

Chapter Fifteen  
Cognitive Luck: Substance Concepts in an Evolutionary Frame<sup>1</sup>

Steven Pinker (1994b) chides the educated layman for imagining Darwin's theory to go something like this (the vertical lines are "begats"):

[Figure #1]

Pinker says, "evolution did not make a ladder; it made a bush" (p. 343), and he gives us the following diagrams instead, showing how it went, in increasing detail, down to us:

[Figure #2]

[Figure #3]

"Paleontologists like to say that to a first approximation, all species are extinct (ninety-nine percent is the usual estimate). The organisms we see around us are distant cousins, not great grandparents; they are a few scattered twig-tips of an enormous tree whose branches and trunk are no longer with us." (p. 343-44). The historical life bush consists mainly in dead ends.

Moreover, when we look more closely at the life bush, examining in detail the various lineages that form the littlest twigs (the species), we see the same pattern over again. The vast majority of individual animals and plants forming these various lineages didn't make it. The twigs are largely made of fuzz--of myriad little lives that broke off before reproduction. An indication of a species' mortality rate is how many more offspring than one per parent are conceived on average. Consider, then, spiders, fish, and rabbits. And recall that Octavius was a common Roman name. To a first approximation, all individual animals die before reproducing.

Species went extinct, typically, because of changing environments, including the comings and goings of other living species. The study of these changes and resulting extinctions is, of course, a purely historical study, a study of the disposition of historical bits of matter, positioned at particular points in space and time, running afoul of other historical bits of matter, positioned in accidental juxtaposition. The places where the streamlets of life managed to flow on, through little chinks in the barriers thrown up by geological history and other competing life forms, were also accidental in the very strongest sense. There are no empirical laws of evolution. There are only applicable and interesting mathematical models of certain aspects of evolution, ways of calculating the necessary outcomes of certain assumptions, as when demonstrating that WERE Johnny to continue to earn 5% a year on his \$10,000 investment for 15 years, and WERE he not to spend any of it, he WOULD accumulate \$20,000. Models of this kind are not empirical laws. The results of the evolutionary process we still have with us

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<sup>1</sup> This chapter is a revised version of "Cognitive luck: Externalism in an Evolutionary Frame," in Philosophy and the Sciences of Mind, Pittsburgh-Konstanz series in the Philosophy and History of Science, Pittsburgh University Press (Millikan 1997a).

today are the outcome of sheer cosmic luck, no more and no less.

There are, however, two great and simple principles that, conjoined, account for the fact, despite vastly changing historical circumstances, that there still exists life, indeed, vastly abundant life. Call these principles "multiplication" and "division." "Multiplication" says that the more progeny each member of a group bears, the more chance there is that some of these progeny will be lucky enough to happen upon accidental chinks in the environmental barriers through which they may slip to the next generation. If enough baby sea turtles are born, a few will accidentally avoid being eaten on the journey from their birth nests to the sea. "Division" says that if enough variety of life is produced, then there is a good chance that some of the environments that chance by will be suited to someone or other. "Division" is effected both by the vast number of species and by polymorphism within species. The history of life is like a lottery that was bound to be won by some, because so many bought tickets and there were so many different kinds of drawings.

Turning to life within a single species, it is easy wrongly to suppose that there is another principle that keeps lineages going. Natural selection, we suppose, has acted to preserve only the "fittest" characteristics for any given species, so that these are had pretty much by all members of the species. The result, we suppose, is that each normal little animal is nearly ideally designed for its own particular niche. Then why do so many species need to have so many babies? Why the thick long fuzz on all the lineage lines if all the animals are so "fit"? The reason is that, like everything else having to do with the propagation of life, fitness is a matter of statistics. Higher fitness lends only a higher probability of survival and reproduction. A die loaded with sixes on two sides doesn't help if you throw one of the other four sides, and that is what you are most likely to do.

