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The Design Argument Elliott Sober¹

The design argument is one of three main arguments for the existence of God; the others are the ontological argument and the cosmological argument. Unlike the ontological argument, the design argument and the cosmological argument are *a posteriori*. And whereas the cosmological argument can focus on any present event to get the ball rolling (arguing that it must trace back to a first cause, namely God), design theorists are usually more selective.

Design arguments have typically been of two types – *organismic* and *cosmic*. Organismic design arguments start with the observation that organisms have features that adapt them to the environments in which they live and that exhibit a kind of *delicacy*. Consider, for example, the vertebrate eye. This organ helps organisms survive by permitting them to perceive objects in their environment. And were the parts of the eye even slightly different in their shape and assembly, the resulting organ would not allow us to see. Cosmic design arguments begin with an observation concerning features of the entire cosmos – the universe obeys simple laws, it has a kind of stability, its physical features permit life and intelligent life to exist. However, not all design arguments fit into these two neat compartments. Kepler, for example, thought that the face we see when we look at the moon requires explanation in terms of intelligent design, as did Newton when he considered the fact that the planets circle the sun in the same direction and in the same plane. Still, the common thread is that design theorists describe some empirical feature of the world and argue that this feature points towards an explanation in terms of God's intentional planning and away from an explanation in terms of mindless natural processes.

The design argument raises epistemological questions that go beyond its traditional theological context. As William Paley (1802) observed, when we find a watch while walking across a heath, we unhesitatingly infer that it was produced by an intelligent designer. No such inference forces itself upon us when we observe a stone. Why is explanation in terms of intelligent design so compelling in the one case, but not in the other? Similarly, when we observe the behavior of our fellow human beings, we find it irresistible to think that they have minds that are filled with beliefs and desires. And when we observe nonhuman organisms, the impulse to invoke mentalistic explanations is often very strong, especially when they look a lot like us. When does the behavior of an organism – human or not -- warrant this mentalistic interpretation? The same question can be posed about machines. Few of us feel tempted to attribute beliefs and desires to hand calculators. We use calculators to help us add, but they don't literally figure out sums; in this respect, calculators are like pieces of paper on which we scribble our calculations. There is an important difference between a device that *we* use to help us think and a device that *itself* thinks. However, when a computer plays a decent game of chess, we may find it useful to explain and predict its behavior by thinking of it as having goals and deploying strategies (Dennett 1987b). Is this merely a useful fiction, or does the machine really have a mind? And if we think that present day chess-playing computers are, strictly speaking, mindless, what would it take for a machine to pass the test? Surely, as Turing (1950) observed,

it needn't look like us. In all these contexts, we face *the problem of other minds* (Sober 2000a). If we understood the ground rules in this general epistemological problem, that would help us think about the design argument for the existence of God. And conversely – if we could get clear on the theological design argument, that might throw light on epistemological problems that are not theological in character.

What is the Design Argument?

The design argument, like the ontological argument, raises subtle questions about what the logical structure of the argument really is. My main concern here will not be to describe how various thinkers have presented the design argument, but to find the soundest formulation that the argument can be given.

The best version of the design argument, in my opinion, uses an inferential idea that probabilists call *the Law of Likelihood*. This can be illustrated by way of Paley's (1802) example of the watch on the heath. Paley describes an observation that he claims discriminates between two hypotheses:

- (W) O_1 : the watch has features $G_1 \dots G_n$.
 W_1 : the watch was created by an intelligent designer.
 W_2 : the watch was produced by a mindless chance process.

Paley's idea is that O_1 would be unsurprising if W_1 were true, but would be very surprising if W_2 were true. This is supposed to show that O_1 favors W_1 over W_2 ; O_1 supports W_1 more than it supports W_2 . Surprise is a matter of degree; it can be captured by the concept of conditional probability. The probability of O given H -- $\Pr(O | H)$ -- represents how unsurprising O would be if H were true. The Law of Likelihood says that we can decide in which direction the evidence points by comparing such conditional probabilities:

- (LL) Observation O supports hypothesis H_1 more than it supports hypothesis H_2 if and only if $\Pr(O | H_1) > \Pr(O | H_2)$.

There is a lot to say on the question of why the Law of Likelihood should be accepted (Hacking 1965, Edwards 1972, Royall 1997, Forster and Sober 2001); for the purposes of this essay, I will take it as a given.

We now can describe the likelihood version of the design argument for the existence of God, again taking our lead from one of Paley's favorite examples of a delicate adaptation. The basic format is to compare two hypotheses as possible explanations of a single observation:

- (E) O_2 : the vertebrate eye has features $F_1 \dots F_n$.
 E_1 : the vertebrate eye was created by an intelligent designer.
 E_2 : the vertebrate eye was produced by a mindless chance process.

We do not hesitate to conclude that the observations strongly favor Design over Chance in the

case of argument (W); Paley claims that precisely the same conclusion should be drawn in the case of the propositions assembled in (E).²

Clarifications

Several points of clarification are needed here concerning likelihood in general and the likelihood version of the design argument in particular. First, I use the term “likelihood” in a technical sense. Likelihood is not the same as probability. To say that H has a high likelihood, given observation O, is to comment on the value of $\Pr(O | H)$, not on the value of $\Pr(H | O)$; the latter is H’s *posterior probability*. It is perfectly possible for a hypothesis to have a high likelihood and a low posterior probability. When you hear noises in your attic, this confers a high likelihood on the hypothesis that there are gremlins up there bowling, but few of us would conclude from the noises we hear that this hypothesis is probably true.

Although the likelihood of H (given O) and the probability of H (given O) are different quantities, they are related. The relationship is given by Bayes’ theorem:

$$\Pr(H | O) = \frac{\Pr(O|H) \Pr(H)}{\Pr(O)}.$$

$\Pr(H)$ is the hypothesis’ *prior probability* – the probability that H has before we take the observation O into account. From Bayes’ theorem we can deduce the following:

$$\Pr(H_1 | O) > \Pr(H_2 | O) \text{ if and only if } \Pr(O | H_1)\Pr(H_1) > \Pr(O | H_2)\Pr(H_2).$$

Which hypothesis has the higher posterior probability depends not only on how their likelihoods are related, but also on how their prior probabilities are related. This explains why the likelihood version of the design argument does not show that Design is more *probable* than Chance (Keynes 1921, p. 298). To draw this further conclusion, we’d have to say something about the prior probabilities of the two hypotheses. It is here that I wish to demur (and this is what separates me from card-carrying Bayesians). Each of us perhaps has some subjective degree of belief, before we consider the design argument, in each of the two hypotheses E_1 and E_2 . However, I see no way to understand the idea that the two hypotheses have *objective* prior probabilities. Since I would like to restrict the design argument as much as possible to matters that are objective, I will not represent it as an argument concerning which hypothesis is more probable. However, those who do have prior degrees of belief in E_1 and E_2 may use the likelihood argument to update their subjective probabilities. The likelihood version of the design argument says that the observation O_2 should lead you to increase your degree of belief in E_1 and reduce your degree of belief in E_2 .

My restriction of the design argument to an assessment of likelihoods, not probabilities, reflects a more general point of view. Scientific theories often have implications about which observations are probable and which are improbable, but it rarely makes sense to describe theories as having objective probabilities. Newton’s law of gravitation (along with suitable background assumptions) tells us that the return of Haley’s comet was to be expected, but what

is the probability that Newton's law is true? Hypotheses have objective probabilities when they describe possible outcomes of a chance process. But as far as anyone knows, the laws that govern our universe were not the result of a chance process. Bayesians think that *all* hypotheses have probabilities; the position I am advocating sees this as a special feature of *some* hypotheses.³

Not only do likelihood considerations leave open what probabilities one should assign to the competing hypotheses; they also don't tell you which hypothesis you should believe. I take it that belief is a dichotomous concept – you either believe a proposition or you do not. Consistent with this is the idea that there are three attitudes one might take to a statement – you can believe it true, believe it false, or withhold judgment. However, there is no simple connection of the matter-of-degree concept of probability to the dichotomous (or trichotomous) concept of belief. This is the lesson I extract from the lottery paradox (Kyburg 1961). Suppose 100,000 tickets are sold in a fair lottery; one ticket will win and each has the same chance of winning. It follows that each ticket has a very high probability of not winning. If you adopt the policy of believing a proposition when it has a high probability, you will believe of each ticket that it will not win. However, this conclusion contradicts the assumption that the lottery is fair. What this shows is that high probability does not suffice for belief (and low probability does not suffice for disbelief). It is for this reason that many Bayesians prefer to say that individuals have *degrees* of belief. The rules for the dichotomous concept are unclear; the matter-of-degree concept at least has the advantage of being anchored to the probability calculus.

In summary, likelihood arguments have rather modest pretensions. They don't tell you which hypotheses to believe; in fact, they don't even tell you which hypotheses are probably true. Rather, they evaluate how the observations at hand discriminate among the hypotheses under consideration.

I now turn to some details concerning the likelihood version of the design argument. The first concerns the meaning of the intelligent design hypothesis. This hypothesis occurs in W_1 in connection with the watch and in E_1 in connection with the vertebrate eye. In the case of the watch, Paley did not dream that he was offering an argument for the existence of *God*. However, in the case of the eye, Paley thought that the intelligent designer under discussion was God himself. Why are these cases different? The bare bones of the likelihood arguments (W) and (E) do not say. What Paley had in mind is that building the vertebrate eye and the other adaptive features that organisms exhibit requires an intelligence far greater than anything that human beings could muster. This is a point that we will revisit at the end of this essay.

It also is important to understand the nature of the hypothesis with which the intelligent design hypothesis competes. I have used the term "chance" to express this alternative hypothesis. In large measure, this is because design theorists often think of chance as the alternative to design. Paley is again exemplary. *Natural Theology* is filled with examples like that of the vertebrate eye. Paley was not content to describe a few cases of delicate adaptations; he wanted to make sure that even if he got a few details wrong, the weight of evidence would still be overwhelming. For example, in Chapter 15 he considers the fact that our eyes point in the same direction as our feet (an example he perhaps drew from Plato's *Timaeus* 44D-45B); this has the convenient consequence that we can see where we are going. The obvious explanation,

Paley (1802, p. 179) says, is intelligent design. This is because the alternative explanation is that the direction of our eyes and the direction of our gait were determined by chance, which would mean that there was only a 1/4 probability that our eyes would be able to scan the quadrant into which we are about to step.

