the traditional truth theories of correspondence, coherence, and pragmatism. And I am aware that such traditional theories make truth a property which is open for scientific study in some deep way and that deflationary theories

of truth such as minimalism deny the need for any such further specification.²⁹ Horwich (1990), for example, maintains that what one calls truth (the semantic issue) is quite separate from whether or not you should be a realist. That is, the decision to be a realist (or not) may have nothing to do with how you think language relates to the world. He states that:

One of the few uncontroversial facts about truth is that the proposition that snow is white is true if and only if snow is white, the proposition that lying is wrong is true if and only if lying is wrong, and so on. Traditional theories acknowledge this fact but regard it as insufficient and, as we have seen, inflate it with some further principle of the form, 'X is true if and only if X has property P' (such as corresponding to reality, verifiability, or being suitable as a basis for action), which is supposed to specify what truth is. Some radical alternatives to the traditional theories result from denying the need for any such further specification (Ramsey, 1927; Strawson, 1950; Quine, 1990). For example, one might suppose that the basic theory of truth contains nothing more than equivalences of the form, 'The proposition *that* p is true if and only if p'(Horwich, 1993, p. 511).

Although I find the deflationary account of truth such as minimalism intriguing and perhaps complementary to evolutionary epistemology, I am not convinced that such a theory has as yet sufficiently accounted for the central facts about truth such as the verification of a proposition as the goal of science, the usefulness of having true beliefs guide action, etc.³⁰ And so for the purpose of

²⁹ See, for example, Frank P. Ramsey, 'Facts and Propositions', *Proceedings of the Aristotelian Society*, Supplementary Volume 7 (1927), 153-70; Alfred Tarski, 'The Concept of Truth in Formalized Languages', in J.H. Woodger (tr.), *Logic, Semantics, Metamathematics* (Oxford: Clarendon, 1956); A.J. Ayer, *Language, Truth and Logic* (London: Gollanz, 1936); W.V.O. Quine, *Philosophy of Logic* (Englewood Cliffs: Prentice Hall, 1970); Dorothy Grover, Joseph Camp, and Nuel Belnap, 'A Prosentential Theory of Truth', *Philosophical Studies* 27 (1975), 73-125; Stephen Leeds, 'Theories of Reference and Truth', *Erkenntnis* 13 (1978), 111-29; Scott Soames, 'What is a Theory of Truth?', *Journal of Philosophy* 81 (1984), 411-29; Michael Williams, 'Do We (Epistemologists) Need a Theory of Truth?', *Philosophical Topics* 14 (1986), 223-42. Only some of these authors advocate deflationism or minimalism but they all offer alternatives to the traditional theories of truth.

³⁰ To consider several good critiques of deflationism, see Anil Gupta (1993a, 1993b).

my account, I shall acknowledge but set aside discussions involving minimalism and focus on the relationship between traditional theories of truth and realism.

To return to our discussion, we must always keep in mind that concepts, models and theories are human-created. That does not mean that they do not describe in comparatively better ways how we understand the external world. It does mean, however, that they cannot be supposed to have absolute objective foundation. We simply cannot determine to what extent our concepts 'correspond' to the external world. We lack the necessary means--the foundational criteria--by which to do so. In this respect, we are indeed ignorant. Neo-Darwinian epistemology makes this painfully clear. A neo-Darwinian, then, must settle for a coherence theory of truth, having recognized the inability to establish such foundational criteria.

That is to say, he/she rejects the idea that his/her thought corresponds to true reality, where 'reality' in this context is some sort of absolute entity, like the thing-in-itself. Obviously, working within the common-sense level, the Darwinian is just as much of a correspondence thinker as anyone else. But at the final level, defending common-sense reality, as we have had to accept, the Darwinian subscribes to a coherence theory of truth, believing that the best you can do is to get everything to hang together (Ruse, 1986, p. 202).

Within such coherence terms, the Darwinian is untroubled by the critics' objections. Thinking in ways different from what we commonly experience in nature is unimaginable. Natural selection provides a solid basis for epistemology. Within our frame of reference, this, says Ruse, is the best we can do--and fortunately, it is enough. He cites Quine's passage: 'I see philosophy and science as in the same boat--a boat which, to revert to [Otto] Neurath's figure as I so often do, we can rebuild only at sea while staying afloat in it. There is no external vantage point, no first philosophy' (Quine, 1969, pp. 126-127). So there is no special status to humans or human thought processes. We are what we are because of three and a half billion years of evolution and random mutation. There was

no inevitability about our current intellectual status. 'People who think otherwise read into evolution all of those seductive but mistaken ideas about progress, and about the intrinsically special nature of the human species...Evolution is going nowhere--and rather slowly at that' (Ruse, 1986, p. 203).

And so, one need not get in touch with metaphysical reality to check that everything is working okay because the common sense level works extremely well.

The properties of trees in forests when no one is around--not even God--seems to make sense, but they do not. Berkeley knew that. One simply has to pull back from a correspondence theory of truth and go with coherence at this point. The picture makes sense, and with Neurath we build our boat as we sail in it (Ruse, 1998).

But for Plantinga, coherence is circular and viciously so. But as we noted earlier, the naturalized circle may be considered virtuous because as the success of science shows, you get an ever-bigger and better picture as you (the human race) get ever-more experiences and put them into the picture; you get a reinforcing (or virtuous) circularity (Ruse, 1998).

When one argues that the world seems to operate at the level of a correspondence theory of truth but upon reflection, we must, according to Hume, admit that our beliefs, concepts, theories, etc., achieve greater or lesser coherence, one is arguing for an internal (coherent) realism. Underlying these assertions is the implication that we assume there is a real world towards which our ideas gradually progress and mirror. Yet we are never quite certain that our theories accurately describe the world. In this regard, we are indeed ignorant. This realization leads to the position of *hypothetical realism*. It is well defined by Vollmer in the following way:

Evolutionary epistemology is inseparably connected with hypothetical realism. This is a modest form of critical realism. Its main tenets are: All knowledge is hypothetical, i.e., conjectural, fallible, preliminary. There exists a real world, independent of our consciousness; it is structured, coherent, and quasi-continuous; it is at least partially knowable and explainable by perception, experience, and intersubjective science. According to this position all knowledge is hypothetical, i.e.,

uncertain (Vollmer, 1987).

This is perhaps the most epistemically safe form of realism. For it does not require conviction that one's theories correspond to any supposed 'facts' of the real world. But even further, it does not require conviction that there are any such facts to begin with. It simply acknowledges that there is a real world which is describable and, hence, knowable according to our currently developed, naturally evolving conceptual systems, and that we do not possess the means by which to check such concepts to such a world to determine any degree of certainty. This, of course, is simply another way of reiterating the ancient 'problem of the criterion' i.e. that we cannot know when or whether we have sufficiently established and satisfied the appropriate criteria for (metaphysical) knowledge.

Although we may think there is a real objective world (like Kant) this belief, like the belief in causation, is something we impose on our experiences. Ruse proposes that there is an epigenetic rule responsible for our belief in a real world--toward a fuller knowledge of which science is supposedly progressing. One supposes, says Ruse, that this rule is closely allied with the rule that tells us coincidences are not mere coincidences, but reflect the true nature of reality.

However, since such a rule (or rules) is that which makes us believe in reality, we must concede with the Humean that our belief has no objective foundation. The aim of science is based on a fiction of human psychology, rather than on the true nature of an objectively existing universe (Ruse, 1986, p. 185).

The distinction between common sense and metaphysical reality has led the neo-Darwinian to abandon a direct/correspondence form of realism and adopt a hypothetical/coherentist form. This distinction was the result of a reflective ignorance--a realization of an inability to speak about knowledge in any absolute sense. In this respect, we might say that the neo-Darwinian is skeptical concerning the acquisition of such knowledge. But the neo-Darwinian's skepticism has limits, and

rightly so.

V

NEO-DARWINISM AND THE PROBLEM OF SKEPTICISM

As I mentioned in the introduction to this chapter, any responsible epistemologist must, at some point, address the problem of skepticism in order to consider the scope, breadth, and explanatory power of his epistemology. In this section, there are two distinct forms of skepticism which I shall consider in light of neo-Darwinian epistemology. The first type is the pure or Cartesian form in which logical possibilities and paradoxes result from the problem of deception i.e. we may not know what we claim to know because situations other than currently sensed may obtain i.e. our senses may not be reliable guarantors of truth. As I mentioned at the beginning of this dissertation, it was this form of skepticism, represented in Peter Unger's work *Ignorance*, which originally spawned my interest in the concept of ignorance. In this section, I shall discuss what I consider to be the standard or classic Cartesian form of skepticism in light of neo-Darwinian epistemology. But then I shall take a much more serious look at Unger's position which is really a linguistic modification of Cartesian skepticism. I shall present a number of arguments from the neo-Darwinian perspective which gives us reason to reject both forms of skepticism outright.

The second type of skepticism is an applied or Pyrrhonian form which dramatically parallels many of the views of neo-Darwinian epistemology. Both views acknowledge a distinction between common sense and metaphysical reality and in acknowledging that knowledge of the latter is not possible, both devise practical methods for acquiring and revising beliefs relative to natural conditions i.e. common sense. In this way, both epistemologies recognize that a reflective ignorance

concerning the limitations of concepts, reveals explanatory parameters relative to a particular perspective. By making a distinction between these two types of pure and applied skepticism, I hope to accomplish two things. First, since skepticism is generally a position which attempts to reveal how little we know, any philosophical examination should, in some ways, contribute to our understanding of the concept of ignorance. And secondly, the parallel between Pyrrhonism and neo-Darwinism will clarify the explanatory parameters relative to hypothetical realism and add an original historical contribution to our analysis of the concept of ignorance.

(i) Cartesian Skepticism

Let us begin by considering the neo-Darwinian's response to the pure or Cartesian form of skepticism. The structure of this form of skepticism is quite familiar: We gain knowledge of the external world through sense experience; because we can be deceived through our senses into believing that specific states of affairs obtain, our senses may not be reliable means for attaining knowledge of the external world; since we cannot determine with certainty i.e. indubitability, that we are not now being deceived, it is possible that the states of affairs we believe obtain, do not obtain; therefore, we can never say we know that a specific state of affairs obtains. This form of skepticism seems to be a powerful argument against any supposed knowledge claims. For it is true that if we cannot know that we are not now being deceived, we really cannot say we know. But we must ask ourselves why the notion of 'certainty' is so important to epistemology? The level of epistemic scrutiny which is placed on satisfying the criteria of certainty is so high, is it conceivable to ever satisfy it and make claims to knowledge? If we recall Campbell's point in Chapter Two, we can see that an evolutionary epistemologist maintains that language is contingent--that is, it has a practical, useful function i.e. it allowed its users to survive and reproduce. Stringent epistemic

criteria such as certainty and the possibility of epistemic deception are theoretically interesting but have no practical significance in the struggle for survival.

What should one say to the critic who would have us doubt everything, even chairs and tables as they are to us in everyday life? Probably, not much needs to be said. It is certainly true that the Darwinian sees the knowing subject actively involved in our common-sense understanding of reality. Epigenetic rules enter into our awareness of ordinary objects. But the pretence that nothing exists strikes me as self-refuting...the basic starting point is that there is a common-sense existence, and that 'truth' and 'knowledge' purport (in a correspondence fashion) to be about it. To be honest, I do not quite know what it would mean to say that 'nothing exists' or 'at the common sense level, nothing exists, or has the nature that we think it has'. At this level, appearance and reality do surely merge, because this is the level of appearance (Ruse, 1986, p.186).

As for the skeptical worries about the possibility of deception, the neo-Darwinian can live and run his life in an ordinary common-sense way, distinguishing 'true' from 'false', 'reality' from 'illusion', and asserting the existence of an external world:

Through coherence, consistency and the like, we can distinguish fictions like Macbeth's dagger from the real thing, like the daggers which killed Caesar. The epigenetic rules, no less than the Humean propensities, justify our ordinary ways of doing things. That is the whole point. *The ordinary way is the way of propensities or rules* (Ruse, 1986, p. 187).

By identifying the propensities or rules of the natural world, the last thing one needs to do is to make the common sense world dissolve into paradox. Hume explicitly committed himself to common-sense realism: 'As to what may be said, that the operations of nature are independent of our thought and reasoning, I allow it...' (Hume, 1978, p. 168). Ruse confesses that the notion that there is not something solidly real to this world sounds somewhat ludicrous to a person whose basic thesis is that we all got here in an ongoing clash between rival organisms. Are we really supposed to doubt the continuous existence of tigers and wolves, antelopes and lambs? (Ruse, 1986, p. 187).

Specifically, there are a number of arguments one can address towards this type of Cartesian

skepticism.

1. First of all, even if skepticism somehow obtains, this does not decisively criticize Darwinian epistemology. Darwinism is not in the business of satisfying foundationally certain criteria of the Cartesian-foundationalist sort:

We are animals, using our evolutionary acquired powers to delve into questions for which such powers were certainly not intended. For the Darwinian, there is no hot line to total truth. If it turns out that the belief in progress is illusory, this will be philosophically disquieting. It will not be a *reductio* of Darwinism (Ruse, 1986, p. 188).

2. Secondly, the philosophical failure to avoid skepticism is quite irrelevant when it comes to the questions which truly count--getting on with survival and reproduction (or even doing science) (Ruse, 1986, p. 188). And the epigenetic rules (like Humean propensities), allow us to do these quite well.

The burnt child fears the fire and avoids it the next time. The caveman looking for his club turns confidently to the corner where he left it, knowing that things do not pop in and out of existence. And his mate carries away the children when there are tiger signs about. Relatedly, the human mind is such that, even if abstract philosophy leads to scepticism, unreasoned optimism keeps us afloat. As human beings, we all believe in the reality of causality and of the external world and of the worth of consiliences, whatever philosophy might prove. And that is what counts (Ruse, 1986, p. 188).

Ruse cites the often quoted Humean passage of dining, conversing and playing backgammon as natural activities which dispel the skeptical chimeras.³¹ To a neo-Darwinian, it would seem that on one level, certain types of philosophy simply do not matter e.g. a new Nobel-prize winner will not be bothered if consiliences do not guarantee absolute truth.

3. It is important to distinguish what is logically possible from what is rational to believe. P. F.

³¹ See Hume, 1978, p. 269.

Strawson mentioned back in the early fifties that it does not matter whether or not induction is justified since it is its proper use which marks it as a sound justification.³² And this is the neo-Darwinian's point at the common-sense level:

The proper use of consiliences defines what we mean by 'truth' and 'rationality'—and the only justification given or needed is that they do not let us down. In real life, the logical possibilities of the philosopher (or the writer of outlandish detective fiction) simply do not occur (Ruse, 1986, p. 189).

We see here, the emergence of a distinction between epistemic justification at the metaphysical or ultimate level and justification at the common sense level. At the common-sense level, we can claim the reality of chairs, trees, electrons, genes, etc. But at the ultimate level, there is a justificatory void.

We believe what our propensities direct us to believe, because it is they which provide us with our criteria of truth and reason. If you doubt these, there is no secure base on which to fall back. Objects pop in and out of existence, which is hardly the mark of the truly real (Ruse, 1986, p. 192).

The metaphysical skeptic 'pounces' at the point where humans simply cannot look or enter. If there is no one in the forest to confirm the existence of the tree's falling or making a sound, you cannot make any confirmation. But, says Ruse, by definition, you have had no experience or confirmation of that what your beliefs carry you across. If answering the skeptic requires some absolute foundation like Kant's *ding an sich*, a Christian God, certainty, etc., then the neo-Darwinian can have no more use for these than with the super-sensible reality of the Platonist (the supposed home of the truths of mathematics). For we cannot know, in human terms, what these things actually are or could be. Ruse asks if metaphysical skepticism is something which can be avoided only by drawing on such intangible notions, can it really be quite the devastating critique it appears to be? The flaw with

³² See P.F. Strawson's *Introduction to Logical Theory* London: Methuen, 1952.

the Cartesian skeptic's approach is that he raises the ante until no answers are possible and then demands an answer.

Suppose it be pointed out, for instance, that many microentities previously hidden (like chromosomes) are now visible. Suppose it then be argued that this is surely analogical reason for taking seriously the existence even of electrons. At once the sceptic lowers the barriers, claiming that he/she is referring to that part of putative existence which lies beyond our reach—including a reach augmented by television and microscopes. Clearly, the sceptic is trying to wrench from the naturalist (like the Darwinian) an answer to a problem to which, by definition, no answer can be given. Since, under these conditions, it is difficult to see what response would satisfy, the suspicion is that there is no genuine assault on the Darwinian (Ruse, 1986, p. 195).

By way of Carnap (but without pushing Darwinism into the Logical Positivists' camp) Ruse states that metaphysical skepticism is not scientifically meaningful. He believes that we have projected our common-sense reality into a commitment to metaphysical reality—that is what our epigenetic rules make us do. Because of our biology, we think that the reality which we have helped to create has to be a person-independent reality. We should not be surprised when this latter reality collapses into paradox and non-being' (Ruse, 1986, p. 196). Hume stated the only solution that a naturalist like a Darwinian really cares about:

Once we leave the classroom or the study, we have a total inability to remain worried by any kind of scepticism. We have an innate tendency to believe in the continued and continuous reality of objects, and this is backed up by our experience (Ruse, 1986, p. 196).

Things do not simply pop in and out of existence. They exist insofar as they are perceived, and when they are perceived, they do, indeed, exist.

If you persist in finding metaphysical scepticism upsetting—hankering after a thing-in-itself or some such thing—all I can do is remind you that natural selection is not in the business of satisfying philosophers. Natural selection has seen to it that we flesh out experience, assuming that objects continue to be, all of the time, and in all dimensions. That is enough for its purposes. If Socrates is not satisfied, he will simply have to go away puzzled (Ruse, 1986, p. 196).

To further the Cartesian skeptic's position of deception, Plantinga states that given neo-Darwinism, the reliability of human cognitive faculties is improbable. He cites Stephen Stich (1990) who, [borrowing from Kahneman, Slovic and Tversky (1982)], states that specific fallacious forms of reasoning are firmly entrenched within human cognition.³³ Plantinga raises a classic Cartesian problem of deception by suggesting that one might think he is dining at Oxford with Richard Dawkins and A.J. Ayer discussing various aspects of evolution and theology "when in fact he is slogging his way through some primeval swamp, desperately fighting off hungry crocodiles (Plantinga, 1993, p. 224). But this is not how evolution's deceptions works.

If we thought what Plantinga suggests, we would be dead--inside a crocodile--and evolution as we understand it would be false. Apparent adaptation would not serve the end of survival and reproduction. The point rather is that the deceptions of natural selection, no less than the non-deceptions, work for good reasons. If there are no good reasons to suspect deception, then it should not be assumed (Ruse, 1998).

But now Plantinga ups the ante, so to speak, and asks how we know that we are not being deceived all of the time. He presents his case by asking us to consider ourselves working in a factory where all widgets coming down the assembly line appear red. Later we find out that the cause of our seeing red widgets was due to red filters. We may respond to Plantinga's Cartesian skepticism by stating that:

...it may be the case that we will never know the whole story and may be mistaken about any detail, but we cannot be mistaken about all of the details, all of the time. The factory example breaks down because at some point--like Socrates's story of the prisoner in the cave--someone gets out to find that the redness is filter-caused. Unfortunately, unlike the factory worker and unlike Socrates's prisoner, we can never check that everything is true-seeming-but-not-really. We can never get beyond the

³³ Aside from Kahneman, Slovic and Tversky's *Judgement Under Uncertainty* (1982), one can also refer to Gilovich's *How We Know What Isn't So* (1991), and Piatelli-Palmarini's *Inevitable Illusions* (1994).

world of common sense to the world of metaphysical reality to check the one against the other (Ruse, 1998).

At this point, we must seriously consider how it is that the Cartesian skeptic can pose the logically possible scenario involving deceptions in the first place. We must admit that although deception and misconception occurs in our common sense world, it happens only against the background of experience characterized by continued regularity. The main reason why Cartesian skeptics can propose scenarios of deception is because we have been deceived in the past on a smaller scale and have come to recognize this deception. And then, by way of analogy, the scenario is expanded to account for all our perceptions; the reasoning being that since we can be deceived on one level i.e. the common sense level, perhaps we are being deceived at the metaphysical level. But in order to even begin to make sense of such large scale deception, there must be an underlying structure of communication relating to concepts commonly held and used by individuals.³⁴ Otherwise, how can the Cartesian skeptic even get started?

In the next section, I wish to examine one of the most current and thorough treatments of Cartesian skepticism. Although much of the same neo-Darwinian criticism applies, Unger's linguistic twist on the problem of skepticism provides fertile ground by which to yield an understanding of what the concept of ignorance is, and especially, what it is not.

(ii) Linguistic Skepticism

The most common form of skepticism involves a Cartesian demon (or some similar formulation) which demonstrates how beliefs can be generated in a radically non-standard way. In this case, one's subjective experiences would be indistinguishable from those produced in a normal, common-

³⁴ This is really a paraphrase of Wittgenstein's private language argument.

sensical fashion. We have seen how Plantinga attempted to use such an argument to undermine naturalism. That we might actually be trudging through a swamp fighting off crocodiles rather than being somewhere else is certainly a logical possibility. But do we really need to know that such a scenario does not obtain in order to claim that our beliefs are likely produced by natural factors experienced and understood according to common sense and science? Some philosophers, such as Peter Unger, believe this to be the case. In this section, we will examine Unger's work *Ignorance: A Case For Scepticism*. The purpose is not to show that skepticism as Unger defines it is a real threat to an evolutionary account of epistemology. Instead, it will stand as a good example of how skeptical scenarios and logical paradoxes can result from a sophisticated language if our epistemic levels of scrutiny are too high to satisfy e.g. attaining certainty, internal justification, correspondence, etc. As we shall see, the downfall of Unger's skepticism is that he raises doubt about our everyday common sense beliefs but the process he uses relies on the very things he doubts: induction, analogy, common sense, and the successful communication of ideas. We shall see that Unger's treatment of the concept of ignorance is not only internally inconsistent, but that his unmitigated skepticism leads him to eventually consider a naturalistic explanation as the possible solution to our apparent widespread ignorance.

In his book, *Ignorance: A Case For Scepticism*, Peter Unger defines skepticism as the position that we do not know anything about the external world:

[skepticism] is the thesis that nobody ever knows anything *about* any concrete entity 'outside his or her own mind'; nobody knows anything *about* any 'external' physical events or mental ones, *about* any such things, processes, properties, and so on. In short, [it is] the thesis that nobody ever knows anything *about* 'the external world' (Unger, 1975, p.10).

In articulating this thesis we find that Unger's position is relatively simple and can be stated in four

points.

1. Unger maintains that skepticism³⁵ has not been philosophically refuted because it is right. This is the same as saying that no one knows anything or is even capable of forming reasonable or justifiable beliefs i.e. we are all ignorant of the external world.

...of all the reasons why scepticism might be impossible to refute, one stands out as the simplest; scepticism isn't wrong, it's right. The reason that sceptical arguments are so compelling, always able to rise again to demand our thought, would then be also a simple one: These arguments, unlike the attempts to refute them, served the truth (Unger, 1975, p. 2).

2. The reason why we are ignorant (and skepticism is right), is due to our inability to attain absolute psychological certainty:

Thinking one matter over after the next, and comparing it with *how* certain someone *might* be of his *own present existence*, the reasonable thing to conclude seems this: in the case of each human being, there is at most hardly anything of which he really is *certain* (Unger, 1975, p. 68).

3. The reason for this inability to attain psychological certainty lies in an imperfect language (English) which contains impossibly-fulfilling epistemic criteria in the form of absolute terms like 'certain' or 'certainty'. Unger maintains that we can never be (psychologically) certain because there are always possibilities which could (logically) undermine such a mental state e.g. the *malin genie* or evil scientist scenario.

...if you know [for example] that there are rocks, then you *can know* that there is no such scientist [deceiving you]. But no one *can ever know* that this exotic situation does *not obtain*; no one *can ever know* that there is no evil scientist who is, by means of electrodes, deceiving him into falsely believing there to be rocks...as a consequence of these two premisses, we have our sceptical conclusion: you never

³⁵ I should like to point out at this time that the word skepticism is sometimes spelled with a 'c' e.g. scepticism. Although I prefer to spell the word with a 'k', there will be times when quoting people like Unger and Stroud, where I will be faithful to their particular choices.

know that there are rocks...From this, we may conclude, finally, that nobody ever *knows* anything about the external world (Unger, 1975, p. 8).

4. The reason we have such an imperfect language is due to the development of imperfect concepts by our ancestors:

In order to gain credence for the idea that a quite sweeping sceptical thesis is correct, then, I will look for a basis for that idea in our language, that is, in contemporary English (Unger, 1975, p.47)...If the meanings of our key terms are impossibly demanding so that the terms don't really apply, the question arises of how things ever developed to this point. How did we come to be in such a conceptual mess, to be, as it were, trapped in it? As it has to other philosophers, there occurred to me the idea of a theory of things embodied in our language, inherited from an ancestor language, or languages. Vague as this idea may be, it seems to provide a framework for explaining why the conceptual mess began and why it has persisted. The theory in our language represents the thinking, conscious or not, of people a very long time ago (Unger, 1975, p. 5).