The tossing, here, is done by the enormous variety among individual environments. The kitten with an immune system resistant to feline distemper is run over by a car. The kitten who exhibits sensible behavior on the roadway gets exposed to distemper. The kitten with both strengths gets into rat poison at a neighbors. There is no way to be "fit" for all contingencies. Where environmental barriers are diverse and shifting, introducing numerous and diverse kittens raises the chances that a few will manage to pass through, but it doesn't raise the chance for each kitten. Assuming probabilities pertinent to relevant environmental factors remain constant over time, one could confidently predict that a species will continue to survive. But to predict how the individual lineages within the species will go so as to make this happen would require a detailed knowledge of every cranny in the environment at every time. Predicting that someone will win is easy enough, predicting who will win is impossible. For the system that propagates a lineage is not contained in the individual bodies of the organisms making up the lineage. It rests also upon statistically reliable yet accidental episodes of environmental cooperation. Individual lineages do not advance lawfully.

Instead of laws for lineage advance, there are mechanisms. Given a propitious environment by the luck of the draw, there are various mechanisms by which selected individual organisms composing a particular species have historically projected themselves forward in time. The working of these mechanisms is explained, not by laws of the particular species, but by laws formulated in more basic sciences. Physical structures with which the organism is equipped, coupled with just the right propitious

supporting physical structures in the environment, project the lineage in accordance with physical laws. There is, for example, a mechanism by which newly hatched green turtles reach the sea when they do. But of course there is no law that they reach the sea--not even a ceteris paribus law, any more than there is a ceteris paribus law that little boys grow up to be President. Similarly, there is a mechanism whereby sand is sometimes prevented from entering our eyes (the eyeblink reflex) but there is no law that sand is kept out of our eyes.

Suppose now that we magnify the little lines that are individual organisms moving moment by moment through their individual life cycles. Over here under the lens is a barnacle. It waves its little fan foot through the water once, twice, ten times, a hundred and ten times, and the hundred and eleventh time it picks up a microscopic lunch. Over here is Tabby, after a squirrel. Whoops, missed! Now she is after a bird. Missed again! An hour of stalking with no profit. Never mind, here she comes now to cry for her dinner, where environmental circumstances are more likely, for her, to bear fruit. Over there, now, is Grackling the goose, doing a mating dance for his chosen. She spurns him today, but perhaps she will not tomorrow. Or he will find another instead, either this season or next. Over here is Rover, kicking up sand as he runs. Despite his healthy eye-blink reflex, one sand grain goes into his eye. The eye waters profusely, but does not wash out the sand. Rover rubs the eye with his paw and eventually manages to clear it. Similarly, looking to less visible behaviors, there are membranes to keep harmful bacteria from entering Rover's body. And there is also a whole series of mechanisms designed to destroy those bacteria that still manage to get through. Often one or another of these various filters works but it can also happen that none do.

In this manner, at every point where an organism interacts with its environment as needed to spin out its life line, we find innumerable failures. Counterbalancing these, we again find Multiplication and Division. We find numerous trials, many of which fail for each success. We find numerous redundant mechanisms, designed to perform the same basic tasks. The result is that the life line occasionally proceeds, small step by small step, right through to the next generation. But there are no laws that govern this process. There are only numerous and diverse mechanisms operating in a stochastic environment hoping for a passible drawing. There are lots of fuzzies everywhere along each individual life line, lots and lots of deadend trials.

Up to now without comment I have been treating biological species not as classes but as big, scattered, historical entities, enduring for longer or shorter periods through time. What species an individual organism belongs to depends not on its timeless properties but on its historical relations to other individuals. Dogs must be born of other dogs, not just be like other dogs; sibling species count as two or more for the same reason that identical twins count as two, not one. Earlier (' 2.3) I mentioned that both Ghiselin and Hull have argued that species are actually individuals, a position that appears reasonable, certainly for the case of familiar sexually reproducing animals. Hull concluded that because species are really historical individuals, "their names function in no scientific laws" (1978), for example, "[t]here is no such thing as human nature." Crossing this current, I claimed, however, that the members of the various biological

species, as well as members of various other biological types, form real substance kinds, over which many well founded generalizations, though not strict laws, can be run entirely legitimately. Inductions from one member of a species to the next often hold up for very good reason. Were this not so, there could be no science of biology. Nor could there be any science of psychology. But we must be careful not to analogize the subject matter of the life sciences and other historical sciences too closely to that of the eternal sciences.