I construe the concept of chance in a particular way. To say that an outcome is the result of a *uniform chance process* means that it was one of a number of *equiprobable* outcomes. Examples in the real world that come close to being uniform chance processes may be found in gambling devices -- spinning a roulette wheel, drawing from a deck of cards, tossing a coin. The term “random” becomes more and more appropriate as real world systems approximate uniform chance processes. As R.A. Fisher once pointed out, it is not a “matter of chance” that casinos turn a profit each year, nor should this be regarded as a “random” event. The financial bottom line at a casino is the result of a large number of chance events, but the rules of the game make it overwhelmingly probable, though not certain, that casinos end each year in the black. All uniform chance processes are probabilistic, but not all probabilistic outcomes are “due to chance.”

It follows that the two hypotheses considered in my likelihood rendition of the design argument are not exhaustive. Mindless uniform chance is one alternative to intelligent design, but it is not the only one. This point has an important bearing on the dramatic change in fortunes that the design argument experienced with the advent of Darwin’s (1859) theory of evolution. The process of evolution by natural selection is *not* a uniform chance process. The process has two parts. Novel traits arise in individual organisms “by chance;” however, whether they then disappear from the population or increase in frequency and eventually reach 100% representation is anything but a “matter of chance.” The central idea of natural selection is that traits that help organisms survive and reproduce have a better chance of becoming common than traits that hurt. The essence of natural selection is that evolutionary outcomes have *unequal* probabilities. Paley and other design theorists writing before Darwin did not and could not cover all possible mindless natural processes. Paley addressed the alternative of uniform chance, not the alternative of natural selection.⁴

Just to nail down this point, I want to describe a version of the design argument formulated by John Arbuthnot. Arbuthnot (1710) examined the birth records in London over 82 years and noticed that in each year, slightly more sons than daughters were born. Realizing that boys die in greater numbers than girls, he saw that this slight bias in the sex ratio at birth gradually subsides until there are equal numbers of males and females at the age of marriage. Arbuthnot took this to be evidence of intelligent design; God, in his benevolence, wanted each man to have a wife and each woman to have a husband. To draw this conclusion, Arbuthnot considered what he took to be the relevant competing hypothesis – that the sex ratio at birth is determined by a uniform chance process. He was able to show that if the probability is ½ that a baby will be a boy and ½ that it will be a girl, then it is enormously improbable that the sex ratio should be skewed in favor of males in each and every year that he surveyed (Stigler 1986, pp. 225-226; see also Sober 200x).

Arbuthnot could not have known that R.A. Fisher (1930) would bring sex ratio within the purview of the theory of natural selection. Fisher’s insight was to see that a mother’s

mix of sons and daughters affects the number of *grandoffspring* she will have. Fisher demonstrated that when there is random mating in a large population, the sex ratio strategy that evolves is one in which a mother invests equally in sons and daughters (Sober 1993, p. 17). A mother will put half her reproductive resources into producing sons and half into producing daughters. This equal division means that she should have more sons than daughters, if sons tend to die sooner. Fisher's model therefore predicts the slightly uneven sex ratio at birth that Arbuthnot observed.⁵

My point in describing Fisher's idea is not to fault Arbuthnot for living in the 18th century. Rather, the thing to notice is that what Arbuthnot meant by "chance" was very different from what Fisher was talking about when he described how a selection process might shape the sex ratio found in a population. Arbuthnot was right that the probability of there being more males than females at birth in each of 82 years is extremely low, if each birth has the same chance of producing a male as it does of producing a female. However, a male-biased sex ratio in the population is extremely probable, if Fisher's hypothesized process is doing the work. Showing that Design is more likely than Chance leaves it open that some third, mindless, process might still have a higher likelihood than Design. This is not a defect in the design argument, so long as the conclusion of that argument is not over-stated. Here the modesty of the likelihood version of the design argument is a point in its favor. To draw a stronger conclusion – that the Design hypothesis is more likely than *any* hypothesis involving mindless natural processes -- one would have to attend to more alternatives than just Design and (uniform) Chance.⁶

I now want to draw the reader's attention to some features of the likelihood version of the design argument (E) concerning how the observation and the competing hypotheses are formulated. First, notice that I have kept the observation (O₂) conceptually separate from the two hypotheses (E₁) and (E₂). If the observation were simply that "the vertebrate eye exists," then since (E₁) and (E₂) both entail this proposition, each would have a likelihood of unity. According to the Likelihood Principle, this observation does not favor Design over Chance. Better to formulate the question in terms of explaining the properties of the vertebrate eye, not in terms of explaining why the eye exists. Notice also that I have not formulated the design hypothesis as the claim that God exists; this existence claim says nothing about the putative designer's involvement in the creation of the vertebrate eye. Finally, I should point out that it would do no harm to have the design hypothesis say that God created the vertebrate eye; this possible reformulation is something I'll return to later.

Other Formulations of the Design Argument, and Their Defects

Given the various provisos that govern probability arguments, it would be nice if the design argument could be formulated deductively. For example, if the hypothesis of mindless chance processes entailed that it is *impossible* that organisms exhibit delicate adaptations, then a quick application of *modus tollens* would sweep that hypothesis from the field. However much design theorists might yearn for an argument of this kind, there apparently is none to be had. As the story about monkeys and typewriters illustrates, it is *not* impossible that mindless chance processes should produce delicate adaptations; it is merely very *improbable* that they should do so.

If *modus tollens* cannot be pressed into service, perhaps there is a probabilistic version of *modus tollens* that can achieve the same result. Is there a Law of Improbability that begins with the premiss that $\Pr(O \mid H)$ is very low and concludes that H should be rejected? There is no such principle (Royall 1997, ch. 3). The fact that you won the lottery does not, by itself, show that there is something wrong with the conjunctive hypothesis that the lottery was fair and a million tickets were sold and you bought just one ticket. And if we randomly drop a very sharp pin onto a line that is 1000 miles long, the probability of its landing where it does is negligible; however, that outcome does not falsify the hypothesis that the pin was dropped at random.⁷

The fact that there is no probabilistic *modus tollens* has great significance for understanding the design argument. The logic of this problem is essentially comparative. To evaluate the design hypothesis, we must know what it predicts and compare this with the predictions made by other hypotheses. The design hypothesis cannot win by default. The fact that an observation would be very improbable if it arose by chance is not enough to refute the chance hypothesis. One must show that the design hypothesis confers on the observation a higher probability, and even then the conclusion will merely be that the observation *favors* the design hypothesis, not that that hypothesis *must be true*.

In the continuing conflict (in the United States) between evolutionary biology and creationism, creationists attack evolutionary theory, but never take even the first step toward developing a positive theory of their own. The three-word slogan “God did it” seems to satisfy whatever craving for explanation they may have. Is the sterility of this intellectual tradition a mere accident? Could intelligent design theory be turned into a scientific research program? I am doubtful, but the present point concerns the logic of the design argument, not its future prospects. Creationists sometimes assert that evolutionary theory “cannot explain” this or that finding (e.g., Behe 1996). What they mean is that certain outcomes are *very improbable* according to the evolutionary hypothesis. Even this more modest claim needs to be scrutinized. However, even if it were true, what would follow about the plausibility of creationism? In a word – *nothing*.

It isn't just defenders of the design hypothesis who have fallen into the trap of supposing that there is a probabilistic version of *modus tollens*. For example, the biologist Richard Dawkins (1986, pp. 144-146) takes up the question of how one should evaluate hypotheses that attempt to explain the origin of life by appeal to strictly mindless natural processes. He says that an acceptable theory of this sort can say that the origin of life on Earth was somewhat improbable, but it cannot go too far. If there are N planets in the universe that are “suitable” locales for life to originate, then an acceptable theory of the origin of life on Earth must say that that event had a probability of at least $1/N$. Theories that say that terrestrial life was less probable than this should be rejected. This criterion may look plausible, but I think there is less to it than meets the eye. Suppose only ten lotteries are held in the whole history of the universe and that you have just won one of them. The fact that $N=10$ does not provide a licence for dismissing any theory about how your lottery worked that says that the probability of your winning was less than $1/10$.

Some of Hume's (1779) criticisms of the design argument in his *Dialogues Concerning*

Natural Religion depend on formulating the argument as something other than a likelihood inference. For example, Hume at one point has Philo say that the design argument is an argument from analogy, and that the conclusion of the argument is supported only very weakly by its premisses. His point can be formulated by thinking of the design argument as follows:

Watches are produced by intelligent design.
Organisms are similar to watches to degree p.
p[=====]
Organisms were produced by intelligent design.

Note that the letter “p” appears twice in this argument. It represents the degree of similarity of organisms and watches, and it represents the probability that the premisses confer on the conclusion. Think of similarity as the proportion of shared characteristics. Things that are 0% similar have no traits in common; things that are 100% similar have all traits in common. The analogy argument says that the more similar watches and organisms are, the more probable it is that organisms were produced by intelligent design.

Let us grant the Humean point that watches and organisms have relatively few characteristics in common (it is doubtful that there is a well-defined totality consisting of all the traits of each, but let that pass). After all, watches are made of metal and glass and go “tick tock”; organisms metabolize and reproduce and go “oink” and “bow wow.” This is all true, but entirely irrelevant, if the design argument is a likelihood inference. It doesn’t matter how overall similar watches and organisms are. With respect to argument (W), what matters is how one should explain the fact that watches are well adapted for the task of telling time; with respect to (E), what matters is how one should explain the fact that organisms are well adapted to their environments. Paley’s analogy between watches and organisms is merely heuristic. The likelihood argument about organisms stands on its own (Sober 1993).