Unger's position is presented in four simple steps:

- 1) Skepticism is right (because)
- 2) We cannot attain psychological certainty (because)
- 3) Our language contains impossibly-fulfilling epistemic criteria (because)
- 4) Our ancestors used imprecise concepts in the development of language.

Ignorance becomes apparent when we make supposed knowledge claims and realize that specific criteria i.e. psychological certainty have not been satisfied. Although *psychological certainty* is Unger's sole criterion for the justification of knowledge, we must never lose sight of the bigger picture. According to the synopsis, above, psychological certainty is only symptomatic of the initial reason for ignorance: the ancestral origin of imperfect concepts. It is only one element in the chain. The criterion of psychological certainty, for Unger, is a signpost which has pointed him in the direction of the initial source of our ignorance: ancestral language.

But why does Unger find the criterion of psychological certainty to be so essential to the acquisition of knowledge? The answer lies in his argument for universal ignorance i.e. that everybody is always *ignorant of everything*...that ignorance is necessary, or inevitable, as well as universal, or complete or total (Unger, 1975, p. 94). This argument, by Unger's own testament, is exceedingly simple and straightforward:

(1) If someone *knows* something to be so, then it is all right for the person to be absolutely *certain* that it is so.

Unger provides the examples that if Mary knows there was a general called Napoleon then it is perfectly all right for her to be absolutely certain that there was; and if Rene really knows that he exists, it is perfectly all right for him to be absolutely certain that he does exist.

(2) It is never all right for anyone to be absolutely *certain* that anything is so.

No matter what Mary's and Rene's situations, it is never all right for them to be absolutely certain of these things. These two premisses entail Unger's conclusion that:

(3) Nobody ever *knows* anything is so.

And so, Unger claims that Mary does not really *know* that there was a general called 'Napoleon' and Rene does not really *know* that he exists. Unger's attachment to the notion of psychological certainty comes from, as he says, his inclination to agree with this "traditional view" of knowledge. I am not entirely clear as to what tradition Unger is referring. He does mention G.E. Moore as a compatriot in this matter. But Unger fails to defend why this "traditional view" is more appropriate than, say, a reliabilist account or an account that stressed justified true belief.

It is worth noting that Moore is the only philosopher whom Unger cites as agreeing with him about the definition of knowledge, a fact that raises questions about his labelling it the "traditional" view of knowledge. Most epistemologists would disagree with Unger's claim that his definition is traditional, holding rather that the traditional

view (at least in modern philosophy) makes no reference to certainty at all, but defines knowledge as "justified true belief"...we should realize that Unger, in his reference to certainty, is offering us an unusual definition of knowledge and one not widely accepted among epistemologists (Johnson, 1979, p. 388).

Oliver Johnson makes the very good point that, on Unger's account, there are many other equally plausible states of mind other than certainty which one could use to argue for skepticism.

...Unger's "Argument from the Necessity of..." could be built around such states as "adamant" (about), "convinced" (of), "dedicated" (to), "unquestioning" (about), "committed" (to), etc., all of which seem to be absolute terms in Unger's sense. If I am right, a large number of arguments parallel to Unger's Argument from the Necessity of Certainty could be produced in support of scepticism (Johnson, 1979, p. 390).

At this point, we must ask what guarantee is certainty as a sufficient condition for knowledge? As Unger stated above, it would never be "all right" for us to claim that either had knowledge. And the reason for this is that certainty implies dogmatism. And dogmatism, on apparently all levels, is, to Unger, a bad thing. And there seems to be two reasons for this. The first involves the idea of deception. This is where Unger borrows the traditional skeptical arguments from Descartes in explaining that since we can never know that we are not dreaming or are deceived by some malevolent being or, to phrase it with a modern twist, hooked up by electrodes to a computer by an evil scientist, it is never "all right" for us to be absolutely certain of anything. Since Unger believes knowledge implies certainty, and certainty is always dogmatic, it seems that knowledge is definitely out of our reach. And secondly, Unger argues that our current language contains absolute terms which precludes the attainment of psychological certainty. Unger's position now takes on the following form:

- 1) It is initially the imperfect concepts (developed in ancestry) which has led to...
- 2) The use of absolute terms as impossibly-fulfilling epistemic criteria;

- 3) The term 'certainty' (among others) is an absolute term;
- 4) To claim to be certain is to be dogmatic;
- 5) We cannot be dogmatic or claim to be certain because we may be deceived in our beliefs.

(a) Absolute Terms

In discussing the notion of 'absolute terms', Unger often vacillates between stating that we are absolutely ignorant and nearly absolutely ignorant. Unger begins his discussion by stating that:

English is a language with absolute terms. Among these terms, 'flat' and 'certain' are *basic* ones. Due to these terms' characteristic features, and because the world is not so simple as it might be, we do not speak truly, at least as a rule, when we say of a real object, 'That has a top which is flat', or when we say of a real person, 'He is certain that it is raining' (Unger, 1975, p. 49).

Unger maintains that terms like 'flat' are absolute because to say that something is flat is no different from saying that it is absolutely or perfectly flat. A flat surface is not a matter of degree. A flat surface cannot be in any way bumpy or curved. Bumpiness and curvature are matters of degree and are 'relative' terms.

Semantically, we may say that our absolute terms indicate, or purport to denote, an absolute *limit*. This limit is approached to the extent that the relevant relative property or properties are absent in the thing to which one might sensibly apply the absolute term, or its correlative relatives. Thus 'flat' purports to denote a limit, flatness, which more or less curved and bumpy things approach to the extent that they are not bumpy, and are not curved, and so on. Accordingly, the absolute terms to which I refer might best be called 'absolute *limit* terms', but I will not use the word 'limit' much explicitly (Unger, 1975, p. 55).

These key limit terms, according to Unger are all adjectives (as are their relative counterparts) which, at best, can only descriptively approximate how close or near something is to being, for example, flat. To Unger, the concept 'certain' is an absolute term i.e. we can approach a state of certainty but can never be totally certain. One of the reasons for this is due to the fact that "the presence of

certainty amounts to the complete absence of doubt" (Unger, 1975, p. 63).

Thus, 'He is certain that p' means, within the bounds of nuance, '*In his mind*, it is not at all doubtful that p', or '*In his mind*, there is no doubt at all but that p'. Where a man is certain of something, then, concerning that thing, all doubt is absent in that man's mind. With these definitions available, we may now say this: Connected negative definitions of certainty suggest that, in its central, literal meaning, 'certain' is an absolute term (Unger, 1975, p. 64).

To illustrate this point, Unger provides the example that hardly anyone (if anyone at all), is certain that forty-five and fifty-six are one hundred and one. Unger believes it is quite reasonable to suppose that hardly anyone could be so certain of such a calculation that it is impossible for there to be any of which he might yet be more certain: "for, hardly anyone *feels* certain, or feels himself to be certain, that those two numbers have that sum" (Unger, 1975 p. 68). I take it, Unger uses this arithmetical example as one which requires immediate confirmation. For with any amount of time, one can easily add together these numbers and corroborate one's findings. If, after determining that the sum of 45 and 56 is 101, how much more can one do? If your calculation is 101 and thousands of others determine 101 to be the correct sum, what could possibly convince us otherwise? Barry Stroud makes the good point that, for example, if I am certain that I have read Unger's book,

I do not think that if I were to explain away more and more bits of putative counter-evidence put up to show that I did not, I should then be described as being more certain that I read it than I am now. On Unger's account of 'certain' as an absolute term, if I would be more certain after successful rebuttal of counterevidence then I am not (absolutely) certain right now. But my present attitude is one of certainty that I read the book and certainty that all such counterevidence is spurious; so demonstrating its spuriousness should not be expected to render me more certain than I am now. I am already certain (Stroud, 1977, p. 252).

As well, "how are we to assess whether we are more certain of anything than we are, say that trees exist? Is it a matter of how much we would stake on it?" (Lamarque, 1976, p. 370). There are cases where, as Stroud points out, there may be no need for further evidence. And so it is not so much as

whether or not one is open for the possibility of new evidence but anticipating what should count as evidence which might possibly shake our current state of certainty.

As well, there are two further problems which I see here. First, in general usage, it seems that, according to Unger's use of the terms, 'flat' is often used as a relative term. When I observe construction workers paving a section of road, they and I have a relatively good conception of what it means for that road to be 'flat'. For it is usually the case that they are paving a particular road section because it was considered rather bumpy or pitted with pot-holes, etc. In this case, the construction workers, myself, and numerous drivers could come to an agreement that, relative to earlier conditions and other roads, the road is now flat. And this can apply in numerous other cases e.g. rolling one's lawn, levelling a surface, etc. In these and many other cases, flatness does admit to degree and is relative to particular situations:

A great variety of things can be flat, from football pitches to pieces of glass. We would not expect the criteria to be the same. A football pitch can be (absolutely) flat under quite different conditions from a piece of glass, and this even on Unger's negative definition. For what counts as a bump is surely different in the two cases. We could truly say of a football pitch that it has no bumps at all even though what relatively negligible surface roughness it has would count as bumpy when exhibited in a piece of glass (Lamarque, 1976, p. 370).

Flatness, like certainty, seems to have a relative use depending on the stringency required for the issue or point at hand.

Secondly, if Unger is going to be insistent on his 'flatness' analogy with certainty, then he is surreptitiously jumping from a conceptual ideal to a natural phenomenon. For flatness is empirical and, when considered at the micro-level, the components of objects i.e. molecules, atoms, etc., are minute bits of three dimensional matter. And so, according to this model of molecular/atomic theory, nothing can ever be absolutely flat. But certainty is a conceptual construction denoting a particular

state of mind. And, as Stroud points out, if I have read Unger's book, I am certain of it. What could convince me that I am mistaken in this belief (and therefore uncertain that such an event occurred) could involve the intervention of a deceiving being who has led me to believe that there is such a book written by Unger. But since I have spoken to Peter Unger about his own book, I tend to doubt that such a state of affair obtains. Nonetheless, since the argument for deception is a rather important feature to Unger's skeptical project, we should devote some time in considering it.

(b) The Argument From Deception

As we saw in the last section, Unger maintains that it is never all right for one to be certain because this is a dogmatic position. And we are told by Unger that dogmatism is a bad thing. It follows, then, that if we can rarely be certain of anything at all, then this takes care of our dogmatism problem. For there seems to be some entailment between the two. That is, if I were certain, for example, that a scientist is not controlling my thoughts, then I would be dogmatic in holding this belief to be true. However, since I cannot be certain that such an exotic scenario does not obtain, I cannot be dogmatic. I may be confident that it does not obtain, but never certain. And certainty cannot be attained because of doubt. By utilizing the For-All-You-Know (or FAYK) hypothesis, Unger maintains that, for all we know, an evil scientist may be deceiving us into believing that there exist in the external world such things as rocks. And we have no way of knowing whether such things as rocks exist or not. We can doubt that the proposition: 'Rocks exist in the external world' is true because such exotic possibilities (as evil scientists) cannot entirely be disputed:

One cannot help but think that for all [anyone] really can know, he might have all his experience artificially induced by electrodes, these being operated by a terribly evil scientist who, having an idea of what his 'protege' is saying to himself, chuckles accordingly...One's belief that one has may, for all one really can know, be due to experiences induced by just such a chuckling operator. For all one can know, then,

there may not really be any rocks. Positive assertions to the contrary, even on one's own part, seem quite out of place and even dogmatic (Unger, 1975, p. 25).

According to Unger, we can never know that such an exotic scenario is not taking place. The scenario need not obtain for Unger to be right in his claims. It merely needs to be possible:

...suppose that electrodes are removed, that your experiences are now brought about through your perception of actual surroundings, and you are, so to speak, forced to encounter your deceptive tormentor. Wouldn't you be made to feel quite *foolish*, even *embarrassed*, by your claims to *know*? Indeed, you would seem to be exposed quite clearly as having been, not only wrong, but rather irrational and even dogmatic. And *if* there *aren't* ever any experiences of electrodes and so on, *that* happy fact can't mean that you are any *less* irrational and dogmatic in saying or thinking that you *know*. In thinking that you know, you will be equally and notably irrational and dogmatic. And, for at least *that* reason, in thinking yourself to *know* there is no such scientist, you will be *wrong* in *either* case. So, it appears that one doesn't ever really *know* that there is no such scientist doing this thing (Unger, 1975, p. 25).

Unger claims that the key idea here is that since any of our experiences may be due to an evil scientist, such experiences can never give us any reason for believing that there is no scientist deceiving us into falsely believing that there are rocks. At this point, we get a glimpse of what Unger claims are things we could know. The skeptical thesis concerning other times and events regarding the external world is a position which denies almost all of our commonly assumed knowledge of things:

I call this position *epistemic solipsism of the present moment*. According to this position, as far as *knowing* goes, if one is interested in contingent truths about concrete entities, one is confined to one's present moment existence, experience, and immediate mental states. In addition to that, the position *allows* one's knowing various necessary truths, and also some contingent things about some abstract entities, if such there be, e.g. *the colour red* is now being experienced by me. But as concerns anything which would normally seem to be of *interest*, it will not be known, now or ever, by anyone at all (Unger, 1975, pp. 44-45).

Allowing for the efficacy of classical logic, Unger does list some things which he believes we can know with certainty. Our own existence, our personal pain, the meanings of our words e.g. in

ostensively referring to objects coloured red, that $1+1=2$, etc. But does this not belie his earlier statement that everybody is always ignorant of everything? Unger seems to jump from claiming total ignorance to near total ignorance. At times Unger states that:

I will not argue that nobody knows anything about anything, though this would be quite consistent with the sceptical thesis for which I will argue. The somewhat less radical thesis which I will defend is this one: Every human being knows at most hardly anything to be so (Unger, 1975, p. 48)

Yet he devotes his entire third chapter to arguing for universal ignorance. And so what are we to make of his earlier statements regarding the notion of certainty? On the one hand, he has claimed certainty to be (like concepts like 'flat') an absolute limit term which can be approached but never attained. Yet he is now stating that there are, in fact, things that can be known. And by 'known', here, we must assume that Unger means known with certainty. Otherwise he is equivocating between two uses of the term 'know'. So if there are things we can know with certainty, then we are largely, but not totally ignorant.

Unger gradually proposes the idea that there are methods which could remedy our current ignorance. This goal is attainable by satisfying two conditions:

1. Examine the Ancestral Language Hypothesis (ALH) to see exactly where we went wrong in the development of the English language.
2. Create new terms (neologisms) which avoid our ancestors' past mistakes and which are precise enough to allow us to remedy our current state of ignorance.

The imprecision of the English language is what allows the skeptic to articulate impossibly-fulfilling epistemic criteria which are manifested in exotic logically possible scenarios. But the fault, according to Unger, lies not in ourselves nor in skepticism itself.

The sceptic isn't the culprit, nor the position he advocates. It is the concepts themselves that mean the trouble. If anyone is to be blamed, likely it will be the

originators of such seemingly lenient but actually demanding conceptions (Unger, 1975, p. 247).

According to Unger, the current imprecision of the English language is due to our ancestors. For our current language evolved from early concepts of related languages.

I write these words at a time when the greatest concentration of philosophical intelligence appears concerned with language, more particularly, with natural languages, and most particularly, with contemporary English. In order to gain credence for the idea that a quite sweeping sceptical thesis is correct, then, I will look for a basis for that idea in our language, that is, in contemporary English. This will be one main theme for the rest of this book (Unger, 1975, p. 47).

It is interesting to see how Unger proposes a naturalistic explanation for a conceptual problem:

If the meanings of our key terms are impossibly demanding so that the terms don't really apply, the question arises of how things ever developed to this point. How did we come to be in such a conceptual mess, to be, as it were, trapped in it?...there occurred to me the idea of a theory of things embodied in our language, inherited from an ancestor language, or languages (Unger, 1975, p. 5).

Unger's caveman metaphysics³⁶ describes an anthropological linguistic setting which is conveniently historically vague. He proposes a theoretical time in the development of language in which, I assume, proto-languages were emerging. The originators of such languages were:

...certain persons who were instrumental in creating an important ancestry, or ancestors, of our language, of English. I place no strict limit on how far back these thinkers go, but I should be surprised if they did not operate, and complete (at least most of) their contribution, a very long time before the Greek thinkers who are commonly taken to represent "ancient" philosophy. In trying to make sense of things, and in trying at the same time to satisfy certain other deep needs or drives, they developed a theory which in certain respects badly failed in various places, of necessity, to fit the world...even if it is without our realizing the fact, their incorrect theory is always on the tips of our tongues. When we make statements we often give expression to it. And...what we state, through analytic connection with the theorems of this theory, always will have entailments which are not true and which fail "to fit the world". Thus, what we state is never true and fails to "fit the world" (Unger,

³⁶ A term Peter Unger mentioned to me during a phone conversation in July of 1997.

1975, p. 274).

By speaking about entailments failing to "fit the world", I assume Unger subscribes to a correspondence theory of truth. He further claims that the problems of skepticism not only originated long ago, but that, having recognized this, it is possible that we may compensate for these archaic linguistic problems. That is to say, our current ignorance may, in fact, be remediable.

...I suggest that we actually look into the historical roots of our contemporary language. My hunch is that as we go further and further back, the sorts of analytic connections for which I have had to dig so hard will be more apparent, closer to the surface, so to speak, and similarly with the relevant necessary existence statements (Unger, 1975, pp. 314-315).

Once we establish the roots of our conceptual problems, we will be left with the task of developing a new and better language:

The need for it will depend on whether there is available to us a natural language, present or past, which, while rather rich in the ways we should want, avoids the difficulties we encountered without, of course, having others which are at least rather nearly as bad. If there is at least one such language, and we can find it and show it to be so good, then there is no very creative task left in connection with our present problems. But I suppose it more likely that no rich natural language is all that much better than English in the relevant respects. Accordingly, to solve our problems, either a new language should be developed and made available or at least an existing language should be radically changed in creative ways (Unger, 1975 p. 317).

If the development of such a language were possible, Unger believes that one may some day be able to write about knowledge, reason, truth, etc., without any paradox or contradiction. Depending upon our interpretation of how daunting Unger's description of our state of ignorance is (i.e. either universal or nearly universal), Unger does consider possible means in which our current state of ignorance is remediable. But he fails to consider this beyond a proposed conjecture.

Unger characterizes his ancestor language hypothesis as "anthropological". This seems to be fair; it is the sort of theory that anthropologists might develop as a result of their researches into ancient civilizations. But this is to imply that it is an empirical

hypothesis based on evidence. Yet Unger offers no evidence for it at all in *Ignorance*. Does any evidence that would support it actually exist? If so, why doesn't Unger cite this evidence? If no such evidence exists, the hypothesis must be judged gratuitous. Unger himself seems to be a bit uneasy about the credentials of his hypothesis. On page 274 he describes it as "bold"; later on he implies that it may be too bold, because it may not be true (Johnson, 1979, p. 407).

We are sometimes left wondering how seriously we should take Unger's theory of ignorance. By placing too much emphasis on the imprecision of language as the reason for ignorance, Unger generates scenarios which drastically deviate from the common sense world of experience. Yet Unger proposes a naturalistic proposal which draws entirely on common sense beliefs i.e. that there was a past composed of settings, people, situations, etc., and that we may have the ability, however imprecise our current language is, to enable us to examine the root of this very imprecision. The idea that we can 'go back', so to speak, presupposes a common sense world of things, people, languages, etc., which is drastically different from the world of deception which Unger uses to articulate his/our ignorant state. His very suggestion that we can possibly remedy our current state of ignorance presupposes that there is a world of a specific type i.e. a common sense world (perhaps Unger is beholding to Moore in more ways than he lets on).

(c) A Critique of Peter's Unger's Treatment of the Concept of Ignorance

As we saw with the classic form of Cartesian skepticism, if we raise the level of epistemic scrutiny to the highest degree i.e. certainty, then there is very little--aside from our immediate perceptions--that we can know. Unger's point has been that relative to our common sense beliefs, there are impossibly-fulfilling criteria which demarcates knowledge from ignorance. That of which we are certain is *known*. Of everything that we cannot be certain, we are ignorant. If we are to take seriously Unger's treatment of ignorance as a product of an imprecise language, there are a number of points

on which we should take issue.

1. Unger uses apparently imprecise common sense terms to articulate a position indicating how our current concepts are imprecise. There must therefore be knowledge or understanding at least at some level.

2. By insisting that in order for knowledge to be possible, one needs to satisfy impossibly-fulfilling epistemic criteria such as certainty, and then placing the burden of proof against the possibility of skeptical scenarios on us, Unger unjustifiably appeals to the *argumentum ad ignorantiam*.

3. We need to seriously question why the level of epistemic scrutiny needs to be raised to such a high level? If, by definition, we cannot satisfy criteria at such a high level, then should we not move on (as did the Pyrrhonians) to satisfy criteria at a more reasonable level? A level guided by natural inclinations and common sense beliefs?

4. What is conspicuously absent in Unger's book is any clear indication of *what* one would have knowledge of *if* one were to somehow remedy the ancestral language problem.

5. And finally, Unger fails to consider that language is a product of cultural development and that it evolves and changes according to various biological, social and environmental factors. In short, it developed contingently due to selective pressures, the purpose of which was functional.

1. First of all, Unger fails to explicitly recognize that his skeptical position--which is the result of acknowledging that our current concepts are imprecise--is articulated by the use of current (imprecise) concepts. This, in itself, is not a weakness of Unger since many skeptical arguments of this form use whatever language is necessary to express a logical paradox or skeptical scenario illustrating how a particular knowledge agent is unjustified in his epistemic claims. The newly developed skeptical position then becomes apparently immune from the logical rules, grammar and forms of reasoning which made possible its formulation. This is often expressed in an ancient metaphor whereby one tips over one's ladder after one has climbed up. The ladder, in this metaphor, is a commonly shared language. The place to which one has climbed up is the skeptical position supported by various logically possible scenarios, paradoxes, etc. When viewed from an evolutionary perspective, the development of any sophisticated language would naturally have conceptual

problems. If language is a contingent development which has arisen due to various selective pressures, then there will naturally exist forms of skepticism which we cannot answer. As Philip Kitcher (1992, p. 88) points out, we hope, but cannot demonstrate, that the system of predicates we actually use will lead to success in the actual world. To Kitcher,

Naturalism offers the optimistic picture of a particular type or organism, beginning with rudimentary representations of nature and primitive notions of how to modify those representations, and gradually replacing these with cognitively superior representations and strategies (Kitcher, 1992, p. 90).

Kitcher addresses what seems to be an Ungerian-type criticism concerning language (and cognition) at an early point in our ancestors' cognitive development: (i) The possibility that we began in so primitive a state that we are incapable of working ourselves into any accurate representation of nature...perhaps our initial state was so bad that there is nothing that we could have done to escape our misrepresentations (Kitcher, 1992, pp. 90-91). In answering the skeptic, Kitcher borrows from Quine (1969), and Ruse (1986) and claims that we may find "encouragement in Darwin":

If our initial cognitive equipment were as unfortunate as the skeptic portrays it as being, then, the suggestion runs, our ancestors would have been eliminated by natural selection. They weren't, so it wasn't. In this way, we can appeal to Darwinian evolutionary theory to support the idea that our initial ways of classifying stimuli must correspond to objective regularities in nature, and our modes of reasoning must work reliably in producing accurate representations (Kitcher, 1992, p. 91).

To take Unger's (or any unmitigated form of) skepticism seriously, is to ignore the argumentative efficacy and power of explanation of induction and analogous reasoning. Unger has failed to recognize that skeptical scenarios develop from apparently veridical experiences which are understandable--at least to some degree--in terms of induction and analogy.

What is disquieting about such positions is not so much their self-refutation, as their false promise of discomfort. What casts suspicion on everything casts suspicion on nothing: even the common or garden paranoiac needs his exercise book of carefully

researched facts. Our suspect assurances will be undermined...only by an interpretative attention which is selectively directed, and which accepts the materials that are needed if its direction of attention is to be intelligible...A blank skepticism about the external world does not constitute a compelling skepticism, in the sense that it gives one any reason to worry whether everything we think we know about the external world might not be false. Equally, there can be no reason to suppose that we do not know a very large number of truths based on observation, whether the observation involves scientific apparatus, or is unassisted by apparatus (Williams, 1995, pp. 26-27).

The comparative element between common sense beliefs and skeptical scenarios is an important distinction. If we consider the notion of deception—the element Unger (and most Cartesian skeptics) uses to demonstrate how knowledge gained from reliable methods may not yield knowledge—we can see that in the case of say, dream skepticism, this only makes sense against the background distinction between dream and waking states. This is similar to Ryle's notion of 'polar concept' arguments. Ryle believed the skeptical argument that we might undetectably be in error at any given time is refuted 'by the fact that just as we cannot have counterfeit coins unless there are genuine ones, so we cannot have a concept of error unless we have the concept of being right, and therefore we must sometimes know we are right' (Grayling, 1993, p. 507). As with supernatural (*malin genie*) or scientific (brain-in-the-vat) types of deception, these are only understood relative to apparent veridical experiences by way of analogy i.e. we have been deceived in the past in lesser forms e.g. the stick in the water looks bent, there seems to be water on the highway up ahead, etc. We have been able to account for i.e. explain these types of deception. But since we have been deceived in these relatively minor ways, it is perhaps possible to be deceived on a much more grand scale. And so the skeptical argument for deception relies quite heavily on analogical reasoning.

