Chapter Three

GOOD EVIDENCE

> The historian must collect, interpret, and then explain his evidence by methods which are not greatly different from those techniques employed by the detective, or at least the detective of fiction. . . . Evidence means different things to different people, of course. The historian tends to think mainly in terms of documents. A lawyer will mean something rather different by the word, as will a sociologist, or a physicist, or a geologist, or a police officer at the moment of making an arrest. For certain problems, evidence must be "hard," while for others it may be "soft." Even if no acceptable list of agreed-upon definitions of evidence may be given, most of us recognize intuitively what we mean when we use the word.
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> --Robin Winks

1. Evidence of Academic Dishonesty

You are one of the student government representatives of the Student Behavior Committee on campus. A hearing has been convened to hear a very serious charge against a couple of your peers. A hard-nosed professor of Philosophy has come before the committee and charged

two of the students in his class with cheating. In the hearing he presents his evidence in support of this accusation.

He was sitting at home reading blue-book essay examinations, and came across two essays that were word-for-word identical -- even the same phrases were underlined for emphasis. Together with this very disturbing fact he was able to assemble some other relevant data. He points out that seventy-eight students took the exam. This was the first time these exam questions had been used. He was out of town at the time of the exam, but had a proctor sit in the front of the room during the exam. The two exams were practically on top of one another in the stack as they were being graded. When he checked his grade book he discovered that one of the students had done very well on the previous exam, while the other bombed it.

2. Evidence and Explanation

We often seek theories that are genuinely explanatory. The sciences are one obvious area, but so is the puzzle before the Student Behavior Committee. We also require that these theories be well supported by evidence. I argue in this book that being explanatory, and being well supported by evidence, are two sides of the same coin. Theories that are well supported by evidential data do the best job of explaining that data. Conversely, if a theory best explains a set of data, that data provides evidence in support of the theory. This suggests a very workable test, one with applications in academic philosophy, but also in everyday life.

Let me suggest to you a recipe for evaluating evidence. This is precisely what you are asked to do as a member of the Student Behavior Committee, but you might put this recipe to work in lots of other contexts as well.

i. Put the argument -- the other person's evidential case -- into schematic form.

ii. List as many reasonable rival explanations as you can think of.

iii. Rank order the rival explanations from most plausible to least.

iv. See if the original explanation is in first place. If it is, you have good, or at least, some, evidence for that theory. If it is not, if one of the rivals is a better explanation, you have poor, or perhaps no, evidence for the original theory.

3. Applying the Recipe

When we schmetize someone else's argument, we need to walk a delicate line. We want to include *all* of the relevant evidence. But at the same time, we want to abbreviate, and certainly leave out any padding or rhetorical excesses. I suggest the following schematization for the argument before the Committee.

e_1. The examination had four questions on it. The students could answer any three.

e_2. This was the first time that the exam questions had been used.

e_3. Seventy-eight students took the examination.

e_4. There was a proctor in the room during the exam, but she merely sat at the front of the room; there were no special attempts at security.

e_5. The two examinations were practically on top of one another in the stack as they were graded.

e_6. The two essays were word-for-word identical.

e_7. One of the students had done very well on the previous exam; the other had done poorly.

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t_0. At least one of the students cheated on the examination.

The schematic form of an argument helps to make clear the connection between evidence and explanation.

EVIDENCE or DATA
e_1

e_2

e_3
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.
.
e_n
==
t_0
THEORY or EXPLANATION

Some of the data provide relevant background information, and some are quite specific and cry out for explanation. Indeed, that is precisely what my hypothesis provides -- an explanation for facts that would otherwise be a complete mystery. Virtually everything to follow builds on the structure of this simple little example. I claim, along with a growing number of epistemologists, that the fundamental structure of evidence is one of explanation.

If you are worried that you might forget the little recipe outlined above, just remember the bit of jargon -- *inference to the best explanation*. Step one schematizes the *inference*. Step two reminds us that it is an inference *to* an explanation -- the theory being defended must explain the data we are using as evidence. Steps three and four concern what is the *best* explanation. Obviously we can have a better, or best, explanation only if there is something to compare the original explanation to. Step three asks us to identify the competitors. And step four asks us to make a judgment as to which is best.

What's going on in the case before the Student Behavior Committee? With minimal time, attention, and just a little imagination, it proves surprisingly easy to generate a list of hypotheses, any of which would explain what we know about the exam.

t_1. It was merely a coincidence that the two essays were word-for-word identical.

t_2. The students had studied together so thoroughly that their thinking on the topic was bound to be very similar.