Hume also has Philo construe the design argument as an inductive argument, and then complain that the inductive evidence is weak. Philo suggests that for us to have good reason to think that our world was produced by an intelligent designer, we’d have to visit other worlds and observe that all or most of them were produced by intelligent design. But how many other worlds have we visited? The answer is – not even one. Apparently, the design argument is an inductive argument that could not be weaker; its sample size is zero. This objection dissolves once we move from the model of inductive sampling to that of likelihood. You don’t have to observe the processes of intelligent design and chance at work in different worlds to maintain that the two hypotheses confer different probabilities on your observations.

Three Objections to the Likelihood Argument

There is another objection that Hume makes to the design argument, one that many philosophers apparently think is devastating. Hume points out that the design argument does not establish the attributes of the designer. The argument does not show that the designer who made the universe, or who made organisms, is morally perfect, or all-knowing, or all-powerful, or that there is just one of him. Perhaps this undercuts some versions of the design argument, but it does

not touch the likelihood argument we are considering. Paley, perhaps responding to this Humean point, makes it clear that his design argument aims to establish the *existence* of the designer, and that the question of the designer's *characteristics* must be addressed separately.⁸ Does this limitation of the design argument make the argument trivial? Not at all – it is *not* trivial to claim that the adaptive contrivances of organisms are due to intelligent design. This supposed “triviality” would be *big* news to evolutionary biologists.

The likelihood version of the design argument consists of two premisses – Pr(O | Chance) is very low and Pr(O | Design) is higher. Here O describes some observation of the features of organisms or some feature of the entire cosmos. The first of these claims is sometimes rejected by appeal to a theory that Hume describes under the heading of the Epicurean hypothesis. This is the monkeys-and-typewriters idea that if there are a finite number of particles that have a finite number of possible states, then, if they swarm about at random, they will eventually visit all possible configurations, including configurations of great order.⁹ The shorter the time frame, the lower the probability that a given configuration will occur. This means that the estimated age of the universe may entail that it is very *improbable* that a given configuration will occur. I set this objection aside in what follows. Thus, the order we see in our universe, and the delicate adaptations we observe in organisms, in fact had a high probability of eventually coming into being, according to the hypothesis of chance. Van Inwagen (1993, p. 144) gives voice to this objection and explains it by way of an analogy: Suppose you toss a coin twenty times and it lands heads every time. You should not be surprised at this outcome if you are one among millions of people who toss a fair coin twenty times. After all, with so many people tossing, it is all but inevitable that some people will get twenty heads. The outcome you obtained, therefore, was not improbable, according to the chance hypothesis.

There is a fallacy in this criticism of the design argument, which Hacking (1987) calls “the inverse gambler’s fallacy.” He illustrates his idea by describing a gambler who walks into a casino and immediately observes two dice being rolled that land double-6. The gambler considers whether this result favors the hypothesis that the dice had been rolled many times before the roll he just observed or the hypothesis that this was the first roll of the evening. The gambler reasons that the outcome of double-six would be more probable under the first hypothesis:

$$\Pr(\text{double-6 on this roll} \mid \text{there were many rolls}) > \Pr(\text{double-6 on this roll} \mid \text{there was just one roll}).$$

In fact, the gambler’s assessment of the likelihoods is erroneous. Rolls of dice have the *Markov property*; the probability of double-six on this roll is the same (1/36), regardless of what may have happened in the past. What is true is that the probability that a double-six will occur *at some time or other* increases as the number of trials is increased:

$$\Pr(\text{a double-6 occurs sometime} \mid \text{there were many rolls}) > \Pr(\text{a double-6 occurs sometime} \mid \text{there was just one roll}).$$

However, the *principle of total evidence* says that we should assess hypotheses by considering *all* the evidence we have. This means that the relevant observation is that *this* roll landed

double-6; we should not focus on the logically weaker proposition that a double-6 occurred *at some time or other*. Relative to the stronger description of the observations, the hypotheses have identical likelihoods.

If we apply this point to the criticism of the design argument that we are presently considering, we must conclude that the criticism is mistaken. There is a high probability (let us suppose) that a chance process will sooner or later produce order and adaptation. However, the relevant observation is not that these events occur at some time or other, but that they are true here and now – *our* universe is orderly and the organisms here on earth are well-adapted. These events *do* have very low probability, according to the chance hypothesis, and the fact that a weaker description of the observations has high probability on the chance hypothesis is not relevant (see also White 2000).¹⁰

If the first premiss in the likelihood formulation of the design argument – that $\text{Pr}(O \mid \text{Chance})$ is very low -- is correct, then the only question that remains is whether $\text{Pr}(O \mid \text{Design})$ is higher. This, I believe, is the Achilles heel of the design argument. The problem is to say how probable it is, for example, that the vertebrate eye would have features $F_1 \dots F_n$, if the eye were produced by an intelligent designer. What is required is not the specification of a single probability value, or even a range of such. All that is needed is an argument that shows that this probability is indeed higher than the probability that Chance confers on the observation.

The problem is that the design hypothesis confers a probability on the observation only when it is supplemented with further assumptions about what the designer's goals and abilities would be if he existed. Perhaps the designer would never build the vertebrate eye with features $F_1 \dots F_n$, either because he would lack the goals or because he would lack the ability. If so, the likelihood of the design hypothesis is zero. On the other hand, perhaps the designer would want to build the eye with features $F_1 \dots F_n$ and would be entirely competent to bring this plan to fruition. If so, the likelihood of the design hypothesis is unity. There are as many likelihoods as there are suppositions concerning the goals and abilities of the putative designer. Which of these, or which class of these, should we take seriously?

It is no good answering this question by assuming that the eye was built by an intelligent designer and then inferring that the designer must have wanted to give the eye features $F_1 \dots F_n$ and must have had the ability to do so since, after all, these are the features we observe. For one thing, this pattern of argument is question-begging. One needs *independent* evidence as to what the designer's plans and abilities would be if he existed; one can't obtain this evidence by *assuming* that the design hypothesis is true (Kitcher 1983; Sober 1999).

This objection to the design argument is an old one (see, for example, Venn 1866, pp. 250-251); it is continuous with the precepts of "negative theology," which holds that God is so different from us and the world we already know about that it is impossible for us to have much of a grasp of what his characteristics are. In fact the basic idea of the criticism of the design argument that I have presented was formulated by Hume. When we behold the watch on the heath, we know that the watch's features are not particularly improbable on the hypothesis that the watch was produced by a designer who has the sorts of *human* goals and abilities with which we are familiar. This is the deep and nonobvious disanalogy between the watchmaker and the

putative maker of organisms and universes. We are invited, in the latter case, to imagine a designer who is radically different from the human craftsmen we know about. But if this designer is so different, why are we so sure that this being would build the vertebrate eye in the form in which we find it?¹¹

This challenge is not turned back by pointing out that we often infer the existence of intelligent designers when we have no clue as to what they were trying to achieve. The biologist John Maynard Smith used to tell the story of a job he had during World War II inspecting a warehouse filled with German war materiel. He and his coworkers often came across machines whose functions were entirely opaque to them. Yet, they had no trouble seeing that these objects were built by an intelligent designer. There are similar stories about archaeologists who work in museums; they often have objects in their collections that they know are artefacts, although they have no idea what the makers of these artefacts had in mind.

My claim is not that design theorists must have independent evidence that singles out the exact goals and abilities of the putative intelligent designer. They may be uncertain as to which of the goal-plus-abilities pairs GA_1, GA_2, \dots, GA_n is correct. However, since

$$\Pr(\text{the eye has } F_1 \dots F_n \mid \text{Design}) = \sum_i \Pr(\text{the eye has } F_1 \dots F_n \mid \text{Design} \ \& \ GA_i) \Pr(GA_i \mid \text{Design}),$$

they do have to show that

$$\sum_i \Pr(\text{the eye has } F_1 \dots F_n \mid \text{Design} \ \& \ GA_i) \Pr(GA_i \mid \text{Design}) > \Pr(\text{the eye has } F_1 \dots F_n \mid \text{Chance}).$$

I think that Maynard Smith in his warehouse and archaeologists in their museums are able to do this. They aren't sure exactly what the intelligent designer was trying to achieve (e.g., they aren't certain that GA_1 is true and that all the other GA pairs are false), but they are able to see that it is not terribly improbable that the object should have the features one observes if it were made by a human intelligent designer. After all, the items in Maynard Smith's warehouse were symmetrical and smooth metal containers that had what appeared to be switches, dials, and gauges on them. And the "artefacts of unknown function" in anthropology museums likewise bear signs of human handiwork.

It is interesting in this connection to consider the epistemological problem of how one would go about detecting intelligent life elsewhere in the universe (if it exists). The SETI (Search for Extraterrestrial Intelligence) project, funded until 1993 by the US National Aeronautics and Space Administration and now supported privately, dealt with this problem in two ways (Dick 1996). First, the scientists wanted to send a message into deep space that would allow any intelligent extraterrestrials who received it to figure out that it was produced by intelligent designers (namely, us). Second, they scanned the night sky hoping to detect signs of intelligent life elsewhere.

The message, transmitted in 1974 from the Arecibo Observatory, was a simple picture of our solar system, a representation of oxygen and carbon, a picture of a double helix

representing DNA, a stick figure of a human being, and a picture of the Arecibo telescope. How sure are we that if intelligent aliens find these clues, that they will realize that they were produced by intelligent designers? The hope is that this message will strike the aliens who receive it as evidence favoring the hypothesis of intelligent design over the hypothesis that some mindless physical process (not necessarily one involving uniform chance) was responsible. It is hard to see how the SETI engineers could have done any better, but one still cannot dismiss the possibility that they will fail. If extraterrestrial minds are very different from our own – either because they have different beliefs and desires or because they process information in different ways -- it may turn out that their interpretation of the evidence differs profoundly from the interpretation that human beings would arrive at, were they on the receiving end. To say anything more precise about this, we'd have to be able provide specifics about the aliens' mental characteristics. If we are uncertain as to how the mind of an extraterrestrial will interpret this evidence, how can we be so sure that God, if he were to build the vertebrate eye, would endow it with the features we find it to have?