As well, skeptical arguments would not be possible without an implicit presupposition of the efficacy of induction. For a skeptic needs to rely on the observation of past events and assume that--

in the case of the brain-in-the-vat scenario—the evil scientist is conducting his devilish task according to regular natural laws. And although people like Stich (1990) and Plantinga (1993) have argued that early hominid representations may be quite at odds with natural regularities and that selection could favour organisms who develop inaccurate systems of representation, the pattern for success for survival is overwhelmingly supported by those organisms which, through millions of years of blind trial and error and, eventually, reflective goal-directed variation, have depended upon induction and analogous reasoning. Ungerian-type skepticism attempts to remove man from the natural, commonly experienced world by using commonly-used concepts, and principles of reasoning. Evolutionary epistemology, on the other hand, does not see this separation between man and language. If mankind's evolution was largely contingent, then so was the emergence of sophisticated languages. If man is considered to be just another animal (though a higher form), and we observe other animal behaviours to be similar in certain respects, and behaving similarly to their environments as we do to ours e.g. eating, reproducing, responding to their environment as though external objects were permanent, solid, etc., then we do have considerable reason to maintain that beliefs are produced by a reliable law-governed procedure.³⁷

2. A second problem with Unger's skepticism is that his skeptical hypothesis i.e. deception

³⁷ There are squirrels which constantly try to get into our bird-feeder. We use 'squirrel baffles' in order to discourage them. It seems obvious that these rodents anticipate and somehow 'know' that if they are successful in their efforts, they will be rewarded with various types of seed. It is not unlikely that, aside from the instinctive drive to find sustenance, these clever little rodents use induction i.e. if they were successful once or twice, then they will continue to return to the bird-feeder; and they could use analogy i.e. if they move from our backyard to the neighbour's (which also contains a bird-feeder), there could be some form of analogous reasoning going on based on a basic stimulus-reward system. Nonetheless, these squirrels have adapted well to this new food source. They have acquired information which is adaptatively advantageous through reliable, law-governed processes without having any (internal) access to this truth.

by evil scientist, depends not on the likelihood or possibility that it obtains, but on a knowledge agent's inability to know that it does not. Again, as we saw in 1. above, languages are bound to produce all sorts of logical paradoxes and skeptical scenarios. The question here is whether or not Unger is justifiably appealing to the *argumentum ad ignorantiam* (or argument from ignorance).

There are a number of forms this argument can take. The form which Unger uses looks like this:

1. We do not know that statement S is false.
Therefore,
2. Statement S is true.

If we recall, Unger's argument for near-absolute ignorance is the result of considering that skepticism is right. Evidence for the truth of skepticism comes from the countless failures to refute it philosophically. Unger concludes that since we do not know that skepticism is false, it must be true. Douglas Walton and John Woods (1978, 1990, 1992) have demonstrated how one can generate nonfallacious arguments from ignorance. For example, if we rightly assume that our knowledge base is complete and some proposition is not known to be in it, we can infer that this proposition must be false:

Example 1: The posted train schedule says that train 12 to Amsterdam stops at Harlem and Amsterdam Central Station (Walton, 1992).

If we want to know whether or not the train stops at Schipol, we can reason that since the schedule did not indicate this, we can infer that this is not one of its stops. We can justifiably assume that our knowledge base concerning this matter is complete--or epistemically closed--on the grounds that if there were additional stops, they would have been posted on the schedule. The principle involved with this non-fallacious use of appeal to ignorance is what de Cornulier (1988, p. 182) calls *epistemic closure* i.e. "If A were true, I would know it". The reasoning involved is presumptive--that

is, not beyond doubt. But the presumption is reasonable based on one's knowledge base or what I have been referring to as background beliefs. The conclusions drawn may not be as strong as a knowledge claim because they are inferred by default. The argument from ignorance:

...is a defeasible (default) conclusion based on a sequence of presumptive reasoning. The premises in this sequence of reasoning are not known to be true (or false), but are presumed to be true (or false) on the basis of what one would normally expect the reasoner to know, given the depth of his, her or its knowledge base, and other circumstances of the case (Walton, 1992, p. 384).

An argument can then proceed tentatively on a practical basis, advocated by a proponent, and subject to refutation by evidence that can be introduced by a respondent in dialogue (Walton, 1992, p. 384). In this way, this form of reasoning is used as a temporary alternative (as Ruse would say: "The best we can do with what we've got") in cases where current knowledge is not completely sufficient to resolve practical conflicts needing opinion or action. And this is exactly what the evolutionary epistemologist does relative to any sort of metaphysical realism. That is, since his knowledge base at such a high level of scrutiny is incomplete, he proceeds to acquire and revise beliefs along practical, common sense lines.

According to Walton's account, Unger does not argue nonfallaciously from ignorance. Instead he unjustifiably puts the burden of proof on us to satisfy exceedingly high epistemic criteria i.e. certainty--especially when it is not needed. Naturally, I am unable to demonstrate the falsity of Unger's skepticism. But then again, I am unable to demonstrate that my mother did not have a past life as Queen Victoria. Excessive skepticism from an evolutionary point of view, simply demonstrates what can naturally occur when a language develops to a high degree of sophistication. And we must be careful to keep the burden of proof exactly where it should be--on Unger. He has simply failed to demonstrate why we should accept his unmitigated skepticism as opposed to a

common-sense and scientific understanding of the world.

3. We now need to ask ourselves why the level of epistemic scrutiny needs to stay at such a high level. If, by definition, we may never be certain in regards to our common sense experiences, then should we not abandon this criterion as practically useless? And hence, move on and acquire and revise beliefs which satisfy less stringent criteria? As Hume so aptly noted, Nature is too strong for such unmitigated skepticism. Unger, on the other hand, actually maintains that the extent of our ignorance precludes our being happy, sad, angry, etc., about anything. But we all experience these states every day--and for good reason. Our behavioural responses are prompted by personal and cultural beliefs which cause us to react to various situations in specific ways. The force of nature and the thousands of years of phylogenetic and ontogenetic evolution which blindly and reflectively elicits responses to various stimuli, is simply a better explanation of behaviour than maintaining that we should, according to various linguistic skeptical scenarios, repress those human feelings.

4. We now need to consider a pressing question which Unger conspicuously fails to address throughout his entire book: If the ancestral language problem were rectified, of *what* would we have knowledge? A world of fixed, discoverable laws, properties, essences? Or good, coherent, albeit contextual, accounts of invented (but clear) concepts describing contextually-laden states of affairs? Ignorance is always ignorance *of* something. But does Unger's brand of skepticism presuppose metaphysical (direct) realism? Or, if we accept his naturalistic proposal, is it merely remediable linguistic skepticism?

The moral of all this, I conclude, is that Unger's ancestor language hypothesis *does not* support the sceptical thesis that he has reiterated throughout *Ignorance*, that our ignorance and irrationality are universal and necessary. At best, it supports a contingent, linguistic scepticism that we can overcome. So, if we take Unger's ancestor language hypothesis seriously, we must recognize that he is not really

arguing for the extreme kind of scepticism that he appears to be...Indeed, we should have to conclude that Unger is not a sceptic at all, in the way in which most of us understand that term and in which he has himself repeatedly claimed to be in *Ignorance* (Johnson, 1979, p. 410).

At times it seems difficult to determine whether or not Unger's naturalistic suggestion undermines his skeptical position. For we are unsure where Unger actually stands relative to naturalism and linguistic skepticism. He seems to be halfway up the ladder between the two.

Although Unger is quick to point out logical paradoxes, he seems totally oblivious to one of the oldest in the book. That is, how is he to avoid the problem of self-reference? In other words, if there is very little that we can know, do we know what Unger is saying with certainty? In the final sentence of the first paragraph of the book, Unger states that no one will be justified or at all reasonable in believing anything (Unger, 1975, p. 1). Yet just one page later, he states the 'rightness' of skepticism claiming that of all the reasons why skepticism might be impossible to refute, one stands out as the simplest: skepticism isn't wrong, it's right (Unger, 1975, p. 2). Does this mean that Unger's belief in the 'rightness' of skepticism *is* justified or at all reasonable? If he maintains this, he contradicts his skeptical position; if he rejects this, what efficacy does his skeptical position have? And if he claims that ignorance is remediable by naturalistic methods, he undercuts his entire skeptical project. If Unger maintains that we are ignorant and we could possibly be subjects involved in the exotic skeptical scenarios of deception, then any appeal to the past, to ancestral languages, to a possible remedy, etc., does, indeed, undermine his skeptical position by presupposing the continuous existence of an external world apart from our conscious perceptions of it.

5. And finally, the most obvious criticism against Unger's ancestral language hypothesis is that language originated and developed as a function of current evolutionary factors e.g.

group/tribal interactions, survival strategies, early hominid vocal tract development, emerging technologies, etc. And so the descriptions, relations and references to various things and states of affairs gradually became either more or less sophisticated depending on the environmental, biological and cultural changes of the time. For some unspecified reason, Unger maintains that early concepts were developed and written in stone and have remained linguistically influential for millennia. This linguistic fall of man hypothesis evokes some cursory interest but is substantially weak because it is merely an uninvestigated conjecture. There are some questions that need to be addressed before we can begin.

First of all, how far back in ancestry should we go in order to detect where things went awry? Written accounts only date back several thousand years B.C.. Before these written records, we must speculate as to how languages originated and developed. Secondly, not all languages evolved from the same protowords.

According to the best evidence we now have from etymologists, the different languages spoken throughout the world today do not have a common origin--although the number of root languages is probably small. For example, Chinese has not developed from the same source as English and other Western languages. Would Unger agree that the Chinese, not having been corrupted by our ancestor language, are neither ignorant nor irrational? If so, what happens to his universal scepticism? Furthermore, if our inability to know anything results from the fact that we speak English, we could overcome this deficiency by learning to speak Chinese (Johnson, 1979, p. 408).

Although theories concerning the emergence of language are speculative at best³⁸ because of the obvious lack of physical evidence, we must consider the origin and development of language prior

³⁸ John McCrone mentions in *The Ape That Spoke*, (McCrone, 1991, p. 143), that at the turn of the century, the Linguistic Society of France had a standing ban on papers about the origins of speech because many of the ideas were simply nonsense.

to written accounts by borrowing from the fossil records hominid specimens displaying vocal development, cranial and brain size increase, social patterns and tool development, etc., in the attempt to piece together a viable explanation. Unger seems oblivious to the voluminous research which has been done in this area.³⁹ From the fossil records we can determine that bipedalism, larger brain sizes, and the end of an ice age all contributed in significant ways to the origin of language. There are numerous theories as to how and why language developed e.g. the Mimicry Theory (hominids imitated natural sounds), the Cooperation Theory (tribal/communal efforts to accomplish focused tasks), the Theory of Ancient Gestures (a baby's cries, warning cries, adhering to the social pecking order, etc.), the Sexual Tool Theory (language became a feature for attracting mates), The Campfire Theory (language was used to articulate the day's events), etc. But many theorists agree that it began crudely, and perhaps accidentally, as a social instrument between close-knit primates.

Troops of early man would thus have spent far more time in each other's company and would have had a lot more opportunity to develop their communication skills. Such close living would have made it easier for a symbolic use of noises to start...it is quite possible for chimps--or early man--to make symbolic use of noises, even if these "protowords" have a fixed meaning only for the individuals uttering them. This use of personal noises would at least be the first step. The next would be for the symbolic noise to be picked up and used by all the members of a troop (McCrone, 1991, pp. 156-157).

³⁹ See, for instance, *On The Origins of Language* by Philip Lieberman (New York: Macmillan, 1975), *The Story of Speech and Language* by C.L. Barber (New York: Apollo, 1972), *Language Origins: A Bibliography* by G. Hewes (Atlantic Highlands, N.J.: Humanities, 1975), *Biological Foundations of Language* by Eric Lenneberg (New York: Wiley, 1967), "The Origin of Speech" by Charles Hockett, *Scientific American*, 203, pp. 88-111, 1960, *The Biology and Evolution of Language* by Philip Lieberman (Cambridge, Mass.: Harvard University Press, 1984), "The Anatomy of Human Speech" by Jeffrey T. Laitman, *Natural History* (August, 1984), *Glossogenetics: The Origin and Evolution of Language*, edited by Eric de Groller (New York: Harwood Academic Publishers, 1981), *Language and Mind* by Noam Chomsky (New York: Harcourt Brace Jovanovich, 1968), *Manwatching* by Desmond Morris (New York: Abrams, 1977).

If Unger is to consider a naturalistic account concerning the origin of concepts, he must realize that the process probably developed gradually and that most protowords referred to very simple states of affairs related to social interactions e.g. anger, displeasure, hunger, grooming, sex, etc. How are we to consider that such referential terms started us off on a gradual evolution to absolute ignorance? If language is to be blamed for our ignorance, surely it is the sophistication of our current language which allows for such exotic scenarios to be articulated. Unger can postulate such a bizarre scenario only because the language he uses accommodates such articulation.

As well, Unger needs to show how the basic structure of our current language was directly influenced by such protowords. Language changes as the users and the environment changes.

Language teachers often talk about grammar as if it were a biblical set of rules carved on tablets of stone, but rather than a list of commandments, grammar is fluid, and changes as fast as cultures change. The common feeling that grammar is or should be fixed probably comes from the mass teaching of writing during the last couple of centuries...The written word, getting no help from the speaker, needs to be precise and orderly to be sure of being understood and this has led to an exaggerated sense of strictness of grammatical rules (McCrone. 1991, p. 166).

Unger proposes that the creation of new terms (neologisms) within an existing language or the development of a new language may eliminate logical paradoxes and hence, our ignorance. But languages have been changing and developing constantly since they began. There were those of the Vienna Circle--the logical positivists--who consciously sought to make language more precise. But the skeptical paradoxes remain if you require satisfaction of extremely stringent criteria. Perhaps in some Orwellian fashion it is possible to limit the meanings and references in an existing language by rewriting it and teaching the new limited language to the next generation. And perhaps, over a period of time, a society will use this modified language and they will not stray beyond its strict grammatical parameters. Such a strict language could conceivably curtail or eliminate any such

skeptical problems found in our current language. But would we say that this language has resolved these problems, or would it simply be a matter of developing a method of communication which simply does not allow such problems to be conceived? At this point we must acknowledge that ignorance is a natural state of not knowing described by a given language and relative to a current perspective. And language is relative to the current usage of terms according to individual, social, biological and environmental conditions. Neanderthal man could never have articulated Unger's exotic skeptical scenario because this was simply not in his vocabulary--a vocabulary which gave meaning and reference to his surroundings.

Early man did not have to invent the whole of language in a single generation; it did not take one genius to come up with the idea of symbolic speech and then teach it to the rest of the group. Instead, language could evolve gradually over thousands of generations with each small step forward in the use of symbolic noises becoming fixed, like the useful mutation of a gene. Steadily, over plenty of time, words and grammar would pile up. Language would have started with a simple vocabulary suited only to childhood needs, but once the habit of speaking was established, an adult would soon have invented new words to help in his grown-up life while out hunting, food gathering, or toolmaking. In a beneficial evolutionary spiral, new words would have paved the way for new social behaviors, which in turn would have led to yet more new words (McCrone, 1991, pp. 158-159).

Unger has failed to acknowledge a significant aspect of what contributes to our ignorance concerning any state of affairs. And that is what we may refer to as historical setting or 'facticity'. On first sight, this may seem to be a trivial point. That is, beliefs are acquired and revised relative to the biological constraints and cultural influences of a particular time. However, it is important to see this relationship in order to more clearly understand how ignorance emerges. For in the context of neo-Darwinian epistemology, ignorance always emerges relative to the context of a specific historic or factitious setting. From approximately five million years ago to the present, the way in which our ancestors (as well as ourselves) respond to a lack of information or procedural technique is

influenced by our changing environment and evolving species. The interaction between species and environment 'fixes', so to speak, an epistemic framework. These frameworks shift and change depending upon the interaction between ourselves and our environment. At any particular time in our evolution, we may refer to ignorance in this factitious sense. In this case, language, itself, contributes to our facticity. For example, in order to communicate, we can use, say, the English language as it is commonly defined and practised today. We are relatively free to stipulate new concepts (neologisms) in order to better articulate our views. But we would have a difficult time indeed creating a new language which either did not refer to currently used concepts or did not refer to those very things we are describing. Our current facticity is influenced by the past but is not wholly fixed by it. Language is somewhat plastic in this respect. Languages throughout the world developed according to various influences and they continue to be modified and changed accordingly.

The facticity of early developers of language would be markedly different than those we face today. We can acknowledge various necessary conditions for the development of language such as the physical changes needed for speech e.g. a high arch in the roof of the mouth (appearing in *Homo erectus* about 1.5. million years ago) which gives the human air passage the necessary shape and length to make a wide range of sounds (McCrone, 1991, p. 160), a gradual elongation of the vocal tract and a dropping of the voice box down the back of the throat, etc. But the facticity constraints on *Homo sapiens* say, 50,000 years ago, would be different still. For these ancestors would have had a much more evolved ability to produce sounds, a greater vocabulary--in short, a much more sophisticated language (or languages). Unger would have a difficult time, indeed, trying to pinpoint

exactly where in our linguistic history, we went wrong.⁴⁰

For the moment, I believe the neo-Darwinian has more than enough reason to reject Cartesian skepticism based on the presuppositions of evolutionary epistemology. At this point, I wish to stress that we should not abandon all forms of skepticism in our examination of the concept of ignorance. For in the next section, we shall see the parallels between neo-Darwinian epistemology and the applied form of skepticism of the ancient Pyrrhonians.

(iii) Parallels Between Neo-Darwinian Epistemology and Pyrrhonian Skepticism

For those uninitiated in the subtleties of the various forms of skepticism, it may seem unusual that a naturalized epistemology could parallel any form of skepticism. However, the neo-Darwinian's procedure of common sense, hypothetical-internal realism, and metaphysical agnosticism bears a remarkable parallel to the skeptical system articulated by Sextus Empiricus in the *Outlines of Pyrrhonism*. To illustrate this parallel, I shall briefly describe the Pyrrhonian skeptical system and then show in what ways neo-Darwinian epistemology is similar.

The Pyrrhonist, like most non-skeptics, begins his pre-skeptical journey in the hopes of attaining knowledge--knowledge concerning what is true and false in things⁴¹ and discerning the truth and falsity of sense impressions (*PH*, I, 26). He anticipates that satisfying this inquiry will, in some way, make him happy. But he is unable to accomplish this. Instead, he finds frustration results

⁴⁰ However, based on his notion of absolute terms such as 'flatness', it has been suggested to me that this may possibly be located around the time of Plato when purely mathematical uses of terms were invented e.g. straight, square, flat, triangular, etc.

⁴¹ Sextus Empiricus, *Outlines of Pyrrhonism*, the Loeb Classical Library, Harvard University Press, 1967, Book I, Chapter 12. All future references will be taken from this edition and inserted directly in the text.

from the equipollence of opposing doctrines. However 'by chance' he realizes that when he suspends belief on these matters (*epoche*), two consequences follow. First, he is no longer burdened by his epistemic plight. Instead, he is tranquil. But the psychological state has not been brought about by accomplishing the Pyrrhonist's initial task i.e. of settling what is true in things and what is false. On the contrary, his tranquillity results *coincidentally* when he suspends judgment i.e. it 'just so happens' that his mental anguish ends with the discovery of *epoche*. Tranquillity comes in the form of easing the mental disquiet associated with uncertainty. Secondly, in the act of suspending judgement, the Pyrrhonist acknowledges a distinction between ontologically ultimate beliefs which have extremely high levels of scrutiny which may never be satisfied; and regionally utilitarian beliefs which are the product of natural inclinations that guide him in his every day common sense dealings with society.

Whereas the dogmatists escape mental disquiet through the supposed assurance that they have attained *the* true system of knowledge and morality, the Pyrrhonians achieve contentment or quietude by acknowledging their epistemic ignorance, suspending their judgment in matters of opinion, and remaining moderate concerning events beyond their control. The *eudaemonic* state of the Pyrrhonist is quite distinct in this respect. That is, the Pyrrhonist's state of *ataraxia* does not produce an elated state of happiness. And this is due to the simple reason that such a move would contradict his use of *epoche* and his conception of moderation. And there are a number of reasons for this.

First of all, by remaining moderate, the Pyrrhonist does not have as far to fall from a state of elation when faced with apparent moral crises, and he does not have as far to climb to overcome such severity. The true Pyrrhonist rides the middle line between such peaks and valleys. What sets

the Pyrrhonians apart from the general run of people is their consistent immunity to opinion on anything whatever: This equipoise enables [the Pyrrhonist] to remain quite indifferent to 'the passions, opinions and futile legislation' that 'weigh down' the opinionated masses, whatever their status, and cause them to veer hither and thither in response to their unfounded judgments about the world (Long and Sedley, 1987, p 20). By maintaining a level of moderation according to the Pyrrhonist's understanding and use of the concept of *epoche*, and thereby living without dogmatic beliefs, the Pyrrhonist attributes neither positive nor negative value to his experiences. He's affected by them of course. He lives according to a four stage practical criterion (*PH*, I, 23-24)—something we shall discuss shortly. But the manner and extent to which he is affected is due to the conventional beliefs of his culture and his time. Instead of steadfastly clinging to a supposed assurance of a particular dogmatic doctrine, the Pyrrhonist realizes that by refraining from placing any value on matters of opinion or things unavoidable, he attains a state of quietude: the Pyrrhonist suspends judgment on matters of objectivity because neither he nor anyone else is capable of providing what is true in things or what is false. And the Pyrrhonist realizes that neither he nor anyone else has any special access to this truth if it exists at all. We may possess beliefs, but we may be ignorant of the causes of these beliefs (Barnes, 1990, p. 142). As Sextus states in *Against the Mathematicians*:

Let us imagine that some people are looking for gold in a dark room full of treasures. It will happen that each will grasp one of the things lying in the room and think he has got hold of the gold. But none of them will be persuaded that he has hit upon the gold even if he *has* in fact hit upon it. In the same way, the crowd of philosophers has come into the world, as into a vast house, in search of truth. But it is reasonable that the man who grasps the truth should doubt whether he has been successful (*AM*, VII, 52).

The inability to satisfy criteria with such high (metaphysical) levels of scrutiny is exactly why Ruse has made the distinction between metaphysical and common sense reality. Since we cannot satisfy

criteria at the metaphysical level, we understand and interact with the world at the common sense level. In this way we acknowledge correspondence truth but settle for coherence.

The final defining characteristic of Pyrrhonian skepticism is that it is *zetetic*. That is, even though they explicitly recognized the difficulties faced in understanding the world, they never accepted that no form of knowledge was possible. They distinguished ultimate from regional knowledge and remained inquisitive. The Pyrrhonian school of skepticism was referred to as the enquiring school (*skeptikos* literally means 'enquiring'); the notion of *epoche* holds good only 'up to now' thereby hinting that future resolution of the doubt and future knowledge are not formally excluded...it remains true that Pyrrhonian skepticism is, formally speaking, open-minded and in principle tolerant of future progress (Barnes, 1990, pp. 10-11).

There are three main themes to Pyrrhonian skepticism which closely parallel neo-Darwinian epistemology. First, the Pyrrhonians held that since we cannot ultimately determine what is true and false in things (or in sense impressions) we should suspend belief and 'acquiesce to the appearances'. The Pyrrhonians maintained that it was foolish to consider that nothing--not even appearances--existed: "no one, I suppose, disputes that the underlying object has this or that appearance; the point in dispute is whether the object is in reality such as it appears to be" (*PH*, I, 22). The Pyrrhonians originally attempted to distinguish between what is true and false in things and sense impressions. But when they realized that a foundational criterion (or set of criteria) was not (currently, and may never be) attainable (well represented in Sextus's gold-in-the-dark-room quotation above), they adopted a practical, common sensical demeanour. The problem of the criterion, combined with the several modes (or *tropoi*), left the Pyrrhonians with little alternative *but* to 'acquiesce to the appearances' and live according to the four stage practical criterion (a feature of Pyrrhonism I shall

discuss shortly). And so the Pyrrhonian acknowledges that we can acquiesce to appearances without committing to dogmatic doctrines.

The Pyrrhonian proposes impressions as a subjective, and possibly mistaken, basis for practical affairs...Sextus carefully avoids the claim that we know appearances, saying only that the Pyrrhonians grant that appearances appear. One finds the same attitude in the claim that the Pyrrhonians do not overthrow sense impressions and do not doubt appearances themselves...This means only that the Pyrrhonian refrains from disputing appearances...According to this account, appearances are to be accepted and adhered to, not because we can establish their true nature, but because we need a foundation for the conduct of practical affairs (Groarke, 1990, pp. 139-140).