> t_3. One of the students had an unusually high degree of ESP; she was unconsciously reading the mind of the other student.

The professor takes it to be obvious that the data above provides good evidence in support to t_0. I think he is absolutely right -- but why?

4. Inference to the BEST Explanation

One philosopher who noticed the connection between explanation and evidence expressed this relationship as follows.

> 1. Some surprising, astonishing phenomena p1, p2, p3, . . . is encountered.
> 2. But p1, p2, p3, . . . would not be surprising or astonishing if H were true -- they would follow as a matter of course from H; H would explain p1, p2, p3, . . .
> 3. Therefore, there is good reason for elaborating H - for proposing it as a possible hypothesis from whose assumption p1, p2, p3, . . . might be explained.
>
> --Harman

The identical essays are surprising (though sadly not as surprising as they should be). They are not surprising given t_0; they follow as a matter of course. But, of course, they follow as a matter of course from the ESP hypothesis, as well. We have the ability to form explanatory theories, but our example shows that we also have the ability to sort out rival theories in terms of explanatory plausibility. Inference to the best explanation can be productively applied to the assessment of evidence because we are often intersubjective in our evaluation of competing explanatory candidates. It would be nice to have clear, mechanical criteria for explanatory plausibility, but the most candid characterizations are vague and abstract.

> There is, of course, a problem about how one is to judge that one hypothesis is sufficiently better than another hypothesis. Presumably such a judgment will be based on considerations such as which hypothesis is

> simpler, which is more plausible, which explains more, which is less *ad hoc*, and so forth.

The cheating hypothesis is the best explanation of the data because it is simpler, it explains more, it is less *ad hoc*, and ultimately, we agree that it is the most plausible. All of these criteria, however, probably reduce to a single judgment about plausibility, which is just to say what is the best.

Inference to the best explanation allows us to distinguish cases of good evidence from cases of poor evidence, or perhaps better, cases of evidence from cases of no evidence. If some candidate for scientific knowledge, or even just provisional acceptance, is claimed to be well supported by evidence, inference to the best explanation implies a straightforward test. The candidate -- the theory, hypothesis, law, or whatever -- will explain at least some of the data. To discover if it provides the *best* explanation, we must obviously compare it to some rival explanations. Sometimes the serious rivals will be obvious -- discussed and debated in the literature, for example. At other times, we will have to exercise our imagination and ask whether some other rival would do a better job of explaining the data. If, in our considered judgment, the original candidate does best explain the relevant data, then that data does provide some evidence for it. If we judge, however, that some rival explanation does a better job of explaining what we know, then we have evidence for that rival and none for the original.

There are lots of cases of general agreement about how good the evidence is. My entire analysis rests on the assumption -- I believe entirely reasonable -- that widespread agreement is the norm. These cases occur in everyday contexts -- the switch blew because the microwave and the toaster were going at the same time; they occur in criminal law -- the motive, reports of witnesses, and the physical evidence all point to the nephew as the murderer; and they occur in the natural sciences -- Darwin's account of the morphological data, the facts from embryology, and the fossil record provide good evidence for evolution by natural selection. In all of these examples, the preferred theory provides a much better explanation of the data than any of the potential rival accounts. In the same way that people agree about the existence of good evidence, they will roughly agree about how to rank order explanatory alternatives. Not only can we agree about an ordinal listing, we are also intersubjectively reliable about qualitative distinctions between explanatory candidates. My cheating hypothesis is not only in first place, it is *way ahead* of whatever is in second place.

5. What Happened to the Dinosaurs?

The following is a case study of inference to the best explanation in a scientific context. The data was developed over a period of time, and this led to a progression of related hypotheses. Below is a newspaper account from the 1970s telling about this surprising theory.

New Theory Offered on Death of Dinosaurs
Robert Strand

A team of scientists is proposing that dinosaurs were wiped out 65 million years ago by a spectacular collision of Earth with an asteroid that cast the globe into several years of dust-choked semi-darkness.

This new hypothesis would explain why 75 percent of all living species disappeared at the same time. This idea was advanced Friday at the annual meeting of the American Association for the Advancement of Science.

The most common explanation for the global catastrophe has been that water retreating from the continental shelves caused climatic changes to which the dinosaurs could not adjust.

A recent theory suggests that the climatic changes were caused by a massive invasion of fresh water from the Arctic Basin into the oceans.

But Dale A. Russell, a Canadian paleontologist, told a symposium that no physical evidence exists to support the notion of sharp temperature declines.

The new hypothesis was explained by Luiz W. Alverez, a Nobel laureate physicist at the University of California. His team has been pondering mysterious deposits of a rare element, iridium, at sites in Denmark, Italy and Spain.