When SETI engineers search for signs of intelligent life elsewhere in the universe, what are they looking for? The answer is surprisingly simple. They are looking for narrow-band radio emissions. This is because human beings build machines that produce these signals and, as far as we know, such emissions are not produced by mindless natural processes. The SETI engineers search for this signal, not because it is “complex” or fulfills some *a priori* criterion that would make it a “sign of intelligence,” but simply because they think they know what sorts of mechanisms are needed to produce it.¹² This strategy may not work, but it is hard to see how the scientists could do any better. Our judgments about what counts as a sign of intelligent design must be based on empirical information about what designers often do and what they rarely do. As of now, these judgments are based on our knowledge of *human* intelligence. The more our hypotheses about intelligent designers depart from the human case, the more in the dark we are as to what the ground rules are for inferring intelligent design.¹³ It is imaginable that these limitations will subside as human beings learn more about the cosmos and the varieties of intelligence it contains. But for now, we are rather limited.

I have been emphasizing the fallibility of two assumptions -- that we know what counts as a sign of extraterrestrial intelligence and that we know how extraterrestrials will interpret the signals we send. My point has been to shake a complacent assumption that figures in the design argument. However, I suspect that SETI engineers are on much firmer ground than theologians. If extraterrestrials evolved by the same type of evolutionary process that produced human intelligence, that may provide useful constraints on conjectures about the minds they have. No theologian, to my knowledge, thinks that God is the result of biological processes. Indeed God is usually thought of as a *supernatural* being who is radically different from the things we observe *in nature*. The problem of extraterrestrial intelligence is therefore an intermediate case, lying somewhere between the watch found on the heath and the God who purportedly shaped the vertebrate eye (but much closer to the first). The upshot of this point for Paley's design argument is this: *Design arguments for the existence of human (and human-like) watchmakers are often unproblematic; it is design arguments for the existence of God that leave us at sea.*

I began by formulating the design hypothesis in argument (E) as the claim that an intelligent designer made the vertebrate eye. Yet, I have sometimes discussed the hypothesis

as if it asserted that *God* is the designer in question. I don't think this difference makes a difference with respect to the objection I have described. To say that some designer or other made the eye is to state a disjunctive hypothesis. To figure out the likelihood of this disjunction, one needs to address the question of what each putative designer's goals and intentions would be.¹⁴ If either God or a superintelligent extraterrestrial built the vertebrate eye, what is the probability that it was God who did so? The theological formulation shifts the problem from the evaluation of a disjunction to the evaluation of a disjunct, but the problem remains the same. Even supposing that God is omniscient, omnipotent, and perfectly benevolent, what is the probability that the eye would have features $F_1 \dots F_n$, if God set his hand to making it? He *could* have produced those results if he had wanted. But why think that this is what he *would* have wanted to do? The assumption that God can do anything is part of the problem, not the solution. An engineer who is more limited would be more predictable.

There is another reply to my criticism of the design argument that should be considered. I have complained that we have no way to evaluate the likelihood of the design hypothesis, since we don't know which auxiliary assumptions about goal/ability pairs we should use. But why not change the subject? Instead of evaluating the likelihood of Design, why not evaluate the likelihood of various conjunctions – (Design & GA_1), (Design & GA_2), etc? Some of these will have high likelihood while others will have low, but it will no longer be a mystery what likelihoods these hypotheses possess. There are two problems with this tactic. First, it is a game that two can play. Consider the hypothesis that the vertebrate eye was created by the mindless process of electricity. If I simply get to invent auxiliary hypotheses without having to justify them independently, I can simply stipulate the following assumption – if electricity created the vertebrate eye, the eye must have features $F_1 \dots F_n$. The electricity hypothesis now is a conjunct in a conjunction that has maximum likelihood, just like the design hypothesis. This is a dead end. My second objection is that it is an important part of scientific practice that conjunctions be broken apart (when possible), and their conjuncts scrutinized (Sober 1999, 2000). If your doctor runs a test to see whether you have tuberculosis, you will not be satisfied if she reports that both of the following inequalities are true:

$$\begin{aligned} & \Pr(\text{your test result} \mid \text{you have tuberculosis \& auxiliary assumption-1}) \\ & \gg \Pr(\text{your test result} \mid \text{you do not have tuberculosis \& auxiliary assumption-1}) \end{aligned}$$

$$\begin{aligned} & \Pr(\text{your test result} \mid \text{you have tuberculosis \& auxiliary assumption-2}) \\ & \ll \Pr(\text{your test result} \mid \text{you do not have tuberculosis \& auxiliary assumption-2}). \end{aligned}$$

You want your doctor to address the question of whether you have tuberculosis, and not make the trivial point that this hypothesis can be embedded in conjunctions of high likelihood and also embedded in conjunctions of low likelihood. The way forward is for your doctor to find out what the error characteristics are of the test procedure used, and to use this *independent* information to interpret your test result. Demand no less of your theologian.

I have focused on Paley's discussion of the watch and the vertebrate eye, but it is interesting to consider what he says about a third example – a stone found on the heath. His point is that the stone – unlike the watch and the eye -- does not cry out for explanation in terms of intelligent design. Why is Paley entitled to say this? Some may think that the key is the fact

that the watch and the eye are complicated, whereas the stone is simple. From the point of view of our likelihood analysis, that distinction is relevant only if it gets reflected in the right sort of probabilistic inequality. If the features of the stone favor Chance over Intelligent Design, then it must be the case that

$$\Pr(\text{the stone has features } F_1 \dots F_n \mid \text{Chance}) > \Pr(\text{the stone has features } F_1 \dots F_n \mid \text{Design}).$$

But why should we think this inequality holds? If Paley gets to help himself to assumptions about the goals and abilities of the putative designer that favor the design hypothesis in the case of the eye, why should he abstain from doing so in the case of the stone? We can easily describe assumptions about the putative stone-maker that lead Design to be more likely than Chance. And, of course, there are other assumptions that have the opposite effect. The Design Argument has no more basis for claiming that Design is the better supported hypothesis in the case of the eye than it has for saying that Chance is the better supported hypothesis in the case of the stone.¹⁵

The criticism I have developed of the design argument is based on a Duhemian point. Duhem (1917) contended that theories in physics do not allow one to deduce predictions about observations unless auxiliary assumptions are brought into play. Quine (1953) generalized this point to a claim about all the hypotheses we might wish to consider. I have generalized the thesis still further, since I think it holds for probabilistic predictions as well as predictions that are deduced. In general, it is (H&A) that tells you what observations to expect, not H all by itself. Perhaps readers who remain convinced that the vertebrate eye favors Design over Chance without the need of auxiliary assumptions will feel less confident if they think of my criticism in the context of this larger Duhemian theme. In this connection, let's briefly consider the famous "ravens problem" (Hempel 1965); Hempel assumed that observing a black raven confirms the hypothesis "All ravens are black" and wondered whether the observation of a white shoe has the same epistemological significance. I.J. Good (1967) pointed out that Hempel's framing of the problem is based on a misconception. Observing a black raven can actually *disconfirm* the generalization that all ravens are black if certain auxiliary assumptions are in place; suppose you antecedently believe that either all ravens are black and there are very few ravens, or not all ravens are black and there are lots of ravens. This auxiliary assumption means that each time you observe a black raven, you are getting evidence that not all of them are black. Hempel (1967) replied that he intended the ravens paradox to be understood in a "theoretically barren" context – one in which one knows nothing at all that is relevant to the confirmational question. Good (1968) replied to this reply like a true Duhemian; he contended that black ravens don't have a determinate confirmational significance in such a setting. I believe that the subsequent development of confirmation theory abundantly supports Good's point. What I have done here is to apply this lesson to the design argument.

My formulation of the design argument as a likelihood inference, and my criticism of it, have implications for the *problem of evil*. The first is a criticism of a well-known argument for atheism; I think it is a mistake to try to *deduce* the nonexistence of God from the fact that so much evil exists. Even supposing that God is all-powerful, all-knowing, and entirely benevolent, there is no contradiction in the hypothesis that God allows various evils to exist because they are necessary correlates of greater goods, where we don't understand what these correlations are or why they must obtain (Plantinga 1974). A similar reply to the argument from evil can be made

when the argument is formulated *nondeductively* (Madden and Hare 1968, Plantinga 1979, Rowe 1979). Suppose it is suggested that the amount of evil that exists *favors* the hypothesis that there is no God. Within the framework of likelihood inference, there are two quantities we must evaluate: What is the probability that there would be so much evil, if the universe were produced by an all-powerful, all-knowing, and entirely benevolent God? And what is the probability of there being so much evil, if the universe were produced by mindless natural processes? Once again, if the ways of God are sufficiently mysterious, we will not be able to evaluate the first of these likelihoods (Wykstra 1984). Theists who agree with this judgment about the problem of evil should agree with my criticism of the argument from design. And atheists who agree with my criticism of the design argument should desist from pressing the argument from evil as a proof that there is no God.

I earlier considered an objection to my critique of the design argument that involves augmenting the design hypothesis; I now want to consider another objection, one that involves diminishing the observations we need to explain. Instead of considering a detailed description of the features that the vertebrate eye possesses and demanding to know what the hypothesis of intelligent design predicts about those features, perhaps we should focus on the following less specific fact about our world – that it contains intelligent life. Assuming that God is all-knowing, all-powerful, and entirely benevolent, won't it be clear that $\text{Pr}(\text{the universe contains intelligent life} \mid \text{God created the universe})$ is high? An omnipotent being can do anything that is possible, so God clearly has the ability to create intelligent life. And as for his goals, doesn't his benevolence entail that he will want to create intelligent life? A proper reply to this objection must await our discussion of the fine-tuning argument and the concept of observation selection effects. But before we turn to that topic, I want to consider how the design argument as I have presented it is related to Darwinian evolutionary theory.

The Relationship of the Organismic Design Argument to Darwinism

Philosophers who now criticize the organismic design argument often believe that the argument was dealt its death blow by Hume. True, Paley and the authors of the *Bridgewater Treatises* (in which the design argument was formulated again and again with respect to a seemingly inexhaustible list of observations) wrote after Hume's *Dialogues* were published. Nonetheless, for the philosophers I have in mind, the design argument after Hume was merely a corpse that could be propped up and paraded. Hume had taken the life out of it.