Acknowledging that there is a world which is observable through appearances is common sense; maintaining that we cannot establish any objective knowledge of it, is simply another way of defining hypothetical realism; and acquiring and revising beliefs according to their internal relationship is (a form of) coherentism.

Second, the Pyrrhonian distinction between appearance and reality led to a further distinction--a practical one--between what we may call regional and ultimate beliefs. That is, we can hold many beliefs concerning many aspects of the world, but when push comes to shove, we must admit that we could be mistaken, that our current methods of inquiry are fallible, and that very few, if any, of our beliefs are beyond revision. The Pyrrhonians were among the first to distinguish beliefs into the categories of ontologically ultimate and regionally utilitarian. And this closely parallels neo-Darwinian distinctions between common sense and metaphysical reality.

And third, since we cannot secure certain knowledge, we have little choice but to acknowledge convention and social custom. The Pyrrhonians were among the few (perhaps only) skeptics to further their skeptical system by establishing a practical guide for living. After suspension of judgement (epoche) regarding various doctrines concerning the truth and falsity of things, and

acquiescing to the appearances, the Pyrrhonians proposed a four-stage practical criterion (*PH*, I, 23-24):

1. The guidance of Nature. Nature's guidance is that by which we are naturally capable of sensation and thought.
2. Constraint of the passions or bodily drives whereby hunger drives us to food and thirst to drink.
3. The traditions of laws and customs whereby we regard piety in the conduct of life good and impiety as evil.
4. Instruction of the arts, that we are not inactive in such arts we adopt.

The first practical criterion has its roots in the works of Arcesilaus' doctrine of natural belief. Arcesilaus proposed the concept of the *eulogon* or the "reasonable" for determining conduct (see *AM*, VII, 158).

The reasonable is that which is in keeping with our nature. One might compare Arcesilaus' views to Hume's suggestion that human nature makes it impossible to reject eating, walking, and talking, especially if our goal is happiness...it would be "unreasonable" to do otherwise and Arcesilaus suggests that we should act accordingly (Groarke, 1990, p. 109).

What appears to us does so as a function of nature. This early form of Pyrrhonism has its roots in Pyrrho and Timon who accepted natural appearances as a guide to life. The practical criterion is substitutive of any supposed criteria of (absolute) truth. It generates *regional* beliefs which may be considered better or worse, true or false, etc. And it is indeed ironic that so much of what Hume states about natural propensities, habit, custom, etc., is consistent with Pyrrhonian skepticism. It is puzzling indeed, to see Hume castigate the Pyrrhonians for their system as one of un-natural philosophy:

The great subverter of Pyrrhonism or the excessive principles of skepticism, is action,

and employment, and the occupations of common life. These principles may flourish and triumph in the schools; where it is, indeed, difficult, if not impossible, to refute them. But as soon as they leave the shade, and by the presence of the real objects, which actuate our passions and sentiments, are put in opposition to the more powerful principles of our nature, they vanish like smoke, and leave the most determined skeptic in the same condition as other mortals (Hume, 1989, p. 121)

As we have seen from the characteristics of Pyrrhonism outlined above, Hume could not have been more mistaken. And I have always been surprised that he has given the Pyrrhonians such a bad reading.⁴² He continues to state that no durable good can ever result from such excessive skepticism. On one level, of course, we all agree with Hume. As we saw, above, unmitigated, excessive skepticism may be academically interesting, but practically useless. But a proper reading of Pyrrhonism reveals that it is mitigated--and according to natural inclinations! Hume goes on to say that a Pyrrhonian cannot expect that his philosophy will have any constant influence on the mind or, if it had, that such influence would be beneficial to society. But this is exactly what the Pyrrhonians intended to accomplish i.e. that after one realizes the difficulty--if not impossibility--of satisfying ultimate epistemic criteria, we should concern ourselves with matters guided by natural inclinations understood according to regional criteria.

The second practical criterion is simply stating physical bodily constraints for survival. That is, hunger does drive one to eat, thirst to drink, etc. We cannot survive for very long without the consumption of fluids and foods. We can survive for a short while, but then would surely perish.

⁴² Actually, it is one of my ongoing concerns that perhaps Hume knew only too well precisely what the Pyrrhonians intended. For it is common knowledge that Hume had access to the *Outlines* (see Leo Groarke and Graham Solomon's "Some Sources for Hume's Account of Cause", in *The Journal of the History of Ideas*, 1991, pp. 645-663. It is not inconceivable to consider that perhaps Hume's misreading of Pyrrhonian skepticism was deliberate in order to bring greater originality to his own philosophical thoughts.

There is a point, then, beyond which, human survival is not possible. This is a point of natural constraint.

The third practical criterion i.e., that the skeptic keeps the rules and observes in the conduct the pieties of a particular society is a statement of societal cooperation. Rather than attempt to change the ways of a particular society, which would not only be difficult but would further aggravate one's particular lot in life, the skeptic suggests that one should be a good citizen. This of course presupposes that one lives in a relatively good society, free from various forms of oppression. But if the latter should be the case, the Pyrrhonian must always revert to *epoche* i.e., that we cannot determine that such states of nature are inherently bad or evil.

The final criterion i.e., that one should practice an art or profession simply advises the skeptic to put his talents to some practical use. This, again, directly conflicts with Hume's account of Pyrrhonism. The skeptic realizes that in various societies, a division of labour emerges, and one must determine how one is to fit in with that particular society.

The articulation of the notions of 'acquiescing to the appearances' and the four stage practical criterion were developed because the Pyrrhonians realized that neither they--nor anyone else--have established or satisfied absolute criteria which could determine the truth and falsity in things and of sense impressions. Since this was apparent, they decided to follow natural guidelines in the acquisition and revision of beliefs. Following natural guidelines (or propensities) is at the very heart of evolutionary epistemology. For millions of years, organisms evolved through genetic variation and natural selection. However, quite recently, mankind has developed the ability to direct variations towards specific goals.

According to the four stage practical criterion, then, the Pyrrhonian remains *zetetic*. That is,

he still inquires into the nature of the world knowing full well that he may never determine any such objective truth. This notion of *zetesis* is what Wilson, Lumsden and Ruse would call an 'epigenetic rule'. However, the Pyrrhonians have revised the rule and apply it in what many would consider a 'Humean' manner. That is, with a realization in the distinction between metaphysical and common sense reality and the need for practical criteria. In this way we can develop regional beliefs in a goal-directed fashion. Although the Pyrrhonian system has long since waned, I believe people like Ruse have indeed carried on the tradition. One of the most refreshing aspects of Ruse's evolutionary epistemology is his 'Pyrrhonian spirit'. As a neo-Darwinian epistemologist, Ruse has recognized that his current beliefs may some day be revised or completely overturned. But he also realizes that they currently cohere and present a consistent understanding of various aspects of the natural world of which philosophy is but a part.

This concludes our analysis of the main issues in evolutionary epistemology. In the next chapter, I shall use this information to formalize an understanding of the neo-Darwinian concept of ignorance.

CHAPTER FOUR

FORMALIZING THE CONCEPT OF IGNORANCE IN EVOLUTIONARY EPISTEMOLOGY

The purpose of this chapter is to formalize the concept of ignorance from our analysis of the main issues of evolutionary epistemology discussed in the last chapter. In order to do this, we need first consider to what extent knowledge, as defined by neo-Darwinian epistemology, is propositional and non-propositional, and justification internal or external. Once this is established, we will have a better understanding of the evolutionary model of knowledge and this will allow us to better formalize the concept of ignorance relative to that particular model.

I

THE STANDARD MODEL OF KNOWLEDGE IN EVOLUTIONARY EPISTEMOLOGY

From our analysis in the first three chapters, we can see several common characteristics emerge which give shape to a neo-Darwinian theory of knowledge. These include the following:

1. There is an open acknowledgement that neo-Darwinian epistemology presupposes hypothetical (non-convergent), common sense realism i.e. that the world exists independently of consciousness and contains diverse biological organisms.
2. These biological organisms acquire information differently but commonly respond to an environment directed by the mechanism of natural selection.
3. Humans have, according to various selective pressures, developed sophisticated languages which are contingent and which developed functionally in order to better adapt to a specific environment.
4. Knowledge as information acquired by an organism is rooted in adaptation and survival. Hence, it is based in utility. Once language developed to a sufficiently high level of sophistication--due to bipedalism, increase in brain size, diet change, socialization, etc.--humans were able to transcend biological constraints. It is hypothesized that, simultaneous with the increase in language sophistication, consciousness developed and culture emerged.

5. Knowledge as the acquisition and revision of information proceeded from a stage of *blind* variation and selection to *goal-directed* variation and selection. But all knowledge—even our most sophisticated scientific theories—developed from a gradual process of adaptation due to selective pressures.

To complete the evolutionary model of knowledge, we need to consider more specifically, to what degree acquired and revised information is propositional and non-propositional, and whether it is justified internally or externally.

The first thing we need to do is distinguish propositional knowledge from other types of knowledge. Eliot Sober makes the distinction by asking us to consider three statements:

(1) S knows how to ride a bicycle.

(2) S knows the President of the United States.

(3) S knows that the Rockies are in North America (Sober, 1991, p. 139).

The first type we can call *know-how* knowledge. This form of knowledge requires us to know how to do a specific activity, function, procedure, etc. It is safe to assume that evolutionary epistemologists would consider this form of knowledge to be historically antecedent to propositional knowledge. That is, it was probably the case that hominids knew *how* to perform particular tasks and functions in their day-to-day struggle for survival prior to understanding the truth values associated with such activities. In the second type of knowledge, the object of the verb is a person i.e. the President of the United States. This form of knowledge is a type of familiarity (or direct acquaintance) with a person, place or thing. Sober refers to this as *object* knowledge. And the third type is *propositional* knowledge. The object of the verb in statement (3) is a proposition i.e. a statement which is either true or false. For S to legitimately claim that the Rockies (i.e. the mountains rather than the major league baseball team) are in North America, it must be true that this

mountain range is indeed in North America. To make such a claim, some epistemologists maintain that three conditions must be satisfied: S must believe p, p must be true and S must have reason to believe p i.e. S must be justified in believing p. The justification may take various forms but for the sake of simplicity, we shall say that a belief is justified by appeal to empirical evidence or rational justification. This is the standard tripartite or Justified True Belief (henceforth, JTB) definition established in Plato's *Theaetetus* and scrutinized in Gettier's famous paper (Gettier, 1963). We need not restate Gettier's counter-examples here to demonstrate how the JTB theory of knowledge breaks down under specific conditions. It is enough for us to acknowledge that a person can be justified in his belief and still be without knowledge. In other words, Gettier's point was to show that we can have highly reliable evidence and still not have knowledge. But we need to draw a distinction between reliable and infallible evidence. If we have infallible evidence, then the JTB theory would be sufficient for knowledge. However, as Sober notes, there are very few instances--if ever--when we have perfectly infallible evidence. So we need to seriously consider just how useful the JTB theory is in considering the sufficiency for knowledge. And we should already guess that to an evolutionary epistemologist, the JTB theory is not sufficient for knowledge. For almost all of our common sense beliefs are based on evidence which is not infallible even though some may have overwhelming probability e.g. claiming that your Lotto 6/49 ticket will not win the next jackpot is more than likely true; however, it is not impossible that you could win. This thin margin of possibility does not make our evidence infallible but only reliable. However, this notion of reliability is, to the evolutionary epistemologist, enough. Sober sees skepticism resulting from strict applications of the JTB theory in the following form:

If S knows that p, then it is not possible that S is mistaken in believing that p.

It is possible that S is mistaken in believing that p.

S does not know that p.

As we saw in the last chapter, this is the classic Cartesian argument which apparently undermines empirical knowledge. Since perceptual mistakes occur e.g. hallucinations, dreams, illusions, etc., we cannot entirely rule out the possibility of error. But as was duly noted, conditions at this high level of scrutiny need not be satisfied in the biological (common sense) world.

Since evolutionary epistemology is a naturalized form of epistemology, the conditions needed to be satisfied are those which are causally related, producing beliefs from a reliably attained law-governed procedure. Robert Shope has stated that there is a causal theory of propositional knowledge which requires that:

...one or another specified relation holds that can be characterized by mention of some aspect of causation concerning one's belief that h (or one's acceptance of the proposition that h) and its relation to state of affairs h*, e.g. h* causes the belief; h* is causally sufficient for the belief; h* and the belief have a common cause (Shope, 1994, p. 399).

There is a similarity between causal theories of propositional knowledge and reliability theories insofar as both drop the requirements that h be justified (or known to be justified). From David Armstrong's analogy (Armstrong, 1973), we can consider the reliability theory of knowledge to be similar to the reading of a thermometer:

The reliability theory of knowledge says that an individual knows a proposition if the individual is related to the proposition the way a reliable thermometer is related to the temperature it measures. A reliable thermometer would not read $n^{\circ}\text{F}$ unless the temperature were $n^{\circ}\text{F}$. An individual knows that there is a page in front of her precisely when the individual would not have believed that there is a page in front of her unless there were one there (Sober, 1991, p. 162).

Armstrong states that one may consider a non-inferential belief as knowledge if the belief has properties whose truth is guaranteed via natural law (or laws). This is the nomic sufficiency account

of knowledge and we could state it in the following way:

If S knows that p, then p is a belief that has been reliably attained by a procedure that is a nomic or law-governed procedure.

And this ties in with the causal theory of propositional knowledge in the following way:

Another way to express this idea is by using the concept of *causality*. A thermometer is reliable in a given circumstance, if the only thing that could cause the thermometer to read $n^{\circ}\text{F}$ is that the temperature really is $n^{\circ}\text{F}$. Similarly, S knows that there is a page in front of her in a given circumstance, if the only thing that could cause S to believe this is that there really is a page in front of her (Sober, 1991, p. 162).

The term 'reliable' is used as a conditional given of what Sober calls *circumstantial necessity*. This means that when S knows there is a page in front of her, she is related to her environment in a special way and that she cannot be mistaken in believing what she does.

Suppose that a real printed page is the only thing that could get S to believe that a printed page is before her. Her senses are functioning normally. There are no evil demons lurking about who provide misleading evidence. If this is so and if S subsequently believes the proposition in question, then S will *know* that there is a printed page in front of her. This is what the reliability theory says. In this circumstance, her belief will be related to the world the way the reading of a reliable thermometer is related to the temperature (Sober, 1991, p. 164).

This has been called the subjunctive or counterfactual account of knowledge developed by Dretske (1971a, 1981), Goldman (1976), and Nozick (1981).

The core of this approach is that S's belief that p qualifies as knowledge just in case S believes p because of reasons that would not obtain unless p were true, or because of a process or method that would not yield belief in p if p were not true. For example, S would not have his current reasons for believing there is a telephone before him, or would not come to believe this in the way he does, unless there *were* a telephone before him. Thus, there is a counter-factually reliable guarantor of the belief's being true. A variant of the counterfactual approach says that S knows that p only if there is no 'relevant alternative' situation in which p is false but S would still believe that p (Goldman, 1994, p. 433).

The hallmark of the causal/reliable theory of knowledge is that one needs to be justified in one's

belief but need not be certain. Knowledge requires truth, but justified belief does not...knowledge requires the impossibility of error; justified belief does not (Sober, 1991, p. 171). Although Hume's point about induction i.e. that we assume the future will resemble the past in various respects, relies on the Principle of the Uniformity of Nature (PUN), we can make inferences according to "degrees of reliability" (Sober, 1991, p. 180).

Induction is a method of inference. Like other methods of inference, it makes predictions and says what generalizations are true, based on a set of observations. We can say of a method of inference how often the predictions or generalizations it endorses have been true. A method that usually leads to truth is highly reliable. One that rarely does so is very unreliable...Common sense may suggest that we are entitled to use induction now because induction has been reliable in the past. Induction has often been used to make predictions, and the predictions endorsed by inductive arguments usually, if not always, turned out to be correct. This is why we rightly take seriously what induction tells us (Sober, 1991, pp. 180-181).

As we saw in the last chapter, induction is an epigenetic rule, the proper use of which assisted early hominids in developing an evolutionary advantage. The proper use of induction would have had high survival value.

The distinction between epistemic justification of propositional knowledge in reliabilism and some form of foundationalism has naturally led us to consider the division of externalism and internalism. I have found Bonjour's distinction of these two types of justification to be quite clear:

...a theory of justification is *internalist* if and only if it requires that all of the factors needed for a belief to be epistemically justified for a given person be *cognitively accessible* to that person, *internal* to his cognitive perspective; and *externalist*, if it allows that at least some of the justifying factors need not be thus accessible, so that they can be *external* to the believer's cognitive perspective, beyond his ken (Bonjour, 1994, p. 132).

In other words, an internalist approach to justification holds that one is epistemically justified only if he actually gives, or is able to give, reasons that warrant belief in the proposition, whereas

externalism holds that the belief in a proposition need only have the right sort of causal ancestry—for example, that it be a product of a mechanism that generally results in true beliefs (Clarke, 1986, p. 39). According to this distinction, the theory of justification in evolutionary epistemology is undoubtedly externalist. And reliabilism is perhaps the most prominent externalist view.

What makes such a view [as reliabilism] externalist is the absence of any requirement that the person for whom the belief is justified have any sort of cognitive access to the relation of reliability in question. Lacking such access, such a person will in general have no reason for thinking that the belief is true or likely to be true, but will, on such an account, none the less be epistemically justified in accepting it. Thus such a view arguably marks a major break from the modern epistemological tradition, stemming from Descartes, which identifies epistemic justification with having a reason, perhaps even a conclusive reason, for thinking that the belief is true (Bonjour, 1994, p. 133).

Bonjour states that there are two lines of argument commonly advanced in favour of externalism.

And, as it turns out, both lines are consistent with evolutionary epistemology.

The first line starts from the allegedly commonsensical premiss that knowledge can be unproblematically ascribed to relatively unsophisticated adults, to young children, and even to higher animals. It is then argued that such ascriptions would be untenable on the standard internalist accounts of epistemic justification...since the beliefs and inferences involved in such accounts are too complicated and sophisticated to be plausibly ascribed to such subjects. Thus only an externalist view can make sense of such commonsense ascriptions and this, on the presumption that commonsense is correct, constitutes a strong argument in favour of externalism (Bonjour, 1994, pp. 133-134).

That information is acquired and revised by different organisms on different levels is a common sense observation in evolutionary epistemology. It is difficult to imagine that various organisms other than humans would require cognitive access to all of the factors needed in the processing of various bits of information. We can observe the cognitive abilities of various organisms to compare how they are alike and dislike in their perceptions and interactions in the world. We have a good indication that higher primates and other various mammals, dolphins, whales, etc., show signs of

intelligence involving language and various forms of reasoning e.g. induction, deduction and especially, analogy. That such animals respond to their environments in these ways, indicates that their actions result from a common sense understanding moulded by reliable i.e. externalist, justification.

The second general line of argument for externalism:

...points out that internalist views have conspicuously failed to provide defensible, non-sceptical solutions to the classical problems of epistemology. In striking contrast, however, such problems are in general easily solvable on an externalist view...Thus if we assume both that the various relevant forms of scepticism are false and that the failure of internalist views so far is unlikely to be remedied in the future, we have good reason to think that some externalist view is true (Bonjour, 1994, p. 134).

A second reason why the neo-Darwinian epistemologist is an externalist is due to the inability to satisfy epistemic criteria at such a high internalist level of scrutiny. This is what the Pyrrhonians recognized. And this is why a neo-Darwinian subscribes to hypothetical realism and a common sense understanding of the world.

It is becoming clear that an evolutionary account of knowledge would consider know-how knowledge to be the first type of knowledge developed through trial, error, and confirmation. Through various selective pressures, language gradually developed, became more sophisticated and allowed a particular species to vastly increase its understanding of its environment. Eventually, propositional knowledge would naturally emerge based on further selective pressures and developed by epigenetic rules. Utility and function would still be the end result in developing propositional knowledge because, according to Campbell's hierarchy of selective-retention processes and Wilson and Lumsden's epigenetic rules, discerning and remembering truth from falsity can be an extremely useful tool in the survival game. I believe it is possible to give a reasonable account of the

evolutionary transition from know-how knowledge to propositional knowledge without becoming excessively Panglossian in the process. I believe also that such an account will provide further explanation of the distinction and transition from blind variation to goal-directed variation. The causes for the transition between know-how to propositional knowledge are the same as those which brought about the shift from blind to goal-directed variation: increased brain size, vocal tract development, further sophistication of language, and the epigenetic rules of induction, deduction, analogy, and especially reflective ignorance (or a cognizance of a lack of information). I shall argue that the transition both from blind to goal-directed variation and know-how to propositional knowledge was aided greatly by the cognitive ability to recognize a lack of information (or technique) relative to a particular perspective. I shall show how reflective ignorance would have been extremely useful for survival because it would have focused the direction of goals in which deductive, inductive and analogical reasoning could be applied.

Our task of reverse-engineering begins with a hypothetical story involving our ancient ancestors. Let us imagine what life might have been like for a pre-linguistic hominid between 30,000 and 100,000 years ago.⁴³ Although our ancestor would be, by our current standards, less intelligent, his senses for evaluating his natural environment would have been much more keen than ours today (See Ornstein and Thompson, 1984, pp. 38-40; McCrone, 1991, pp. 94-95; Pinker, 1997, pp. 191-197). For instance, he would have had a very good sense of smell not only to detect food or sustenance, but to detect predators as well. We can well imagine that his hearing, vision, taste, constitution, endurance, sleep patterns, etc., would all be markedly different from ours today (and

⁴³ By 'pre-linguistic', I mean prior to a relatively sophisticated language involving rudimentary noun and verb phrasing.

for good reason).⁴⁴ Possessing such heightened senses would, in some ways, eventually contribute to his rational development. But there are physical features which would necessarily facilitate this rational development. Once brain size increased (and the cerebral cortex developed), and language centres became localized, i.e. the supralaryngeal vocal tract developed a larynx with an elongated pharynx, the physical features would be in place to facilitate further language development. With such physical features properly in place, our ancestor is better equipped to articulate an understanding of his environment.⁴⁵ But he does not immediately begin by discussing Cartesian dream skepticism, or quantum mechanics, etc. What would have been most apparent to our ancestor is the stark contrasts in his environment. For these contrasts would be felt most acutely and would have been extremely significant to his degree of comfort and survival. Such contrasting observations might have included those of night/day, warmth/cold, hunger-thirst/satiation, male/female pleasure/pain, living/dead, etc. That particular natural conditions either obtained or did not obtain was, I believe, the first natural influence leading to the development of the law of excluded middle.

These sharp contrasts and the importance an understanding of them would have had on our ancestor's life, would tie in with another very important epigenetic rule: analogy, or what Soren

⁴⁴ This is not mere guess-work. The development of the cerebral cortex and larger limbic system in earlier hominids is quite commonly accepted among physical and paleo-anthropologists, human biologists, and neurologists. See Ornstein and Thompson (1984), Pinker (1994, 1997), McCrone (1991). Although Cro-Magnon had a larger brain mass than we do today, this species did not have as great a brain-to-body mass as we do. As well, we are uncertain in what regions of the brain Cro-magnon was larger. Remember it's not just size that counts, but what regions of the brain are larger and more fully developed.

⁴⁵ I will acknowledge, of course, the complexity involved in reconciling ancestral genotypical influences which develop innate and instinctive behaviour with the emergence of propositional knowledge. However, my focus is primarily with the transition from learned know-how knowledge to propositional knowledge.

Hallden calls 'dispositional knowledge' (Hallden, 1986). The ability to determine whether something is sufficiently like or dislike something else, has significant survival value as well. If our ancestor is hungry, and he comes across berries which look like berries he has safely eaten in the past but they are of a different colour, he may reason that the basic composition of the berries satisfies the rule of analogy sufficiently enough to eat them. However, if they make him sick, he will quickly learn that colour rather than composition is an important disanalogy to remember. However, our ancestor never needs to know that he has understood and is applying the epigenetic rule of analogy. He simply needs to abide by it and repeatedly use it in similar cases. This is why evolutionary epistemology is externalist and based on common sense reliabilism. The main criterion for belief acquisition and revision at this point in our ancestor's life would have been utility or, to relate this to specific instances, *circumstantial efficacy*. It follows that if a belief and ensuing action were circumstantially efficacious, then our ancestor would do well to remember it, repeat it, and use it analogously where possible in the future.⁴⁶ With the repetition of acting on a particular belief, and the necessary physical features properly in place, our ancestor would learn to articulate his beliefs socially. In other words, it would no longer be necessary to individually confirm or falsify beliefs and actions over and over again. Repetition, alone, would assure external justification of induction and would allow our ancestor to gradually develop an understanding of propositional truth and falsity abstracted from the circumstantial efficacy of specific actions. So when our ancestor, S communicates to a fellow hominid, H that:

⁴⁶ This is simply a reiteration of E.L. Thorndike's two laws of effect and exercise i.e. reward strengthens the link between stimulus and response, punishment weakens it, repetition strengthens it. See Hallden, 1986, p. 167.