The iridium was laid down at the exact time of the dinosaurs' demise, and the iridium concentration was 160 times what might have been expected.

Iridium is a thousand times more abundant in meteorites than in the Earth's crust, a fact that suggests the deposits came from an extraterrestrial source.

Alverez proposed that Earth was struck by an asteroid six miles in diameter that blasted a crater 100

> miles wide with the force of 100 million hydrogen bombs.
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> Such an explosion would have thrown an enormous quantity of dust into the stratosphere where, according to the hypothesis, it remained for several years casting Earth into semidarkness.
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> Lack of sunlight would have killed plankton in the oceans and plants on land, thus depriving fish and animals of food. Russell concluded from evidence in fossils that 75 percent of all living species, including dinosaurs, the most intelligent of creatures at the time, became extinct.

Before going on with your reading, you should try to apply my four-step recipe for discovering if you have a case of good evidence. Is there good evidence for the Alverez hypothesis about what happened to the dinosaurs?

There is a lot going on here; schematizing the argument may take a little time and thought. I think it looks something like the following.

> e_1. A high percentage of living species, including the dinosaurs, became extinct sixty-five million years ago.
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> e_2. Mysterious deposits of a rare element, iridium, have been found at sites world wide.
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> e_3. The iridium was laid down in the clay at the time of the dinosaurs' demise.
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> e_4. The iridium concentrations are 160 times what might normally be expected.
>
> e_5. Iridium is a thousand times more abundant in meteorites than in the Earth's crust.
>
> e_6. No physical evidence exists to support the notion of sharp temperature declines.
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> t_0. Earth was struck by an asteroid six miles in diameter that blasted a crater 100 miles wide with the force of 100 million hydrogen bombs.

If you have any worry that your audience might not understand, you might also choose to include a description of the effects of the postulated collision on plant life and the food chain as e_7.

In order to generate a helpful list of rival explanations we would do well to remember that the most suprising thing in all of this is that the extinction occurred at the same time that the iridium deposits were laid down. There is much worry in statistics about inferring a cause from a correlation. What is usually of concern is a pattern of observations, a number of data points. In everyday contexts, however, correlations can be one-time occurrences. You hear a gun shot and the next morning find the butler dead of a wound to the head. Obviously, the shot caused the wound and death. It was precisely this kind of reasoning that Alvarez used to explain the co-occurrence of the "iridium spike" and the mass extinctions.

Two rival explanations of the mass extinction are mentioned in the newspaper article.

> t_1. Water retreating from the continental shelves caused climatic changes to which the dinosaurs could not adjust.
>
> t_2. The climatic changes were caused by a massive invasion of fresh water from the Arctic Basin into the oceans.

Both of these are silent on the question of where the iridium came from, to say nothing of their problems in explaining e_6. We should probably include, therefore, a couple of general purpose rivals.

> t_3. It was just a coincidence that the mass extinction occurred at the same time as the iridium deposits were laid down. One thing explains the deaths and a totally different thing explains the iridium.
>
> t_4. The iridium deposits and the mass extinction are connected alright, but not by a collision of Earth with an asteroid. Something else, volcanic activity perhaps, explains the iridium and the deaths.

Scientists were not especially happy with the Alverez hypothesis when it was first proposed. But many were forced to admit that there was some evidence in its support. In terms of inference to the best explanation, this is because these scientists rank-ordered the explanatory theories in something like the following way.

t_0

t_4

t_3

t_2

t_1

Since the best explanation, at least the one that is better than any we have been able to think up, is the original one in the argument, we have some, perhaps good, evidence in its behalf. Had one of our rivals proved to be better than the original, then our argument would have provided no evidence in support of the Alverez hypothesis.

6. Further Applications

The chapters to follow we will take this basic tool, the model, or what I called "the recipe," of inference to the best explanation and apply it to a number of specific kinds of practical, scientific, and philosophical evidence. Some of the examples we will discuss will prove very controversial, while others are likely to produce wide consensus. Your responsibilities as a student, and ultimately as an independent thinker, are to use the inference to the best explanation model as a way of clarifying, and perhaps defending ***your own*** evaluation of the strength of someone else's evidence. You need to bend over backward to be fair and complete in your presentation of the evidence. I, also, urge you to try to base your judgment of explanatory plausibility more on what your own intellectual conscience tells you, and less on which theory you would like to be true. Still, you should expect that there will be many instances where you will find yourself in disagreement with authors, including this author. Don't let that worry you. Part of the fun of philosophical reasoning is discovering the interesting and complex ways in which intelligent people can disagree.