Biologists often take a different view. For them, Hume's skeptical attack was not the decisive moment; rather, it was Darwin's development and confirmation of a substantive scientific explanation of the adaptive features of organisms that really undermined the design argument (at least in its organismic formulation). Philosophers who believe that a theory can't be rejected until a better theory is developed to take its place often sympathize with this point of view.

My own interpretation coincides with neither of these. As indicated earlier, I think that Hume's criticisms largely derive from an empiricist epistemology that is too narrow. However, seeing the design argument's fatal flaw does not depend on seeing the merits of Darwinian theory. The Likelihood Principle, it is true, says that theories must be evaluated comparatively,

not on their own. But for this to be possible, each theory must make predictions. It is at this fundamental level that I think the design argument is defective.

Biologists often present two criticisms of creationism. First, they argue that the design hypothesis is untestable. Second, they contend that there is plenty of evidence that the hypothesis is false. Obviously, these two lines of argument are in conflict. I have already endorsed the first criticism; I now want to say a little about the second. A useful example is Stephen Jay Gould's (1980) widely read article about the Panda's thumb. Pandas are vegetarian bears who have a spur of bone (a "thumb") protruding from their wrists. They use this device to strip bamboo, which is the main thing they eat. Gould says that the hypothesis of intelligent design predicts that pandas should *not* have this inefficient device. A benevolent, powerful, and intelligent engineer could and would have done much better. Evolutionary theory, on the other hand, says that the panda's thumb is what we should expect. The thumb is a modification of the wrist bones found in the common ancestor that pandas share with carnivorous bears. Evolution by natural selection is a *tinkerer* (Jacob 1977). It does not design adaptations from scratch; rather, it modifies pre-existing features, with the result that adaptations are often imperfect.

Gould's argument, I hope it is clear, is a likelihood argument. I agree with what he says about evolutionary theory, but I think his discussion of the design hypothesis leads him into the same trap that ensnared Paley. Gould thinks he knows what God would do if he built pandas, just as Paley thought he knew what God would do if he built the vertebrate eye. But neither of them knows anything of the sort. Both help themselves to *assumptions* about God's goals and abilities. However, it is not enough to make assumptions about these matters; one needs independent evidence that these auxiliary assumptions are true. Paley's problem is also Gould's.¹⁶

Anthropic Reasoning and Cosmic Design Arguments

Evolutionary theory seeks to explain the adaptive features of organisms; it has nothing to say about the origin of the universe as a whole. For this reason, evolutionary theory conflicts with the organismic design hypothesis, but not with the cosmic design hypothesis. Still, the main criticism I presented of the first type of design argument also applies to the second. I now want to examine a further problem that cosmic design arguments sometimes encounter.¹⁷

Suppose I catch 50 fish from a lake, and you want to use my observations O to test two hypotheses:

- O: All the fish I caught were more than 10 inches long.
- F1: All the fish in the lake are more than 10 inches long.
- F2: Only half the fish in the lake are more than 10 inches long.

You might think that the Likelihood Principle says that F1 is better supported, since

$$(1) \quad \Pr(O \mid F1) > \Pr(O \mid F2).$$

However, you then discover how I caught my fish:

- (A1) I caught the fish by using a net that (because of the size of its holes) can't catch fish smaller than 10 inches, and I left the net in the lake until there were 50 fish in it, knowing that there are at least 50 fish in the lake that are larger than 10 inches.

This leads you to replace the analysis provided by (1) with the following:

$$(2) \quad \Pr(O \mid F1 \ \& \ A1) = \Pr(O \mid F2 \ \& \ A1) = 1.0.$$

Furthermore, you now realize that your first assessment, (1), was based on the erroneous assumption that

- (A0) The fish I caught were a random sample from the fish in the lake.

Instead of (1), you should have written

$$\Pr(O \mid F1 \ \& \ A0) > \Pr(O \mid F2 \ \& \ A0).$$

This inequality is true; the problem, however, is that (A0) is false.

This example, from Eddington (1938), illustrates the idea of an *observational selection effect* (an OSE). When a hypothesis is said to render a set of observations probable (or improbable), ask yourself what assumptions allow the hypothesis to have this implication. The point illustrated here is that the procedure you use to obtain your observations can be relevant to assessing likelihoods.¹⁸

One version of the cosmic design argument begins with the observation that our universe is “fine-tuned.” That is, the values of various physical constants are such as to permit life to exist, and if they had been even slightly different, life would have been impossible. McMullin (1993, p. 378) summarizes some of the relevant facts as follows:

If the strong nuclear force were to have been as little as 2% stronger (relative to the other forces), all hydrogen would have been converted into helium. If it were 5% weaker, no helium at all would have formed and there would be nothing but hydrogen. If the weak nuclear force were a little stronger, supernovas could not occur, and heavy elements could not have formed. If it were slightly weaker, only helium might have formed. If the electromagnetic forces were stronger, all stars would be red dwarfs, and there would be no planets. If it were a little weaker, all stars would be very hot and short-lived. If the electron charge were ever so slightly different, there would be no chemistry as we know it. Carbon (¹²C) only just managed to form in the primal nucleosynthesis.

I'll abbreviate the fact that the values of these physical constants fall within the narrow limits specified by saying that “the constants are right.” A design argument can now be constructed, one that claims that the constants' being right should be explained by postulating the existence of an intelligent designer, one who wanted life to exist and who arranged the universe so that this

could occur (Swinburne 1990a). As with Paley's organismic design argument, we can represent the reasoning in this cosmic design argument as the assertion of a likelihood inequality:

$$(3) \quad \Pr(\text{constants are right} \mid \text{Design}) > \Pr(\text{constants are right} \mid \text{Chance}).$$

However, there is a problem with (3) that resembles the problem with (1). Consider the fact that

(A3) We exist, and if we exist the constants must be right.

We need to take (A3) into account; instead of (3), we should have said:

$$(4) \quad \Pr(\text{constants are right} \mid \text{Design} \ \& \ \text{A3}) = \Pr(\text{constants are right} \mid \text{Chance} \ \& \ \text{A3}) = 1.0.$$

That is, given (A3), the constants must be right, regardless of whether the universe was produced by intelligent design or by chance.

Proposition (4) reflects the fact that our observation that the constants are right is subject to an OSE. This likelihood equality provides a natural representation of the epistemological significance of the *weak anthropic principle* -- "what we can expect to observe must be restricted by the conditions necessary for our presence as observers" (Carter 1974). The argument involves no commitment to *strong anthropic principles*. For example, there is no assertion that the correct cosmology must entail that the existence of observers such as ourselves was inevitable, nor is it claimed that our existence *explains* why the physical constants are right (Barrow 1988, Earman 1987, McMullin 1993).¹⁹

Although this point about OSEs undermines the version of the design argument that cites the fact that the physical constants are right, it does not touch other versions. For example, when Paley concludes that the vertebrate eye was produced by an intelligent designer, his argument cannot be refuted by claiming that:

(A4) We exist, and if we exist vertebrates must have eyes with features F1 ... Fn.

If (A4) were true, the likelihood inequality that Paley asserted would have to be replaced by an equality, just as (1) had to be replaced by (2), and (3) had to be replaced by (4). But fortunately for Paley, (A4) is false. However, matters change if we think of Paley as seeking to explain the modest fact that organisms have adaptive features. If this were false, we would not be able to make observations; indeed, we would not exist. Paley was right to focus on the details; the more minimal description of what we observe does not sustain the argument he wanted to endorse.²⁰

The issue of OSEs can be raised in connection with other cosmic versions of the design argument. Swinburne (1990b, p. 191) writes that "the hypothesis of theism is that the universe exists because there is a God who keeps it in being and that laws of nature operate because there is a God who brings it about that they do." Let us separate the *explananda*. The fact that the universe exists does *not* favor Design over Chance; after all, if the universe did not exist, we would not exist and so would not be able to observe that it does. For just this reason, the question "why is there something rather than nothing" cannot be parlayed into an argument for

intelligent design. The same point holds with respect to the fact that the universe is law-governed. Even supposing that lawlessness is possible, could we exist and make observations if there were no laws? If not, then the lawful character of the universe does not discriminate between Design and Chance. Finally, we may consider the fact that our universe is governed by one set of laws, rather than another. Swinburne (1968) argues that the fact that our universe obeys *simple* laws is better explained by the hypothesis of Design than by the hypothesis of Chance. Whether this observation also is subject to an OSE depends on whether we could exist in a universe obeying alternative laws.

Before taking up an objection to this analysis of the argument from fine-tuning, I want to summarize what it has in common with the fishing example. In the fishing example, the source of the OSE is obvious – it is located in a device outside of ourselves. The net with big holes insures that the observer will make a certain observation, regardless of which of two hypotheses is true. But where is the device that induces an OSE in the fine-tuning example? There is none; rather, it is the observer's own existence that does the work. Nonetheless, the effect is the same. Owing to the fact that we exist, we are bound to observe that the constants are right, regardless of whether our universe was produced by chance or by design.²¹

This structural similarity between fishing and fine-tuning may seem to be undermined by a disanalogy. In the latter case, we know that proposition (3) is correct – the probability that the constants will be right if the universe is created by a powerful deity bent on having life exist is greater than it would be if the values of the constants were set by a uniform chance process. This inequality seems to hold, regardless of how or whether we make our observations. The fishing example looks different; here we know that proposition (1) is false. There is no saying whether a likelihood inequality obtains until we specify the procedure used to obtain the observations; once we do this, there *is* no likelihood inequality. Thus, in fine-tuning, we have an inequality that is true because it reflects facts that have nothing to do with our act of observation; in fishing, we have an inequality that is false for reasons having to do with the method we use to obtain our data. My response is that I agree that this point of difference exists, but I contend that it does nothing to save the argument from fine-tuning. Although proposition (3) is true, we are bound to observe that the constants are right (if we go to the trouble of asking what values they have), regardless of whether our universe arose by chance or by design. My objection to proposition (3) is not that it is false, but that it should not be used to interpret the observations; (4) is the relevant proposition to which we should attend.