The berries on the bush by the bend in the river are good,⁴⁷ the concept of 'good' could mean:

1. They taste sweet.
2. They will not make you sick or kill you.
3. They will satiate hunger.
4. They are good like other berries, etc.

After confirming or falsifying that the berries did or did not satisfy any (or other) of these conditions, H can conclude, at first, in a crude way, that S's statement was true (or false). We can then say that H's 'existence gamble' (Hallden, 1986, pp. 172-173) paid off or did not pay off by trusting S. In this way, propositional truth becomes abstracted out of the utility or circumstantial efficacy of individual (and like) cases. When propositional knowledge can be attained and applied generally and analogously, it becomes adaptatively advantageous for at least two reasons: it saves time and reduces energy expenditure. Hominids need not continuously confirm or falsify single events. With an increase in the sophistication of language, time can be focused on developing other areas conducive to survival. With propositional knowledge, one's ability to direct variants becomes broadened. With a more highly developed language and epistemic framework, one can more easily articulate a need or 'lack' and develop ways in which to account for it. The development of propositional knowledge from know-how knowledge would have dramatically increased the intellectual development of our ancestors.

Isaac Levi has said that it is a daunting task for evolutionary epistemologists to explain the emergence of intelligent bearers of propositional attitudes in terms of natural selection (Levi, 1988,

⁴⁷ There may have been many ways in which S could communicate this message e.g. with finger pointing gestures, crude terms socially accepted by specific groups, etc.

p. 129). But I do not believe this to be the case. If one accepts an evolutionary account of knowledge and knowledge development, then it seems that a transition from know-how type knowledge to propositional knowledge can be accounted for according to selective pressures. And though my account of this, above, may seem to some to be a 'just so' story, I believe it offers a plausible--albeit untestable account, into this eventual transition. For it seems absurd to say that on the one hand we are cultural beings possessing consciousness and sophisticated concepts, with goal-directed sciences, etc., and on the other hand, to say that we were once far less intelligent beings, surviving and perishing according to blind variation and selection, and *not* consider that at some point there must have been a natural transition between the two. We have indeed transcended biology through culture. But it was selective pressures and epigenetic rules which allowed for culture and goal-direction to develop.

II

THE FORMAL COMPONENTS OF THE CONCEPT OF IGNORANCE

From the three types of knowledge discussed above, i.e. know-how, object, and propositional knowledge, we can see three ways in which there is a privation or lack of knowledge in each case. For example, if one is uninformed, unskilled in or unacquainted with a subject, we can say that one is lacking in know-how knowledge. As well, to be unable to recognize some thing or someone is a lack of familiarity or object knowledge. And finally, if one is destitute of information either generally or with respect to a particular fact or subject, we can say one is lacking in propositional

knowledge.⁴⁸ There is also the case of *ignoring* in which one can either unconsciously or deliberately refuse to acknowledge or regard or leave out of account or consideration, relevant information. But this differs from the other three types of ignorance because whereas the former are epistemic states which one can remedy in some way, ignoring involves the deliberate or conscious intention to avoid any such possible remedy whether it involves know-how, object, or propositional knowledge. For our purposes, I shall focus mainly on know-how and propositional ignorance in evolutionary epistemology (however it will also be necessary at times to address the voluntary act of ignoring).

(i) Modes of Ignorance

According to neo-Darwinian epistemology, we see a distinction between two modes or states of ignorance relative to know-how and propositional knowledge: non-reflective (or 'blind') and reflective ignorance. The former refers to an epistemic state in which a knowledge agent, S, has no awareness of his ignorance of p. The latter mode refers to S's awareness that he is ignorant or lacking knowledge of p. Blind or unreflective ignorance is the type of ignorance which we can attribute entirely to pre-conscious hominids, lower animals, young children, etc., and, in many ways, to post-conscious humans. To be unaware that one is ignorant of some (type of) information relative to a particular perspective is something which I believe all humans experience, and will continue to experience. For instance, no one reading this dissertation right now could tell me precisely whether or not it is raining in Canton, China (or Canton, Ohio for that matter). One could guess, or consult a reliable source (there is that word again). But until I mentioned it, I doubt very much if the reader

⁴⁸ Similar definitions of ignorance can be found in the *Oxford English Dictionary*, 2nd ed. Prepared by J.A. Simpson and E.S.C. Weiner. Vol. 7 (hat-Intervacuum), Clarendon Press: Oxford, 1989, pp. 640-641.

was aware of his ignorance concerning this particular state of affairs. We may be said to be blindly ignorant in this regard of a good many things. And rightly so. There is little need for us to know such propositional knowledge. That is not say that we cannot acquire such information. Simply that we are unaware that we do not currently know it. For example, I can be blindly ignorant of such things as the square root of 531,441 (which is 297) and whether or not my spouse is cheating on me. Non-reflective or 'blind' ignorance means that S is not only ignorant of p but oblivious to the fact that he is ignorant of p. In other words, S does not know that he does not know p. We can represent blind ignorance in the following way:

$$(1) \neg Iap \rightarrow IaIap$$

If a is ignorant that p, then a is ignorant that he is ignorant that p. We could call this the 'Ignorance of Ignorance' or the II Principle. This principle is exactly opposite to the KK Principle, because it deals with a lack of knowledge and not cognizance (or awareness) that one is lacking in knowledge. Consider another example. Consider S to be a 7 year old child who is unfamiliar with the game of chess. In this case, S is not only unaware of the rules, concepts, strategies, etc. of the game, but, until his attention is directed towards this game, he is also unaware that he is lacking such knowledge. It is only when the concepts associated with the game of chess are learned by S that he can begin to acknowledge his previous state of ignorance in comparison to his current state of knowledge.

In reference to reflective ignorance, we can note an acknowledgement by S of his ignorance of p. Reflective ignorance can be further characterized by one's response to it i.e. either by passive acceptance or a guided attempt in which to remedy one's current lack of knowledge. For example, if S realizes that he does not know the chemical composition of a particular Class 3 star, he can consult various authorities or references in astrophysics e.g. trusted astronomers proficient in

spectroscopy, in order to remedy this lack of knowledge. Or, if I have reason to suspect but do not know if my spouse is cheating on me, I can take measures to either confirm or dispel such a suspicion. In both examples, I can actively choose to remedy my ignorance or passively remain without such knowledge. As we have seen, it is this reflective mode of ignorance which I consider to be an important epigenetic rule in contributing to the development of goal-directed knowledge. Cognizance of a lack of information relative to a particular perspective is extremely important in focusing one's epistemic inquiries. This 'lack' of information and the attempt to remedy it, gives way to what I call the Lacunae Definition of Ignorance.

(ii) The Lacunae Definition of Ignorance

As we have seen, there is a plausible natural explanation which accounts for the emergence of intelligent bearers of propositional attitudes. And we can consider that gradual development emerged from hominids who were blindly ignorant of the truth or falsity of propositions describing various aspects of their environment, but obviously adopted well enough to select circumstantially efficacious know-how techniques. Reflective propositional knowledge emerged when the proper natural conditions i.e. social, supralaryngeal, brain cortex development, etc., were in place, **and** this form of knowledge had survival value. If propositional knowledge did not have immediate survival value, it is plausible to assume that it never would have flourished.⁴⁹ Once propositional knowledge proved to be adaptatively advantageous, hominids gradually developed languages with greater sophistication. With a more detailed vocabulary by which to describe, understand and interact with their environment, our ancestors would have been better facilitated to make inferences and build

⁴⁹ As Campbell correctly states (1974a), language has the social function of economy of cognition.

further on common sense using trial and error heuristics. If, as Popper, Campbell, Quine and Ruse maintain, science is simply common sense *writ large*, then it follows that more sophisticated languages would have assisted in this development. With propositional knowledge, one is not only conscious that some of his beliefs are more justified than others, he is better able to articulate his second-order awareness of his lack of knowledge--relative to his current perspective(s) of the world--and he can take measures to direct his efforts towards resolving this 'lack'. In this way, his epistemic/scientific endeavours become consciously goal-directed and coherently expanded. He can understand that relative to his current understanding of the world--various perspectives which comprise his 'belief system'--there are specific problems which arise and questions which can be asked. These questions address areas yet accounted for in one's belief system. As we noted in the last chapter, the notion of 'goal-directed variation' in evolutionary epistemology, refers in some ways, to one's ability to acknowledge this 'lack' and take means by which to account for or remedy it. To actively direct one's selection of variants indicates that there is:

1. A *lack* of knowledge relative to a particular perspective for which such a selected variant will account.
2. At least *apparent autonomy* (doxastic voluntarism) in devising ways by which to direct one's selection.
3. Some relationship--however metaphysically vague--between the concepts one uses in selecting a variant in addressing this *lack* and the particular part of one's environment one is trying to better understand (I have stated this earlier as minimal or hypothetical realism).

We have already discussed some of the problems associated with the third condition, above, in the last chapter. And I shall address the problem of realism again in the next chapter. As for the second condition, I think we can generally agree that there is at least *apparent autonomy* in the ways in which we direct our selection of variants. To what degree--if at all--one is *free* in devising conceptual

models is, itself, an issue over which many are divided. However, we may want to briefly consider the issue this way. If we do lack information relative to a particular perspective in our belief system, and the problem of doxastic voluntarism/involuntarism is itself an issue in which we lack such information, then it follows that we should accept the second condition of goal-direction, above, with the qualification that we have at least *apparent autonomy* in selecting and directing variants in pursuit of a particular goal in response to a lack of knowledge.

This leaves us to consider the first--and I believe the most important--condition of goal direction: the acknowledgement of a lack of knowledge for which such a selected conceptual variant will account. As we noted last chapter, the eventual move from blind to goal-directed variation involves the *developed ability* to acknowledge that, relative to one's particular perspective(s), there is a lack of knowledge (or information), and that this lack may be remedied by satisfying specific conditions which define a particular 'goal'. This presupposes that there are means which can direct one in accomplishing these goals. In other words, criteria emerge which further guide or direct one's scientific beliefs. And one's goal is accomplished by satisfying the specified, accepted criteria. Epistemically, once goals become consciously directed, one has developed an awareness of a lack of knowledge and the goal represents the directions towards which one moves to account for this lack of knowledge.

In directing one's goals, one consciously attempts to 'fill in the gaps', so to speak, for which one's particular perspective does not account. In the transition from blind to goal-directed variation, from know-how to propositional knowledge, or from biology to culture, what we see emerging is a definition of ignorance as a lack of information relative to particular perspectives. A perspective is composed of beliefs acquired and revised according to reliable law-governed processes which are

externally justified. Metaphorically, we can conceive of this lack of information as gaps, holes, or *lacunae* relative to any particular perspective.

In science, beliefs are acquired and revised and may be abandoned as one's environment changes.⁵⁰ As new concepts emerge and new models develop, gaps or 'lacunae' emerge as problems or questions which need to be answered or filled in. In the last chapter, I argued for a coherence of beliefs while explicitly recognizing the circularity of coherentism (a point Campbell also made explicit). And we had also seen Vollmer's description of specific coherent circles being virtuous rather than vicious depending upon the explanatory power of a coherent system. It follows, then, that if ignorance emerges as gaps within a particular coherent perspective, the fewer the gaps, the stronger the power of explanation, the more virtuous the circle. What determines 'explanatory power' are communally accepted criteria such as parsimony, consilience, experimental and predictive success, etc. Since neo-Darwinian epistemology produces a foundationless epistemic system i.e. a system which is coherent, there is no further justification required for the above criteria other than their particular explanatory and functional utility.

Ignorance emerges as a lack of information or gaps which may be filled in relative to a body of background information. The background information has been accepted and used in developing a particular perspective because it has satisfied specific criteria. An evolutionary account of knowledge maintains that the criteria e.g. simplicity, consilience, prediction, explanatory power, etc. as well as methods or forms of reasoning used to satisfy these criteria e.g. induction, deduction,

⁵⁰ We must remember that, if we accept an evolutionary epistemological account of ignorance, we are consciously presupposing a hypothetically realist, common sensical world in which both genotypical and phenotypical features go through periods of stasis and change.

analogy, etc., emerged as a result of common sense interactions between mankind and his environment. Ignorance as lacunae is acknowledged only against the background of currently established beliefs. As Bernard Williams states:

Our concerns about what we do not know can get a real and compelling grip on us only if there are some things that we do know...What casts suspicion on everything casts suspicion on nothing: even the common garden paranoid needs his exercise book of carefully researched facts. Our suspect assurances will be undermined...only by an interpretive attention which is selectively directed, and which accepts the materials that are needed if its direction is to be intelligible (Williams, 1995, p. 26).

And so ignorance emerges as a lack of knowledge relative to a particular perspective from which such gaps emerge. According to this definition, the accumulation of beliefs and the emergence of ignorance is an ongoing dynamic process. New ideas flourish and old ones perish based on currently accepted criteria. The development of new methods and models in which to articulate an understanding of various states of affairs is historically dependent on previous theories which become modified, revised and transformed.

Usually, the *cumulative* process of science is metaphorically apprehended as a 'positive', ever increasing sum. However, it also could be conceived as the 'negative'-in the photographic sense of the term--of an activity geared towards the relentless construction of ignorance, an architecture of holes, gaps, and lacunae, so to speak (Bouissac, 1992).

The lacunae definition of ignorance accounts both for blind and goal-directed variation. Prior to conscious reflection viz. a sophisticated language, gaps would have been filled in blindly through continuous trial and error and the degree of success in gap-filling would be measured in fitness or adaptation. After conscious reflection and sophisticated languages developed, so too would hominids develop the ability to consciously acknowledge a deficiency relative to specific desires, curiosities, etc. In the development of conscious reflection and goal-direction of variants, decisions would have

been made--some fortuitous, others devastating.

(iii) The Strategy of Ignorance in Neo-Darwinian Epistemology

Soren Hallden has examined the concept of evolutionary ignorance in decision theoretic terms. He believes the process of evolution proceeded from a stage of blindness and stupor to one of insight and mental ability.⁵¹ And this gradual development is the result of constant failed and successful evaluative and existence gambles. There are times when, in lacking a sufficient amount of information, gambles must be taken. Sometimes the gambles pay off with success i.e. continued existence, and sometimes they do not i.e. sickness or death. In some cases, the success or failure of the gambles can determine either survival or extinction.

Prescientific nutrition theory may be represented as the outcome of successful gambling activities, where success has stabilized a group of useful and pleasant beliefs and practises, and failure has eliminated poisonous and nutritionally deficient substances (Hallden, 1986, pp. 153-154).

Hallden also uses the notion of gambling to explain the later sophistication of scientific theories:

University learning has its roots in non-academic traditions...The first general principles within the field of science were guided by ideas of more primitive origin...Indeed we all know that science is a development of everyday common sense. But it should be acknowledged that what we call 'common sense' is an extremely extensive epistemic gambling system (Hallden, 1986, p. 154).

Hallden has touched upon a very unique aspect of evolutionary ignorance. The notion that gambles had to be taken due to lack of sufficient information is consistent with the Lacunae definition of ignorance. For the Lacunae definition states that ignorance emerges relative to an already established belief system. And so it is interesting to consider how one might react when confronted with situations, the analysis of which are foreign to one's particular set of beliefs. In the early stages of

⁵¹ This does not suggest, of course, that evolution is naturally, teleologically progressive.

exercising common sense reasoning, one learns through trial and error, selective pressures, epigenetic rules, existence gambles, etc. Let's return to our hominid example where S is ignorant of p (where p = the berries on the bush are either nutritious or toxic). At the hominid's disposal are crude forms of induction and analogy i.e. comparative measures which can be applied to similar cases. Maybe he has had similar looking berries which provided sustenance. However, if the berries are unique to his experiences, he lacks the analogous or comparative aspect and must rely, instead, solely on the keenness of his senses, his bodily reactions, and the desperation of his particular state of hunger. When confronted with unique situations requiring existence gambles, I believe there are only four possible outcomes:

1. If S gambles and loses, he perishes and risks sickness or death.
2. If S gambles and wins, his hunger is not only satiated but he also adds more information to his current belief system which may be of considerable benefit in the future.
3. If S gambles and becomes ill, he loses current nutritional benefit but gains some consolation in the form of information of what he should not eat in the future.⁵²
4. And finally, if S chooses indifference i.e. does not gamble at all, he will require other sustenance--a choice not always available based on current foraging means.

From something as fundamentally basic as daily sustenance, Hallden believes lies the roots of reflective thought in early hominid thinking. Reflection tells us that survival makes selection a necessity--if you eat without discrimination, there is a considerable risk that you will gorge yourself on something which upsets you, or kills you (Hallden, 1986, p. 156). The hard-wired rules for early hominid survival were fairly basic:

⁵² Echoing Bismark and Nietzsche, if the berries do not kill the hominid, they may make him stronger by increasing his knowledge to avoid them and perhaps, by way of analogy, similar berries in the future.

- a) Eat.
- b) Don't get eaten.
- c) Procreate.

This is a scaled-down version of the four F's of survival: Fight, Flight, Feeding, and Procreation. Gap-filling at this level could be accomplished blindly. In this regard, Hallden speaks favourably of the stimulus-response pattern (S-R scheme) of John Watson, E.L. Thorndike, and Clark Hull. External stimulation and internal drive together form the stimulus which sets off the response. Such reaction patterns are moulded through the influence of success and failure--knowledge which takes the form of a reaction pattern belongs to the behavioral levels, and we do not have to ascribe mental life to plants and animals which also exhibit these patterns of behaviour--consciousness is not a prerequisite. Hallden echoes Wilson and Lumsden's notion of epigenetic rules by stating that later hominids would have gradually developed the ability to distinguish similarities and dissimilarities in their environment. As we noted earlier, he refers to the character of finding phenomena similar or different 'dispositional knowledge' and considers how such dispositions may be innate:

A moment's thought reveals that a disposition to find good analogies, to see things as similar which should be regarded as similar, and to regard things as different which should be classified as different, really amounts to an ability for good generalizations and appropriate inductions. If evolution has given us feelings of similarity and difference which to a certain degree are appropriate, one may truly say that we have been born with an innate knowledge of great value and considerable scope. This machinery for identification and discrimination is a processing unit for practical inductions, and as such a form of knowledge (Hallden, 1986, p 162).

Hallden refers to Thorndike's two classical principles, the laws of effect and exercise, to further his point: Reward strengthens the link between stimulus and response, punishment weakens it, repetition strengthens it (Hallden, 1986, p. 167). It is in this manner that Hallden imagines that the process of

evolution proceeded from a stage of blind stupor to one of insight and mental ability.

Plants and animals are entirely unconscious, and the development of consciousness is dependent upon the growing complexity of the brain...We are led to a belief according to which the understanding of organisms has evolved in two steps, the first purely behavioral and free from any admixture of consciousness, the second partly behavioral, partly mental (Hallden, 1986, p. 168).

Hallden is referring to the transition between blind and goal-directed variation (or the gradual evolution of consciousness and culture from selective pressures). In both blindly and consciously directing our goals, Hallden believes the long run effect of evolution guards the survival of true belief, and shortens the life-span of incorrect convictions.

My point of departure in the present work has been the admission of a miracle, that of human knowledge. My object has been to give an external explanation of this miracle, on the basis of facts already accepted. I have tried to show that the miracle is divested of its wonders, if we take into consideration the effect of quite simple mechanisms. Human knowledge has, if I am right, been made possible through numerous judicious choices and the survival value of truth (Hallden, 1986, p. 177).

Evolutionary epistemology articulates what I have called the Lacunae definition of ignorance i.e. that gaps emerge as problems or questions unaccounted for by particular perspectives. And we have seen how this definition of ignorance would apply in both blind and goal-directed variation. To further our evolutionary account of ignorance, we now need to consider the various ways in which a knowledge agent can be ignorant relative to a particular perspective.

(iv) Types of Ignorance

Evolutionary epistemologists are in general agreement that language is contingent and was developed according to various selective pressures. Terms like 'certainty', 'correspondence', and 'internal justification' are by-products of a sophisticated language and have limited referential meaning. With the explicit distinction between ontologically ultimate and regionally utilitarian

beliefs, evolutionary epistemologists often dispense with such notions and consider knowledge in terms of `reliability', `coherence', and `external justification'. If language, cognition and reflection are products of selective pressures which are themselves contingent--the variants of which are blindly selected--then perhaps our concepts produce only diverse scientific perspectives, not blueprints which actually mirror the precise workings of the world. Although evolutionary epistemology presupposes realism, it is a minimal form which acknowledges the continued existence of the external world--complete with various living and non-living things--but stresses the active and subjective role the evolved mind (or brain) takes in describing and understanding the world. As such, there is an explicit recognition that humans devise various perspectives in understanding and interacting (with) the world. Whether or not, and to what degree, any language can describe the world in an ontologically ultimate sense is not known. For we lack the conceptual means by which to objectively establish foundational criteria.⁵³ It is for this reason that we can acknowledge that ignorance, as a lack of knowledge, emerges relative to a particular perspective.

From an evolutionary perspective, the origin and development of different perspectives are due to one's particular historical setting--what I have referred to in Chapter Three as *facticity*.⁵⁴ Relative to our current facticity, there emerges a reflective form of ignorance in the form of gaps or questions which we can pose and attempt to answer. Our ignorance which emerges relative to a particular perspective may or may not be remediable given the stringency of the criteria used to evaluate new information. As we have seen, accepted criteria in evolutionary epistemology includes

⁵³ This, of course was explicitly recognized by the Pyrrhonians as the `problem of the criterion'.

⁵⁴ Not to be confused with Heidegger and Sartre's use of this term.

beliefs generated by law-governed procedures, which hang together or cohere (in virtuous circles).
are externally justified, and further satisfy the criteria of consilience and simplicity.

These criteria may function only implicitly, but they form a necessary subset of criteria governing the development of scientific thought throughout its history. Without such norms, we would not be dealing with the selection of *scientific* ideas. The criteria thus aid historians of science in distinguishing their subject from other cognitive occupations. It should be stressed, however, that these selection criteria are themselves the result of previous idea generation and continuous selection, processes by means of which science has descended from protoscience--just as the mammals have descended from the reptiles. The complete set of selection criteria define what in a given historical period constitutes the standard scientific acceptability (Richards, 1987, p. 582).

An evolutionary epistemologist cannot claim that such criteria lead to objectivity. He can only state that these criteria currently offer a plausible means by which to establish the explanatory power of particular statements. According to the evolutionary epistemologist, ignorance is factitiously perspectival. What we do not know relative to what we claim to know depends on our current historical setting which is relative to various natural and cultural factors such as language, logical systems, technologies, etc., which have developed gradually over an extended period of time. We do, so to speak, stand on the shoulders of others when we acquire and revise beliefs.

According to our facticity, and relative to any particular perspective, there are questions we simply cannot ask. That is to say, we currently lack the conceptual means for such articulation. For example, Aristotle could never have considered and discussed the half-life of various uranium isotopes or current methods in gene therapy. His scientific understanding of the world at the time was relative to the language, technology, and advancements of the day. There are gaps or questions which will arise in 2,000 years (given continued human survival) which we cannot ask for the same reasons. As Williams states:

With regard to knowledge that people may acquire in the future...we do not have any such conception. It was a positivist error, to which no-one now is attached, to suppose that the fundamental vocabulary or conceptual resources of science are fixed, and that what will be discovered in the future can only be new facts or theories expressible in that same vocabulary. On the contrary, we believe that theoretical advances typically consist of introducing new concepts, and that those concepts may not be strictly commensurable with concepts that we presently have. I do not think that this need lead to a radical relativism; but it does mean that future science may contain theoretical innovations which, as things are, we could not understand at all (Williams, 1995, p. 30).

Williams goes on to say that:

...future discoveries, we are assuming, would be *discoveries*, which is to say that they could constitute knowledge. But we cannot know what that knowledge would be, for the radical reason that we have no ways of expressing it; consequently we cannot know what it is exactly that, in lacking that knowledge, we do not know (Williams, 1995, p. 30).

In evolving from a state of blind to goal-directed variation, we can recognize a lack of knowledge relative to particular perspectives. The notion of abduction or of proposing viable hypotheses as causal explanations of specific behaviour is a formalized step in filling in gaps. It is a first step in satisfying our curiosity—a drive which is fuelled by a reflective ignorance. Our factitious ignorance is the first type of ignorance we have identified from our understanding of evolutionary epistemology. Relative to any particular perspective, there are two more types which emerge. Each type can be defined according to the relationship in which problems develop and questions can be posed and responded to relative to a particular perspective.

The second type of ignorance is, relative to a particular perspective, remediable. That is, from some perspective, there are questions we can ask and answer in relation to specified criteria e.g. reliability, coherence, external justification, etc. Relative to whatever languages, logical systems, concepts, models, theories, etc., which we develop, we can fill in gaps consistently according to

background information. This type of ignorance emerges at both the common sense and the scientific level. I can, for instance, ask a TTC employee what time the next subway arrives at Dupont Station. and he can respond with an appropriate approximation. I can also ask a chemist for the relative atomic mass of cesium and she could answer by saying that it is 132.905. Both instances are testable i.e. I can verify or falsify either through observation. In this way, commonly understood and communally accepted beliefs can allow a knowledge agent to remedy his ignorance relative to background information.