Biological species form historical substance kinds in part because of historical connections among their members. Roughly, the members have been copied from one another, and natural selection, operating on a variety of levels has enforced a high degree of copying fidelity. Adult members of a species are alike also in part because they have developed in what is relevantly the same historical environment. And they continue to be alike. Indeed, may continue to survive only in so far as they continue to inhabit what is, in relevant respects, the same environment. They live on land, or in the sea, or alone, or in groups, or in language communities, and so forth.

Now it is always possible to study the properties that are common to most individuals of a given species at a given stage of life, apart from their normal environment. You can study these properties just as you might study the properties of any chunk of inorganic matter lying on the lab table. In this case, any dispositions that characterize the kind, or that would characterize the kind in any physically possible environment, are as legitimate to study as any other. These dispositions may show up, for example, when the species members are in the wild, or in cages, or in spaceships, or in laboratory apparatuses, or under the microscope, or after injection with chemicals, or under 5 atmospheres pressure, or subjected to 5000 volts current. For what these objects are disposed to be like and to do in one environment is as much a part of their objective nature as in any other. Their nature as such objects makes no reference to an environment. The environment will have been instrumental in the past of these objects, molding them into a roughly uniform substance kind, but truths can be discovered about their relations to many possible environments, not just their historical environment.

Clearly there is another way to study a species scientifically, however. It can be studied with an eye to the properties that allowed it to survive through time as a Hullan historical individual. This sort of study is intrinsically ecological, deeply interested in the environment. It focuses on the contrast between the individual life lines, and individual episodes within these lives, that have pushed on in contrast to those that have failed. It studies the various mechanisms by which the life bush has thrust forth new shoots in those episodes in which the environment happened to be cooperative. It studies the mechanisms that helped to bias the species' chances in favor of winning the vast lottery of life. It is interested in the environment, not just as some sort of average container for members of a species, but in just those respects that have historically been propitious for that particular kind of organism engaging in these or those particular productive activities. This sort of study is a study of organisms as life forms, rather than merely as collections of like physical objects.

Now no one will deny, of course, that the study of normal human psychology

should be a study of the human mind as it operates, in some sense, "in its normal environment." Just as we study fish in the water, pigs on land, and birds in the air, we study human cognizers surrounded by air containing oxygen, at about one atmosphere pressure, with a supporting a surface underneath, within a certain range of temperatures, whose heads are not in strong electric fields, or being banged on too hard, or chewed on too eagerly by tigers. It is against this sort of stable background that the normal human cognizer is studied as a natural kind. Thus we study human cognizers not just as a current kind of interesting physical object, but after having taken a peek at historical human life lines, as opposed to human life ends, and after examining the environmental contexts of these differences. A question that needs examining, however, is what it means exactly to claim that the sort of environment just described is "the normal one" in which human cognition takes place.

First, it will help to ward off a possible confusion in the wake of the discouraging words uttered above about survival chances for most species. Haven't I claimed that in the environment that is statistically normal for a species, the environment in which animals of that species typically find themselves, the animal dies? It dies before maturing or reproducing. Then doesn't it follow that we must study the individual not in the normal environment but in an especially lucky one? But of course it is only over their whole lives that the statistics on individuals are so terrible. Hour by hour, supporting rather than threatening environments may be statistically normal. So there may after all be some relatively fixed and stable set of conditions, for many species, relative to which the lifeline mechanisms of its members can be studied, deaths before reproduction being viewed as caused by temporary disruptions of these conditions. Similarly, although nobody doubts that human cognition requires a supporting environment, perhaps it requires, on the whole, merely the same mundane set of stable supporting conditions that sustains the human body from hour to hour. Against this steady background environment, the human, including the cognitive systems, might be studied purely as a natural kind. That, I believe, is the image most have of the study of human cognition.

But there is something important left out of this picture. What is left out is the fuzz on the individual life lines. Remember Tabby in search of her dinner, Grackling in search of a mate, and Rover with sand in his eye. In general, the behaviors of animals effect loops through the environment that feed back into their life lines only under quite special conditions, conditions that are not statistically average at all. Moreover the various mechanisms controlling different kinds of behaviors each require different supporting conditions. Each behavior has its own special needs. Tabby's hunting behavior requires a proximate mouse or bird that is not too vary and fleet; Grackling's dancing behavior requires a proximate female who is willing, and so forth. The job of the cognitive systems is to collect information about the specifics of the environment on which such behaviors will be based. The question arises, then, whether the cognitive systems also have fuzz on them--whether they too require special supporting conditions that vary with the tasks to be performed.