To visualize this point, imagine that a deity creates a million universes and that a chance process does the same for another million. Let's assume that the proportion of universes in which the constants are right is greater in the former case. Doesn't it follow that if we observe that the constants are right in our universe, that this observation favors the hypothesis that our universe arose by design? In fact, this does not follow. It *would* follow if we had the same probability of observing any of the first million universes if the Design hypothesis were true, and had the same probability of observing any of the second million universes if the Chance hypothesis were true. But this is not the case -- our probability of observing a universe in which the constants are right is unity in each case.

What this means is that a full understanding of the workings of OSEs must acknowledge

that there are two stages at which a bias can be introduced. There is first the process by which the system described by the hypotheses under test generates some state of the world that we are able to observe. Second, there is the process by which we come to observe that state of the world. This two-step process occurs in fishing and fine-tuning as follows:

Composition of the Lake → Contents of the net → We observe the contents of the net

Origin of the Universe → Constants are right → We observe that the constants are right

The OSE in the fishing example arises in step 1; the OSE in fine-tuning crops up in step 2.

Leslie (1989, pp. 13-14, 107-108), Swinburne (1990a, p. 171), and Van Inwagen (1993, p. 135,144) all defend the fine-tuning argument against the criticism I have just described. Each mounts his defense by describing an analogy with a mundane example. Here is Swinburne's rendition of an example that Leslie presents:

On a certain occasion the firing squad aim their rifles at the prisoner to be executed. There are twelve expert marksmen in the firing squad, and they fire twelve rounds each. However, on this occasion all 144 shots miss. The prisoner laughs and comments that the event is not something requiring any explanation because if the marksmen had not missed, he would not be here to observe them having done so. But of course, the prisoner's comment is absurd; the marksmen all having missed is indeed something requiring explanation; and so too is what goes with it – the prisoner's being alive to observe it. And the explanation will be either that it was an accident (a most unusual chance event) or that it was planned (e.g., all the marksmen had been bribed to miss). Any interpretation of the anthropic principle which suggests that the evolution of observers is something which requires no explanation in terms of boundary conditions and laws being a certain way (either inexplicably or through choice) is false.

First a preliminary clarification – the issue isn't whether the prisoner's survival "requires explanation" but whether this observation provides evidence as to whether the marksmen intended to spare the prisoner or shot at random.²²

My response takes the form of a dilemma. I'll argue, first, that if the firing squad example is analyzed in terms of the Likelihood Principle, the prisoner is right and Swinburne is wrong – the prisoner's survival does not allow him to conclude that Design is more likely than Chance. However, there is a different analysis of the prisoner's situation, in terms of the *probabilities* of hypotheses, not their *likelihoods*. This second analysis says that the prisoner is mistaken; however, it has the consequence that the prisoner's inference differs fundamentally from the design argument that appeals to fine-tuning. Each horn of this dilemma supports the conclusion that the firing squad example does nothing to save this version of the design argument.

So let us begin. If we understand Swinburne's claim in terms of the Likelihood Principle, we should read him as saying that

$$(L1) \quad \Pr(\text{the prisoner survived} \mid \text{the marksmen intended to miss}) > \Pr(\text{the prisoner survived} \mid \text{the marksmen fired at random}).$$

He thinks that the anthropic principle requires us to replace this claim with the following irrelevancy:

$$(L2) \quad \Pr(\text{the prisoner survived} \mid \text{the marksmen intended to miss} \ \& \ \text{the prisoner survived}) = \Pr(\text{the prisoner survived} \mid \text{the marksmen fired at random} \ \& \ \text{the prisoner survived}) = 1.0.$$

This equality would lead us to conclude (mistakenly, Swinburne thinks) that the prisoner's survival does not discriminate between the hypotheses of Design and Chance.

To assess the claim that the prisoner has made a mistake, it is useful to compare the prisoner's reasoning with that of a bystander who witnesses the prisoner survive the firing squad. The prisoner reasons as follows: "given that I now am able to make observations, I must be alive, whether my survival was due to intelligent design or chance." The bystander says the following: "given that I now am able to make observations, the fact that the prisoner is now alive is made more probable by the design hypothesis than it is by the chance hypothesis." The prisoner claims that he is subject to an OSE, while the bystander says that he, the bystander, is not. Both, I submit, are correct.²³

I suggest that part of the intuitive attractiveness of the claim that the prisoner has made a mistake derives from a shift between the prisoner's point of view and the bystander's. The bystander is right to use (L1) to interpret his observations; however, the prisoner has no business using (L1) to interpret his observations since he, the prisoner, is subject to an OSE. The prisoner needs to replace (L1) with (L2). My hunch is that Swinburne thinks the prisoner errs in his assessment of likelihoods because we bystanders would be making a mistake if we reasoned as he does.²⁴

The basic idea of an OSE is that we must take account of the procedures used to obtain the observations when we assess the likelihoods of hypotheses. This much was clear from the fishing example. What may seem strange about my reading of the firing squad story is my claim that the prisoner and the bystander are in different epistemic situations, even though their observation reports differ by a mere pronoun. After the marksmen fire, the prisoner thinks "I exist" while the bystander thinks "he exists;" the bystander, but not the prisoner, is able to use his observation to say that Design is more likely than Chance, or so I say. If this seems odd, it may be useful to reflect on Sorenson's (1988) concept of *blindspots*. A proposition *p* is a blindspot for an individual *S* just in case, if *p* were true, *S* would not be able to know that *p* is true. Although some propositions (e.g., "nothing exists," "the constants are wrong") are blindspots for everyone, other propositions are blindspots for some people but not for others. Blindspots give rise to OSEs; if *p* is a blindspot for *S*, then if *S* makes an observation to determine the truth value of *p*, the outcome must be that not-*p* is observed. The prisoner, but not the bystander, has "the prisoner does not exist" as a blindspot. This is why "the prisoner exists" has an evidential significance for the bystander that it cannot have for the prisoner.^{25,26}

To bolster my claim that the prisoner is right to think that likelihood does not distinguish

between Chance and Design, I want to describe a slightly different problem. Suppose that a firing squad always subjects its victims to the same probabilistic process, which has the result that the prisoner before it either survives or is killed. A thousand prisoners who one by one have survived the firing squad are assembled and are asked to pool their knowledge and estimate the value of an unknown probability. What is the probability that a prisoner will survive if the firing squad fires? The standard methodology here is *maximum likelihood estimation*; one finds the value of the parameter of interest that maximizes the probability of the observations. For example, if a coin lands heads 512 times out of a thousand tosses, the best point estimate of the probability that the coin will land heads when tossed is 0.512. Those who believe that the single prisoner has evidence about his firing squad's intentions are obliged to conclude that the best estimate in this new problem is that the probability is unity. However, those persuaded that the single prisoner is subject to an OSE will want to maintain that the thousand prisoners are in the same boat. These skeptics will deny that the observations provide a basis for estimation. Isn't it *obvious* that testimony limited to survivors provides no evidence on which to base an estimate of the probability that someone will survive?²⁷ And if this is true of a *thousand* survivors, how can a *single* survivor be said to know that Design is more likely than Chance?

I now turn to a different analysis of the prisoner's situation. The prisoner, like the rest of us, knows how firing squads work. They always or almost always follow the orders they receive, which almost always are to execute the prisoner at hand. Occasionally, they produce fake executions. They almost never fire at random. What is more, firing squads have firm control over outcomes; if they want to kill (or spare) someone, they always or almost always succeed. This and related items of background knowledge support the following *probability* claim:

$$(Pf) \quad \Pr(\text{the marksmen intended to spare the prisoner} \mid \text{the prisoner survived}) > \Pr(\text{the marksmen intended to spare the prisoner}).$$

Firing squads rarely intend to spare their victims, but the survival of the prisoner makes it very probable that his firing squad had precisely that intention. The likelihood analysis led to the conclusion that the prisoner and the bystander are in different epistemic situations; the bystander should evaluate the hypotheses by using (L1), but the prisoner is obliged to use (L2). However, from the point of view of probabilities, the prisoner and the bystander can say the same thing; both can cite (Pf).

What does this tell us about the fine-tuning version of the design argument? I construed that argument as a claim about likelihoods. As such, it is subject to an OSE; given that we exist, the constants must be right, regardless of whether our universe was produced by Chance or by Design. However, we now need to consider whether the fine-tuning argument can be formulated as a claim about probabilities. Can we assert that

$$(Pu) \quad \Pr(\text{the universe was created by an intelligent designer} \mid \text{the constants are right}) > \Pr(\text{the universe was created by an intelligent designer})?$$

I don't think so. In the case of firing squads, we have frequency data and our general knowledge of human behavior on which to ground the probability statement (Pf). But we have neither data nor theory to ground (Pu). And we cannot defend (Pu) by saying that an intelligent

designer would ensure that the constants are right, because this takes us back to the likelihood considerations we have already discussed. The prisoner's conclusion that he can say nothing about Chance and Design *is* mistaken if he is making a claim about probabilities. But the argument from fine-tuning can't be defended as a claim about probabilities.

The rabbit/duck quality of this problem merits review. I've discussed three examples – fishing, fine-tuning, and the firing squad. If we compare fine-tuning with fishing, they seem similar. This makes it intuitive to conclude that the design argument based on fine-tuning is wrong. However, if we compare fine-tuning with the firing squad, *they* seem similar. Since the prisoner apparently has evidence that favors Design over Chance, we are led to the conclusion that the fine-tuning argument must be right. This shifting gestalt can be stabilized by imposing a formalism. The first point is that OSEs are to be understood by comparing the *likelihoods* of hypotheses, not their *probabilities*. The second is that it is perfectly true that the prisoner can assert the *probability* claim (Pf). The question, then, is whether the design argument from fine-tuning is a likelihood argument or a probability argument. If the former, it is flawed because it fails to take account of the fact that there is an OSE. If the latter, it is flawed, but for a different reason – it makes claims about probabilities that we have no reason to accept; indeed, we cannot even *understand* them as objective claims.²⁸

A Prediction

It was obvious to Paley and to other purveyors of the organismic design argument that if an intelligent designer built organisms, that designer would have to be far more intelligent than any human being could ever be. This is why the organismic design argument was for them an argument for the existence of *God*. I predict that it will eventually become clear that the organismic design argument should never have been understood in this way. This is because I expect that human beings will eventually build organisms from nonliving materials. This achievement will not close down the question of whether the organisms we observe were created by intelligent design or by mindless natural processes; in fact, it will give that question a practical meaning, since the organisms we will see around us will be of both kinds.²⁹ stripped of its theological trappings. However, it will be abundantly clear that the fact of organismic adaptation has nothing to do with whether God exists. When the Spanish conquistadors arrived in the New World, several indigenous peoples thought these intruders were gods, so powerful was the technology that the intruders possessed. Alas, the locals were mistaken; they did not realize that these beings with guns and horses were merely *human* beings. The organismic design argument for the existence of God embodies the same mistake. Human beings in the future will be the conquistadors, and Paley will be our Montezuma.