The third type of ignorance involves gaps which appear as questions relative to a particular perspective, which are currently undetermined. That is, relative to particular perspectives, we can acknowledge that there are questions which have not yet been satisfactorily answered. It is this type of ignorance that we see addressed in Duncan and Weston-Smith's (eds.) *The Encyclopaedia of Ignorance*. In this work, a number of the world's leading scientists are asked to reflect on what their disciplines currently cannot explain but perhaps may some day be able to explain. In the editorial preface, Duncan and Weston-Smith state that:

Compared to the pond of knowledge, our ignorance remains atlantic. Indeed the horizon of the unknown recedes as we approach it. The usual encyclopaedia states what we know. This one contains papers on what we do not know, on matters which lie on the edge of knowledge. In editing this work we have invited scientists to state what it is they would most like to know, that is, where their curiosity is presently focused. We found that this approach appealed to them. The more eminent they were, the more ready to run to us with their ignorance. Clearly, before any problem can be solved, it has to be articulated...A decade hence many of the problems mentioned in these pages will have been solved. It could be said that science has to date advanced largely on the elbows and knees of technology. Even the concept of relativity depended on technology to prove its validity. In some disciplines we have already reached the point when the Heisenberg principle applies and the observer alters the object observed. And it may well be in cosmology especially, in our attitudes to space and time, that our concepts are our limiting factor. Perhaps imagination is a part of our technology? Perhaps some answers depend only on asking the correct

question? (Duncan, Weston-Smith, 1977, p. ix).

With entries from eminent scientists such as John A. Wheeler, Roger Penrose, John Maynard Smith, Francis Crick, Roger Sperry, etc., the book illustrates well how within differing scientific perspectives e.g. physics, chemistry, biology, immunology, nutrition, mathematics, ecology, etc., gaps emerge as questions or problems yet accounted for or remedied by the current concepts, theories, models, etc., of these particular perspectives. Whether or not we can remedy our current state of ignorance or "fill in the gaps", is dependent upon various factors such as conceptual, technological, and monetary constraints.⁵⁵ And this is directly related to our facticity. That is, no matter whether gaps in our perspectives are sufficiently 'fillable' depends on our current historical setting which is relative to various languages, logical systems, technologies, etc., which have developed gradually over a long period of time. We simply understand the world according to particular perspectives which are a product of our current state of development. These perspectives are dynamic and are continuously expanded and revised. However, they are always revised based upon prior background information, however specious.

In the next chapter, I shall draw some conclusions concerning what evolutionary epistemology has informed us about the concept of ignorance and also, what this information can tell us about evolutionary epistemology.

⁵⁵ For information concerning the monetary and technological constraints on the development of science see Nicholas Rescher's *Scientific Progress* (1978), and John Horgan's *The End of Science* (1996).

CHAPTER FIVE

CONCLUSIONS: SYNTHESIZING THE FORMAL COMPONENTS OF IGNORANCE WITH THE MAIN ISSUES OF EVOLUTIONARY EPISTEMOLOGY

It was the purpose of this dissertation to examine what evolutionary epistemology could tell us about the concept of ignorance. And from our examination, I believe we have broadened our understanding not only of this concept, but of the main issues of evolutionary epistemology which structured our examination.

First of all, we have found that prior to any account of how evolutionary theory may shed light on epistemological issues, it was imperative to initially establish a clear account of what evolutionary theory is (and what it is not). I have argued for the New Synthetic or neo-Darwinian theory of evolution. And in so doing, I have strongly come out against the opponents to this standard orthodoxy: the pluralists (represented most ardently by Stephen Jay Gould). Although rapid speciation following extended periods of stasis (allopatric speciation or punctuated equilibrium) may account for the gaps in the still incomplete fossil record; and although neutral genetic drift and large scale natural catastrophes may influence the direction of evolution, we simply cannot deny that, at the level of the phenotype, natural selection is the central mechanism responsible for species change, adaptation, and survival. I have also shown that the pluralists' auxiliary processes are just that: auxiliary i.e. complementary, secondary, etc., and that they can fit well into the adaptationist program provided that they are viewed *as* auxiliary processes to natural selection and *not* as alternative explanations for evolution.

Secondly, we have seen that, from an understanding of evolutionary theory as neo-Darwinian, we can provide a plausible account for the development of cognitive mechanisms which

eventually gave rise to the development of language, consciousness, reflective reasoning, and science. I have argued against Popper and Campbell's account of the EET program of evolutionary epistemology and for the EEM program. I have shown how Campbell's (and hence, Popper's) ignorance tautology is misguided. Campbell's tautology states that in going beyond what is already known, one cannot go but blindly, for if one were to go wisely, this indicates already achieved wisdom of some sort (Campbell, 1974a, p. 422). To Campbell, when one extends knowledge beyond what one already knows, one must do so blindly, stupidly, haphazardly. And so Campbell sees scientific evolution as *analogous* to organic evolution i.e. both proceed 'blindly'--that is, randomly. But I have argued not only that scientific evolution is not analogous to organic evolution in this manner, but that the cognitive mechanisms which are necessary for scientific inquiry, developed (literally) from biological mechanisms e.g. natural selection and epigenetic rules. I have argued that there are several disanalogies which show why we should reject the EET program, the strongest of which is most convincingly revealed in the distinction between the types of variation in both. Whereas organic evolution proceeds in a non-progressive manner according to blind or random genetic variation and a competition for selection over which variant best 'fits' its environment, scientific evolution proceeds by goal-directed variation--that is, the object of science is to come up with a better and better understanding of the world. In this way, we can observe, at the very least, a comparatively *progressive* nature to scientific evolution. Our current theories simply possess greater explanatory power than those of the distant and even fairly recent past.

In scientific reasoning, we do not wildly throw up hypotheses because we are 'blindly' ignorant. We are not just taking shots in the dark. We have at our disposal, entire fields of research--particular perspectives--from which to formulate new hypotheses, theories, abductions, etc. Relative

to these perspectives, we acknowledge gaps (or lacunae). This is necessary (but not sufficient) for the procedure of abduction. We are thus 'reflectively ignorant' or 'cognizant of a lack' of information (propositional knowledge) or procedural technique (know-how knowledge) relative to those perspectives. Acknowledging these gaps focuses more clearly our abductions, hypotheses, etc., and further distinguishes scientific evolution from organic evolution.

Thirdly, in explaining how evolutionary processes can account for the development of cognitive mechanisms (which were necessary for the development of science), I have shown how natural selection would have favoured those hominids who learned best how to direct variants towards specific goals. As we have noted, above, scientific evolution differs significantly from organic evolution *because* there is the ability to goal-direct variants. The process of goal-direction could not have developed *unless* one had a cognizance of a lack (of information or procedure) which sharpened the focus of the specific goal in question. The cognizance of lack or 'reflective ignorance' is always relative to a particular perspective. Once the necessary physical features were sufficiently in place i.e. enlarged brain size, developed vocal tract, etc., the development of more sophisticated languages and the use of epigenetic rules would have assisted our ancestors in survival. The epigenetic rules are the mediating factor which bridges the gap from blind variation to goal-directed variation, know-how to propositional knowledge, and biology to culture. Whatever beliefs our ancestors held, they would have been acquired and revised through trial and error, gamble and confirmation. But gradually, our ancestors would have recognized their lack of knowledge relative to their particular perspectives. However well they applied the epigenetic rules, would determine their success rate. And we must not forget that there is a strong connection between the efficacy of the epigenetic rules and an interaction with the commonly-sensed world. For example, no matter

how strong one's convictions, you cannot sustain life by consuming, say, sand. If, for whatever reason--causal, quasi-religious, etc.--a hominid should believe this, it would not be long before he perished. Likewise, with any other beliefs which drastically conflicted with common sense reality. You simply cannot believe just anything--there is some indication as to what you can believe by acting on those beliefs in the commonly-sensed world. This is the level at which our ancestors understood and interacted with the world.

We have determined that the state of ignorance early in the development of cognitive mechanisms would have been survival-based. If hominid A cannot remedy her ignorance concerning the danger of tar pits or quick sand, she will perish. There are basic properties and characteristics experienced and understood at the common sense level. They work the same for chipmunks as they do for elephants. And early hominids need never have known specifically about forces, laws, or any other way in which science describes the common sense world in order to survive. They simply needed to observe and repeat those actions favourable to survival, avoid those which were not, and use crude modes of reasoning e.g. induction, deduction, analogical reasoning, to build on their current body of beliefs. During this period of hominid development, ignorance kills.⁵⁶ Those hominids which could remedy ignorance in various circumstances by developing means by which to better understand these properties and characteristics, stood a better chance of surviving and reproducing than those who did not.

Fourthly, we have noticed the amount of importance the development of more sophisticated

⁵⁶ This, of course, is true in any time period. However, it would have been felt much more acutely in the early period of hominid development. Although recent views about unforeseen consequences of biological and chemical interventions in nature can also point to the present state.

languages would have had on the development of cognitive mechanisms. From Campbell, we have seen that when considered in terms of evolution, language has no *a priori* status. We must consider language not as the medium which shall guarantee absolute objective truth, but as a contingent tool which had developed purely because it allowed its users to better adapt to a specific environment. Once we understand language in these terms, we can see why it would have greatly increased a hominid's chances for survival and reproduction. For language among all animals--dancing bees, pheromone tracing ants, hominids, etc.--has the social function of economy of cognition. Linguistic representation, though contingent and localized, would have greatly improved social interaction, and the communication and understanding of one's environment. With an expanded vocabulary, revisions to survival tactics would increase and improve. Goals would be consciously acknowledged and the procedure of trial and error, gamble and confirmation would also increase. The acknowledgement of goals is a direct response to a want or need. The want or need represents a 'lack' of something. In the early stages of hominid development, needs would have been pursued unreflectively. Prior to a sophistication of language, it is difficult to say to what extent our ancestors were consciously aware of the causal relationships between needs and fulfilment. With the development of more sophisticated languages, however, needs or wants can be better understood and articulated as 'lacks', gaps or lacunae relative to (factitious) belief systems. The more sophisticated the language(s), the more a hominid would have become aware of the relationship between what he knew and what he wanted to know. The control over directing variants was due, at least in part, to the application of the epigenetic rule of reflective ignorance i.e. the recognition of a 'lack' or need or want relative to one's particular perspective or belief system. When consciously applied, this epigenetic rule of a cognizance of a 'lack' of information would have provided sharper focus to one's curiosities and

inquisitions. Curiosity and inquisition can be blind or directed. In the case of the former, we can say that one is blindly ignorant i.e. one does not know that one is ignorant (relative to a particular perspective). In the case of the latter, one is reflectively ignorant i.e. one desires to know something for which his current belief system cannot account. The 'goal' in this case, is the intention to fill in this explanatory 'gap'. In this sense, ignorance is considered to be gaps, holes, or *lacunae* which emerge relative to a particular perspective. We must think of these lacunae in the following metaphoric way: ignorance is a lack of knowledge in much the same way a hole⁵⁷ is a lack of matter. A hole is recognized and defined by the matter which surrounds it. So too is ignorance defined by knowledge claims which fail to satisfy specific criteria. The holes or gaps always must emerge relative to particular perspectives. In early hominid development, the success of filling in these gaps would have been measured by functional utility. After more sophisticated languages developed, success would be measured according to accepted epistemic criteria e.g. simplicity, power of explanation, consilience, etc. If we maintain a neo-Darwinian understanding of epistemology, then we must realize that the criteria which determines the acceptability or non-acceptability of our theories, concepts, beliefs, etc., is derived from a language which developed through biological mechanisms i.e. natural selection and epigenetic rules. And so the neo-Darwinian cannot attribute any *a priori* status to either language or the criteria he uses to assess the satisfaction of his goals. In this way, the explanatory power of the neo-Darwinian is limited. And for good reason.

The fifth point concerning the concept of ignorance that we noted is that both neo-Darwinian evolutionary theory and epistemology cannot exceed beyond the explanatory limits of non-

⁵⁷ See Roberto Casati and Achille C. Varzi's *Holes and Other Superficialities*, MIT Press, (Bradford), 1994, Cambridge, MA.

convergent hypothetical realism. To do so, is to extend science into the realm of metaphysics. The inability to apply Darwinian theory and epistemology to areas it was simply not designed to explain is the result of what I have defined as 'factitious ignorance'. That is, what we now know of evolutionary theory determines not only how we can talk about the concept of ignorance, but what the approximate extent of its explanatory power is. In other words, our understanding of ignorance, in turn, provides us with sharper distinctions demarcating what neo-Darwinian evolutionary theory can and cannot explain.

We noticed in Chapter One that both Dennett and Ruse have mentioned that Gould's motives for pluralism may not be purely scientific. That is, he may oppose strict adaptationism because it reduces humankind to the level of a blindly operating biological machine--albeit, a very complex one. And perhaps if Gould can rescue contingency in some way, he preserves our autonomy and makes us moral, accountable agents. Perhaps Gould is fearful to consider the ultimate ramifications of Darwinian evolution i.e. that we are simply the product of an algorithmic process. Popper referred to Darwinism as being a metaphysical position. On one level, he was right; on another, he was wrong. Darwinism can become a metaphysical position but it need not be. Although he was fully aware of the ramifications of his theory, Darwin intended it to be a good intermediary explanation of the behaviour of natural organisms. But it is difficult to keep a good theory down at the level of science. Someone will always read more into it more than it actually does--or at least *should*--say. Daniel C. Dennett, Richard Dawkins, Alvin Plantinga and Philip Johnson are just such people.

When Dennett teases out the ramifications of natural selection as a 'universal acid', his position becomes a form of metaphysical naturalism in at least two distinct ways. First, he presupposes that direct or some form of direct realism obtains. And secondly, he dismisses outright

any alternative to his materialistic programme. Does Dennett assume that he is simply stating the inevitable consequences of such a theory? He believes that people such as Gould are reluctant to surrender the possibility that there is an unknown skyhook which can account for the evolution of species. And, after all, this is what we are really talking about, isn't it? Dennett is assuming that all--or at least most--of the relevant evidence is in. The open-endedness of the future and the possibility of future evidence does not appear to sway Dennett in the least from his dogmatic, unyielding conviction that he is right. That is not to say Dennett is wrong. On the contrary, he may very well be right. In fact, based on the current evidence, he has argued his case very well. However, Dennett is not practising good science. He has failed to exercise restraint in the face of incomplete evidence. And in so doing, he may eventually be proven wrong (not on a metaphysical but a scientific level). Although atheistic materialism may very well follow from natural selection, we simply do not know this. In this respect, we are indeed ignorant. And for good reason. We may have some indication that atheistic materialism follows from neo-Darwinian evolutionary theory, but this is not sufficient. There may be other causal factors at work in the universe for which we have, as yet, accounted. Dennett takes causality--blind, algorithmic causality--all the way back to the origin of the planet, and then pushes further on. He saw the handwriting on the wall, and anticipated confrontations of possible unaccountable causal forces which may have "started the ball rolling" so to speak. Dennett marries the notion of natural selection with the cosmological concept of (Wheeler's) oscillating universe in order to account for a non-theistic, perpetual, self-originating universe.⁵⁸ But exactly how much thought has he given to this process? And to the two other possible fates of our currently

⁵⁸ See Dennett, 1995, pp. 179, 181-182.

expanding universe i.e. steady-state and continuous expansion? He claims that consistency and simplicity are in favour of the oscillating universe but he never mentions what led to this conclusion. Does he know that astro-physicists have made general calculations that if there is more than one atom per 88 gallons of space in the universe there will be enough gravitational force to begin contraction and an inevitable Big Crunch? But it is questionable as to how much matter there is in the universe. Since there is currently no way to determine the precise amount of 'dark matter' in the universe, or the specific mass of neutrinos, or whether protons decay, etc., we are left without a precise calculation of the fate of our universe. Yet Dennett assumes that the oscillating model is the correct one based on its consistency and simplicity.

On the whole, I believe Dennett has extended Darwinism beyond the limitations of its explanatory power. He uses natural selection in places where it would logically follow IF there were no other causal factors--or even the possibility (natural, not logical)--of other causal factors. But all of the evidence is not in; and may never entirely be in. Dennett has failed to remember that the language of science is subjective and metaphoric and never the language of reality itself (Campbell, 1975, p. 1120). And, as we saw above, Dennett lacks scientific prudence. He simply assumes that there are no other possible causal factors. But since he shares the same ignorance about aspects of the universe that we all share i.e. its cosmological origins and destiny, various unknown causal influences, etc., he should have stated his thesis in the form of a conditional such that: IF evolution is strictly adaptational, blindly algorithmic, etc., AND it accounts for the evolution of organisms AND most, or at least, a sufficient amount of evidence has been gathered, THEN it follows, that we (that is, humans) like all other species, originated and evolved in the way in which Dennett has interpreted Darwin i.e. as atheistically materialistic.

It comes as somewhat of a shock to see Dennett, a learned philosopher, extend his regional beliefs of evolution into the realm of ultimate truth. In so doing, he is turning science into metaphysics. And although this move is implicit in other areas of science, one must always qualify this step with the appropriate set of conditionals. Otherwise, Dennett is forcing science to do what it was not designed to do:

Once we take 'the world' to be the world as described by science, then the presumed fact of the truth of science is not a fact in the world, since science does not assert its own truth. Once we presume the truth of science as a datum for explanation, we move to a level of explanation where scientific evidence does not count (Skagestad, 1978, p. 618).

Perhaps Dennett goes too far for a reason. After all, this is exactly why he believes Darwin's idea to be so dangerous, i.e., as a universal acid, it cuts through our most cherished beliefs about our place in the universe. But when he makes this move, he extends natural selection beyond what we can say scientifically. Dennett should have displayed greater scientific prudence by avoiding such metaphysical trappings. This is not to say that he should not acknowledge the possible philosophical ramifications of Darwinian theory. On the contrary, I find his treatment of the connection between biology and epistemology to be among the best in the field. What I wish to make clear is that one needs to be skeptically cautious about how far Darwinism can and should extend. A good Darwinian should also be a good skeptic insofar as one must recognize the limitations of the very language and logic of the science we use. Since we cannot extend science into this metaphysical realm, we should understand Darwinian evolutionary theory as best we can: as an intermediary causal mechanism. And once such an understanding is achieved, we can consider what this can tell us about various issues in epistemology.

When the explanatory power of Darwinism is exceeded it can be viewed by some to be a

secular religion. Since Darwinism tells us who we are and where we came from, it is a starting point for speculating about how one ought to live, believe, and value. From here, says Ruse, some believe it is just a short step to sex, drugs, and contempt for capitalism. Philip Johnson states that the outlook on family morality as a whole rightly becomes entirely different once the death of God becomes fully assimilated as knowledge (Johnson, 1995, pp. 31-32). First of all, Johnson is trying to bridge the fact/value gap by claiming that description leads to prescription. But secondly, even if the ramifications of Darwinism were entirely atheistic and amoral, that does not mean we need to become so.

There have been Darwinians of the political and moral and religious right of a kind to make Johnson and his fellows look like escapees from the 1960s. Sir Ronald Fisher, for example, is certainly the most distinguished theoretical biologist in the history of evolutionary thought...He was also a Christian, a member of the Church of England, a conservative, a member of the British Establishment, and one whose social views were somewhere to the right of Louis the Fourteenth. There simply must be something wrong with the claim that Darwinism leads straight to the *Playboy* Philosophy (Ruse, 1998).

In his follow-up book: *Reason in the Balance: The Case Against Naturalism in Science, Law and Education* (1995), Johnson makes the distinction between "methodological naturalism" and "metaphysical naturalism". The former is the attitude by scientists that one should explain as far as possible in terms of natural unbroken laws; the latter is the belief that unbroken-law-governed material is all there is to existence (Ruse, 1998). Johnson believes that although the scientist begins using methodological naturalism, he inevitably ends up with metaphysical naturalism. And this leads to atheism and complete moral licence.

We must realize first of all, that the connection between methodological and metaphysical naturalism does not necessarily obtain and that, even if it did, it would not lead to moral nihilism.

For there are many who are committed to methodological naturalism who are theists in every sense of the word. The current Pope is just such a person.

Recently, the Pope has come out four-square in favour of evolution and yet he reserves to God His traditional full power of action (John Paul II, 1997). How can this be? Two moves are made. On the one hand, a theist like John Paul II does not take all manifestations of God's miraculous powers to be in conflict with science working according to law...On the other hand, the theist argues (or feels free to argue) that at some points God simply overrides laws. The resurrection is surely such an event (Ruse, 1998).

Ruse states that even if Darwinism did imply atheism, there is no logical reason to think that such a person would be committed to moral nihilism.

In the last century, although people like Thomas Henry Huxley described themselves as agnostics, they were certainly atheistic with respect to Johnson's kind of God. Yet they were moral--boringly and obsessively moral--in a very conventional manner. Huxley met and admired George Eliot; but, given that she lived openly with a man to whom she was not married, he would not invite her to his own house to meet his wife and children (Ruse, 1998).

I must admit that there certainly are those who do, in fact, maintain that Darwinism implies atheism. We have already seen how Dennett maintained that Darwinism is a corrosive universal acid which cuts through our most cherished moral beliefs. But Richard Dawkins has long been an exponent of the relationship between Darwinism and atheism. And he bases this connection on at least two aspects of Darwinian theory.

First, adaptation accounts for the development and behaviour of organisms without having to bring in a supernatural explanation. And secondly, the problem of evil is intensified through our witnessing the constant struggle for survival in the natural world. To Dawkins, this understanding of Darwinism makes atheism the only option of integrity.

If Nature were kind, she would at least make the minor concession of anesthetizing caterpillars before they are eaten alive from within. But Nature is neither kind nor

unkind. She is neither against suffering nor for it. Nature is not interested one way or the other in suffering, unless it affects the survival of DNA. It is easy to imagine a gene that, say, tranquilises gazelles when they are about to suffer a killing bite. Would such a gene be favored by natural selection? Not unless the act of tranquilizing a gazelle improved that gene's chances of being propagated into future generations. It is hard to see why this should be so, and we may therefore guess that gazelles suffer horrible pain and fear when they are pursued to the death--as most of them eventually are. The total amount of suffering per year in the natural world is beyond all decent contemplation. During the minute it takes me to compose this sentence, thousands of animals are being eaten alive; others are running for their lives, whimpering with fear; others are being slowly devoured from within by rasping parasites; thousands of all kinds are dying of starvation, thirst or disease. It must be so. If there is ever a time of plenty, this very fact will automatically lead to an increase in population until the natural state of starvation and misery is restored (Dawkins, 1995, p. 131).

Dawkins concludes by saying:

The universe we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil and no good, nothing but blind, pitiless indifference. As that unhappy poet A.E. Houseman put it:

For Nature, heartless, witless Nature Will neither know nor care.

DNA neither knows nor cares. DNA just is. And we dance to its music (Dawkins, 1995, p. 133).

There are a number of problems with Dawkins' breach of the explanatory power of Darwinism. First, although natural selection does not make necessary an appeal to a creator, it does not make such an appeal impossible. Many have thought--including Darwin himself at the time when he wrote the *Origin*--that the Creator designs at a distance through unbroken law, but that He designs nevertheless (Ruse, 1998). And, as Ernan McMullin points out, one who argues for the sufficiency of evolutionary models may (if a theist) insist that the natural order itself is created, dependent on God for its very existence. As a theist, McMullin believes that (a Christian-defined) God created the universe but has allowed the evolution of organisms on earth to develop naturally i.e. without Divine

intervention. On the other hand, William Provine has argued that Christian belief is only compatible with evolutionary biology if we suppose that God "works through the laws of nature" instead of actively steering the biological process by way of miraculous intervention; and this, says Provine, is "worthless" and "equivalent to atheism" (Provine, 1987). But what is really at issue here, is confusion over the concepts of 'created' and 'designed'. Darwinism may have replaced a supernatural explanation for organic design.⁵⁹ But the cosmological question concerning creation is still open.

Secondly, although natural selection may focus our attention on the problem of evil, it does not create it.

[Evil] was a problem for Christian belief for centuries before Darwin. This means that, if you have found some way to reconcile evil with your religious belief, there is really no reason why Darwinism should disturb it. If you have not, then perhaps you will use Darwinism as part of your artillery, but that is another matter. The point is that Darwinism is not going to tip you into atheism. Either you are there already, or you are not and have no new compelling argument to be there (Ruse, 1998).

This is a point on which many would disagree. On the one hand, I think that one's faith in some form of a Creator will not necessarily be shaken by Darwinism if evil is reconciled with a strong belief in some ultimate moral plan. On the other hand, however, I think underlying Dawkins' and Provine's atheism is the notion that Darwinism more easily explains religion than religion can explain Darwinism. And pain and suffering seems to be better accounted for in a natural context than a supernatural one. It is difficult indeed to imagine how a benevolent God could possibly justify the unbearable pain and suffering of a two year old child dying of bone cancer, or any other countless

⁵⁹ By 'replace', here, I mean the physico-theological theories of earlier naturalists like John Ray and William Derham who had shown a pervasive presence in nature in means-ends relationships along with the apparent intentional adjustments of structure and instinctive behaviour matching the welfare of each specific organism. See McMullin, 1993, p. 305.

number of human atrocities which occur every day. Although it may very well be the natural atrocities which tips one in favour of atheism, given the choice between a benevolent God and blind, algorithmic law, the latter might often be chosen as the better explanation. In this way, however, one is pushing the explanatory envelope of Darwinian theory. For these matters are purely metaphysical in nature.