A contemporary tradition in epistemology has it that whether a thinker has knowledge as opposed to true belief is determined by a partly serendipitous relation

between thinker and environment. Contrary to Plato's claims, there is cognitive luck involved in knowing. More fundamental, cognitive luck is required for success in thinking OF things, for success in entertaining coherent propositions. Environmental luck is required for the cognitive systems to maintain a coherent inner representational system. This means that cognitive psychology must be the study of happy interactions with the environment, an essentially ecological study. This follows from the externalist view of mental semantics I have been presenting in this book.

Assume that the central job of the cognitive systems is to collect information over time, to amplify this information through inference, and to bring it to bear in determining action. Note that amplificatory inference always depends on a middle term ('10.2). In order to make valid amplificatory inferences, then, the cognitive systems must be able to tell when various separate bits of information that have been collected over time concern the same thing and when they concern different things. Similarly, whenever information that has been collected is brought to bear upon action. From this we have concluded that a crucially important task that must continually be performed by the cognitive systems is managing to recognize when new information coming in concerns the very same thing again, something one already knows something about. Without this, none of the information taken in can be used. Without this the representational system would become wholly corrupted. Its representations would cease to have any clear meanings, becoming hopelessly referentially equivocal or, at the limit, referentially empty. The capacity correctly to recognize sources of incoming information<sup>2</sup> is a requirement for having any coherent thought at all.

This then is the question to be pressed. Does this capacity rest merely on the same mundane set of stable supporting conditions that sustains the human body from hour to hour, or does it have its own special environmental needs, differing perhaps from one cognitive task to another?

That our powers of recognition can fail is obvious enough. Take places or spouses, colors, minerals, tunes, species, buildings, diseases Cwhatever it is, you can misidentify it. It is possible to construct conditions Cexternal conditionsC under which someone completely familiar with it may still fail to recognize it. Are such failures the fault of the cognitive systems, or is it epistemic bad luck that sometimes puts these systems beyond their powers?

We should keep clearly in focus what the cognitive systems are for. Their mission is not, for example, the acquisition of justified certainty. They are not at fault or malfunctioning when they take risks, when they rely on environmental stability. As modern skeptics are well aware, no one lives by justified certainty. Justified certainty is not what is needed to advance the life line. Instead, once again we find at work the principles of multiplication and division. Having many different fallible methods of recognizing the same person, the same mineral, the same species, the same disease, some methods that can be used under some conditions, others under other conditions,

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<sup>2</sup> CinformationC. See Appendix B.

employing these methods redundantly whenever possible, employing each whenever an opportunity for it happens to arise--this is the strategy that gets us by. Much of the time it gets us by. But every one of these diverse methods requires its own unique sort of environmental support.

Consider a stereoscope which produces an illusory three dimensional image by causing the visual systems to misidentify. It causes them to take visual contents derived from two different objects as though derived from the same source, thus creating the illusion of a three dimensional scene (' 10.3). The illusory image is not formed due to a malfunction within the (internal) visual system. The visual system is not broken or reacting in a way it should not when forming such an image. Instead, the environment is abnormal Cnot abnormal in some general feature constantly needed to sustain human life, but in a very specific feature, needed to sustain correct binocular vision.

Sometimes we recognize people by their faces, sometimes by their stature and walk, sometimes by their voices, sometimes by their names. But an uncooperative environment can produce two people who look (at least for the moment, or at least from here) just too much alike, or who sound (in this context) just too much alike, or who have exactly the same name. No matter how carefully our recognizing abilities are tuned, and no matter how clever the various mechanisms by which they work, providence will sometimes put up misleading signs. Coherent thinking rests, not on some one steady set of normal environmental conditions, but on a vast variety of special circumstances, each required for proper exercise of a different recognition skill.

Like the species lines, and the individual life lines, and the little lines representing behaviors, the cognitive lines too often get broken off by the environment. Just as the ability to live on and to multiply requires environmental support, the ability to maintain coherent thoughts Cto have clear ideasC requires environmental support.