References

Arbuthnot, J. (1710): "An Argument for Divine Providence, taken from the Constant Regularity Observ'd in the Births of both Sexes." *Philosophical Transactions of the Royal Society of London* 27: 186-190.

- Barrow, J. (1988): *The World Within the World*. Oxford: Clarendon Press.
- Behe, M. (1996): *Darwin's Black Box*. New York: Free Press.
- Carter, B. (1974): "Large Number Coincidences and the Anthropic Principle in Cosmology." In M.S. Longair (ed.), *Confrontation of Cosmological Theories with Observational Data*. Dordrecht: Reidel, pp. 291-298.
- Cottingham, J., Stoothoff, R., and Murdoch, D. (1985): *The Philosophical Writings of Descartes*, 2 volumes, Cambridge: Cambridge University Press.
- Darwin, C. (1859): *On the Origin of Species*. Cambridge, MA: Harvard University Press, 1964.
- Dawkins, R. (1986): *The Blind Watchmaker*. New York: Norton.
- Dembski, W. (1998): *The Design Inference*. Cambridge: Cambridge University Press.
- Dennett, D. (1987a): "Intentional Systems in Cognitive Ethology – the 'Panglossian Paradigm' Defended." In *The Intentional Stance*. Cambridge: MIT Press, pp. 237-286.
- Dennett, D. (1987b): "True Believers." In *The Intentional Stance*. Cambridge: MIT Press, pp. 13-42.
- Dick, S. (1996): *The Biological Universe – the Twentieth-Century Extraterrestrial Life Debate and the Limits of Science*. Cambridge: Cambridge University Press.
- Earman, J. (1987): "The SAP Also Rises – a Critical Examination of the Anthropic Principle." *American Philosophical Quarterly* 24: 307-317.
- Eddington, A. (1939): *The Philosophy of Physical Science*. Cambridge: Cambridge University Press.
- Edwards, A. (1972): *Likelihood*. Cambridge: Cambridge University Press.
- Fisher, R. (1930). *The Genetical Theory of Natural Selection*. New York: Dover, 2nd edition, 1957.
- Fitelson, B., Stephens, C., and Sober, E. (1999): "How not to Detect Design – a Review of W. Dembski's *The Design Inference*." *Philosophy of Science* 66: 472-488. Also available at the following URL: <http://philosophy.wisc.edu/sober>.
- Forster, M. and Sober, E. (2001): "Why Likelihood?" In M. Taper and S. Lee (eds.), *The Nature of Scientific Evidence*. Chicago: University of Chicago Press. Also available at the following URL: <http://philosophy.wisc.edu/forster>.

- Good, I.J. (1967): "The White Shoe is a Red Herring." *British Journal for the Philosophy of Science*. 17: 322.
- Good, I.J. (1968): "The White Shoe Qua Herring is Pink." *British Journal for the Philosophy of Science* 19: 156-157..
- Gould, S. (1980): *The Panda's Thumb*. New York: Norton.
- Hacking, I. (1965): *The Logic of Statistical Inference*. Cambridge: Cambridge University Press.
- Hacking, I. (1987): "The Inverse Gambler's Fallacy: The Argument from Design. The Anthropic Principle Applied to Wheeler Universes." *Mind* 96: 331-340.
- Hempel, C. (1965): "Studies in the Logic of Confirmation." In *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*. New York: Free Press, pp. 3-46.
- Hempel, C. (1967): "The White Shoe – No Red Herring." *British Journal for the Philosophy of Science* 18: 239-240.
- Hume, D. (1779): *Dialogues Concerning Natural Religion*. London: Penguin. 1990.
- Jacob, F. (1977): "Evolution and Tinkering." *Science* 196: 1161-1166.
- Keynes, J. (1921): *A Treatise on Probability*. London: Macmillan.
- Kitcher, P. (1983): *Abusing Science -- the Case against Creationism*. Cambridge: MIT Press.
- Kyburg, H. (1961): *Probability and the Logic of Rational Belief*. Middletown, CT: Wesleyan University Press.
- Leslie, J. (1989): *Universes*. London: Routledge.
- Madden, E. and Hare, P. (1968): *Evil and the Concept of God*. Springfield, MA: Charles Thomas.
- McMullin, (1993): "Indifference Principle and Anthropic Principle in Cosmology." *Studies in the History and Philosophy of Science* 24: 359-389.
- Paley, W. (1802): *Natural Theology, or, Evidences of the Existence and Attributes of the Deity, Collected from the Appearances of Nature*. London: Rivington.
- Plantinga, A. (1974): *The Nature of Necessity*. New York: Oxford University Press.
- Plantinga, A. (1979): "The Probabilistic Argument from Evil." *Philosophical Studies* 35: 1-53.
- Rowe, W. (1979): "The Problem of Evil and Some Varieties of Atheism." *American*

Philosophical Quarterly 16: 335-341.

Royall, R. (1997): *Statistical Evidence -- a Likelihood Paradigm*. London: Chapman and Hall.

Sober, E. (1993): *Philosophy of Biology*. Boulder, Co.: Westview Press.

Sober, E. (1999): "Testability." *Proceedings and Addresses of the American Philosophical Association* 73: 47-76. Also available at the following URL <http://philosophy.wisc.edu/sober>.

Sober, E., (2000a): "Evolution and the Problem of Other Minds." *Journal of Philosophy* 97: 365-386.

Sober, E. (2000b): "Quine's Two Dogmas." *Proceedings of the Aristotelean Society, Supplementary Volume* 74: 237-280.

Sober, E. (200x): "Sex Ratio Theory, Ancient and Modern – the Debate among Arbuthnot, Bernoulli, and Demoivre, and the Evolutionary Ideas of Darwin, Düsing, Fisher, Williams, and Hamilton."

Sorenson, R. (1988): *Blindspots*. Oxford: Oxford University Press.

Stigler, S. (1986): *The History of Statistics*. Cambridge: Harvard University Press.

Swinburne, R. (1968): "The Argument from Design." *Philosophy* 43: 199-212.

Swinburne, R. (1990a): "Argument from the Fine-Tuning of the Universe." In J. Leslie (ed.), *Physical Cosmology and Philosophy*. New York: Macmillan, pp. 160-179.

Swinburne, R. (1990b): "The Limits of Explanation." In D. Knowles (ed.), *Explanation and Its Limits*. Cambridge: Cambridge University Press, pp. 177-193.

Turing, A. (1950): "Computing Machinery and Intelligence." *Mind* 59: 433-460.

Van Inwagen, P. (1993): *Metaphysics*. Boulder, Co.: Westview Press.

Venn, J. (1866): *The Logic of Chance*. New York: Chelsea.

White, R. (2000): "Fine-Tuning and Multiple Universes." *Nous* 34: 260-276.

Wykstra, S. (1984): "The Humean Obstacle to Evidential Arguments from Suffering: On Avoiding the Evils of 'Appearance'". *International Journal for Philosophy of Religion*, 16: 73-93.

Notes

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² Does this likelihood version of the design argument conflict with the idea that the argument is an *inference to the best explanation*? Not if one's theory of inference to the best explanation says that observations influence the assessment of explanations in this instance via the vehicle of likelihoods.

³ In light of the fact that it is possible for a hypothesis to have an objective likelihood without also having an objective probability, one should understand Bayes' theorem as specifying how the quantities it mentions are related to each other, *if all are well-defined*. And just as hypotheses can have likelihoods without having (objective) probabilities, it also is possible for the reverse situation to obtain. Suppose I draw a card from a deck of unknown composition. I observe (O) that the card is the four of diamonds. I now consider the hypothesis (H) that the card is a four. The value of $\Pr(H \mid O)$ is well-defined, but the value of $\Pr(O \mid H)$ is not.

⁴ Actually, Paley *does* consider a "selective retention" process, but only very briefly. In Chapter 5 (pp. 49-51) he explores the hypothesis that a random process once generated a huge range of variation, and that this variation was then culled, with only stable configurations surviving. Paley argues against this hypothesis by saying that we should see unicorns and mermaids if it were true. He also says that it mistakenly predicts that organisms should fail to form a taxonomic hierarchy. It is ironic that Darwin claimed that his own theory *predicts* hierarchy. In fact, Paley and Darwin are both right. Darwin's theory contains the idea that all living things have common ancestors, while the selection hypothesis that Paley considers does not.

⁵ More precisely, Fisher said that a mother should have a son with probability p and a daughter with probability $(1-p)$, where the effect of this is that the expected expenditures on the two sexes are the same; the argument is not undermined by the fact that some mothers have all sons while others have all daughters.

⁶ Dawkins (1986) makes the point that evolution by natural selection is not a uniform chance process by way of an analogy with a combination lock. This is discussed in Sober (1993, pp. 36-39).

⁷ Dembski (1998) construes design inference as "sweeping from the field" all possible competitors, with the effect that the design hypothesis wins by default (i.e., it never has to make successful predictions). As noted above, Paley, Arbuthnot, and other design theorists did not and could not refute all possible alternatives to Design; they were able to test only the alternatives that they were able to formulate. For other criticisms of Dembski's framework, see Fitelson *et al.* (1999).