Since we are dealing with metaphysical matters, i.e. theism and atheism, we must stay our ground and remain both a good Darwinian and a good skeptic. That is, we should neither extend Darwinism nor epistemology into places they were not designed to go. As Ruse so aptly state:

The conclusion I am drawing is that you can and should step between the Charybdis of Johnson and the Scylla of Dawkins. If you buy the chief message of this book, you are going to accept a naturalistic account of... epistemology... If like me you are a sceptic, not knowing if anything lies beyond, then that is all you are going to get. You do not have a religion, but you have something instead. If you have a religion as well, then so be it. You can fuse your Darwinism into it. A Johnsonian contradiction between science and religion is not inevitable. But neither is Dawkinsian contradiction between science and religion. Most especially, a "Darwinist religion", in the sense that Darwinism is the religion, does not have to be part of one's package (Ruse, 1998).

Recognizing that one does not know what lies beyond a naturalistic account of epistemology, is to properly identify some current (and perhaps tentative) explanatory limitations of natural selection. Whereas Dennett/Dawkins/Provine and Johnson/Plantinga argue that Darwinism properly understood leads to atheistic materialism (and moral nihilism), we must resist this temptation. That is not to say that Darwinism *does not* ultimately lead to atheism. On the contrary, it may very well lead to this. However, the point to note here is the extent of the explanatory power of such a theory. And many--both atheists like Dawkins and theists like Plantinga--are tempted to extend natural selection beyond its explanatory limits. But as we saw, above, this temptation must only be carried

out conditionally. Science cannot extend into metaphysics because there is an explanatory limit to how far our concepts can extend. And our understanding of the concept of ignorance has clarified the boundary conditions concerning the explanatory power of our scientific concepts. Science is characterized by universality and utilizes methods favouring systematic observation, experimentation, generalization, and testing of explanatory hypotheses. Science does not test for God. Nor does it test for non-God. Science tests for those things about which we can all commonly sense and reason. Dennett and Dawkins have attempted to fill in the gap between science and metaphysics by maintaining that natural selection necessarily leads to atheistic materialism. On the other side of the spectrum, Johnson, Plantinga, and McMullin use [a] God to fill in gaps either consistent with or contrary to natural selection. But in the end, we must do what any good Darwinian and any good skeptic *must* do--understand the apparent limitations of rational explanation that our current scientific hypotheses (in evolutionary biology) provide us with. Natural selection is a very good intermediary position which explains consistently how we became what we are. But we must not extend this theory either too far back in time i.e. to cosmology, or too far ahead in time i.e. teleology, because the theory is limited in its range or breadth of explanation. The acknowledgement of this limitation of explanatory power is simply a responsible philosophical move which is made obvious by a clear understanding of the concept of ignorance. For it indicates that we have acknowledged a degree of ignorance concerning the explanatory powers of natural selection. We simply do not know that natural selection leads to atheistic materialism in the same sense as we know that natural selection is a very good intermediary causal mechanism which explains the way in which species have evolved. Where evidence abounds for the latter, the former must only be stated conditionally *because* it requires evidence that science cannot find. It is, in short, a leap of faith.

Understanding the limitations of rational explanation of current scientific hypotheses (such as evolutionary theory), has led to the sixth and final issue related to the concept of ignorance: skepticism. We have noticed that Cartesian skeptics like Unger have presented logically possible scenarios involving elaborate forms of deception because of the sophistication of language. By placing great epistemic weight upon the concept of psychological certainty, Unger has presupposed that language possesses special *a priori* status. We have seen that if we understand that language is a human invention, developed out of biological necessity and functional utility, then such status is reduced significantly. And it follows that we are not as ignorant as the Cartesian skeptic suggests. For neo-Darwinian epistemology shows that we can give up the notion of holding all knowledge in abeyance until the possibility of knowledge is first logically established, or until indubitable first principles of incorrigible sense data are established upon which to build (Campbell, 1974, p. 418). Due to the contingent survival-based nature of language, we cannot answer the Cartesian skeptic by providing some absolute foundation. But then, again, the burden of proof lies with the Cartesian skeptic to show us why we need to. We are what we are because of millions of years of evolution. If this is true, then this simple, common sense presupposition, reduces any threat of Cartesian skepticism in an instant.

But there is a form of skepticism which applies extremely well to a neo-Darwinian account of the concept of ignorance. We have noticed a 'Pyrrhonian spirit' to neo-Darwinian epistemology. Both Pyrrhonian skeptics and neo-Darwinian epistemologists make a distinction between common sense and metaphysical reality or beliefs which are ontologically ultimate and regionally utilitarian. This is in response to the exceedingly high level of scrutiny at which epistemic criteria can be placed. Satisfying such high levels of scrutiny such as certainty, internal justification, non-

pressuppositionless starting points, etc., may never be satisfied. Rather than waste time or concern over such unlikely epistemic pursuits, both choose to 'acquiesce to the appearances' and understand and interact in the world according to practical criteria. This is an acceptance of common sense reality and an implicit acceptance of external justification. That is, one is justified in believing p if p was produced by a nomic or law-governed procedure. Acknowledging that there is a world in which we are unable to establish objective knowledge, leads to the problem of the criterion and the presupposition of hypothetical realism; presupposing that there is a world describable at least in subjective terms, leads to a common sense (and scientific) understanding of the world; due to the contingent status of language and the problem of the criterion, the acquisition and revision of beliefs are justified externally and accepted according to how well they hang together with current beliefs i.e. coherentism. A better understanding of the concept of ignorance has shown us why the explanatory power of neo-Darwinian evolutionary theory and epistemology is always tentative and provides descriptive accounts 'up until now'. Any neo-Darwinian account must be an 'up until now' form of explanation due to the tentative and subjective nature of its own explanatory capabilities. If tomorrow, someone could genuinely show that induction should be abandoned as a form of reasoning in science and epistemology, we might find it necessary to alter our understanding of the world in an evolutionary context. Until then, we can continue to understand and interact in the world at the level of common sense.

So we have seen why a neo-Darwinian does not make philosophic or scientific assertions beyond the explanatory boundaries of his epistemology. It is because he has recognized explanatory limits to his theory of knowledge. When Ruse states that "we cannot get beyond the world of common sense to the world of metaphysical reality to check one against the other" (Ruse, 1998), he

is acknowledging an epistemic boundary condition--a condition of our epistemology--as a function of natural causes and mechanisms. He has recognized an inherent ignorance in our human capacity to know beyond which, neo-Darwinian theory cannot apply. As well, when he states that "I cannot get in touch with objective metaphysical reality to check that everything is working okay" (Ruse, 1998), he is reiterating Sextus's gold in the dark room metaphor. And this metaphor illustrates that we are indeed ignorant at this conceptual level i.e. we simply cannot satisfy criteria at this high level of scrutiny.

This concludes our analysis of an evolutionary epistemological account of the concept of ignorance. It was my intention to show why a neo-Darwinian account of this concept is epistemically significant. And I believe we now have a clearer understanding not only of the concept of ignorance, itself, but of the main issues of evolutionary epistemology as well.

Bibliography

- Aiello, Leslie. 1982. *The Concise Book of the Origins of Man*. Scarborough: Prentice-Hall Canada.
- Ammerman, Robert R. ed. 1970. *Belief, Knowledge and Truth*, New York: Charles Scribner's Sons.
- Annas, Julia and Barnes, Jonathan. 1986. *The Modes of Scepticism*, Cambridge: Cambridge University Press.
- Arduini Paolo, and Teruzzi, Giorgio. 1986. *Guide to Fossils*. Simon and Schuster: New York.
- Armstrong, David. 1973. *Belief, Truth and Knowledge*, Cambridge: Cambridge University Press.
- Axinn, Sidney and David. 1976. 'Notes on the Logic of the Ignorance Relations'. *American Philosophical Quarterly*, 13.
- Baldwin, James Mark. 1902. *Development and Evolution*. New York: Macmillan.
- Barber, C.L. 1972. *The Story of Speech*. New York: Apollo.
- Barham, J. 1992. 'From Enzymes to $E = mc^2$: A Reply to Critics', *Journal of Social and Evolutionary Systems* 15, 249-305.
- Barkow, Jerome H., Cosmides, Leda, and Tooby, John (eds.) 1992. *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. New York: Oxford University Press.
- Barnes, Jonathan. 1990. *The Toils of Scepticism*. Cambridge: Cambridge University Press.
- Barrow, John D. 1992. *Pi in the Sky*, Oxford: Clarendon Press.
- Bechtel, W. 1984. 'The Evolution of Our Understanding of the Cell: A Study in the Dynamics of Scientific Progress,' *Studies in the History and Philosophy of Science* 15, 309-356.
- Beck, L.J. 1965. *The Metaphysics of Descartes*. Oxford: Oxford University Press.

- Behe, M. 1996. *Darwin's Black Box: The Biochemical Challenge in Evolution*. New York: Free Press.
- Bennett, Jonathan. 1990. 'Why Is Belief Involuntary?' *Analysis*, Vol. 50, No. 2, March.
- Blackwell, R.J. 1973. 'The Adaptation Theory of Science', *International Philosophical Quarterly* 13, 319-334.
- Bonjour, Laurence. 1980. "Externalist Theories of Knowledge", *Midwest Studies in Philosophy V*.
- 1985. *The Structure of Empirical Knowledge*. Cambridge, Mass.: Harvard University Press.
- 1994. 'Externalism/Internalism' in *A Companion To Epistemology*. Cambridge, Mass.: Basil Blackwell Inc.
- Bouissac, Paul. 1992. 'The Construction of Ignorance and the Evolution of Knowledge'. *University of Toronto Quarterly*, Vol. 61, No. 4, Summer.
- Bradie, Michael. 1986. 'Assessing Evolutionary Epistemology'. *Biology and Philosophy*, 1: pp. 401-450.
- 1994. 'What Does Evolutionary Epistemology Tell Us About Philosophy and Religion?' *Zygon*, Vol. 29, No. 1, March, pp. 45-53.
- 1996. 'Ontic Realism and Scientific Explanation'. *Philosophy of Science*, 63. S315-S321.
- Bonowski, J. 1973. *The Ascent of Man*. Boston: Little, Brown and Company.
- Brueckner, Anthony. 1992. 'Conceiving One's Environment While Denying Metaphysical Realism'. *Australasian Journal of Philosophy*. Vol. 70, No. 4; December.
- Bunge, Mario. 1983. *Treatise on Basic Philosophy*, Vol. 5: *Epistemology and Methodology I: Exploring the World*. D. Riedl, Dordrecht.
- Burnyeat, Myles ed. 1983. *The Skeptical Tradition*, Los Angeles: University of California Press.
- Callebaut Werner (ed.). 1987. *Evolutionary Epistemology: A Multiparadigm Program*. D. Reidel Publishing Co. Dordrecht, Holland.
- Campbell, D.T. 1974a. 'Evolutionary Epistemology'. In P.A. Schilpp ed., *The Philosophy*

- of Karl Popper, LaSalle, Ill.: Open Court Publishing, 1, 413-463.
- 1974b. 'Unjustified Variation and Selective Retention in Scientific Discovery. In F.J. Ayala and T. Dobzhansky eds., *Studies in the Philosophy of Biology*, London: Macmillan, 179-86.
- 1975. 'On the Conflicts Between Biological and Social Evolution and Between Psychology and Moral Tradition', *American Psychologist*, 30, 1103-1126.
- Casati, Roberto and Varzi, Achille C. 1994. *Holes and Other Superficialities*. Cambridge, MA: MIT Press.
- Chomsky, Noam. 1968. *Language and Mind*. New York: Harcourt Brace Jovanovich.
- Clarke, Murray. 1986. 'Doxastic Voluntarism and Forced Belief'. *Philosophical Studies*, Vol. 50.
- Clayton, Patti H. 1996. 'A Promise Rather Than A Threat'. *American Scientist*, May-June.
- Collier, John D. 1990. 'Could I Conceive Being A Brain In A Vat?' *Australasian Journal of Philosophy*. Vol 68, No. 4, December.
- Cooper, Jack R. et al 1996. *The Biochemical Basis of Neuropharmacology*. New York: Oxford University Press.
- Cronin, J.E. et al. 1981. 'Tempo and Mode in Hominid Evolution', *Nature* 292" 113-122.
- Curley, E.M. 1978. *Descartes Against the Skeptics*. Cambridge, MA: Harvard University Press.
- Dancy, Jonathan. 1985. *Contemporary Epistemology*. Oxford: Basil Blackwell.
- Dancy, Jonathan and Sosa, Ernest, (eds.). 1992. *A Companion To Epistemology*. Cambridge, MA.: Basil Blackwell Ltd.
- Darwin, Charles. 1909. *The Origin of Species*. New York: P.F. Collier and Son Co. (Darwin's Sixth Edition from January, 1872).
- Dawkins, Richard. 1976. *The Selfish Gene*. Oxford: Oxford University Press (2nd ed. 1989, OUP).
- 1986. *The Blind Watchmaker*. London: Longmans.
- 1995. *River Out of Eden: A Darwinian View of Life*. New York: Basic Books.

- 1996. *Climbing Mount Improbable*. New York: Norton.
- Dennett, Daniel C. *Consciousness Explained*. 1991. Boston: Little, Brown and Company.
- 1993. 'Confusion Over Evolution: An Exchange'. *New York Review of Books*, January 14, pp. 43-44.
- 1995. *Darwin's Dangerous Idea*. New York: Simon and Schuster.
- Descartes, Rene. 1979. *Meditations on First Philosophy*. Cambridge: Hackett Publishing Inc.
- 1960. *Discourse on Method (Parts I-III), The European Philosophers From Descartes to Nietzsche*. New York: The Modern Library.
- de Groller, Eric (ed.). 1981. *Glossogenetics: The Origin and Evolution of Language*. New York: Harwood Academic Publishers.
- Dewey, John. 1929. *The Quest For Certainty*, New York: Minton, Balch and Co.
- di Carlo, Chris. 1987. 'What is Philosophy? A Causal Explanation'. *Eidos: The Canadian Graduate Journal of Philosophy*, Vol. VI, No. 1, June, pp. 129-141.
- 1996. 'Art, Aesthetic Theory and the Two Faces of Ignorance'. *The Journal of Aesthetic Education*, Vol. 30, No. 1, Spring, pp. 107-110.
- 1998. 'How Tranquil The Skeptic(?)'. *Philosophia*, Vol. 27, No. 28, pp. 213-223.
- di Carlo, Chris and Irene Switankowsky. 1997. 'A Decision Procedure for Achieving an Informed Consent'. *Humane Health Care International*, Vol, 13, No. 3, Fall, pp. 72-76.
- Dobzhansky, T. *Genetics and the Origin of Species*, (3rd ed.) 1951. New York: Columbia University Press.
- 1962. *Mankind Evolving*. New Haven: Yale University Press.
- 1970. *Genetics of the Evolutionary Process*. New York: Columbia University Press.
- Dretske, F.. 1971a 'Conclusive Reasons', *Australasian Journal of Philosophy*, 49, 1-22.
- 1971b. 'Perception From an Epistemological Point of View', *Journal of Philosophy*, LXVIII, 19, 584-591.

- 1981. *Knowledge and the Flow of Information*. Cambridge, Mass.: MIT Press.
- Duncan, Ronald and Miranda Weston-Smith, ed. 1977. *The Encyclopedia of Ignorance*, New York: Pergamon Press Ltd.
- Driver, Julia. 1989. 'The Virtues of Ignorance'. *Journal of Philosophy*, Vol. 86.
- Durrant, Michael. 1991. 'Scepticism: Three Recently Presented Arguments Examined'. *Philosophical Investigations*. 14:3, July.
- Eldredge, Niles. 1967. *Reinventing Darwin: The Great Debate at the High Table of Evolutionary Theory*. New York: John Wiley and Sons.
- Eldredge, N. and Gould, S.J. 1972. 'Punctuated Equilibria: An Alternative to Phyletic Gradualism. In T.J.M. Schopf, ed., *Models in Paleobiology* (San Francisco: Freeman, Cooper and Co.) pp. 82-115.
- Elster, Jon. 1979. *Ulysses and the Sirens: Studies in Rationality and Irrationality*. Cambridge: Cambridge University Press.
- Empiricus, Sextus. 1967. *Outlines of Pyrrhonism*, Cambridge, Mass.: Harvard University Press.
- 1967. *Adversus Mathematicos*. Cambridge, Mass.: Harvard University Press.
- Enc Berent. 1990. 'Is Realism Really the Best Hypothesis?' *The Journal of Philosophy*. 667-668, November.
- Fales, Evan. 1996. 'Plantinga's Case Against Naturalistic Epistemology'. *Philosophy of Science*, 63, September.
- Falk, Raphael. 1993. 'Evolutionary Epistemology: What Phenotype is Selected and which Genotype Evolves?', *Biology and Philosophy* 8: 153-172.
- Feyerabend, Paul. 1975. *Against Method*. London: New Left Books.
- Fisher, R.A. 1930. *The Genetical Theory of Natural Selection*. Oxford: Oxford University Press.
- Fogelin, Robert. 1994. *Pyrrhonian Reflections on Knowledge and Justification*. New York: Oxford University Press.
- Foley, Richard. 1993. *Working Without A Net*. New York: Oxford University Press.

- Forbes, Graeme. 1995. 'Realism and Skepticism: Brains in a Vat Revisited', *The Journal of Philosophy*, April.
- Gardenfors, Peter. 1984. 'Epistemic Importance and Minimal Changes in Belief'. *Australasian Journal of Philosophy*, Vol. 62, No. 2, June.
- Gardner, John E. et al. 1991. *Principles of Genetics*, 8th ed. Toronto: John Wiley and Sons, Inc.
- Gettier, Edmund. 1963. 'Is Justified True Belief Knowledge?', *Analysis*, 23, 121-123.
- Giere, Ronald N. 1997. *Understanding Scientific Reasoning* (4th ed.). Fort Worth: Harcourt Brace College Publishers.
- Gilovich, Thomas. 1991. *How We Know What Isn't So*, Toronto: Maxwell Macmillan Canada.
- Gingerich, P.D. 1976. Paleontology and Phylogeny: Patterns of evolution at the Species Level in Early Tertiary Mammals. *American Journal of Science*, 276, 1-28.
- 1977. Patterns of Evolution in the Mammalian Fossil Record. In A. Hallam, ed. *Patterns of Evolution As Illustrated by the Fossil Record* (Amsterdam: Elsevier), pp. 469-500.
- Goggans, Phil. 1991. 'Epistemic Obligations and Doxastic Voluntarism'. *Analysis*, Vol.51, No. 2.
- Goldman, A.I. 1976. 'Discrimination and Perceptual Knowledge', *Journal of Philosophy* 73, 771-91.
- 1986. *Epistemology and Cognition*. Cambridge, Mass.: Harvard University Press.
- 1994. 'Reliabilism', in *A Companion To Epistemology*. Cambridge, Mass.: Basil Blackwell Inc.
- Gould, Stephen Jay. 1977a. *Ever Since Darwin*, New York, Norton.
- 1977b. *Ontogeny and Phylogeny*. Cambridge: Belknap.
- 1980a. *The Panda's Thumb*. New York: Norton.
- 1980b. 'Is a New and General Theory of Evolution Emerging?' *Paleobiology*, Vol. 6, pp. 119-130.
- 1982a 'Darwinism and the Expansion of Evolutionary Theory'. *Science*, 216, pp. 380-387.

- 1982b. 'Punctuated equilibrium--A Different Way of Seeing'. In J. Cherfas ed. *Darwin Up to Date* (London: IPC Magazines), pp. 26-30.
- 1982c. 'The Meaning of Punctuated Equilibrium, and Its Role in Validating a Hierarchical Approach to Macroevolution'. In R. Milkman, ed., *Perspectives On Evolution* (Sunderland, Mass.: Sinauer) pp. 83-104.
- 1989. *Wonderful Life: The Burgess Shale and the Nature of History*. New York: Norton.
- 1990. 'The Individual in Darwin's World'. Edinburgh: Edinburgh University Press.
- 1991. *Bully for Brontosaurus*. New York: Norton.
- 1993. 'Fulfilling the Spandrels of World and Mind'. In Jack Selzer ed. 1993, *Understanding Scientific Prose*, Madison, Wisc.: University of Wisconsin Press, 1993, pp. 310-336.
- 1997a. 'Darwinian Fundamentalism'. *New York Review of Books*, June 12, pp. 34-37.
- 1997b. 'Evolution: The Pleasures of Pluralism'. *New York Review of Books*, June 26, pp. 47-52.
- Gould, S.J. and Eldredge, N. 1993. 'Punctuated Equilibrium Comes of Age'. *Nature*, Vol. 366, pp. 223-227.
- Gould, S.J. and Lewontin, R. 1979. 'The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Program'. *Proceedings of the Royal Society*, Vo. B205, pp. 581-598.
- Grayling, A.C. 1985. *The Refutation of Scepticism*, London: Gerald Duckworth and Co.
- 1993. 'Transcendental Arguments', in Dancy J. and Sosa, E. (eds.) *A Companion to Epistemology*. Cambridge, MA: Basil Blackwell Ltd.
- Groarke, Leo. 1990. *Greek Scepticism: Anti-Realist Trends In Ancient Thought*, Montreal: McGill-Queen's University Press.
- Groarke, Leo and Solomon, Graham. 1991. 'Some Sources for Hume's Account of Cause', *Journal of the History of Ideas*, pp. 645-663.
- Gupta, Anil. 1993a. 'A Critique of Deflationism', *Philosophical Topics*, Vol. 21, No. 2, Spring, 57-81.
- 1993b. 'Minimalism', *Philosophical Perspectives*, 7, Language and Logic, 359-369.

- Hacking, Ian. 1983. *Representing and Intervening*, Cambridge: Cambridge University Press.
- Hallden, Soren. 1986. *The Strategy of Ignorance: From Decision Logic to Evolutionary Epistemology*. Stockholm: Library of Theoria.
- Hardcastle, Valerie Gray. 1993. 'Evolutionary Epistemology as an Overlapping, Interlevel Theory', *Biology and Philosophy* 8: 173-192.
- Harman, Gilbert. 1986. *Change in View*. Cambridge, MA: The MIT Press.
- Heil, John. 1983. 'Doxastic Agency'. *Philosophical Studies*, 43.
- 1987. 'Are We Brains in a Vat: Top Philosopher Says "No"'. *Canadian Journal of Philosophy*, June.
- Hempel, C.G. 1966. *Philosophy of Natural Science*. Englewood Cliffs, NJ: Prentice-Hall Inc.
- Hewes, G. 1975. *Language Origins: A Bibliography*. Atlantic Highlands, N.J.: Humanities.
- Hockett, Charles. 1969. 'The Origin of Speech', *Scientific American*, 203, pp. 88-111.
- Horgan, John. 1996. *The End of Science*. Reading, MA.: Addison-Wesley Publishing Co.
- Horgan, Terry (ed.). 1995. 'Vagueness: The Spindel Conference 1994. From the *Southern Journal of Philosophy*. Vol. 33 (Supplement).
- Horwich, Paul. 1990. *Truth*, Cambridge, Mass.: Basil Blackwell Ltd.
- 1993. 'Theories of Truth' in Dancy, J. and Sosa, E. (eds.), *A Companion to Epistemology*. Cambridge, MA: Basil Blackwell Ltd.
- Hull, David. 1982. 'The Naked Meme', in Plotkin, H.C. (ed.) *Learning, Development, and Culture*. John Wiley and Sons, New York.
- 1988. *Science As A Process*. Chicago: The University of Chicago Press.
- Hume, David. 1978. *A Treatise of Human Nature*. L.A. Selfy-Bigge ed. 2nd ed. P.H. Nidditch ed., Oxford: Oxford University Press.
- 1989. *An Inquiry Concerning Human Understanding*. New York: Macmillan Publishing Company.