⁸ Paley argues in Chapter 16 that the benevolence of the deity is demonstrated by the fact that organisms experience more pleasure than they need to (p. 295). He also argues that pain is useful (p. 320) and that few diseases are fatal; he defends the latter conclusion by citing statistics

on the cure rate at a London hospital (p. 321).

⁹ For it to be certain that all configurations will be visited, there must be infinite time. The shorter the time frame, the lower the probability that a given configuration will occur. This means that the estimated age of the universe may entail that it is *very improbable* that a given configuration will occur. I set this objection aside in what follows.

¹⁰ It is a standard feature of likelihood comparisons that O_s sometimes fails to discriminate between a pair of hypotheses, even though O_w is able to do so, when O_s entails O_w . You are the cook in a restaurant. The waiter brings an order into the kitchen – someone ordered bacon and eggs. You wonder whether this information favors the hypothesis that your friend Smith ordered the meal, or the hypothesis that your friend Jones did. You know the eating habits of each. Here is the probability of the order's being for \pm bacon and \pm eggs, conditional on the order's coming from Smith and conditional on the order's coming from Jones:

	Pr(– Smith)			Pr(– Jones)	
	Eggs			Eggs	
	+	-		+	-
	-----			-----	
	+ 0.3	0.4		+ 0.3	0.2
Bacon	- 0.2	0.1	Bacon	- 0.1	0.4
	-----			-----	

The fact that the customer ordered bacon favors Smith over Jones (since $0.7 > 0.5$) and so does the fact that the customer ordered eggs (since $0.5 > 0.4$). However, the fact that the customer ordered bacon and eggs does not discriminate between the two hypotheses (since $0.3 = 0.3$).

¹¹ The objection I have described applies both to a design hypothesis that postulates some otherwise unspecified designer and also to a hypothesis that postulates the existence of God. Descartes objects to the latter version of the design argument in the *Principles of Philosophy*: “when dealing with natural things we will, then, never derive any explanations from the purpose which God or nature may have had in view when creating them, and we shall entirely banish from our philosophy the search for final causes. For we should not be so arrogant as to suppose that we can share in God’s plans (I,28);” see also *Principles* (III, 2) and his replies to Gassendi (Cottingham 1985, vol. 2, pp. 215 ff.). In contrast, Descartes had no objection to explaining human behavior by describing the mental states that cause them. Apparently, invoking human purposes to explain a set of observations is one thing, invoking God’s purposes is another.

¹² The example of the SETI project throws light on Paley’s question as to why we think that watches must be the result of intelligent design, but don’t think this when we observe a stone. It is tempting to answer this question by saying that watches are “complicated” while stones are not. However, there are many complicated natural processes (like the turbulent flow of water coming from a faucet) that don’t cry out for explanation in terms of intelligent design. Similarly, narrow-band radio emissions may be physically “simple” but that doesn’t mean that the SETI engineers were wrong to search for them.

¹³ The fact that there is a continuum here, rather than a crisp cut-off, suggests that there will be problems that fall in the grey area. Matthew Seligman has suggested the following example as a possible candidate – suppose that Paley had found a digital watch. Its display gives the time in hours, minutes, and seconds, as well as the date, but upon opening the watch, Paley discovers that it uses a technology that is completely opaque to him. Is this watch enough like the mechanical watches driven by springs and gears for him to infer that Intelligent Design is better supported than Chance? Or is it so alien that he should have no clue as to how to reason? Readers who feel secure in saying that Paley should be able to tell that the digital watch points to Design and away from Chance should modify this example to construct a different example that falls in the grey area. I should add that Paley’s ability to infer that the digital watch has an intelligent designer is not an objection to the criticism of the Design Argument that I have presented.

¹⁴ Assessing the likelihood of a disjunction involves an additional problem. Even if the values of $\Pr(O \mid D1)$ and $\Pr(O \mid D2)$ are known, what is the value of $\Pr(O \mid D1 \text{ or } D2)$? The answer is that it must be somewhere in between. But exactly where depends on further considerations, since $\Pr(O \mid D1 \text{ or } D2) = \Pr(O \mid D1) \Pr(D1 \mid D1 \text{ or } D2) + \Pr(O \mid D2) \Pr(D2 \mid D1 \text{ or } D2)$. If either God or a superintelligent extraterrestrial built the vertebrate eye, what is the probability that it was God who did so?

¹⁵ I am grateful to Susanna Rinard for drawing my attention to the issues raised by the stone.

¹⁶ Darwin (1859) asks the right question in Chapter 6: “Have we any right to assume that the Creator works by intellectual powers like those of man?” But then, at the end of the book, in Chapter 14, he says “on the view of each organic being and each separate organ having been specially created, how utterly inexplicable it is that parts ... should so frequently bear the plain stamp of inutility!”

¹⁷ To isolate this new problem from the one already identified, I’ll assume in what follows that the design hypothesis has built into it auxiliary assumptions that suffice for its likelihood to be well-defined.

¹⁸ This general point surfaces in simple inference problems such as the ravens paradox (Hempel 1965). Does the fact that the object before you is a black raven confirm the generalization that all ravens are black? That depends on how you gathered your data. Perhaps you sampled at random from the set of *ravens*; alternatively, you may have sampled at random from the set of *black ravens*. In the first case, your observation confirms the generalization, but in the second it does not. In the second case, notice that you were bound to observe that the object before you is a black raven, regardless of whether all ravens are black.

¹⁹ Although weak and strong anthropic principles differ, they have something in common. For example, the causal structure implicitly assumed in the weak anthropic principle is that of two effects of a common cause:

we exist now

(WAP) origin of universe ↗
 ↘
 constants now are right

In contrast, one of the strong anthropic principles assumes the following causal arrangement:

(SAP) we exist now → origin of the universe → constants now are right

Even though (WAP) is true and (SAP) is false, both entail a *correlation* between our existence and the constants' now having the values they do. To deal with the resulting OSEs, we must decide how to take these correlations into account in assessing likelihoods.

²⁰ This point is worth contemplating by those who think that the intelligent design hypothesis is not required to explain the detailed features of the adaptive features we observe organisms to have, but that the burden is only to address an *explanandum* that is logically weaker. Can an explanandum be found that is logically weak, but not too weak, so that the design argument is not caught in the snares of an OSE?

²¹ The fishing and fine-tuning examples involve *extreme* OSEs. More modest OSEs are also possible. If C describes the circumstances in which we make our observational determination as to whether proposition O is true, and we use the outcome of this determination to decide whether H1 or H2 is more likely, then a *quantitative* OSE is present precisely when

$$\Pr(O \mid H1 \ \& \ C) \neq \Pr(O \mid H1) \text{ or} \\ \Pr(O \mid H2 \ \& \ C) \neq \Pr(O \mid H2).$$

A *qualitative* OSE occurs when taking account of C alters the likelihood ordering:

$$\Pr(O \mid H1 \ \& \ C) > \Pr(O \mid H2 \ \& \ C) \text{ and } \Pr(O \mid H1) \not> \Pr(O \mid H2) \text{ or} \\ \Pr(O \mid H1 \ \& \ C) = \Pr(O \mid H2 \ \& \ C) \text{ and } \Pr(O \mid H1) \neq \Pr(O \mid H2).$$

Understood in this way, an OSE is just an example of *sampling bias*.

²² There is a third possibility – that the marksmen intended to kill the prisoner – but for the sake of simplicity (and also to make the firing squad argument more parallel with the argument from fine-tuning), I'll ignore this for most of my discussion.

²³ The issue, thus, is not whether (L1) or (L2) are true (both are), but which an agent should use in interpreting the bearing of observations on the likelihoods of hypotheses. In this respect the injunction of the weak anthropic principle is like the principle of total evidence – it is a pragmatic principle, concerning which statements should be used for which purposes.

²⁴ In order to replicate in the fine-tuning argument the difference between the prisoner's and the bystander's points of view, imagine that we observe through a telescope another universe in which the constants are right. We bystanders can use this observation in a way that the

inhabitants of that universe cannot.

²⁵ Notice that “I exist” when thought by the prisoner, is *a priori*, whereas “the prisoner exists,” when thought by the bystander, is *a posteriori*. Is it so surprising that an *a priori* statement and an *a posteriori* statement should differ in their evidential significance? I also should note that my claim is that the prisoner’s observing “I am alive” does not permit him to conclude that Design is more likely than Chance. I do not say that there is no proposition he can cite after the marksmen fire that discriminates between the two hypotheses. Consider, for example, the observation that “no bullets hit me.” This favors Design over Chance, even after the prisoner conditionalizes on the fact that he is alive. Notice also that if the prisoner were alive but riddled with bullets, this would not so clearly make Design more likely than Chance.

²⁶ If the prisoner and the bystander talk to each other after the prisoner survives, what new information can the prisoner gather from the bystander’s testimony? I leave the dialectics of this conversation to the reader to explore.

²⁷ The problem is that the survivors know the numerator, but not the denominator, of a fraction that represents the *actual frequency* of survivors. To see my point, assume that the prisoners have no idea how many prisoners have gone before the firing squad, except that there must have been at least 1000. Parallel assumptions are needed for the fishing example to embody an OSE.

²⁸ The hypothesis that our universe is one among many has been introduced as a possible explanation of the fact that the constants (in our universe) are right. A universe is here understood to be a region of space-time that is causally closed. See Leslie (1989) for discussion. If the point of the multiverse hypothesis is to challenge the design hypothesis, on the assumption that the design hypothesis has already vanquished the hypothesis of chance, then the multiverse hypothesis is not needed. Furthermore, in comparing the multiverse hypothesis and the design hypothesis, one needs to attend to the inverse gambler’s fallacy discussed earlier. This is not to deny that there may be other evidence for the multiverse hypothesis; however, the mere fact that the constants are right in our universe does not favor that hypothesis.

²⁹ As Dennett (1987a, pp. 284-285) observes, human beings have been modifying the characteristics of animals and plants by *artificial selection* for thousands of years. However, the organisms thus modified were not created by human beings. Recall that I formulated the design argument as endorsing a hypothesis about how organisms were brought into being. This is why the work of plant and animal breeders, *per se*, does not show that the design argument should be stripped of its theological trappings.