- John Paul II. 1997. 'The Pope's Message On Evolution'. *Quarterly Review of Biology*. 72: 377-383.
- Johnson, Oliver A. 1979. 'Ignorance and Irrationality: A Study in Contemporary Scepticism'. *Philosophical Research Archives*, 5, No. 1310.
- Johnson, Philip. 1991. *Darwin on Trial*. Washington, D.C.: Regnery Gateway.
- 1995. *Reason in the Balance: The Case Against Naturalism in Science, Law and Education*. Downers Grove, Ill.: InterVarsity Press.
- Kahneman, D., Slovic, P., and Tversky, A. (eds.) 1982. *Judgement Under Uncertainty: Heuristics and Biases*. New York: Cambridge University Press.
- Kaplan, David. 1979. 'On the Logic of Demonstratives'. *Journal of Philosophical Logic*. 8.
- Kellog, D.E. 1975. 'The Role of Phyletic Change in the Evolution of *Psuedocubus vema* (Radiolaria)'. *Paleobiology*, 1, 359-70.
- 1983. 'Phenology of Morphologic Change in Radiolarian lineages From Deep-Sea Cores: Implications For Macroevolution. *Paleobiology*, 9, 355-62.
- Kim, Kihyeon. 1994. 'The Deontological Conception of Epistemic Justification and Doxastic Voluntarism'. *Analysis*, 54.4, October.
- Kimura, Motoo. 1983. *The Neutral Theory of Molecular Evolution*. Cambridge: Cambridge University Press.
- Kitcher, Philip. 1992. 'The Naturalists Return'. *The Philosophical Review*. Vol. 101, No. 1, January.
- Klein, Peter D. 1981. *Certainty: A Refutation of Scepticism*. Minneapolis: University of Minnesota Press.
- Kornblith, Hilary. 1987. "Naturalizing Rationality", in *Naturalism and Rationality*, Newton Garver, ed., Buffalo, N.Y.: Prometheus.
- Kornblith, Hilary. 1983. "Justified Belief and Epistemically Responsible Action", *Philosophical Review*, 92.
- 1985a. "Ever Since Descartes", *Monist*, 68.
- 1985b. *Naturalizing Epistemology*. Cambridge, MA: The MIT Press.

- Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions*, 2nd ed., Chicago: University of Chicago Press.
- Laitman, Jeffrey. 1984. 'The Anatomy of Human Speech', *Natural History*, August.
- Lakatos, Imre. 1985. *The Methodology of Scientific Research Programmes*. Philosophical Papers, Vol. 1, Cambridge: Cambridge University Press.
- Lamarque, Peter, 1976. Review of Peter Unger's *Ignorance: A Case For Scepticism in Philosophical Quarterly*, Vol. 74, October.
- Leakey, Richard E. 1979. *The Illustrated Origin of Species*. New York: Hill and Wang.
- Lenneberg, Eric. 1967. *Biological Foundations of Language*. New York: Wiley.
- Leslie, John. 1989. 'Demons, Vats and the Cosmos'. *Philosophical Papers*. Vol. XVIII, No. 2.
- Leplin, Jarrett, ed. 1984. *Scientific Realism*, Berkely: University of California Press.
- Levi, Isaac. 1977. 'Four Types of Ignorance'. *Social Research*, 44, Winter.
- 1988. 'Review: Soren Hallden's The Strategy of Ignorance', pp.129- 148.
- Levinton, J.S. and Simon, C.M. 1980. 'A Critique of the Punctuated Equilibria Model and Implications for the Detection of Speciation in the Fossil Record', *Systematic Zoology* 29: 130-142.
- Lewontin, R.C. 1974. *The Genetic Basis of Evolutionary Change*. Columbia: Columbia University Press.
- 1980, 'Theoretical Population Genetics in the Evolutionary Synthesis. In E. Mayr and W. Provine eds. *The Evolutionary Synthesis*. Cambridge, MA.: Harvard University Press, pp. 56-68.
- Lieberman, Philip. 1975. *On The Origins of Language*. New York: Macmillan.
- 1984. *The Biology and Evolution of Language*. Cambridge, Mass.; Harvard University Press.
- Long, A.A. and Sedley, D.H. 1987. *The Hellenistic Philosophers*, Vol. 1. Cambridge: Cambridge University Press.
- Lorenz, Konrad. 1962. "Kant's Doctrine of the A Priori in the Light of Contemporary

Biology" translated in *General Systems*, ed. by L. von Bertalanffy and A. Rapoport (Ann Arbor: Society for General Systems Research, 1962), Vol. VII. The original "Kants Lehre vom apriorischen im Lichte gegenwartiger Biologie" can be found in *Blatter fur Deutsche Philosophie*, 15 (1941), 94-125.

Lumsden, C. and Wilson, E.O. 1981. *Genes, Mind, and Culture*. Cambridge, Mass.: Harvard University Press.

Malcolm, Norman. 1966, 1977, and 1989. *Theory of Knowledge*, 1st, 2nd and 3rd editions, Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Malthus, T.R. 1963. *An Essay on the Principle of Population*. 1st edn 1798. 6th edn 1826, 6th edn reprinted in Homewood, Illinois:Irwin.

Marian, David. 1991. 'Neither Mentioning "Brains in a Vat" nor Mentioning Brains in a Vat Will Prove the We Are Not Brains in a Vat'. *Philosophy and Phenomenological Research*. Vol. LI, No. 4. December.

Martin, Andrew. 1981. 'The Genesis of Ignorance: Nescience and Omniscience in the Garden of Eden'. *Philosophy and Literature*. Vol. 5, Spring.

Maynard Smith, John. 1958. *The Theory of Evolution*. Cambridge: Cambridge University Press. (Canto ed. 1993).

---- 1972. *On Evolution*. Edinburgh: Edinburgh University Press.

---- 1978. *The Evolution of Sex*. Cambridge: Cambridge University Press.

---- 1982. *Evolution Now: A Century After Darwin*. San Francisco: Freeman.

---- 1988. *Games, Sex and Evolution* (also published under the title *Did Darwin Get it Right?*). London: Harvester.

---- 1991. 'Dinosaur Dilemmas'. *New York Review of Books*, April 25, pp. 5-7.

---- 1995. Review of Daniel C. Dennett's *Darwin's Dangerous Idea* in *The New York Review of Books*, November 30, pp. 46-48.

Mayr, Ernst. 1942. *Systematics and the Origin of Species*. New York: Columbia University Press.

---- 1963. *Animal Species and Evolution*. Cambridge, Mass.: Belknap.

- 1978. *Evolution*. San Francisco: W.H. Freeman.
- 1988. *Toward a New Philosophy of Biology*. Cambridge: Harvard University Press.
- McCrone, John. 1991. *The Ape That Spoke*. New York: William Morrow and Co.
- McCullagh, C. Behan. 1988. "The Virtue of Cognitive Relativism". *Australasian Journal of Philosophy*, 66, 101-104, March..
- McMullin, Ernan. 1993. 'Evolution and Special Creation', *Zygon*, Vol. 28, No. 3, September, 299-335.
- Meiland, Jack. 1980. "What Ought We To Believe?", *American Philosophical Quarterly*, 17.
- Miller, Jonathan and Van Loon, Borin. 1982. *Darwin for Beginners*. New York: Pantheon Books.
- Montagu, Ashley, and Darling, Edward. 1970. *The Ignorance of Certainty*. New York: Harper and Row Publishers.
- Montaigne, Michel de. 1959. *In Defense of Raymond Sebond*, trans. Arthur H. Beattite, New York: Milestones of Thought.
- Montgomery, Richard. 1989. "Does Epistemology Reduce to Cognitive Psychology?", *Philosophia (Israel)*, 19 (2-3), 245-263, October.
- Montmarquet, James. 1986. 'The Voluntariness of Belief', *Analysis*, Vol. 46, No. 1, January.
- 1992. 'Epistemic Virtue and Doxastic Responsibility'. *American Philosophical Quarterly*, Vol 29, No. 4, October.
- 1995. 'Culpable Ignorance and Excuses'. *Philosophical Studies*, Vol. 80.
- Morris, Desmond. 1977. *Manwatching*. New York: Abrams.
- Nagel, Ernest. 1956. *Logic Without Metaphysics*. Glencoe: IL: Free Press.
- Nagel, Thomas. 1986. *The View From Nowhere*, New York: Oxford University Press.
- Naylor, Margery Bedford. 1985. 'Voluntary Belief'. *Philosophy and Phenomenological Research*, Vol. XLV, No. 3.
- Nelson, Harry, et al. 1992. *Essentials of Physical Anthropology*. St. Paul, MN: West Publishing Co.

- Nozick, Robert. 1981. *Philosophical Explanations*. Cambridge, Mass.: Harvard University Press.
- Odegard, Douglas. 1989. 'Scepticism: The Current Debate'. *Eidos: The Canadian Graduate Journal of Philosophy*. Vol VIII, No. 2, December.
- Ornstein, Robert and Thompson, Richard F. 1984. *The Amazing Brain*. Boston: Houghton Mifflin Company.
- Orr, H. Allen. 'Dennett's Dangerous Idea'. This first appeared in the journal *Evolution*, however I am unsure of the volume and issue number. It can be found on the Internet at: <http://www-polisci.mit.edu/BostonReview/br21.3/Orr.html>
- Parker, Steve and Bernor, Raymond L. 1990. *The Practical Paleontologist*. London: Simon and Schuster.
- Pascal, Blaise. 1966. "A Learned Ignorance" from *Pensees*, trans. A.J. Krailsheimer, Penguin.
- Peirce, C.S. 1931-1935. *Collected Papers*. C. Harshorne and P. Weiss, eds. Cambridge, Mass.: Harvard University Press.
- Penrose, Roger. 1989. *The Emperor's New Mind*, Oxford: Oxford University Press.
- Piatelli-Palmerini, Massimo. 1994. *Inevitable Illusions*. New York.
- Pinker, Steven. 1994. *The Language Instinct*. New York: Harper Collins.
- 1997a. *How The Mind Works*. New York: W.W. Norton and Co.
- 1997b. 'Evolutionary Psychology: An Exchange'. *The New York Review of Books*, Oct. 9. pp. 55-58.
- Plantinga, Alvin. 1991. 'An Evolutionary Argument Against Naturalism', *Logos* 12: 27-49.
- 1993. *Warrant and Proper Function*. New York: Oxford University Press.
- Plotkin, Henry. 1994. *Darwin Machines and the Nature of Knowledge*. Cambridge, MA: Harvard University Press
- Pojman, Louis P. 1978. 'Belief and Will'. *Religious Studies*, Vol. 14.
- Popper, Karl. 1959. *The Logic of Scientific Discovery*. New York: Basic Books.

- 1963. *Conjectures and Refutations*. London: Routledge and Kegan Paul; New York: Basic Books.
- 1972. *Objective Knowledge: An Evolutionary Approach*, Oxford: Clarendon Press.
- 1978. 'Natural Selection and the Emergence of Mind', *Dialectica*, 32, 339-55.
- 1984. 'Evolutionary Epistemology', in Pollard J.W. (ed.), *Evolutionary Theory: Paths into the Future*, John Wiley and Sons Ltd., London.
- Putnam, Hilary. 1981. *Reason, Truth and History*, Cambridge: Cambridge University Press.
- 1987. *The Many Faces of Realism*, LaSalle, Illinois: Open Court.
- Quine, W.V.O. 1953 *From A Logical Point of View*, Cambridge, Mass.: Harvard University Press.
- 1964. *Word and Object*, Cambridge, Mass.,: MIT Press.
- 1969. Natural Kinds. In *Ontological Relativity and Other Essays*. New York: Columbia University Press.
- 1981. 'Reply to Stroud', in French, P.A., Ueling, T.E. Jr., Wettstein, H.K. (eds.), *Midwest Studies in Philosophy VI*, University of Minnesota, Minneapolis, 473-475.
- 1981a. 'What Price Bivalence?' *The Journal of Philosophy* 78.
- 1990. *The Pursuit of Truth*, Cambridge, Mass., Harvard University Press.
- Quine, W.V.O. and Ullian, J.S. 1978. *The Web of Belief*. Random House, New York.
- Radnitzky, Gerard and Bartley, W.W. III. 1987. *Evolutionary Epistemology, Rationality, and the Sociology of Knowledge*, La Salle, Illinois: Open Court.
- Rescher, Nicholas. 1978. *Scientific Progress*. Southampton: Basil Blackwell, Camelot Press Ltd.
- 1980. *Scepticism: A Critical Reappraisal*, Oxford: Basil Blackwell.
- 1990. *Evolution, Cognition and Realism: Studies in Evolutionary Epistemology*. Lanham, Maryland: University Press of America.
- Reidl, Rupert. 1984. *Biology of Knowledge: The Evolutionary Basis of Reason*. Chichester:

John Wiley and Sons.

Restak, Richard M. 1995. *Brainscapes*. New York: Hyperion.

Richards, Robert J. 1987. *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior*. Chicago: University of Chicago Press.

Rorty, Richard. 1979. *Philosophy and the Mirror of Nature*. Princeton, N.J.: Princeton University Press.

Rosenberg, Alex. 1996. 'A Field Guide to Recent Species of Naturalism', *The British Journal for the Philosophy of Science*, Vol. 47, No. 1, March, 1-29.

Ruse, Michael. 1982. *Darwinism Defended*. Reading, MA: Addison-Wesley.

---- 1988. *Philosophy of Biology Today*. Albany: State University of New York Press.

---- 1989. *The Darwinian Paradigm*. London: Routledge.

---- 1995. *Evolutionary Naturalism*. London: Routledge.

---- 1986. *Taking Darwin Seriously: A Naturalistic Approach To Philosophy*. New York: Basil Blackwell Inc. There is also reference to an unpublished chapter in the second edition, forthcoming in 1998.

Ryle, Gilbert. 1931-32. 'Systematically Misleading Expressions', *Proceedings of the Aristotelian Society* 22, 139-70.

---- 1937-38. 'Categories', *Proceedings of the Aristotelian Society* 38, 189-206.

---- 1945-46. 'Knowing How and Knowing That', *Proceedings of the Aristotelian Society* 46, 1-16.

Sagan, Carl. 1977. *The Dragons of Eden*. New York: Ballantine Books.

Sainsbury, R.M. 1986. "Degrees of Belief and Degree of Truth", *Philosophical Papers*, XV, Nos. 2 and 3.

Schilpp, Paul Arthur. 1974. *The Philosophy of Karl Popper*. La Salle, Illinois: Open Court.

Shepherd, Gordon M. 1994. *Neurobiology* (3rd ed.). New York: Oxford University Press.

Shimony, A. 1981. 'Integral Epistemology', in Brewer, M.B. and Collins, B.E., *Scientific Inquiry and the Social Sciences: A Volume in Honor of Donald T. Campbell*, Jossey-

- Bass, San Francisco. pp. 98-123.
- Shope, Robert. 1994. 'Propositional Knowledge' in *A Companion to Epistemology*, Cambridge, Mass.: Basil Blackwell Inc. pp. 396-401.
- Skagestad, Peter. 1978. 'Taking Evolution Seriously: Critical Comments on D.T. Campbell's Evolutionary Epistemology'. *The Monist*, 61, 611-621.
- Smith, Holly. 1983. 'Culpable Ignorance'. *The Philosophical Review*, Vol. XCII, No. 4, October.
- Smithson, Michael. 1989. *Ignorance and Uncertainty*. New York: Springer-Verlag.
- Sober, Eliot. 1991. *Core Questions in Philosophy*. New York: Macmillan Publishing Company.
- Sorenson, Roy. 1988. *Blindspots*. Oxford: Oxford University Press.
- Stein, Edward and Lipton, Peter. 1989. 'Where Guesses Come From: Evolutionary Epistemology and the Anomaly of Guided Variation', *Biology and Philosophy* 4, 33-56.
- Steinitz, Yuval. 1994. 'Brains in a Vat: Different Perspectives'. *The Philosophical Quarterly*, April.
- Stich, Stephen P. 1990. *The Fragmentation of Reason*, Boston, Mass.: MIT Press.
- 1991. "The Fragmentation of Reason: Precis of Two Chapters", *Philosophy and Phenomenological Research*, 51, 1, 179-183.
- 1996. *Deconstructing the Mind*. New York: Oxford University Press.
- Stidd, Benton. 1980. 'The Neotonous Origin of the Pollen Organ of the Gymnosperm Cycadeoidea and the Implications for the Origin of Higher Taxa', *Paleobiology* 6: 161-167.
- 1985. 'Are Punctuacionists Wrong About the Modern Synthesis?', *Philosophy of Science*, 52: 98-109.
- Stjernberg, Fredrik. 1993. 'A Note From Your Local Vat Operator'. *Analysis*. July.
- Stroud, Barry. 1977. Book Review: Peter Unger's *Ignorance*, *The Journal of Philosophy*, 74, April.

- 1981. 'The Significance of Naturalized Epistemology', in French, P.A., Uehling, T.G. Jr., and Wettstein, Howard K. (eds.), *Midwest Studies in Philosophy* VI, University of Minnesota Press, Minneapolis, 455-471.
- 1984. *The Significance of Philosophical Scepticism*, Oxford: Oxford University Press,
- Thagard, Paul. 1980. 'Against Evolutionary Epistemology', in Asquith, P.D. and Giere, R.N. (eds.), *PSA*, 187-196.
- 1988. *Computational Philosophy of Science*. Cambridge, MA.: MIT Press.
- 1992. *Conceptual Revolutions*. Princeton, NJ.: Princeton University Press.
- Thompson, Paul. 1983. 'Tempo and Mode in Evolution: Punctuated Equilibria and the Modern Synthetic Theory', *Philosophy of Science* 50: 432-452.
- 1988. 'Some Punctuationists *are* Wrong About the Modern Synthesis', *Philosophy of Science* 55: 74-86.
- 1989. *The Structure of Biological Theories*. Albany: State University of New York Press.
- Toulmin, Stephen. 1967. 'The Evolutionary Development of Natural Science', *American Scientist*, 55.
- 1972. *Human Understanding*. Oxford: Oxford University Press.
- Tymoczko, Thomas. 1989. 'In Defense of Putnam's Brains'. *Philosophical Studies*. 57.
- Unger, Peter. 1975. *Ignorance*, Oxford: Clarendon Press.
- Visvader, John. 1978. "The Use of Paradox in Uroboric Philosophies", *Phil East West*, 28, 455-467, October.
- Vogel, Jonathan. 1990. 'Cartesian Skepticism and Inference to the Best Explanation'. *The Journal of Philosophy*. 658-666, November.
- Vollmer, G. 1975. *Evolutionäre Erkenntnistheorie*. Frankfurt: S. Hirzel.
- 1987. 'On Supposed Circularities in an Empirically Oriented Epistemology', in *Evolutionary Epistemology, Theory of Rationality, and the Sociology of Knowledge*, ed. G. Radnitzky and W.W. Bartley, LaSalle, Ill.: Open Court, 163-200.

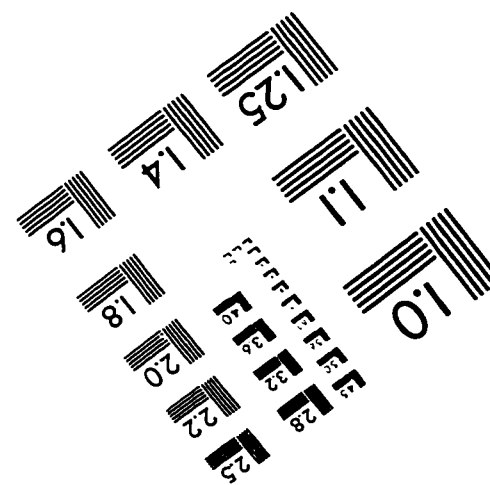
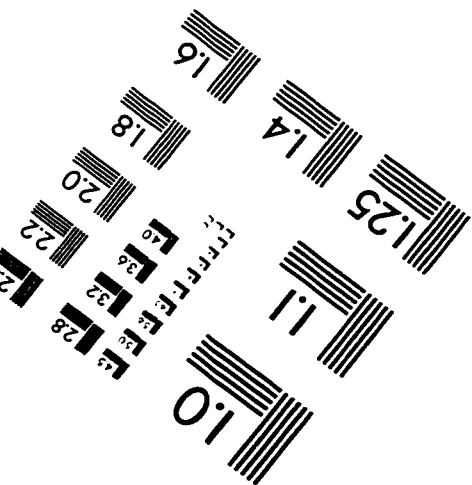
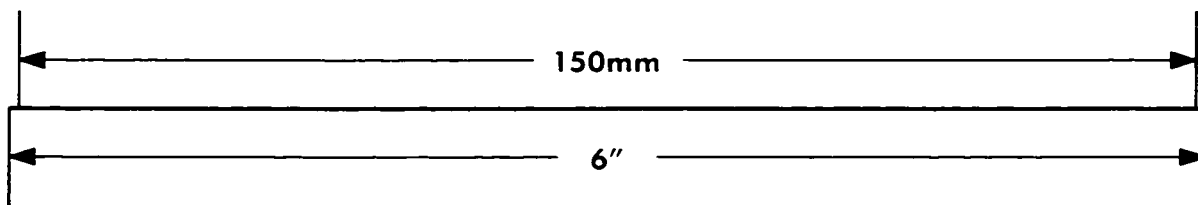
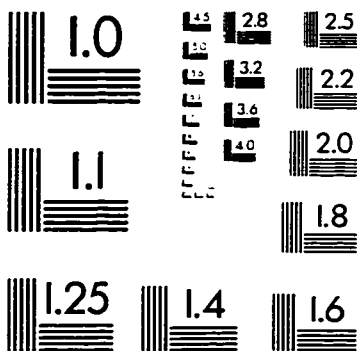
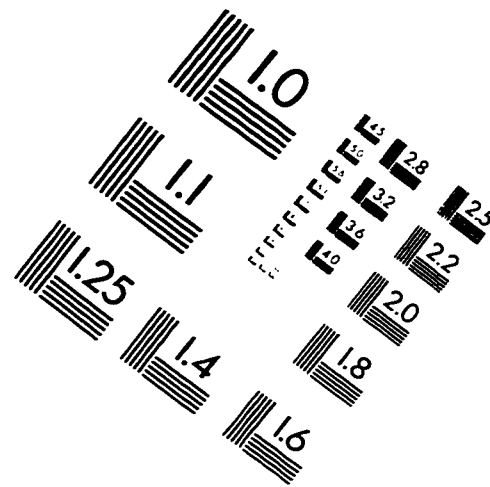
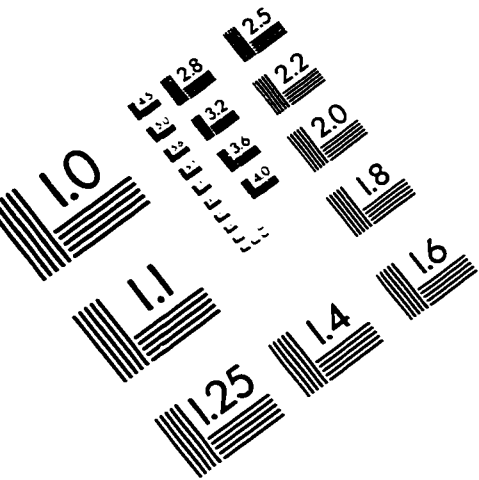
- Walton, Douglas. 1990. *Practical Reasoning: Goal-Driven, Knowledge-Based, Action-Guiding Argumentation*. Savage, MD: Rowman and Littlefield.
- 1992. 'Nonfallacious Arguments From Ignorance', *American Philosophical Quarterly*, Vol. 29, No. 4, October, 381-387.
- Weinberg, Steven. 1992. *Dreams Of A Final Theory*, New York: Pantheon Books.
- White, M.J.D. 1968. 'Models of Speciation', *Science* 159: pp. 1065-1070.
- Wilkes, Kathleen. 1988. *Real People: Personal Identity Without Thought Experiments*. Oxford: Clarendon Press.
- Williams, Bernard. 1995. 'Philosophy and the Understanding of Ignorance'. *Diogenes*, No. 169, Vol. 43/1, Spring.
- Williams, Michael. 1991. *Unnatural Doubts: Epistemological Realism and the Basis of Scepticism*. Cambridge, MA: Blackwell Publishers Inc.
- Williamson, P.G. 1981. 'Paleontological Documentation of Speciation in Cenozoic Molluscs from Turkana Basin', *Nature* 293: 437-443.
- Williamson, Timothy. 1994. *Vagueness*. New York: Routledge.
- Wilson, David Sloan. 1990. 'Species of Thought: A Comment on Evolutionary Epistemology', *Biology and Philosophy*, 5, 37-62.
- Wilson, E.O. 1975. *Sociobiology: The New Synthesis*. Cambridge, Mass.: Harvard University Press.
- 1978. *On Human Nature*. Cambridge, Mass.: Harvard University Press.
- Woods, John and Walton, Douglas. 1978. 'The Fallacy of *Ad Ignorantium*', *Dialectica*, Vol. 32, pp. 87-99.
- Wright, J.P. 1983. *The Sceptical Realism of David Hume*, Minneapolis: University of Minnesota Press.
- Wright, Sewall. 1969. *Evolution and the Genetics of Populations.*, Vol. 2, *The Theory of Gene Frequencies*. Chicago: University of Chicago Press.
- 1977. *Evolution and the Genetics of Populations*, Vol. 3, *Experimental Results and Evolutionary Deductions*. Chicago: University of Chicago Press.

— 1978. *Evolution and the Genetics of Populations*, Vol. 4, *Variability Within and Among Natural Populations*. Chicago: University of Chicago Press.

Wuketits, Franz M. 1990. *Evolutionary Epistemology and Its Implications for Humankind*. Albany, NY: State University of New York Press.

---- 1995. 'A Comment on Some Recent Arguments in Evolutionary Epistemology--and Some Counterarguments', *Biology and Philosophy* **10**: 357-363.

IMAGE EVALUATION TEST TARGET (QA-3)



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